# An Introduction to Logic

Spring 2020 edition

Table of Contents


**Chapter One: Introductory Materials**

| | |
|---|---|
| Course concepts: definitions and terminology | 3 |
| Practice: identifying premises and conclusions | 9 |
| Understanding validity and soundness | 16 |
| Practice: Validity and soundness | 19 |
| Enthymemes | 26 |

**Chapter Two: Introduction to Categorical Logic**

| | |
|---|---|
| Categorical propositions | 30 |
| Parts and terminology | 31 |
| Quantity, Quality, & Distribution | 32 |
| Two-circle Venn diagrams | 35 |
| **Quick reference page** | **38** |
| Practice | 39 |
| Standard form categorical syllogisms | 47 |
| Practice | 49 |
| Answers to select problems | 56 |
| Review guide for chapter two | 58 |

**Chapter Three: Analysis in Categorical Logic**

| | |
|---|---|
| Formal fallacies | 65 |
| **Quick reference page** | **68** |
| Practice | 70 |
| Three-circle Venn diagrams | 75 |
| Practice | 78 |

**Chapter Four: Working with Categorical Logic**

| | |
|---|---|
| Translation from ordinary language | 82 |
| Practice | 87 |
| Translation into syllogisms | 92 |
| Practice | 96 |
| Categorical Operations | 101 |
| Complementary terms; narrowing the scope of discourse | 104 |
| Practice | 106 |
| Using immediate inferences in syllogisms | 111 |
| Practice | 115 |
| Review guide for chapter four | 118 |
| Answers to select problems | 122 |
| **Quick reference guides and charts** | **124** |

**Chapter Five: Propositional Logic**
Four operations 126
Truth functions 128
**Quick reference for truth-functions** **131**
wffs 132
Complex symbolization 134
Practice 138
Symbolizing arguments 140
Practice 141
Determining truth values of given claims 143
Creating and reading long truth tables 145
Practice 150
Complex tables 154
Practice 155
Creating and reading short (indirect) truth tables 158
**Quick reference for symbolization** **161**
Review problems for chapter six 162
Answers to select problems 167

**Chapter Six: Inductive reasoning, informal fallacies, and Responding to Arguments**
Evaluating strength 175
Practice 177
Analogies 178
Practice 179
Analysis of analogies 181
Informal fallacies 183
Set one 184
Set two 188
Set three 192
Set four 197
**Quick reference checklist for fallacies** **202**
Review fallacies 203
Responding to arguments: logical analogies 208
Responding to arguments: contradicting premises 211
Answers to select problems 215

**Works Referenced** 216

 *Thanks to Padraig Gallagher and Eric Salahub for their generous contributions to this logic text.*

# Chapter One
# Introductory Materials

## Basic Definitions and Fundamental Concepts of Logic

**Logic** in the context of Philosophy is the tool for objectively evaluating reasoning.

**Reasoning** is the mental act of drawing new information from given information.

**Proposition or statement:** sentence with a truth-value; it makes sense to say a proposition could be true or false even if we are unsure of the truth-value. Some sentences are not propositions; also, though questions *are not* propositions, rhetorical questions *may be* translated or understood as propositions.

**Truth** is a property of propositions that correspond to states of affairs in the real world or that describe reality*. Even if we disagree on the truth of a given claim in a given scenario, we can still talk hypothetically or objectively about it for the sake of working through examples and understanding logical structure.

> *For the sake of practicality, we will assume that there is such thing as actual truth. If you are interested in questions about 'truth' (i.e., how to define it, if it can be defined, what it is relative to, if relativity is irrelevant, or any other issues surrounding the notion of 'truth', then consider taking more Philosophy classes where this may be discussed in depth).

**Truth-value** refers to a statement being true or false. If we cannot determine the truth-value of a given statement or we don't know if it is true or false, then we say that statement is either true or false but that the information is unknown to us or undefined; we will use 'undetermined' to describe the unknown state of truth for a statement.

**Arguments** are one way we use reasoning. Arguments are sets of propositions, typically in which one of these (the conclusion) is claimed to follow from the others (the premises). Every argument has at least one premise and at least one conclusion. Some arguments have sub-conclusions, implicit premises or conclusions, dependent premises, or independent premises. Most of the example arguments in this course pack will have one main conclusion. Indicator words, as described further in this chapter, can be used to help identify premises and conclusions.

**Parts of arguments:**

- **Premise:** the reasons, the support, the evidence, and the information intended to support a claim in an argument.

- **Conclusion:** the goal, the intended outcome, or the main point the premises attempt to support, or the information that can be derived in an argument.

- **Standard form** arguments are (generally) those whose premises are listed in statement form above the conclusion in statement form. When writing an argument in standard form, exclude premise indicator words and extra rhetoric--'∴' is the symbol for 'therefore'.

An example of standard form:

This is premise one.
Here is premise two.
<u>The rest of the premises go here in statement form.</u>
∴The conclusion is here.

- **Indictor words** are words or phrases that can help us identify the parts of an argument. They are words commonly used to point out a premise or conclusion. These words typically come before the statement. Here are *some* examples:

  - Premise indicators: **because**, **since**, **as**, **for**, **inasmuch as**, **given that, due to**
  - Conclusion indicators: **therefore**, **hence**, **so**, **thus**, **it follows that**, **for these reasons**

  It is important to note that though these words often precede a premise or a conclusion, they can be used in non-indicative ways. For example:

  *"We should get to the shelter since there are ominous clouds moving our way." This* is *a case of the word 'since' indicating a premise.*

  *"I haven't seen her since high school." This is* not *a case of 'since' being a premise indicator.*

**<u>Types of arguments:</u>**

- **Syllogisms** are arguments with exactly two premises and one conclusion.

- **Enthymemes** are arguments with an implicit premise or conclusion.

- **Sorites** are certain kinds of arguments where one conclusion is used as a premise for a second syllogism. An argument consisting of propositions so arranged that the predicate of any one forms the subject of the next and the conclusion unites the subject of the first proposition with the predicate of the last. (sorites)

- **Inductive arguments** are arguments for which we are prepared to make the claim that the premises are evidence for the conclusion, though they do not necessarily guarantee it. Adding new premises can potentially strengthen or weaken an inductive argument. Often times, words like *probably*, *it is likely that*, or *we can reasonably assume that* are used in inductive arguments.

  For example, "Usually traffic on I-25 between Fort Collins and Denver is terrible. It seems worse weekdays between 4:30 pm and 6:30 pm. So, traffic on that section of I-25 is probably going to be bad this Monday at 5:00 pm." Adding a premise such as 'There is going to be a huge snow storm Sunday and Monday' could impact the argument's strength. Or, adding 'The Broncos have a home game on Monday' would also impact the argument. Do you see in what ways these claims could affect the argument?

- **Deductive arguments** have a structure that deals in certainties, unlike inductive arguments, which deal in probability. Adding more information will not change the validity of a deductive argument like additions can change the strength of inductive arguments.

**Argument evaluation terminology:**

- **Inductive strength** of an argument is determined by examining the content of an inductive argument. For inductive arguments, we ask how likely it is that true premises would lead to a true conclusion. The evaluation lies on a spectrum of very weak to very strong; for some it is highly likely that the conclusion would follow from given premises while for others we may find it highly unlikely that the conclusion would follow.

- A **valid deductive argument** is an argument such that the premises absolutely guarantee the conclusion. The premises necessarily lead to the conclusion. If every premise were true, then the conclusion would have to be true. Valid arguments are such that it is impossible that every premise is true while the conclusion false. If the information given in the premises is such that there is no way around the conclusion, then that argument is valid. Adding new premises cannot make a valid argument invalid, even if a new false premise is added. Validity can be determined by examining the formal relationship between the premises and the conclusion. (In the beginning stages of the course, knowing that validity deals with form and structure is sufficient.)

**Example:**

All M are A and All I are M, so All I are A.

**Standard form:**

All M are A.
All I are M.
∴ All I are A.

**Analysis:**

Deductive argument, valid

Nothing we could add would change the fact that the premises necessarily lead to the conclusion. The structure or form of the valid argument retains the validity regardless of outside information or even of the truth of its components. We know that whatever the letters 'I', 'A', and 'M' represent, *it is the case* that the conclusion would follow with certainty from the premises.

**Example in standard form:**

If you head South on I-25 from Fort Collins, you'll get to Loveland.
You did not get to Loveland.
∴ You did not head South on I-25 from Fort Collins.

**Analysis:**

Deductive argument, valid

- An **invalid argument** appears to have a deductive argument structure though the premises fail to guarantee the conclusion. The argument may at first seem as though it is deductively valid, yet with further analysis, it is proven otherwise. These arguments use words that suggest certainty not mere probability.

  For every invalid argument, it is possible that every premise could be true while the conclusion false. The possibility alone makes the structure invalid, even if an example or one instance of the argument form doesn't instantiate all true premises and a false conclusion. In these cases, the conclusion may be a possibility to be derived from the premises but not a certainty.

  **Example:**

  Logic is a course at FRCC because all FRCC courses require tuition and logic is a course that requires tuition.

  **Standard form:**

  All FRCC courses require tuition.
  Logic is a course that requires tuition.
  ∴Logic is a course at FRCC

  **Analysis:**

  Invalid argument

  Now, even if all of this were true, the structure itself does not necessitate the conclusion. It *appears* to take deductive form due to the language and structure. However, it fails to deliver a guaranteed conclusion. For this reason, it is considered invalid. Another way to think of this is that if we were to fill in 'Organic Chemistry 410' in place of 'Logic', look at what happens to the argument. The argument would, in real life, have all true premises and a false conclusion. The structure of the argument *allows for that possibility* and is an invalid form.

  **Example in standard form:**

  No cats are humans.
  No kittens are humans.
  ∴No kittens are cats.

  **Analysis:**

  Invalid argument

  Clearly in this structure, it *is* possible to have all true premises and a false conclusion since this example demonstrates *just that*.

- **Soundness** of an argument relates to the truth-values of the statements comprising a given argument. If we determine that a given argument structure is valid, we are not necessarily stuck accepting the conclusion. That is, there is a further step in the analysis of a valid argument. Soundness can be a tool for analyzing valid arguments. If we do not want to accept a conclusion of a valid argument, then we could argue that at least one premise of that argument is false. If that is the case, then the valid argument would be considered an unsound argument.

**Example in standard form:**

All members of group B are members of group C.
All members of group A are members of group B.
∴ All members of group A are members of group C.

**Analysis:**

Valid argument, unable to determine soundness

We are able to determine the argument's validity even though we have no idea what A, B, and C represent. However, because we have no idea about the truth-value of these statements, we are unable to determine soundness.

- A **sound deductive argument** is a valid deductive argument with all true premises. Invalid arguments are not sound even if they have all true premises.

**Example:**

All humans are mortal beings and Socrates is a human, so Socrates is mortal.

**Standard form:**

All humans are mortal beings.
Socrates is a human.
∴ Socrates is mortal.

**Analysis:**

Valid argument, sound

- An **unsound argument** is both a way of referring to any invalid argument structure and a way of discussing a valid argument with at least one false premise. Invalid arguments, regardless of the truth of their propositions, and all arguments with at least one false premise are unsound.

**Example:**

Today is Saturday or today is Sunday. Since it is not Saturday, it must be Sunday.

**Standard form:**

Today is Saturday or today is Sunday.
It is not Saturday.
∴ Today is Sunday.

**Analysis:**

Valid argument, unsound

**<u>One process of logically evaluating arguments:</u>**

- ❖ Is the example an argument or not (is it just an explanation, a description, etc.)?
  - ▪ No, not an argument: stop.
  - ➢ Yes, it is an argument: is it inductive or deductive?
    - ❖ Does the conclusion contain words like 'probably', 'likely', 'possibly', or 'reasonably'?
      - ➢ Yes, likely inductive: how strong is the argument?
        - ➢ Debate: very weak, weak, strong, very strong, etc.
      - ➢ No, likely deductive: is the argument valid or invalid?
        - ▪ Invalid (the premises may lead to the conclusion but they do not guarantee it; may also be called 'unsound' regardless of truth of premises.): stop.
        - ➢ Valid (the premises necessarily lead to the conclusion; if the premises were true, the conclusion could not be false; the conclusion is guaranteed by the premises): is the argument sound or unsound?
          - ▪ Sound: all the premises are true, stop.
          - ➢ Unsound: there is at least one false premise, debate.

**<u>Argument Structures Examples</u>** *(Salahub)*

Identify the indicator words used in these various versions of the same argument.

1.I have never been good at memorizing names and dates of events. I don't like reading about wars. I have little interest in hearing the winners' side of historic events. For these reasons, I should not be a history major.

2.Given the following reasons, I should not be a history major: I have never been good at memorizing names and dates of events and I don't like reading about wars. In addition, I have little interest in hearing the winners' side of historic events.

3.Given that I have never been good at memorizing names and dates of events and I don't like reading about wars, I should not be a history major. Inasmuch, I have little interest in hearing the winners' side of historic events.

4.Since I have little interest in hearing the winners' side of historic events, it follows that I should not be a history major. Especially because I have never been good at memorizing names and dates of events and I don't like reading about wars.

5.I should not be a history major for I have never been good at memorizing names and dates of events. Also, I neither like reading about wars nor have any interest in hearing the winners' side of historic events.

The argument in standard form:

I have never been good at memorizing names and dates of events.
I don't like reading about wars.
<u>I have little interest in hearing the winners' side of historic events.</u>
∴ I should not be a history major.

**Practice problems: Identifying premises and conclusions**

For each of the arguments below, distinguish premises from conclusion. If the argument contains indicator words, identify these in some way (for example, underline all premise indicator words and circle all conclusion indicator words). Where possible, identify who is making the argument. Remember that the person making the argument is not always as straight forward as locating where it the argument is located. *These arguments compiled by Padraig Gallagher.*

1. The light we see from distant galaxies left them millions of years ago; and in the case of the most distant object that we have seen, the light left some eight thousand million years ago. Thus, when we look at the universe, we are seeing it as it was in the past.
Stephen W. Hawking

2. Since there are no mental diseases, there can be no treatments for them.
Dr. Thomas S. Szasz

3. Missiles are easier to defend than cities, for two reasons: first, missile sites are small and tough, whereas cities are large and vulnerable; second, a defense of missile sites is considered effective if it can save half the missiles, whereas a defense of cities has to try to save them all.
Freeman Dyson

4. The advanced technologies applied in supercomputers tend to quickly permeate the entire computer industry. So the nation that leads in supercomputer development tends to have a jump on other countries in producing more powerful—and more lucrative—lower-level computers.
Dwight B. Davis

5. Because of the massive importance of religion in human affairs, because religions continue to contest secular accounts of the world, because public institutions must take seriously the full range of ideas in our marketplace of ideas, because the Establishment Clause requires neutrality between religion and nonreligion, and because the truth has become increasingly elusive even for intellectuals, religion must be taken seriously in public schools and universities.
Warren Nord

6. People cause global warming. Mars has global warming. So Mars has people.
Excerpted from the cartoon *Mallard Fillmore,* by Tinsley

7. Roundabouts are in our future—they are known to save everyone time, reduce accidents, air pollution and congestion while saving the city the installation and maintenance costs of computer and fiber-optic controlled traffic lights.

Paul Avery

8. Conservative talk-show hosts argue that President Bush was justified in invading Iraq since many foreign intelligence agencies and prior U.S. administrations thought that WMD's were there, and since Saddam Hussein would not provide proof to the contrary.

9. The Arctic Plain is a small 1.5 million acre portion located on the extreme northern edge of the giant 19.6 million acre [Arctic National Wildlife] Refuge. Only 2,000 acres of that area would actually be used for exploration activities. The U.S. Geological Survey estimates that there could be as much as 16 billion barrels of oil in this part of Alaska. That amount could replace all of our imports from Saudi Arabia for over 30 years. As you can see, allowing drilling in this tiny portion of the Refuge will reduce our dependence on foreign oil, create jobs, help to safeguard our national security and move us one step closer to energy independence. Further, relying on more foreign oil places greater risks on the environment.

U.S. Senator Wayne Allard, excerpted from a form letter sent to letter writers on ANWR, sent 2/25/2005

10. In response to the essay that posits that Star Wars kicks Star Trek's ass, Ryan (a true-to-life NASA rocket scientist), responds: "*Star Trek* is superior to *Star Wars*, because *Star Wars* is just ludicrous nonsense (though highly entertaining), whereas *Trek* is an extrapolation of what actually is possible today, and may be possible in the future. Take that George Lucus!!"

-Jeepish.com "Star Trek versus Star Wars"

11. Besides weapons of mass destruction, there were plenty of other — and far more important reasons — for prompt action now: Saddam had broken the 1991 armistice agreements and after September 11 it was no longer tolerable to allow Middle East dictators to continue as rogue states and virtual belligerents. Two-thirds of Iraqi airspace were de facto controlled by the United States — ultimately an unsustainable commitment requiring over a decade of daily vigilance, billions of dollars, and hundreds of thousands of sorties to prevent further genocide. He had defied U.N. resolutions; and he had expelled inspectors, demanding either enforcement or appeasement and subsequent humiliation of the international community.

-Victor Davis Hanson, "Weapons of Mass Hysteria." National Review Online, <www.nationalreview.com/hanson> February 06, 2004

12. Should we be in Iraq? Yes, though not for any of the reasons listed above. We should be in Iraq because: (1) Iraq was a hostile nation that funded terrorism (though not al-Qaeda specifically). (2) Iraq could have potentially passed chemical or biological weapons to terrorists or other hostile nations (I say potentially because, at the start of the war, the true status of Iraq's WMDs was unknown – and to some degree still is). And, (3) because Iraq was in obvious violation of the terms of its surrender at the end of the Gulf War.

-Posted by: Neil May 25, 2004 2:06 pm
http://www.donotremove.net/mexigogue/archives/002874.html

13. If a Klingon pissed him off, Kirk kicked his ass. *Star Trek* had Kirk kicking ass all over the place. One time, in the *Star Trek* episode called "Space Seed" Captain Kirk whooped the shit out of a guy who was five times as strong as any man. Yet that didn't stop Kirk from kicking his ass…So in short, Captain Kirk is the ultimate badass.

-Posted by: BasementDwellingNinja. 05-28-2005, 11:02 AM
http://aetherealforge.com/aeforum/showthread.php?t=2642

14. I mean the stupid people like we have here in the vast heartland of the United States... They think we should be in Iraq because we ARE in Iraq. That's it. End of reasons to be in Iraq.

-Posted by: Fishgrease May 27, 2004 03:38 am
http://www.majorityreportradio.com/weblog/archives/000198.php

15. "I think we should be in Iraq because those people need our help," [Amber Conklin, 17] said.

Joe Hallett and Jonathan Riskind "Wisconsin typifies swing-state divide"
-*Columbus Dispatch*. 09/26/04

16. I had lunch with a guy, a self-professed libertarian, who told me that we shouldn't be in Iraq because "they're too stupid to deserve freedom." Literally. In those words.

-Posted by redsugar at 12:20 PM www.redsugar.com/muse/archives/006663.html

17. Denis Halliday… told Bill Moyers on his Friday night program that the U.S. should not wage war against Iraq for the following reasons: the U.S. sided with Iraq during the Iran-Iraq war; that Iraq's neighbor's don't want the U.S. to fight Iraq; and that Iraqi civilians will be killed in a war.

- Lawrence Auster, *View from the Right*, <www.amnation.com> August 24, 2002

**Homework: premise and conclusion identification** **NAME:_____________________**

**Directions:** Read each example. Identify any indicator words in some way (for example, circle). Then rewrite each argument into standard form, listing the premise(s) above the conclusion as demonstrated on page 4 of this text and in the examples below. Assume each letter represents a statement. Remember to exclude indicator words from standard form.

*(example one) A and B. Thus, C.*

*A*
*<u>B</u>*
*∴C*

*(example two) It must be the case that G, for Q and T.*

*Q*
*<u>T</u>*
*∴G*

1. A therefore B.

2.We can conclude that C because D; in addition, E.

3. Because F, G.

4. Given that H and I, it follows that J.

5. We see evidence of both K and L. Ergo, M.

6. N due to O; inasmuch P.

7. Q given the following reasons: R and S.

8. T; also, U. Hence, V.

9. We see that W. Thus, since X and Y, Z.

10. Since S and L, D.

**<u>Practice problems:</u>** Using reason
**Directions:** Using the reasoning skills that you have already, what, if anything, can we logically infer or deduce?

**Part A: Assuming the provided information is correct or true, would the inference or deduction logically follow? Why or why not?**

1.Every time my cat Bigsby eats too much grass, he throws up. He has been in the yard for a few hours eating grass at his leisure. So, he's probably going to throw up.

2.Flameless candles will not burn you, do not have a fire risk, and they last a long time. Given that regular candles have flames and melt away, they are neither a safe nor economical choice. Thus, flameless candles are the way to go.

3.If a band plays at New West Fest, then it is sure to be rockin'. Wire Faces played at New West Fest. Therefore, Wire Faces is rockin'.

**Part B: What, if anything, *can* we infer or deduce given the provided information?**
4.Every college course has tuition fees. This is a college course. Hence,…?

5. The parking lots on campus are near capacity during peak hours. This morning, the lots all seemed to be at or near capacity. It is likely that…?

**Part C: Look closely at 6 and 7. What's going on here?**
6.Every Philosophy class provides a mind-expanding, critical-thinking experience. This class provides a mind-expanding, critical-thinking experience. Ergo,…?

7.There aren't any sharks that are mammals. There aren't any whales that are sharks. We can conclude that…?

**Revisiting validity**

We can examine the structure of a deductive argument to determine if indeed the premises guarantee the conclusion. We can do this by assuming the premises are true and affirming the claim that **if** the premises are true, then the conclusion **must be** true. Again, in a valid deductive argument, it is **impossible** for the premises to be true and the conclusion to be false.

Another way to understand this is to just 'pretend' that the reasons the arguer gives are true and, assuming that, see if we would absolutely know that the conclusion is then also true. If we start with something true, we should end up with something true.

Validity is about the form the argument takes and not so much *what* the argument says. That is, we can tell by the structure alone if the reasons given will lead us, without a doubt, necessarily to what the arguer wants us to believe, accept, or conclude. Even if the premises happen to be false in real life, which is not necessarily consequential for determining validity, we can still evaluate the relationship of premises to conclusions. We are concerned only with the relationship of the premises guaranteeing the conclusion. (The truth or falsity of the statements can be examined separately after validity is confirmed, when we consider whether the argument is sound or unsound.) For an argument to be valid, the premises must necessarily lead us to the conclusion.

A valid deductive argument is one in which, if the premises are true, then the conclusion must be true. *If* the premises of a deductive argument are true, then there is no way for the conclusion to be false. The premises 'guarantee' the conclusion in a deductively valid argument. It is *impossible* for the premises of a valid deductive argument to be true while the conclusion is false. For this determination, pretend the premises are true and see if there is any way the conclusion could be false; if there is no way the conclusion could be false in this situation, then it is a valid argument. (Alternatively, if there IS a way to have the premises actually true and the conclusion false, the argument is necessarily invalid.) Validity concerns form and inference not necessarily actual truth or falsity of the premises or conclusions. The conclusion that *logically follows* from premises that are assumed to be true cannot logically be false at the same time. The premises must necessarily lead to the conclusion. An argument is deductively valid if and only if, the premises guarantee the conclusion.

*Note: Since we may put forth 'bad' arguments, whether deductive or inductive, the definitions for "argument", "deductive argument" and "inductive argument" all contain the word "claim"; that is, we explicitly or implicitly claim that the conclusion follows from the premises, but we may be mistaken, (Gallagher).*

We can say that 'a valid formula is such that if the inputs are true, the output must be true'. We can also say that 'if a formula is valid and the output is false, then there must be a false input' and that 'if it is possible that a formula have true inputs and false outputs, the formula is invalid'. But we cannot say that 'if the inputs are false, the outputs must be false', nor, 'if the output is true, the formula is valid', nor 'if the output is false, the formula is invalid'.

Now, consider the following deductive arguments:

| Argument 1: | | Argument 2: | |
|---|---|---|---|
| Premise 1 | All *B* are *C* | Premise 3 | All *D* are *E* |
| Premise 2 | <u>All *A* are *B*</u> | Premise 4 | <u>No *F* are *E*</u> |
| Conclusion 1 | All *A* are *C* | Conclusion 2 | No *F* are *D* |

In a fashion similar to geometric formulas, these arguments can be thought of as truth formulas. That is, the goal is to have an argument such that if the premises were true, then the conclusion would have to be true. If this goal is met, then the argument is valid.

This is the definition of a valid deductive argument: an argument such that if all the premises are true, then the conclusion must be true.

In the case of Argument 1, there is no possible way that premise 1 and premise 2 be true and conclusion 1 be false. Think of *A*, *B* and *C* as variable terms which can correspond to any person, place, thing, group—any noun or noun-phrase. Regardless of the terms used in their place in this formula, if they relate to one another in such a way that premise 1 and premise 2 are true, then it is impossible that conclusion 1 be false. Argument 1 is valid.

So too is Argument 2. Regardless of what *D*, *E* and *F* correspond to—be they fish, unicorns, Tuesdays, socks, depressions...—if they relate to one another in such a way that premise 3 and premise 4 are true, then conclusion 2 *must* be true.

This being the case, an invalid deductive argument is such that it is possible that the premises be true and the conclusion false:

| Argument 3: | | Argument 4: | |
|---|---|---|---|
| Premise 5 | All *B* are *C* | Premise 7 | No *D* are *E* |
| Premise 6 | <u>All *A* are *B*</u> | Premise 8 | <u>No *F* are *E*</u> |
| Conclusion 3 | Some *A* are not *C* | Conclusion 4 | All *F* are *D* |

In these cases, even if the premises were true, it is possible that the conclusion be false. Note that in the case of Argument 3, it is actually *impossible* that the conclusion *be true* if the premises are true. In the case of Argument 4, however, it is indeed possible that the conclusion be true. This possibility is not sufficient, however. If a deductive argument is valid, the truth of its premises must necessitate the truth of its conclusion. So, Argument 4 is invalid and *it would be even if the terms made it so that both premises and the conclusion were true:*

No *Dogs* are *Elephants*
<u>No *French Poodles* are *Elephants*</u>
All *French Poodles* are *Dogs*

Note, however, that a valid deductive argument does not guarantee the truth of the conclusion. A valid deductive argument only states that <u>if</u> the premises are true, the conclusion must be true. The argument cannot guarantee that this will in fact be the case. Even an argument as simple as Argument 1 can provide a false conclusion if a premise is actually false. Indeed, if the argument is valid and the conclusion is false, it means that there must be a false premise.

So, now we can say that 'a valid deductive argument is such that if the premises are true, the conclusion must be true'. We can also say that 'if a deductive argument is valid and the conclusion is false, then there must be a false premise' and that 'if it is possible that an argument have true premises and a false conclusion, the argument is invalid'. But we *cannot* say that 'if the premises are false, the conclusion must be false', nor, 'if the conclusion is true, the argument is valid', nor 'if the conclusion is false, the argument is invalid'.

**But what about soundness?**

**Example A:**
If evil exists, then God does not exist.
Evil exists.
∴God does not exist.

This example A and some of the examples above are cases in which one could argue over the soundness of valid argument forms. For instance, in the case here, the argument is a valid form. However, some may disagree with or not like the conclusion. In this case, one could argue that premise two is false, and in fact evil does not exist. The respondent would basically create a new argument with the conclusion being 'it is not the case that evil exists'. This of course is just one example of how debating the soundness of a valid argument structure could happen in philosophical discussions.

Let's look at another example.

**Example B:**
If science cannot explain our existence, then God does exist.
But science *can* explain our existence.
∴God does not exist.

Notice that in both examples here, the conclusion is the same: God does not exist. However, notice also that the *way* the conclusion is reached is different in each case. After having completed the analysis, we found that example A is a valid structure and example B an invalid structure. Often in Philosophy, the importance lies in *how* a conclusion is achieved, not just in the conclusion itself. In this case, argument example A would deserve further attention while argument structure B could be dismissed.

**<u>Examples: Validity and soundness identification</u>**
Directions: Put the following arguments in standard form (list in statement form the premises above the conclusion). Then examine the argument to determine if it is valid or invalid. (Ask, is there any way that the given premises might not get to the conclusion? If you can 'get around' the conclusion given the information from the premises, then the argument is invalid. If there is no way around the conclusion given the premises, then it is valid.) IF IT IS VALID, then determine if the argument is sound or unsound.

**Example:**

Minneapolis is north of Atlanta and south of Denver, thus Atlanta is south of Denver.

**Standard form:**

Minneapolis is north of Atlanta.
<u>Minneapolis is south of Denver</u>.
∴ Atlanta is south of Denver.

**Analysis:**

Valid argument, unsound

When checking for validity, you can think of it in these terms: the premises taken together give us all the information we have to work with; assuming the information we have is the case, we need to see what information we can draw from that. If you get the same information as the conclusion with certainty, then the argument structure should be valid. If there is a possibility aside from the conclusion, then the argument should be invalid.

Considering the argument; is there any way you *wouldn't* get to the conclusion that Atlanta is south of Denver? Is the conclusion guaranteed given the premises? This diagram may help you visualize the concept of validity.

Premise one says the relationship between Minneapolis and Atlanta is this:

Minneapolis


Atlanta

Premise two says the relationship between Minneapolis and Denver is this:

Denver

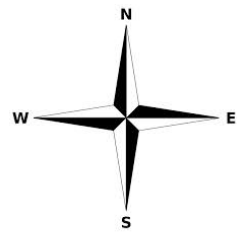

Minneapolis

Now, when we take the information from both premises, visually we get this:

Denver

Minneapolis

Atlanta




No other possibilities of the relation between these places are available. This is the only possible outcome. Note that this is representative of the information in the conclusion. Thus, this is an example of a valid argument structure. However, as you may have noticed, something is still not quite right about this argument. Though the form is one in which the premises do guarantee the conclusion, this argument is unsound. This is the case because premise two is false; Minneapolis is not south of Denver.

**Example:**

Because Socrates lived before Kant, and Kant lived after Descartes, it follows that Socrates lived before Descartes.

**Standard form:**

Socrates lived before Kant.
Kant lived after Descartes.
∴ Socrates lived before Descartes.

**Analysis:**

Invalid argument

Premise one says this relationship between Socrates and Kant:

Socrates | Kant

Premise two says this relationship between Kant and Descartes:

Descartes | Kant

Now, when we take the information from both premises, visually what would we get? It may seem as though we should get the conclusion:

Socrates | Descartes | Kant

However, this is not guaranteed by the information given in the premises. Do you see any other possible conclusions we could have drawn just given what the premises state?

We could have drawn one of these scenarios that *do not* show the same conclusion:

Descartes | Socrates | Kant

OR

Descartes | Kant
Socrates

Because we did find options other than the conclusion, this argument form is invalid. Yes, the stated conclusion was a possibility, as shown in the first attempt, but that is the problem; the desired conclusion is MERELY a possibility, *not* a certainty. This possibility demonstrates the invalidity of this argument form. Also note that in this case, both the premises and the conclusion are actually true! This does not make the argument structure valid; it simply means we have a group of true claims that do not necessarily entail one another.

**Example:**

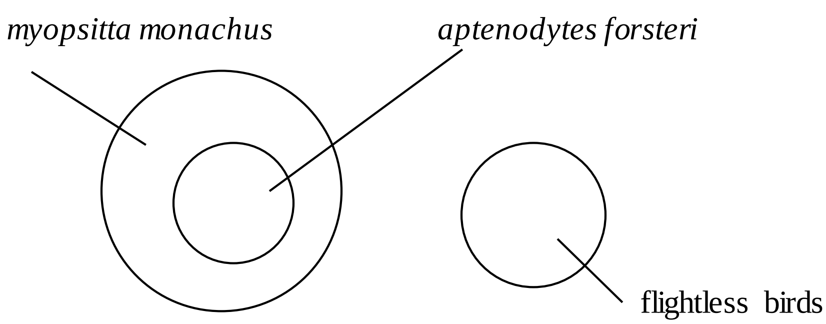
There are not any *aptenodytes forsteri* that are flightless birds, since no *myopsitta monachus* are flightless birds, and all *aptenodytes forsteri* are *myopsitta monachus*.

**Standard form:**

No myopsitta monachus are flightless birds.
<u>All aptenodytes forsteri are myopsitta monachus</u>.
∴ There are not any aptenodytes forsteri that are flightless birds.

**Analysis:**

Valid argument, unsound



**Practice problems: Validity and soundness identification**
Please follow the directions from the 'Examples: Validity and soundness identification' section

1. We can conclude that Fantasia is east of Gotham City, for Fantasia is west of Narnia and Narnia is east of Gotham City.

2.If Curtis goes to the bar, then he will do a shot of tequila. He took a shot of tequila, so he must be at the bar.

3.Since the *ailurus fulgens* is an herbivore, and all herbivores are *gazella subgutturosa,* we can conclude that the *ailurus fulgens* is a *gazella subgutturosa.*

4.If Johnny Depp is a real pirate, then William Kidd knows him. Thus, William Kidd does not know him because Johnny Depp is not a real pirate.

5. Given that all valid arguments are ones in which the premises guarantee the conclusion, it follows that sound arguments' premises guarantee their conclusions considering that every sound argument is valid.

**Standard Form Syllogistic Argument Examples**

You can use these standard form examples for further practice determining the validity of arguments. Also, these examples may be used later in the course as practice with categorical or propositional logic. As you examine the following standard form arguments, note the patterns and similar structures. Determine the argument form's validity without being distracted by your feelings for the premises or conclusions. Remember to consider only the information given in the premises and see if the conclusion necessarily follows.

1. All cats are mammals.
All tigers are cats.
∴All tigers are mammals.

2.No mothers are fathers.
No fathers are sofas.
∴No sofas are mothers.

3.All Martians are comedians.
Some Martians are humans.
∴Some humans are comedians.

4. All mortals are humans.
All elected officials are humans.
∴All elected officials are mortals.

5.All women are daughters.
All mothers are daughters.
∴All mothers are women.

6.All fathers are human.
All mothers are human.
∴All mothers are fathers.

7.All gazelles are red pandas.
All penguins are gazelles.
∴All penguins are red pandas.

8.All women are human.
All mothers are human.
∴All mothers are women.

9. All gorillas are robots.
Some chinchillas are robots.
∴Some chinchillas are gorillas.

10. Some textbooks are paper products.
Some notebooks are paper products.
∴Some notebooks are textbooks.

11. Some space creatures are scary aliens.
No scary aliens are trustworthy beings.
∴Some space creatures aren't trustworthy beings.

12. All films Quentin Tarantino works on are great.
The film *Killing Zoe* is a great film.
∴ Quentin worked on *Killing Zoe*.

13. Killing animals causes harm.
All immoral acts are acts that cause harm.
∴Killing animals is immoral.

14.No invalid arguments are worth further investigation.
Some invalid arguments are conversations that contain controversial claims.
∴Some conversations that contain controversial claims are not worth further investigation.

15. We accept truth or we go without.
We will not go without.
∴We accept truth.

16. Facebook is addictive or it is not harmful.
Facebook is addictive.
∴Facebook is harmful.

17.If P, then Q.
It is not the case that Q.
∴It is not the case that P.

18.If P, then Q.
We find P.
∴ We find Q.

19.If P, then Q.
If Q, then R.
∴If P, then R.

20.If P, then Q.
In fact, we do have Q.
∴We also find P.

21. If A is the case, then we would find D.
We do find D.
∴A must be the case!

22. If God exists, then we would see design in the world.
We do see design in the world.
∴God must exist!

23. If B, then C.
It is *not* the case that B.
∴It must *not* be that C.

24. If F, then Y.
We *do not* find Y.
∴We *will not* find F.

25. If God didn't exist, then no one would have any concept of God.
However, it is clear that people *do* have a concept of God.
∴God *must* exist.

26. All cars are mice.
All kites are cars.
∴ All kites are mice.

27. All cats are mammals.
All kittens are cats.
∴ All kittens are mammals.

28. No zebras are mammals.
No dogs are mammals.
∴ No dogs are zebras.

29. All humans are mammals.
No dogs are humans.
∴ No dogs are mammals.

***Challenge: what patterns made valid arguments and which revealed invalid forms?***

## <u>Enthymemes</u>

Enthymemes are arguments with unstated, yet understood, information. An enthymeme typically contains either an implicit premise or an implicit conclusion. For our purposes, we will use what is often called the *Principle of Charity*. This means that we will give the author of the argument the benefit of the doubt and assume the author intended for the argument to be valid. That is, when examining enthymematic arguments, we will supply the implicit piece that makes the argument valid.

The purpose in using an enthymeme can vary. Sometimes we argue in an enthymematical fashion because our audience already has or understands the information we are not explicitly saying. In other words, in our everyday conversations, we leave out excess information.

Perhaps you have heard or seen the commercial for the Real California Cheese Happy Cows campaign. It states, "Great cheese comes from happy cows. Happy Cows come from California. This is an enthymeme. What they haven't explicitly said is the main point of the commercial: 'Great cheese comes from California'. Sometimes it is more powerful *not* to say something than to come right out and say it. In fact, sometimes it may serve one's purpose better to imply rather than state certain pieces of information. In the case of the commercial, if they had closed by telling you the implicit statement, wouldn't you find that redundant?

Here is an example: 'If Clint's band is playing then Jennie won't go to the party; so I guess we won't see her at the party tonight!'

> In this case, the standard form of the argument would look like this:
> Premise: <u>If Clint's band is playing then Jennie won't go to the party.</u>
> Conclusion: I guess we won't see her at the party tonight.

As it stands, there does not appear to be enough information to make this argument valid. However, we can understand that a premise has been excluded from being said, but it is implicitly heard by the listener. The argument was probably intended to be analyzed like this:

> Premise: If Clint's band is playing then Jennie won't go to the party.
> *Implicit premise:* *<u>Clint's band is playing tonight.</u>*
> Conclusion: I guess we won't see her at the party tonight.

Another reason enthymemes may be used is because the author does not want to explicitly state a premise or a conclusion. This may be due to the premise or conclusion 'sounding bad' when it is heard, but it may go unnoticed if it is not stated.

Example: 'So I guess you support over-development of the green space between Fort Collins and Denver since you won't donate to this organization.'

Implicitly contained in this argument is the premise 'If you don't donate money, then you support the elimination of green space'. This premise's truth-value could probably be debated. For instance, could there be other reasons why one did not donate aside from one's hatred of green space?

When approaching enthymematic arguments, it is helpful to first identify what parts of the argument are given. In other words, determine if you are supplying the missing conclusion or a missing premise. Once you have done this, it should make stating the implicit piece easier.

*Example: All Spring Breakers are responsible people, so all students from Alyson's Logic class are responsible.*

*Answer: unstated premise, 'Alyson's Logic students observe Spring Break'.*

| | |
|---|---|
| *All S are R* | *S = people who observe Spring Break* |
| *<u>All A are S</u> (implicit)* | *R = responsible people* |
| *All A are R.* | *A = Alyson's Logic students* |

**<u>Enthymeme introductory practice</u>** *(Gallagher/Huff)*

**Directions part A:** Given the information, can you supply the implicit piece using the principle of charity to make these arguments valid?

1) p1: All monkeys fling poo.
p2: ________________
∴ Chester flings poo.

2) p1: If there's smoke, there's fire.
p2: ___________________________
∴ There is fire.

3)p1: A Lannister always pays his debts.
p2: Tyrion is a Lannister.
∴ ________________________

4)p1: Everyone finishing quiz one is happy.
p2: I am finishing quiz one.
∴________________________

**Directions part B:** For each of the following, use the principle of charity to determine what proposition will complete the valid argument. Start by identifying what is given (what parts of the argument are stated) to know what you are looking for (a premise or a conclusion).

5.All cows saying "budda-budda-budda-budda" are cows that think they are helicopters, hence all cows saying "budda-budda-budda-budda" are cows suffering from Mad Cow Disease.

6.All good excuses are excuses involving a catastrophic rip in space-time and no excuses I've heard this semester are excuses involving a catastrophic rip in space-time.

**Directions part C:** For each of the following, use the principle of charity to determine what proposition will complete the valid argument. Start by identifying what is given (what parts of the argument are stated) to know what you are looking for (a premise or a conclusion). **Also, remember that a valid argument is not necessarily a sound argument.** We can consider the truth of their premises after we see the complete argument.

8. Barak Obama is an elitist, so he shouldn't be able to tell us common folk what is best for us.

9. George W. Bush is a cowboy, so he belongs on a ranch.

10. Sara Palin can't have a good argument against teaching sex education in schools because she had a pregnant teenager.

11. If you can't keep your husband in line, you can't expect to keep a country in line, so we can't count on Hilary Clinton keeping the country in line.

12. Mike Huckabee says, "If you're going to have some sausages, you've got to kill some pigs…[so]we need to do some pig-killing."

13. All Secret Santas have crushes on each other, so Rush Limbaugh and Michael Moore have a crush on each other.

14. All those offering an alternative to the two-party-system are good third party candidates, so Bernie Sanders doesn't offer an alternative.

15. If you want to fix this country, you've gotta vote for Trump…and you know you want to fix this country.

**Directions part D**

Choose one or more problems from part C above to **question the soundness of the argument**. What might a skeptic say about the truth of the missing premise or conclusion? Are there better or more convincing ways to argue for the same conclusions? Why or how might a premise be false and how would we convey that to an audience?

# Chapter Two
# Introduction to Categorical Logic

**Standard form categorical propositions**

In this section, we are going to examine the possible relationships between groups of things, or between categories. To start, by 'category' we mean a group or classification, typically we mean something that could have members or constituents or parts. For our purposes, we will say that our categories in discussion must be nouns or noun phrases.

There are four types of relationships between categories that Aristotle noted. These relationships are put into statements form. There are four possible relationships shared between two categories. They are called 'standard form categorical propositions'. Remember that a statement or proposition is a sentence with a truth-value. The capital letters A, E, I, and O are used as a quick way to refer to each relationship in proposition form. They appear as follows.

The first standard form categorical proposition type we will look at is called an 'A' claim. A claims display an inclusive relationship between two categories. The relationship can be thought of saying 'all members of one group are also members of another group' or 'if we were to find a member of group one, then it would necessarily be part of group two'. Instead of arbitrarily referring to the two compared groups, we will call these 'subject' and 'predicate' categories. Often we will use abbreviations or variable to represent the entire group. Formally, we write an A claim like this:

**A claims:** All S are P
All subject category members are predicate category members.

The second standard form categorical proposition type we will look at is called an 'E' claim. E claims display an exclusive relationship between two categories. The relationship can be thought of saying 'no members of one group are members the other group' or 'if we were to find a member of group one, then it would necessarily not be part of group two'. Formally, we write an E claim like this:

**E claims:** No S are P
No subject category members are predicate category members.

The third standard form categorical proposition type we will look at is called an 'I' claim. I claims display a partially inclusive relationship between two categories. The relationship can be thought of saying 'some members of group one are also members of group two' or 'at least one member of group one is also a member of group two'. Formally, we write an I claim like this:

**I claims:** Some S are P
Some subject category members are predicate category members.

The fourth standard form categorical proposition type we will look at is called an 'O' claim. O claims display a partially exclusive relationship between two categories. The relationship can be thought of saying 'some members of group one are not members of group two' or 'at least one member of group one is not a member of group two'. Formally, we write an O claim like this:

**O Claims:** Some S are not P
Some subject category members are not predicate category members.

## Parts of standard form categorical propositions

When in standard form, the categorical propositions must meet certain requirements. Each will fit a formal structure. With this, terminology is involved. You will need to know the parts and terminology of each categorical proposition.

**Quantifier:**

The first word of a standard form categorical proposition is called the 'quantifier'. The standard form quantifiers are 'all', 'no', or 'some'. Though many sentences do not start with a standard form quantifier, all categorical propositions must.

**Subject term:**

The second part of a standard form categorical proposition is called the 'subject term'. The subject term is the first category in comparison. Formally, a subject term must be noun or noun phrase. It may be helpful to ask yourself, 'could there be a group of these?' It should make sense to ask the question if the subject is actually a noun or noun phrase. In other words, at least for our purposes, assume we could not have 'pretty' or 'quickly' as nouns. It would not make sense to say 'there could be a group of 'pretty' or 'quickly''. It *would* on the other hand make sense to say 'there could be a group of *pretty flowers*' or 'there could be a group of *time that flies too quickly*', as these are noun phrase.

**Copula:**

The third of a standard form categorical proposition is called the 'copula'. The copula technically must be any form of the verb 'to be'. That is, it must be 'is', 'are', 'was', 'were', 'am', 'will be', and so on. For our purposes and for uniformity sake, we will always use the present plural tense, 'are'. Note that the only time you see 'are not' is in the copula of an O claim.

**Predicate term:**

The fourth part of a standard form categorical proposition is called the 'predicate term'. The predicate term is the second category in comparison. Formally, a predicate term must be noun or noun phrase.

**Scope:**

The subject term and predicate term both need to members of some larger or encompassing category. This is often called the 'scope of discourse' or the 'scope of the universe'. Examples of broad scopes include: people, places, things, times. This is discussed in greater detail in chapter four, but for now just keep in mind that the terms should all be related in some way.

| Type | QUANTIFIER | SUBJECT TERM | COPULA | PREDICATE TERM |
|---|---|---|---|---|
| AEIO | All, No, Some | noun/noun phrase | 'to be' verb | noun/noun phrase |

**Examples:**

| Type | quantifier | subject term | copula | predicate term | scope |
|---|---|---|---|---|---|
| A | All | cats | are | mammals. | animals |
| E | No | markers | are | staples. | things |
| I | Some | smart students | are | awesome parents. | people |
| O | Some | philosophy classes | are not | logic classes. | classes |

## Classification of standard form categorical propositions

There are two characteristics every categorical proposition possesses. Each has a 'quantity' and each has a 'quality'. The two possible quantities are 'universal' or 'particular'. The two possible qualities are 'affirmative' or 'negative'.

### Quantity: Universal or Particular

The quantity indicates the amount or the number of members to which the proposition refers. For an A claim, the proposition is talking about all the members of the subject group in relation to the predicate group, it is all-inclusive. In this case, we say that the quantity of an A claim is universal. The same for an E claim. In an E claim, the proposition is talking about all the members of both groups. That is, we know that there are not any members of the subject class who are also part of the predicate class, and thus we say the quantity of an E claim is universal. Since the I and O claims discuss *some* or *part* of the group, we identify the I and O claims as having particular quantity. Notice that the *quantifier* is indicative of the *quantity*.

### Quality: Affirmative or Negative

The quality of a categorical proposition is not always as immediately obvious. The quality may be reflected in the *quantifier* or the *copula*. The E claim has a negative quality as reflected in the quantifier 'no'. The O claim has a negative quality as reflected in the copula 'are not'. It is important to remember that a negative sounding claim does not necessarily mean it is a categorical proposition with a negative quality. It may be the case that the word 'not' is found in a subject or predicate term, neither of which indicates quality. The remaining two statement types, A and I, have an affirmative quality.

**A claims**: Universal Affirmative
**E claims**: Universal Negative
**I claims**: Particular Affirmative
**O claims**: Particular Negative

## Distribution

To say a term in a categorical proposition is distributed is to say that one could know **everything about that term in relation to the other term** in the proposition. In other words, distribution is a property of a category such that the statement (taken as a whole) gives **information about every member of that category**. We can ask, does the whole statement give us information about every member of the class?

What would it mean to 'know everything about some group in relation to another group'? Each group is made up of at least one member. If we were to replace the group name with ANY member of that group and still necessarily retain the same truth-value of the original claim, then we are justified in saying that term is distributed. If we follow the same procedure but there is any member of the group that would change the truth-value of the original claim, then that term is not distributed.

## Distribution explanation

**'A' claims, Universal Affirmative statements, distribute the subject term:**
All **S** are P.

Consider a basic 'A' claim: All S are P. In every 'A' claim, the subject term is distributed. We can know everything about the members of the subject term class in relation to the members of the predicate term class. In an example, 'all cats are mammals' we can know everything about the group 'cats' in relation to the group 'mammals'. How can this be the case? Let's create a short list of members for each group:

| All | cats | are | mammals |
|---|---|---|---|
| | Garfield | | cats |
| | Nermal | | tigers |
| | Morris | | lions |
| | Felix | | zebras |

Notice that if we take any member from the 'cats' category, we still find that they are necessarily members of the 'mammals' category. Thus, each time we replace the group with a member of the group, we will necessarily retain the same truth-value of the original claim. However, try to replace the group 'mammals' with a member of the group. Sure, the first option will work as it is still true that all cats are cats, but what about the other choices? Surely it changes the truth-value of the original claim to say that all cats are humans, or any of the other options.

**'E' claims, Universal Negative statements,**
**distribute both subject term and predicate term:**
No **S** are **P**.

On to the 'E' claim: No S are P. For every 'E' claim, both the subject and predicate terms are distributed. Here is an example. No dogs are fish.

| No | dogs | are | fish |
|---|---|---|---|
| | Fido | | Nemo |
| | Snoopy | | Jaws |
| | Lassie | | Flounder |

Assuming it is true that there are not any dogs that are fish, could that truth-value change if we replace a member of either group with the group itself? It will still be true that Fido is not a fish, it will still be true that Flounder is not a dog, and it is still true that Snoopy is not Nemo. We could replace the group with any member of the corresponding group and always retain the same meaning and truth-value; thus, both terms are distributed.

**'I' claims, Particular Affirmative statements, distribute neither term:**
Some S are P.

For the 'I' claim, neither term is distributed. 'Some S are P' does not tell us *everything* about either of the two groups in relation to one another. It merely states that there is at least one member of S who is also a member of P and vice versa. 'Some students are parents'. Yes, we could retain the same truth value by finding a student who is also a parent, but finding even *one* student who is not a parent or finding one parent who is not a student, is enough to show that neither the subject nor the predicate term of an 'I' claim are distributed.

**'O' claims, Particular Negative statements, distribute the predicate term:**
Some S are not **<u>P</u>**.

How should we approach the distribution is for the 'O' claim? It may take some thinking about to see why the predicate term of every 'O' claim is distributed. Consider 'Some purebred dog breeds are not Labradoodle breed dogs'.

| | | | |
|---|---|---|---|
| Some | <u>purebred dog breeds</u> | are not | <u>Labradoodle breed dogs</u>. |
| | Beagle | | Australian labradoodle |
| | Bloodhound | | |
| | Bulldog | | |

So, to start with the predicate term, it would still be the case that there is at least one other purebred dog breed besides Labradoodle breed. Also, there is at least one purebred dog breed aside from the Australian labradoodle. But what about the subject term? Is it not the case that there is in fact at least one Beagle that is not a Labradoodle, and at least on Bloodhound that is not a Labradoodle, and so on? Yes, but there is a problem. Remember that we need find only one case that changes the truth-value of the claim in order to show that the term is not distributed. What vital member of the subject class is missing? Do you see it yet? How about the LABRADOODLE!? Now if we go to replace it, our new claim says that at least one Labradoodle is not a Labradoodle; this does not have the same truth-value as the original claim.

**<u>Distribution patterns:</u>**
If the conceptual nature of distribution is still elusive, you can look for an alternative method of understanding. There is a pattern involved in distribution. When the claim has a *universal quantity*, the subject term of that claim is distributed. When the claim has a *negative quality*, the predicate term of that claim is distributed.

| | | | |
|---|---|---|---|
| All | **members of the subject term** | are | members of the predicate term. |
| No | **members of the subject term** | are | **members of the predicate term**. |
| Some | members of the subject term | are | members of the predicate term. |
| Some | members of the subject term | are not | **members of the predicate term**. |

**Distribution identification examples:**
(the circled terms are the distributed terms)

A: All Kentucky bourbons are whiskeys.

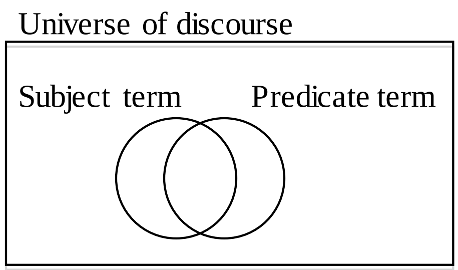
E: No Kentucky bourbons are Irish whiskeys.

I: Some whiskeys are Irish whiskeys.

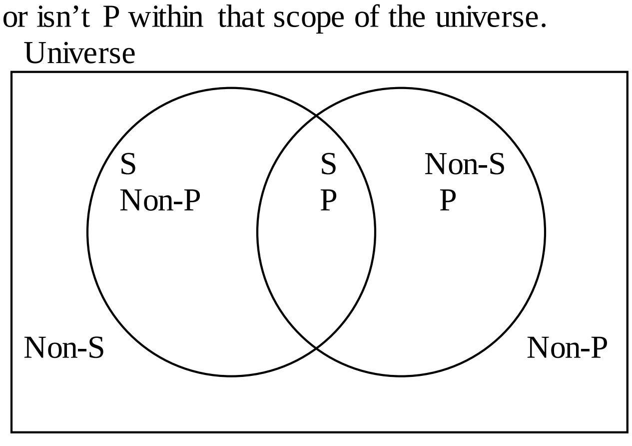
O: Some whiskeys are not bourbons.

**<u>Venn diagrams for standard form categorical propositions</u>**

"Mathematician John Venn…a fellow of Caius College, Cambridge, is best known for Venn diagrams, pictorial representations of the relations between sets that have become an oft-used tool in the teaching of mathematics and logic, among other concepts," (Biography). We will see further application of Venn's ideas later in the chapter, too. We can use these to demonstrate the workings of categorical logic. These diagrams can be used to visually represent the relationships between groups of things or categories. We use these to show the relationship indicated by categorical propositions (subject term and predicate term), and later the interaction of three terms in categorical syllogisms (major term, minor term, and middle term). The labels that are required will be placed outside the circles to indicate the subject and predicate term of a categorical proposition as displayed here.




Below is a blank Venn diagram with labels to display the location of the various members of each group, or category. These labels are used here solely for demonstration purposes and are not required in completed diagrams. This diagram, and the way categorical propositions are generally diagrammed, show the subject class on the left and the predicate group on the right. Here, 'S' means 'subject term', 'P' means 'predicate term', 'Non-S' and 'Non-P' refer to anything that isn't S or isn't P within that scope of the universe.



Look at the blank diagram. Think about what you would find in each area. Assume that S stands for 'swimmers' and P stands for 'pirates'. Who would be in the left crescent? The middle area? The right crescent? Outside both circles?

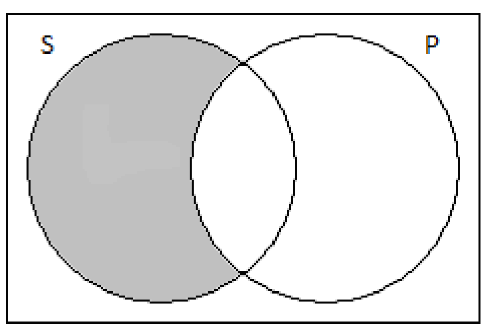
In the left crescent, we find members of S who are also non-P. In ordinary words, we find swimmers who aren't pirates; for example, Michael Phelps. In the middle, we find swimmers who are pirates, like Davey Jones. In the right crescent, pirates who are not swimmers, like Mullroy. Outside the circles we find things that are neither swimmers nor pirates. In fact, we find *everything* else. This includes but is not limited to ninjas that can't swim and aren't of the pirate persuasion, day old infants, shoes, socks, rocks, planets, trees, houses, and so on. This is the reason the box surrounding the Venn diagram is labeled 'universe' as it quite literally should include everything within the universe.

**The Two-Circle Venn Diagrams**

Each standard form categorical proposition can be diagrammed used a two-circle Venn diagram. To do this uniformly, label the left circle as the subject term and the right circle as the predicate term. The way Venn diagrams are used in categorical logic may be different than in a Literature or Science course, as you may have seen them before. For our purposes, shading within an area means that nothing can be found there. Think shading an area as driving all the constituents of that group out of the shaded area. On the other hand, an 'x' found in these Venn diagrams indicates that at least one member is found in that location. There is one standard Venn diagram for each of the four categorical propositions. They are described in detail below.

**'A' claims, Universal Affirmative statements**

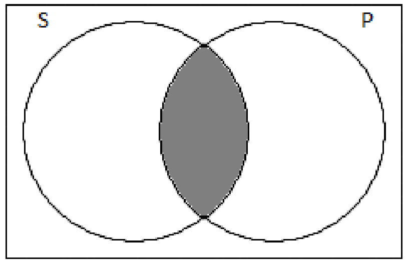
For any 'A' claim, regardless of the terms used, the two-circle Venn diagram will display the same information. 'A' claims assert that every possible member of the subject group must be a member of the predicate group. To demonstrate this in the Venn, for any 'A' claim, we will shade the area where you find the subject term *without* the predicate term. Here is an example: All S are P. We need to shade where we find 'S' without 'P'. Look below; the only area of the Venn that contains 'S' but does not contain 'P' is the subject crescent.




All S are P.

**'E' claims, Universal Negative statements**

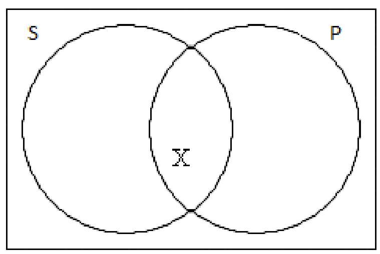
For any 'E' claim, regardless of the terms used, the two-circle Venn diagram will display the same information. 'E' claims assert that for every possible member of the subject group, it will not be a member of the predicate group and for every possible member of the predicate group, it will not be a member of the subject group. To demonstrate this in the Venn, for any 'E' claim, we will shade the area where you find the subject term *and* the predicate term together. Here is an example: No S are P. We need to shade where we find 'S' and 'P'. Look below; the only area of the Venn that contains 'S' and 'P' in the same place is the area between the two crescents.




No S are P.

**'I' claims, Particular Affirmative statements**

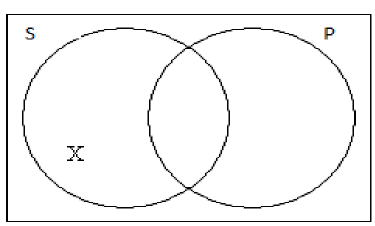
For any 'I' claim, regardless of the terms used, the two-circle Venn diagram will display the same information. 'I' claims assert that there exists at least one member of the subject group who is also a member of the predicate group. To demonstrate this in the Venn, for any 'I' claim, we will place an 'x' in the area where you find the subject term *and* the predicate term together. Here is an example: Some S are P. We need to place an 'x' in the area where we find 'S' and 'P'. Look below; the only area of the Venn that contains 'S' and 'P' in the same place is the area between the two crescents.




Some S are P.

**'O' claims, Particular Negative statements**

For any 'O' claim, regardless of the terms used, the two-circle Venn diagram will display the same information. 'O' claims assert that there exists at least one member of the subject group who is not a member of the predicate group. To demonstrate this in the Venn, for any 'O' claim, we will place an 'x' in the area where you find the subject term *without* the predicate term. For 'Some S are not P', we need to place an 'x' in the area where we find 'S' without 'P'. Look below; the only area that contains 'S' but does not contain 'P' is the subject crescent.



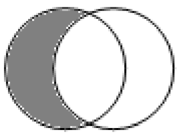

Some S are not P.

***Quick Study Reference***

***<u>Tips for basic Venn diagrams</u>***

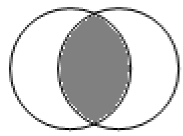
A: shade the area where you find the SUBJECT term WITHOUT the PREDICATE term.
E: shade the area where you find BOTH the SUBJECT term and the PREDICATE term.
I: place an 'x' where you find BOTH the SUBJECT term and the PREDICATE term.
O: place an 'x' where you find the SUBJECT term WITHOUT the PREDICATE term.

A: ALL S ARE P.



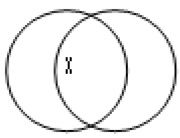
S P

E: NO S ARE P.



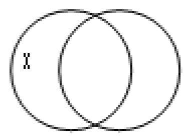
S P

I: SOME S ARE P.




S P

O: SOME S ARE NOT P.




S P

***<u>Standard form categorical propositions parts and terminology</u>***

| QUANTIFIER | SUBJECT TERM | COPULA | PREDICATE TERM |
|---|---|---|---|
| All, no, some | noun/noun phrase | 'to be' verb | noun/noun phrase |

Standard form of categorical propositions:

**U**A A: All S are P.
**UN** E: No S are P.
PA I: Some S are P.
P**N** O: Some S are not P.

Distribution: (bold terms distributed)

A: All **subject term** are predicate term.
E: No **subject term** are **predicate term**.
I: Some subject term are predicate term.
O: Some subject term are not **predicate term**.

REMEMBER:
*All categorical propositions must be propositions; it must make sense to say 'that statement could be true or it could be false' even if it is unknown to be true or false or debatable.
*All categorical propositions must begin with ALL, NO, or SOME.
*The copula must be ARE or ARE NOT (technically any form of 'to be').
*The subject term and predicate term must be NOUNS or NOUN PHRASES. (It must make sense to say 'there could be a bunch of ___')

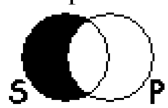
**Practice problems: Categorical proposition parts and terminology**

For each categorical proposition, complete the following:

A. Identify the *statement type* (A, E, I, O)
B. Identify the *quantity* (Universal or Particular)
C. Identify the *quality* (Affirmative or Negative)
D. Circle all *distributed terms* (remember the *entire term* is distributed, not just part of it)
E. Complete a *two-circle Venn diagram with labels*. If you use abbreviations, underline the *entire* term and assign a letter. Use the same letter to label your diagram.
F. Identify the scope of discourse (could be as broad as people, places, things, times).
*For practice identifying the parts of the proposition, draw slashes after quantifier, subject term, and copula as you see in the example.

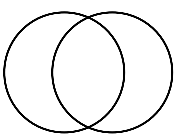
S P

Example: All / Sasquatches/ are / pitfalls for biologists.



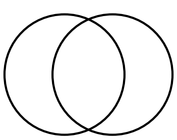

Statement type: A Quantity: U (universal) Quality: A (affirmative)

1.Some strict vegetarians are not vegans.



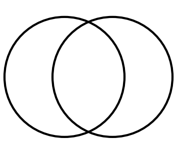
Statement type: ____ Quantity: ______________ Quality:__________________

2.No Red Sox fans are people that like the Yankees.



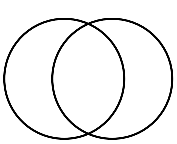
Statement type: ____ Quantity: ______________ Quality:__________________

3.All prunes are dried up plums.



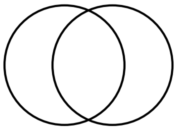
Statement type: ____ Quantity: ______________ Quality:__________________

4. Some rabbits are violence-seeking attackers.



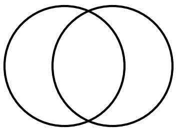
Statement type: ____ Quantity: ______________ Quality:__________________

5. Some cows are not future hamburgers.



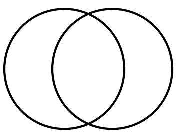
Statement type: _____ Quantity: _______________ Quality:____________________

6.All rabbits are vampires.



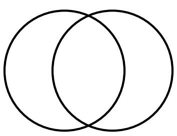
Statement type: _____ Quantity: _______________ Quality:____________________

7. No logic examples are repetitive examples.



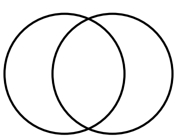
Statement type: _____ Quantity: _______________ Quality:____________________

8. Some Canadians are French-speaking people.



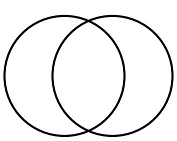
Statement type: _____ Quantity: _______________ Quality:____________________

9. Some clowns with red noses are not funny beings.



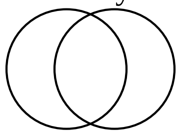
Statement type: _____ Quantity: _______________ Quality:____________________

10. Some televisions are high definition sets.



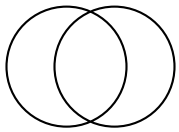
Statement type: _____ Quantity: _______________ Quality:____________________

11. All cyclists are fit people.



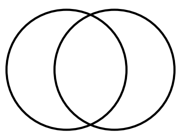
Statement type: _____ Quantity: _______________ Quality:____________________

12. No free thinkers are people who are willfully ignorant.



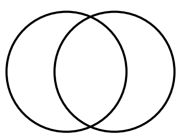
Statement type: _____ Quantity: _______________ Quality:____________________

13.No Weeblers are wobblers who fall down.



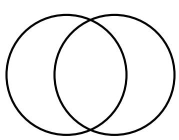
Statement type: _____ Quantity: _______________ Quality:____________________

14.Some avid surfers are not typical guitar playing tree-hugging hippies.



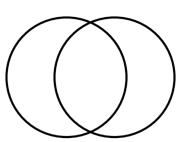
Statement type: _____ Quantity: _______________ Quality:____________________

15.Some rules are stipulations that are meant to be broken.



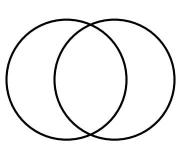
Statement type: _____ Quantity: _______________ Quality:____________________

16.No Kentucky bourbons are Irish whiskeys.



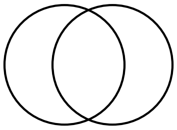
Statement type: _____ Quantity: _______________ Quality:____________________

17.Some good whiskeys are Irish whiskeys.



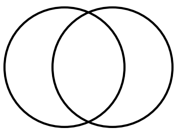
Statement type: _____ Quantity: _______________ Quality:____________________

18. Some cats are those that love mieces to pieces.



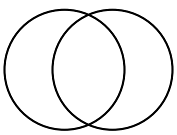
Statement type: _____ Quantity: ______________ Quality:__________________

19.Some dams found in rivers are dams made of wood that a woodchuck chucked.



Statement type: _____ Quantity: ______________ Quality:__________________

20.No nonsensical mumbo jumbo statements are statements that are not awesome to analyze.



Statement type: _____ Quantity: ______________ Quality:__________________

Further practice: Can you identify which type of claim or claims (AEIO) would work for each of these criteria? Identify a standard form categorical proposition:

*Example: with an affirmative quality: A, I*

a. with a negative quality:

b. whose predicate term is distributed:

c. with a universal quantity:

d. with no terms distributed:

e. with a negative quality and a universal quantity:

f. whose subject term is distributed:

g. with a particular quantity and an affirmative quality:

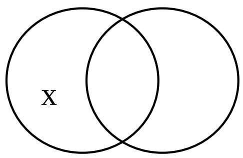
h. with both terms distributed:

***Challenge:*** *Try to create one of each standard form proposition using different groups for terms.*

**Homework: standard form categorical propositions        NAME:______________________**

For each categorical proposition, complete the following:
A. Identify the *statement type* (A, E, I, O)
B. Identify the *quantity* (Universal or Particular)
C. Identify the *quality* (Affirmative or Negative)
D. Circle all *distributed terms* (remember the *entire term* is distributed, not just part of it)
E. Complete a *two-circle Venn diagram with labels*. If you use abbreviations, underline the *entire* term and assign a letter. Use the same letter to label your diagram.
F. Identify the scope of discourse (could be as broad as people, places, things, times).

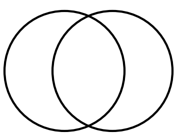
*Example: Some homework assignments are not asinine wastes of time.*
*H* *A*




*Statement type: O  Quantity: Particular  Quality: Negative*

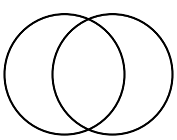
*H* *A*

1.All brick buildings on Loomis street are privately owned homes.



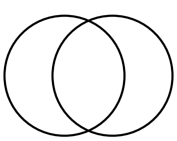
Statement type: _____ Quantity: ______________ Quality:__________________

2.Some textbooks are hardcover books.



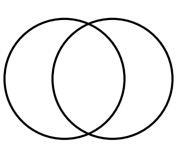
Statement type: _____ Quantity: ______________ Quality:__________________

3.No iguanas are monkeys.



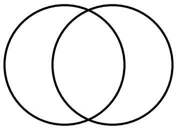
Statement type: _____ Quantity: ______________ Quality:__________________

4.Some brilliant mathematicians are not dorks.

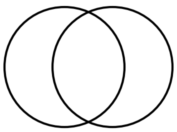


Statement type: _____ Quantity: ______________ Quality:__________________

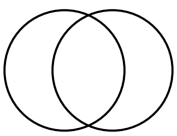
5.All penguins are silly animals.


Statement type: _____ Quantity: ______________ Quality:__________________

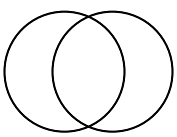
6.No unicorns are make-believe mammals.


Statement type: _____ Quantity: ______________ Quality:__________________

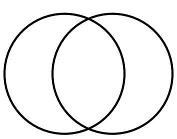
7.Some silver chalices are not sacred objects.


Statement type: _____ Quantity: ______________ Quality:__________________

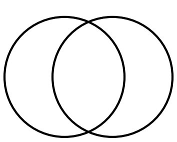
8.Some slimy salamanders are scary cesspool swimmers.


Statement type: _____ Quantity: ______________ Quality:__________________

9.All places identical to Fantasia are fanciful locations.


Statement type: _____ Quantity: ______________ Quality:__________________

10. All monarchs are modest magistrates who do not rule with an iron fist.


Statement type: _____ Quantity: ______________ Quality:__________________

## Standard form categorical syllogisms

A standard form categorical syllogism:

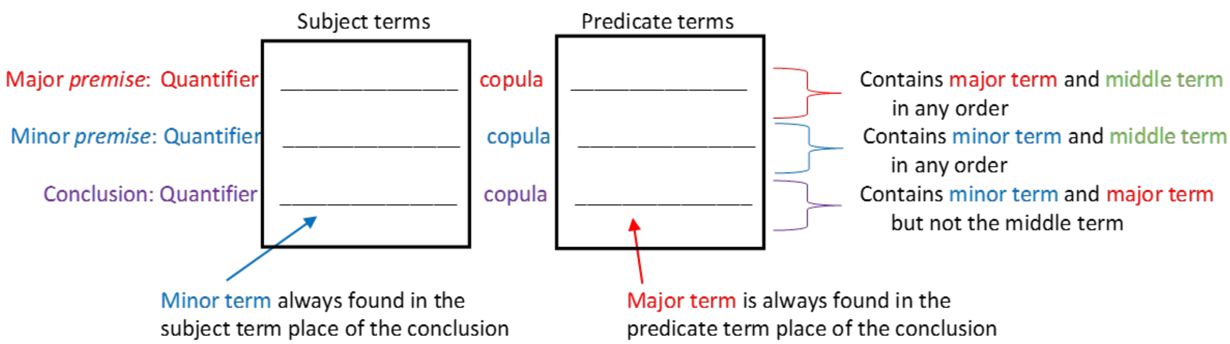
•is comprised of two premises and one conclusion

•contains exactly three categorical propositions (as the premises and conclusion)

•contains exactly three terms, within the same scope, each used exactly twice. These terms have unique names: major term, minor term, and middle term.

Once in standard form, the premises have names: The major premise and the minor premise. Each of these will have one term that is the same and one different term. The **shared term** is called the **middle term**; it is possible for the middle term to fill either the subject or the predicate term locations for either premise. The term other than the middle term **in the major premise** is called the **major term**. The term other than the middle term in the **minor premise** is called the **minor term**. The conclusion always contains the **minor term** and the **major term**. The subject term position of the conclusion always houses the minor term. The predicate term position of the conclusion always houses the major term.

The standard form will look EXACTLY like this:




## Determining standard categorical syllogism forms

The **FORM** of the standard form categorical syllogism is made up of two parts, the MOOD and the FIGURE. It will have this layout.

____ ____ ____ - ____

**MOOD:** The three categorical propositions used in the argument determine the mood. Simply list the proposition types in order from major premise, minor premise, and conclusion. The mood is always three letters (a combination of A's, E's, I's, & O's).

**FIGURE:** The position of the middle term in the premises determines the figure. There are 4 figures identified as 1, 2, 3, or 4. Here are the four figures.

Key: A=Major term, I=Minor term, M=middle term

| | | | |
|---|---|---|---|
| Quantifier M copula A | Quantifier A copula M | Quantifier M copula A | Quantifier A copula M |
| Quantifier I copula M | Quantifier I copula M | Quantifier M copula I | Quantifier M copula I |
| ∴Quantifier I copula A | ∴Quantifier I copula A | ∴Quantifier I copula A | ∴Quantifier I copula A |
| 1 | 2 | 3 | 4 |

For example:

All A are M — M is the middle term because it is found in the premises, not the conclusion.
No I are M — I is the minor term because it is the subject of the conclusion.
∴Some I are A — A is the major term because it is the predicate of the conclusion.

The placement of the middle term is the predicate of the major premise and predicate of the minor premise. This fits the figure 2 pattern. The mood is the type of claims used: A, E, I respectively. Thus, the form for this argument is AEI-2.

Some P are Z. — Z is the middle term because it is found in the premises, not the conclusion.
All Z are K. — K is the minor term because it is the subject of the conclusion.
∴Some K are not P. — P is the major term because it is the predicate of the conclusion.

The placement of the middle term is the predicate of the major premise and subject of the minor premise. This fits the figure 4 pattern. Thus, the form is IAO-4.

Or you can think of it like this:

| FIGURE: A=Major, I=Minor, ***M***=Middle | | | |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| ***M*** A | A ***M*** | ***M*** A | A ***M*** |
| I ***M*** | I ***M*** | ***M*** I | ***M*** I |

Or you can think of it like this:

"Ma'am I m I m"
M A A M
I M I M

Mirror

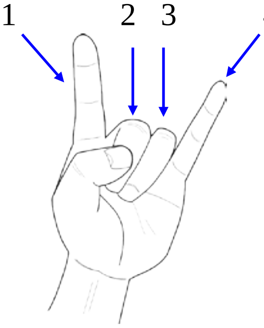
**THEN→**

Mirror image

| M A | A M | M A | A M |
|---|---|---|---|
| I M | I M | M I | M I |
| **1** | **2** | **3** | **4** |

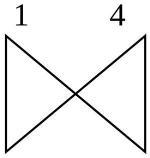
Or my personal favorite: You can think of the shape the 'metal' sign, as shown below.

1 2 3 4



The placement of the fingers is the same as that of the middle term in the four figures. Notice that the middle two fingers are close together, just as the middle terms are in the figures.
Or consider a bow tie shape:

1 4
3 2



**Practice problems: Components of standard form categorical syllogisms** *(Gallagher/Huff)*
Part A: Identify the three terms by their placement in these standard form categorical syllogisms.
Part B: Name the scope.
Part C: Name the mood and figure of the standard form categorical syllogism.

1.No debt-forgetters are Lannisters.
Some Starks are debt-forgetters.
∴Some Starks are not Lannisters.

Major term______________________________________________
Minor term______________________________________________
Middle term_____________________________________________
Scope: ___________________________________
Form: (Mood-Figure) ____ ____ ____ - ____

2.All people with scurvy are people who don't eat enough oranges.
Some pirates are people who don't eat enough oranges.
∴Some pirates are people with scurvy.

Major term______________________________________________
Minor term______________________________________________
Middle term_____________________________________________
Scope: ___________________________________
Form: (Mood-Figure) ____ ____ ____ - ____

3.No dog food ingredients are unicorns.
No dog food ingredients are cats.
∴No cats are unicorns.

Major term______________________________________________
Minor term______________________________________________
Middle term_____________________________________________
Scope: ___________________________________
Form: (Mood-Figure) ____ ____ ____ - ____

4.Some college students are Colorado natives.
Some Colorado natives are not equestrians
∴Some equestrians are not college students.

Major term______________________________________________
Minor term______________________________________________
Middle term_____________________________________________
Scope: ___________________________________
Form: (Mood-Figure) ____ ____ ____ - ____

5. No scissors are things you should run with.
All scissors are impaling objects.
∴ No impaling objects are things you should run with.

Major term______________________________________________
Minor term______________________________________________
Middle term_____________________________________________
Scope: __________________________________
Form: (Mood-Figure) ____ ____ ____ - ____

6.All people opposed to violence are peace lovers.
Some people opposed to violence are hateful persons.
∴ Some hateful persons are not peace lovers.

Major term______________________________________________
Minor term______________________________________________
Middle term_____________________________________________
Scope: __________________________________
Form: (Mood-Figure) ____ ____ ____ - ____

Part D: The following syllogisms are comprised of categorical propositions, but the syllogisms are not in standard form. Order the premises correctly above the conclusion, putting the argument into standard form. Then name the form.

7. All A are B and No C are B, so Some C are not A.

8. Some P are Q; therefore, Some P are not Z, for No Z are Q.

9. No A are K since All K are B and Some B are not A.

10. Some J are K inasmuch as Some K are not R and All J are R.

11.Some animals at the zoo are zebras. Therefore, some animals at the zoo are monkeys since no monkeys are zebras.

12. All sound arguments are valid arguments because all sound arguments are arguments with all true premises and all arguments with all true premises are valid arguments.

13. All times that Melissa goes to work are times she needs money. So some times she dances are times she needs money, for some times she goes to work are times she dances.

14. No people identical to George Clooney are people used in logic examples because some hilarious people are not people used in logic examples and all people identical to George Clooney are people are just that.

15. Some logic puzzles are not things that make people pull their hair. Some things that make people pull their hair are Sudoku puzzles, thus some Sudoku puzzles are not logic puzzles.

**Further application of standard form notation**

Once we understand what the standard form categorical syllogism notation means, we are able to work backwards to re-write an argument in standard form given the mood and figure alone. Re-write an argument (using any letters) in standard form given the following forms.

1. AEE-2

2. IAI-3

3.OAO-4

4. EIO-1

5. AAA-1

6. IOO-1

7. AAA-3

8. OOO-2

**Homework: categorical syllogism forms** Name:______________________

Directions Part A: Name the mood and figure for each example.

1. All C are D.
Some C are M.
∴Some M are not D

____ ____ ____ - ____

2. No B are A.
Some A are E.
∴All E are B.

____ ____ ____ - ____

3. Some W are not T.
No T are Q.
∴Some Q are W.

____ ____ ____ - ____

4. Some C are J.
All N are J.
∴No N are C.

____ ____ ____ - ____

5. Some Y are not L.
No I are Y.
∴All I are L.

____ ____ ____ - ____

6. All V are G.
All R are G.
∴All R are V.

____ ____ ____ - ____

Directions Part B: Use your understanding of premise and conclusion indicator words to correctly identify the parts of the syllogism. Transcribe the statements into a standard form categorical syllogism (list the major premise, the minor premise, and then the conclusion above one another as you see above). Then name the form.

7. No A are B since All B are Z and Some Z are A.

Major premise:____________________________________________

Minor premise:____________________________________________

Conclusion:_______________________________________________

Form: ____ ____ ____ - ____

8. Inasmuch as Some P are Q, we can conclude that Some Q are not S, for Some S are P.

9. Given that No H are K and Some R are K, it follows that Some R are not H.

10. Because All Y are B and All B are T, All Y are T.

**Answer to select practice problems**

1.Major term: Lannisters, L
Minor term: Starks, S
Middle term: debt-forgetters, D
Scope: people
Form: EIO-1

2.Major term: people with scurvy, S
Minor term: pirates, P
Middle term: people who don't eat enough oranges, O
Scope: people
Form: AII-2

3.Major term: unicorns, U
Minor term: cats, C
Middle term: dog food ingredients I
Scope: things
Form: EEE-3

4.Major term: college students, S
Minor term: equestrians, E
Middle term: Colorado natives, C
Scope: Coloradans / people
Form: IOO-4

5. Major term: things you should run with, R
Minor term: impaling objects, I
Middle term: scissors, S
Scope: things
Form: EAE-3
Invalid, illicit minor

6.Major term: peace lovers, P
Minor term: hateful persons, H
Middle term: people opposed to violence, V
Scope: people
Form: AIO-3

7. All A are B
No C are B
Some C are not A
Major term: A
Minor term: C
Middle term: B
Form: AEO-2

8. No Z are Q
Some P are Q
Some P are not Z
Major term: Z
Minor term: P
Middle term: Q
Form: EIO-2

9.All K are B
Some B are not A
No A are K
Major term: K
Minor term: A
Middle term: B
Form: AOE-4

10. Some K are not R
All J are R
Some J are K
Major term: K
Minor term: J
Middle term: R
Form: OAI-2

11. A=animals at the zoo; Z=zebras; M=monkeys // animals
No **M** are **Z**
Some A are Z
Some A are M
EII-2

12. S=Sound arguments; V=Valid argument; T=arguments with all true premises // arguments
All **T** are V
All **S** are T
All **S** are V

AAA-1

13. W=times that Melissa goes to work; N=times she needs money; D =times she dances // times
All **W** are N
Some W are D
Some D are N
AII-3

14. G = people id to George Clooney L = people in logic examples H = hilarious people // people
Some H are not **L**
All **G** are H
No **G** are **L**
OAE-1

**Review guide through chapter two:**
You should be familiar with the following information. Try the practice problems and check your answers on the next page.

*Terminology from chapter one: valid, invalid, sound, unsound, truth-value, syllogism, proposition; premise and conclusion indicator words; standard form

*Terminology from chapter two: quantifier, subject term, copula, predicate term, quantity, quality, distribution; mood, figure, form

*Standard form categorical propositions: types; parts; quality and quantity; two-circle Venn diagrams; distribution

*Categorical syllogisms: identify conclusion; standardize order of premises; major term, minor term, middle term; name form; move from form name to standard form syllogism

Given the following categorical propositions:
a) Name the statement type, quality, quantity, quantifier, and copula of the given statement.
b) Draw a two-circle Venn diagram for the given statements.
c) Circle all distributed terms.

1. All people who know karate are young grasshoppers.
2. No fish that live in fish bowls are dogs that aren't house trained.
3. Some college textbooks are hard cover books that cost too much money.
4. Some occupants of Earth are not humans.

Determine the conclusion and the premises for the following syllogisms. Put the categorical syllogism into standard order. Name the form of the argument (mood and figure).

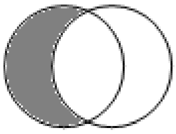
1. All X are Q, due to that fact that No Q are S, and No S are X.
2. We can conclude that Some E are not T, because No E are P. Also, Some P are T.
3. Some B are V, and Some W are V, so Some W are B.
4. All F are I. Therefore, All I are N, for All F are N.
5. No U are H. Thus, since All Q are H, No U are Q.

Given the form name, move into a standard form syllogism.
1. AEI-1
2. EEE-2
3. OIO-3
4. IAI-4

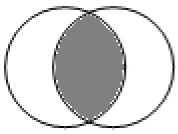
ANSWERS: review problems **(bold = distributed term)**

1.All / **people who know karate (P) /** are / young grasshoppers (Y).
Quantifier / Subject term / copula / Predicate term A: Universal Affirmative

P Y

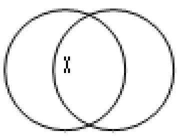


2.No / **fish that live in fish bowls (F)** /are/ **dogs that aren't house trained (D).**
Quantifier / Subject term / copula / Predicate term E: Universal Negative



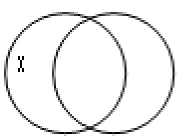
F D

3.Some / college textbooks (C) / are / hard cover books that cost too much money (M).
Quantifier / Subject term / copula / Predicate term I: Particular Affirmative



C M

4.Some / occupants of Earth (O) / are not **/ humans (H)**.
Quantifier / Subject term / copula / Predicate term O: Particular Negative



O H

1.No Q are S EEA-4
No S are X
All X are Q

2. Some P are T IEO-1
No E are P
Some E are not T

3. Some B are V III-2
Some W are V
Some W are B

4. All F are N AAA-3
All F are I
All I are N

5.All Q are H AEE-2
<u>No U are H</u>
No U are Q

1. All M are A AEI-1
<u>No I are M</u>
Some I are A

2. No A are M EEE-2
<u>No I are M</u>
No I are A

3. Some M are not A OIO-3
<u>Some M are I</u>
Some I are not A

4. Some A are M IAI-4
<u>All M are I</u>
Some I are A

# Chapters One and Two Segue to Chapter Three
# Concepts and Terminology Review

1. In categorical logic, what are the two **quantities** called?

2. Identify the **quantity** for each of the standard form categorical propositions.
   A:
   E:
   I:
   O:

3. What part or parts of a standard form categorical proposition indicates the **quantity**:
   Quantifier, subject term, copula, or predicate term?

4. In categorical logic, what are the two **qualities** called?

5. Identify the **quality** for each of the standard form categorical propositions.
   A:
   E:
   I:
   O:

6. What part or parts of a standard form categorical proposition indicates the **quality**:
   Quantifier, subject term, copula, or predicate term?

7. In categorical logic, what does the word **'term'** mean?

8. What are the two **terms** in a standard form categorical **proposition** called? Where are they located?

9. Which **terms are distributed** in each of the standard form categorical propositions?
   A:
   E:
   I:
   O:

10. What are the **three terms** in a standard form categorical **syllogism** called? Where are they located?

11. What does the word 'some' mean in categorical logic?

12. When using Venn diagrams for categorical logic, what does the 'x' mean?

13. When using Venn diagrams for categorical logic, what does a shaded area mean?

14. Draw a **Venn diagram** for each of the standard form categorical propositions.

    A:

    E:

    I:

    O:

15. In deductive logic, what does the phrase 'valid argument' mean?

16. In deductive logic, what does the phrase 'invalid argument' mean?

17. Can an argument be both valid and invalid? Why or why not?

18. When is the soundness of a deductive argument evaluated?

**Challenge questions:**

a) *What, conceptually, does it mean for a term to be distributed?*
b) *Why can't universal propositions have shading in one area and an 'x' in another?*
c) *What is the quality and categorical statement type of the following sentence: All humans are not teachers.*
d) *Create a categorical proposition with a negative quality and a true truth-value.*
e) *Create a categorical proposition with an affirmative quality and a false truth-value.*
f) *What other categorical propositions can we necessarily infer from this claim: Some dogs are not Muppets.*

# Chapter Three
# Analysis in Categorical Logic

**Tools for analysis**

We have two main tools we can use to determine the validity of standard form categorical syllogisms: detection of formal fallacies and completion of three-circle Venn diagrams. In this chapter, we'll describe what these are and how to use them. The two techniques can be used separately or can be used to confirm the findings of one method. Recall that a valid argument is one in which the premises would guarantee the conclusion. That if the premises were actually true, it would be impossible for the conclusion to be false.

If a formal fallacy is detected, then there is something about the form that causes the conclusion to only be a possibility, not a certainty. Finding one structural problem in reasoning, or formal fallacy, is enough to know every argument in that form (i.e., EEE-1 or AAA-2) is invalid (regardless of the actual truth of its components.)

The three-circle Venn diagrams utilize the work we did with two-circle Venn diagrams for categorical propositions. Since categorical syllogistic arguments have three terms and three categorical propositions, three circles are used to represent those three terms. As we diagram the premises into the three circles, we look for the conclusion claim in the completed diagram. If at least the information from the conclusion is visually contained there, then the argument is valid. If something is missing, if we'd have to add anything, or if we don't see at least that conclusion statement's diagram information in the three circles, then the argument is invalid. Again, we can use the diagrams and the fallacies together to check our findings.

**Formal Fallacies for Standard Form Categorical Syllogisms**

If we identify at least one formal fallacy in a standard form categorical syllogistic argument, then the argument is invalid. Some invalid forms may commit more than one fallacy, but one is sufficient to label the argument form invalid. If we run through the list of fallacies and find that none of the rules have been violated, then it is a valid argument form.

- **Undistributed Middle Fallacy:** The middle term must be distributed *at least once*, or the argument is invalid.

**Example:**

Some P are B.<br>
All C are P.<br>
Some C are B.

**Procedure:**

Circle all distributed terms.

- In the I claims, nothing distributed; in the A claim, the subject is distributed.

What is the middle term?

- P, found in premises not conclusion

Is it (the middle term) distributed (circled)?

- ✓ Nope, only the minor term in the minor premise distributed, not a middle term.

**Findings:**

This argument is invalid due to the undistributed middle fallacy.

- **Illicit Major Fallacy:** If the **major term** is distributed **in the conclusion**, *then* it must be distributed in the major premise, or the argument is invalid.

**Example:**
Some B are M
No I are M
No I are B

**Procedure:**
Circle all distributed terms.
- Done above.

What is the major term?
- B, found in predicate of the conclusion

Is it distributed (circled) **in the conclusion**?
- ***If no,*** *move on to another fallacy.*
- **If yes**, is it also distributed (circled) **in the premise?**
  - ✓ **No, B is distributed in the conclusion but not in the premise.**

**Findings:**
This argument is invalid due to the illicit major fallacy.

- **Illicit Minor Fallacy:** If the **minor term** is distributed **in the conclusion**, *then* it must be distributed in the minor premise, or the argument is invalid.

**Example:**
All K are Z
All K are I
All I are Z

**Procedure:**
Circle all distributed terms.
- Done above.

What is the minor term?
- I, found in subject of the conclusion

Is it distributed (circled) **in the conclusion**?
- ***If no,*** *move on to another fallacy.*
- **If yes**, is it also distributed (circled) **in the premise?**
  - ✓ **No, I is distributed in the conclusion but not in the premise.**

**Findings:**
This argument is invalid due to the illicit minor fallacy.

- **One-for-One Fallacy:** The number of **negative premises** must match the number of **negative conclusions**, or the argument is invalid.

**Example:**
Some B are not Y.
<u>No B are W.</u>
No W are Y

**Procedure:**
How many negative premises are there? How many negative conclusions?
  - Two negative premises
  - One negative conclusion

Do those numbers match?
  - Nope. Two does not equal one.

**Findings:**
This argument is invalid due to the one-for-one fallacy (also called *exclusive premises fallacy)*.

**Example:**
No P are Q.
<u>All Q are L.</u>
All L are P.

**Procedure:**
How many negative premises are there? How many negative conclusions?
  - One negative premise
  - Zero negative conclusions

Do those numbers match?
  - Nope. One does not equal zero.

**Findings:**
This argument is invalid due to the one-for-one fallacy (also called the *'drawing' fallacy)*.

- **Existential Fallacy:** If a syllogism has ***two*** **universal premises** then it cannot have a **particular conclusion**, or the argument is invalid argument.

**Example:**
No M are A.
<u>All M are I.</u>
Some I are not A.

**Procedure:**
Are there two universal premises?
  - ***If no,*** *go on to another fallacy.*
  - **If yes,** is the conclusion also universal?
    - ✓ No, the conclusion is particular.

**Findings:**
This argument is invalid due to the existential fallacy.

**Putting it all together:**
Some B are C.
<u>All A are B.</u>
Some A are not C.

**Procedure:**
- Circle all distributed terms to visually check for distribution rules.
  - ✓ Done above
- Identify the mood and figure to quickly identify quantity and quality fallacies
  - ✓ IAO-1 (PA, UA, PN)

**Findings:**
- o Undistributed middle: B is not circled at all
- o Illicit major: C is circled in the conclusion but not in the corresponding premise
- o One-for-one: zero negative premises, one negative conclusion, those #s do not match

- o This argument form IAO-1 does *not* commit the illicit minor fallacy because the minor term is not distributed in the conclusion. It does *not* commit the existential fallacy because we find only one universal premise.

So, this argument (and every IAO-1) is invalid. It commits numerous fallacies but finding one is sufficient information to know it is invalid.

**Putting it all together again:**
All Z are K.
<u>Some Z are G.</u>
Some G are K.

**Procedure:**
- Circle all distributed terms to visually check for distribution rules.
  - ✓ Done above
- Identify the mood and figure to quickly identify quantity and quality fallacies
  - ✓ AII-3 (UA, PA, PA)

**Findings:**
- o This argument does *not* commit the undistributed middle fallacy because Z is circled.
- o It does *not* commit either the illicit major *or* the illicit minor fallacy because nothing is circled in the conclusion.
- o It does *not* commit the one-for-one fallacy because there are zero negative premises and zero negative conclusions, those #s match.
- o It does *not* commit the existential fallacy because we find only one universal premise.

So, this argument in the form AII-3 is valid because it commits no fallacies.

**A sample checklist for detecting fallacies:**

- ✓ Is the middle term distributed at least once? (Have you circled it at all?)
- *Yes. Check another fallacy.*
- o No. Stop. Invalid, **undistributed middle fallacy.**
  - ✓ Is anything distributed in the conclusion?
- *No. Check another fallacy.*
  - ▪ Yes. Is that term also distributed in a premise?
- o No. Stop. Which term (major or minor) is it? Invalid, **illicit major or illicit minor.**
- *Yes. Check another fallacy.*
  - ✓ How many negative premises?
  - ✓ How many negative conclusions?
  - ✓ Do those numbers match?
- *Yes. Check another fallacy.*
- o No. Stop. Invalid, **one-for-one fallacy.**
- ✓ Are there two universal premises?
- *No. Check another fallacy.*
  - ▪ Yes. Is the conclusion also universal?
- *Yes. Check another fallacy*
- o No. Invalid, **existential fallacy.**

- ✓ If you've exhausted the list and still find **no fallacies, then the argument is valid**!

**Metatheoretical Results *(Smith)***

Having established which deductions in the figures are possible, Aristotle draws a number of metatheoretical conclusions, including:

1. No deduction has two negative premises
2. No deduction has two particular premises
3. A deduction with an affirmative conclusion must have two affirmative premises
4. A deduction with a negative conclusion must have one negative premise.
5. A deduction with a universal conclusion must have two universal premises

**<u>More on the Existential Fallacy:</u>**

**Boolean and Aristotelian interpretations, from the Stanford Encyclopedia of Philosophy**

"Aristotle's logic, especially his theory of the syllogism, has had an unparalleled influence on the history of Western thought…in later antiquity, following the work of Aristotelian Commentators, Aristotle's logic became dominant, and Aristotelian logic was what was transmitted to the Arabic and the Latin medieval traditions," (Smith).

George Boole questioned Aristotle's notion of 'conditionally valid' syllogisms. For Boole, it is always unsound reasoning to start with hypothetical scenarios and result in assertion of existence. For this reason, we have the Existential Fallacy under Boolean interpretation. In modern evaluation, any categorical syllogism that contains two universal premises and a particular conclusion is invalid due to this fallacy. For Aristotle, for any specific argument in this form, the validity was contingent upon the actual existence of the items in discussion. If in fact the conclusion was true and no other rules were broken, then the argument in that instance was valid. If no other rules were broken but the conclusion was false, then the argument in that instance was invalid. This is probably the only case where an argument in the same categorical standard form can be valid or invalid depending on the actual truth of its components. The problem for Boole is:

> "where the simple symbols *x*, *y*, etc., can refer to the empty class as well as to a non-empty class. With modern semantics one cannot have the Conversion by Limitation which held in Aristotelian logic: from All *X* is *Y* follows Some *Y* is *X*. In his *Formal Logic* of 1847, De Morgan pointed out that all writers on logic had assumed that the classes referred to in a categorical proposition were non-empty. This restriction of the class symbols to non-empty classes, and dually to non-universe classes, will be called *Aristotelian semantics*," (Burris).

To comply with science and modern thinking, for all 256 categorical syllogism forms, the form in question is either valid or invalid, regardless of what its terms represent and regardless of the actual truth of its components in every instance. (Burris)

**<u>Practice problems: detecting formal fallacies in categorical syllogisms</u>**

Part A. The following arguments are standard form categorical syllogisms. Determine is the argument form is valid or invalid. If valid, state ‘no fallacies’, and if invalid, name a fallacy.

1. All S are P.<br><u>No S are M.</u><br>∴Some M are P

2. Some A are B.<br><u>Some A are E.</u><br>∴All E are B.

3. No W are T.<br><u>No T are Q.</u><br>∴All Q are W.

4. Some C are not J.<br><u>Some N are J.</u><br>∴Some N are not C.

5. Some Y are not L.<br><u>Some I are Y</u>.<br>∴Some I are L.

6. Some G are V.<br><u>All G are R</u>.<br>∴All R are V.

**Part B ‘Mood’ examples:** Given the following moods of categorical syllogisms, name all the fallacies that can be detected from this information alone.

1. EEA    2. OII    *3. OO__

4. AEI    5. EOE    6. AAI

**Part C.** The following syllogisms contain categorical propositions, but the syllogisms are not in standard form. Order the premises correctly above the conclusion, putting the argument into standard form. Then name the mood and figure. Lastly, determine the argument’s validity using the formal fallacy detection method.

1. All X are Q, since No Q are S, and No S are X.

2. We can conclude that Some E are not T, because No E are P. Also, Some P are T.

3. Some B are V, and Some V are W, so Some W are B.

4. All F are I. Therefore, All I are N, for All F are N.

5. No U are H. Thus, since All Q are H, No U are Q.

**Part D.** Order the premises correctly above the conclusion using abbreviations for clarity, name the argument form, then determine validity using the formal fallacy detection method.

1.All hurricanes are storms that hit Florida and all storms that hit Florida are things that raise the cost of oranges, so all hurricanes are things that raise the cost of oranges.

2. No Super Heroes identical to "Uber-Unicorn" are caped crusaders who are able to defeat the Venn Villain. This being the case, it certainly follows that no mild-mannered logic instructors identical to Paddy are Super Heroes identical to "Uber-Unicorn", for all mild-mannered logic instructors identical to Paddy are caped crusaders who are able to defeat the Venn Villain.

3. All food items that contain bone marrow are food items I would not eat. Thus, since all candies that contain gelatin are food items that contain bone marrow, all candies that contain gelatin are food items I would not eat.

4.No occasions that are explicable from the materialistic position are phenomenological events, for all phenomenological events are instances of pure qualia, and no instances of pure qualia are occasions that are explicable from the materialistic position.

5. Some bands that are playing at Coachella are bands playing at Bonnaroo therefore some bands that are playing at Coachella are not bands worthy of seeing since some bands playing at Bonnaroo are not bands worthy of seeing.

**Homework: categorical syllogisms and formal fallacies** NAME:____________________

Directions: Given the following syllogisms, determine if a fallacy has been committed. If so, name one fallacy you found; if not, state 'no fallacy' or 'none' to indicate your understanding. Then circle 'valid' or 'invalid' according to your findings.

1.No mothers are fathers.
<u>No fathers are sofas.</u>
∴No sofas are mothers.

Fallacy? ____________________________
Circle: Valid or Invalid

2.All Martians are comedians.
<u>Some Martians are humans</u>.
∴Some humans are comedians.

Fallacy? ____________________________
Circle: Valid or Invalid

3.All women are daughters.
<u>All mothers are daughters.</u>
∴All mothers are women.

Fallacy? ____________________________
Circle: Valid or Invalid

4.All gazelles are purple mammals.
<u>All humans are gazelles</u>.
∴All humans are purple mammals.

Fallacy? ____________________________
Circle: Valid or Invalid

5.Some chinchillas are not robots.
<u>All gorillas are robots.</u>
∴Some gorillas are not chinchillas.

Fallacy? ____________________________
Circle: Valid or Invalid

6. No scary aliens are trustworthy beings.
<u>Some space creatures are scary aliens.</u>
∴Some space creatures are not trustworthy beings.

Fallacy? ____________________________
Circle: Valid or Invalid

Read the following syllogism. Rewrite the argument into a standard form categorical syllogism by identifying the conclusion and listing the premises in the correct order above the conclusion. Label your terms if using abbreviations. Then follow the directions from above.

7. Since no social networking sites are harmful creations and all things identical to Facebook are harmful creations, it follows that all things identical to Facebook are social networking sites.

______________________________________________________________________

______________________________________________________________________

∴_____________________________________________________________________

Fallacy? ______________________
Circle: Valid or Invalid

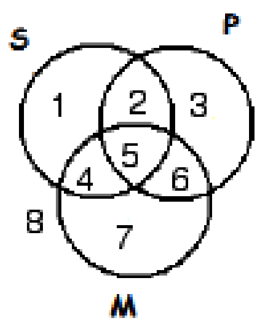
**Three-circle Venn diagrams for categorical syllogisms**

As noted earlier, we have four basic Venn diagrams to represent the relationships between the two terms involved in each of the four categorical propositions. When dealing with standard form categorical syllogisms, we can diagram the relationship between all three terms. Venn noted that the eight sections of the diagram allow for all 256 Boolean categorical syllogisms. These diagrams work in a similar fashion to the formal fallacies. When done correctly, they consistently show whether the syllogism in question is valid or invalid, without exception. This is a visual way of determining the validity of a standard form categorical syllogism.

The procedure is as follows. In the three-circle Venn diagram, we will diagram the information found in the two premises of the standard form categorical syllogism. (Always remember to label your Venn diagram just as we did for the basic two circle diagrams.) Then we will complete a separate two-circle diagram displaying the information found in the conclusion. Finally, we will look at the completed three-circle Venn and see if we find the information from the conclusion contained within the information from the two premises taken together. If the argument is valid, we will always find at least the exact information from the conclusion, though there may be extra information. This will probably become clearer as we look at a visual example.

For the sake of uniformity, the minor and major terms should be placed left and right respectively with the middle term below.

Given this example, the diagram would be labeled as follows. For communication purposes, the parts of the diagram are marked with numbers. This is done for demonstration use and it is not required.




If S=students, P=poor people, and M=musicians and the scope of discourse is ‘people’:

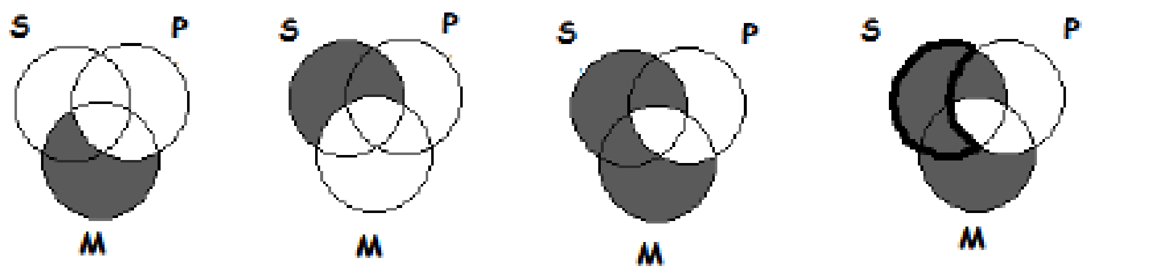
1.Students who are neither musicians nor poor people.
2.Poor students who are not musicians.
3.Poor people who are neither students nor musicians.
4.Student musicians who are not poor people.
5.Poor student musicians.
6.Poor musicians who are not students.
7.Musicians who are neither students nor poor people.
8.People (or ‘all else’ within the universe of discourse) who are neither students, musicians, nor poor people.

Example:
If someone were to say: “Of course all students are poor--they’re all musicians and all musicians are poor.”

Put it into standard form that argument would look like this:

| | |
|---|---|
| All musicians are poor people | All M are P |
| <u>All students are musicians</u> | <u>All S are M</u> |
| ∴ All students are poor people | ∴All S are P |

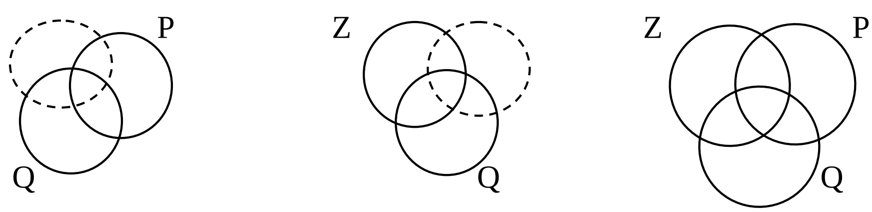
This is the process one could take to diagram the information from the premises into the three-circle Venn diagram. Note that each premise is diagramed individually within the three.




Premise one    Premise two    Both premises    Outlined conclusion

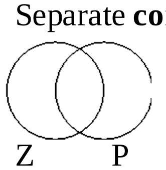
**<u>Creating and reading three-circle Venn diagrams for standard form categorical syllogisms</u>**
We will work through these examples together. In the beginning, it may be easier to draw separate circles for the premises in the same layout they take in the three circles. This way you can transfer the information visually. These first steps are not required; however a separate conclusion diagram is required. The first example is set up for you to complete.

1. AEE-4
All P are Q.
<u>No Q are Z.</u>
∴No Z are P.



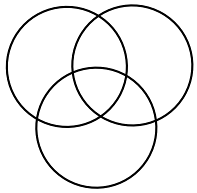

**Step one**: All P are Q.    **Step two**: No Q are Z.    Put it **together**

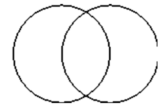
Separate **conclusion** diagram:



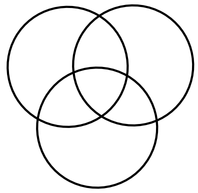

**Analysis:** Yes, we find at least the information from the conclusion diagram contained in the three circle diagram of the premises. Valid

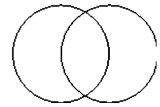
2.AEE-3, invalid
All M are A.
No M are I.
∴No I are A.



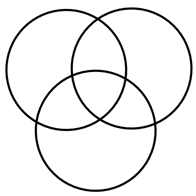


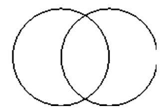
3. AAA-2, invalid
All A are M.
All I are M.
∴All I are A.



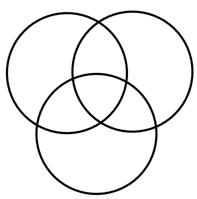


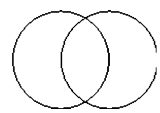
4. EOO-4, invalid
No A are M.
Some M are not I.
∴Some I are not A.



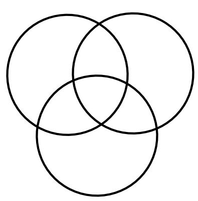


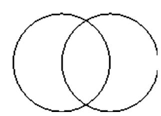
5.IAI-3, valid
Some M are A.
All M are I
∴Some I are A.



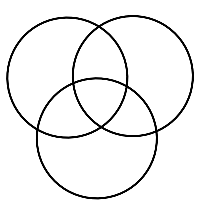


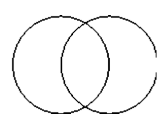
6.EIO-3, valid
No M are A.
Some M are I.
∴Some I are not A.





7.AII-4, invalid
All A are M
Some M are I.
∴Some I are A.

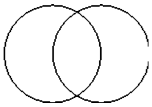
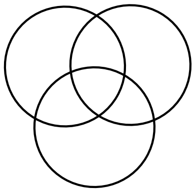




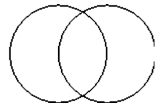
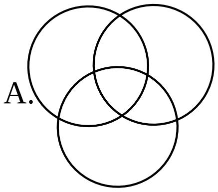
**Practice problems: Three-circle Venn diagrams**

Using the following symbolized standard form categorical syllogisms; complete a three-circle Venn diagram for the argument. Tell whether the argument is valid or invalid.

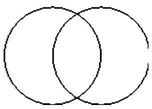
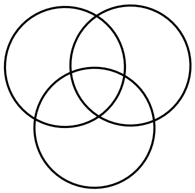
1. All A are M.
No I are M.
∴ No I are A.

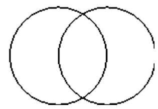
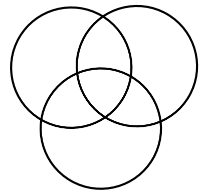
2. No M are A.
Some I are M.
∴ Some I are not A.

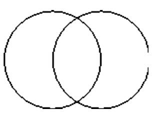
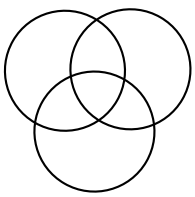
3. Some M are A.
Some M are not I.
∴ Some I are A.

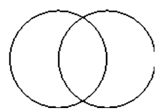
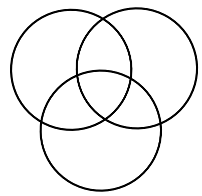
4. Some A are M.
All I are M.
∴ All I are A.

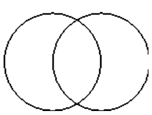
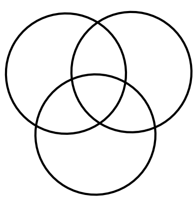
5. No W are M.
No M are I.
∴ No I are W.

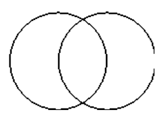
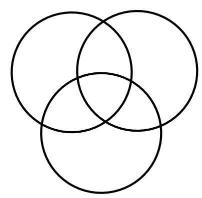
6. All R are A.
All I are R.
∴ All I are A.

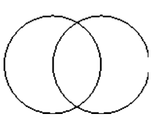
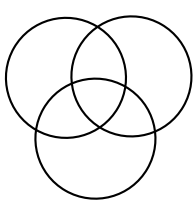
7. All T are G.
Some I are not G.
∴ Some I are not T.

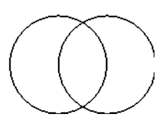
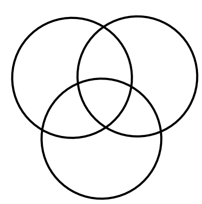
8. Some E are not B.
Some E are C.
∴ No C are B.

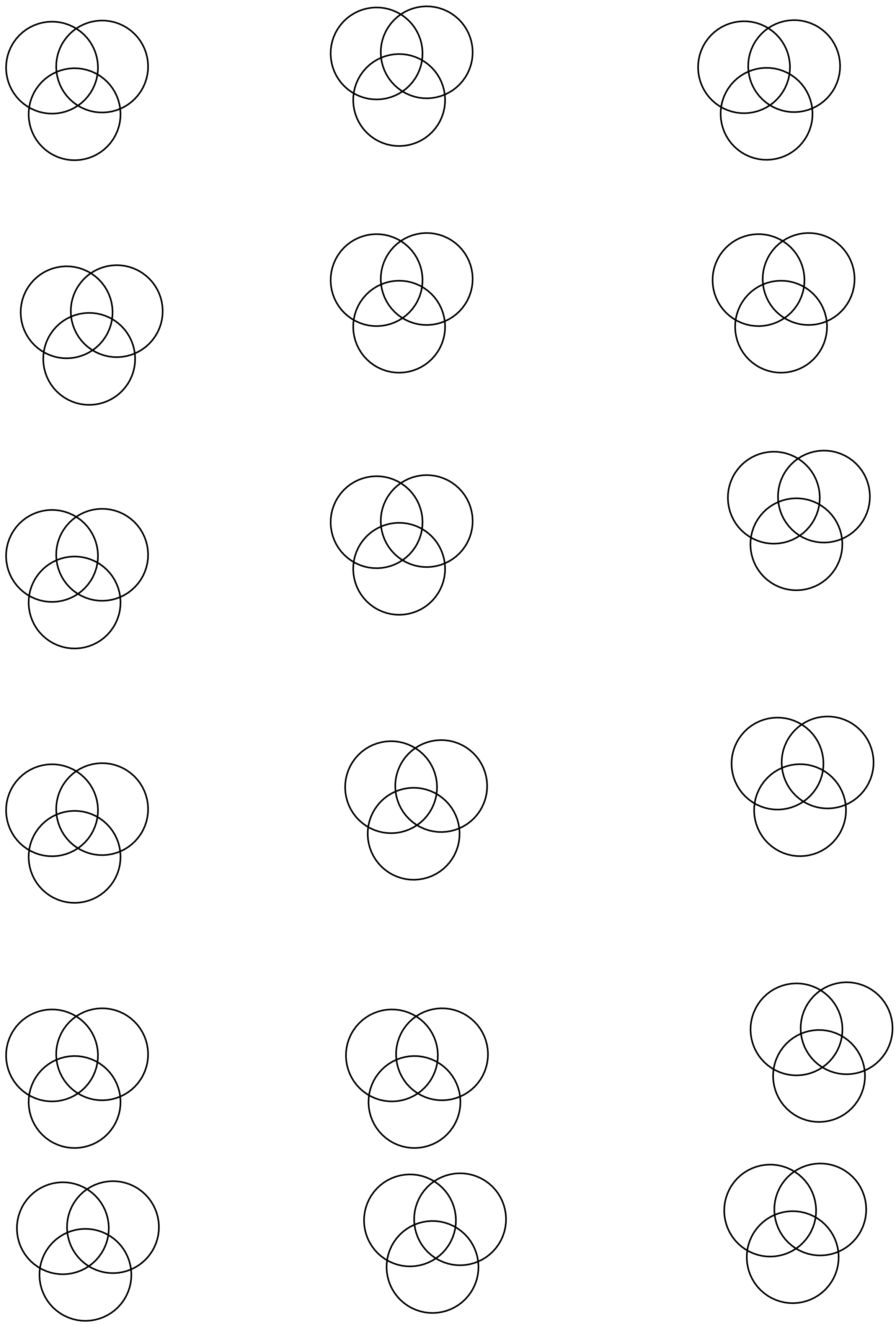
9. Some Q are N.
All Q are L.
∴ Some L are N.

10. Some H are M.
Some M are I.
∴ Some I are H.

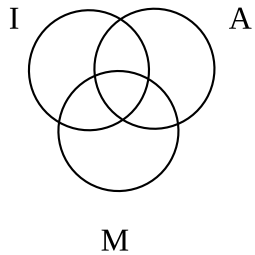
**Blank Venns for more practice.**

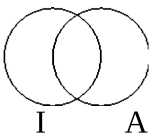


**<u>Homework Problems: Three-circle Venn diagrams</u>** **Name:_____________________**

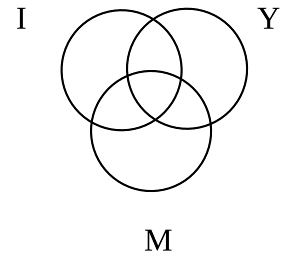
Directions: Using the following symbolized standard form categorical syllogisms: complete a three-circle Venn diagram for the argument including the conclusion diagram and then state whether the argument is valid or invalid.

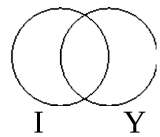
1. All A are M.
<u>All I are M</u>
∴ All I are A



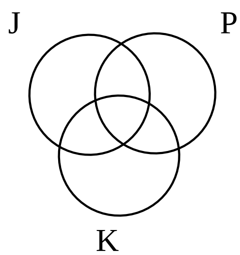



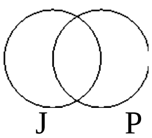

2. No M are Y
<u>All M are I</u>
∴ No I are Y



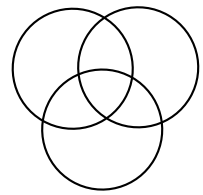



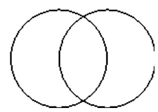

3. No P are K.
<u>Some K are J</u>
∴ Some J are not P



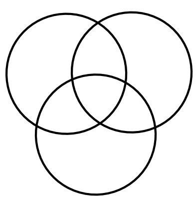



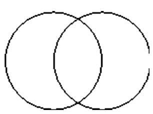

4. All M are A
<u>Some I are M</u>
∴ Some I are A



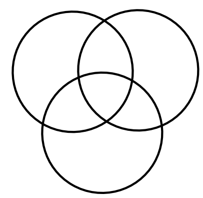


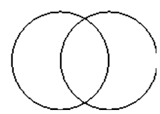
5. Some P are Q.
<u>Some Q are Z</u>
∴ Some Z are P



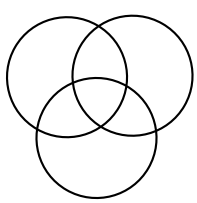


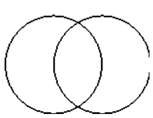
6. All T are M
<u>Some Z are M</u>
∴ Some Z are T



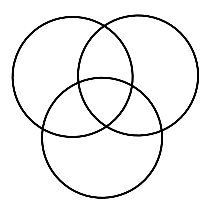


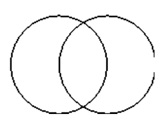
7. All W are R.
<u>All X are W</u>
∴ All X are R





8. All G are M
<u>No O are M</u>
∴ No O are G





# Chapter Four
# Working with Categorical Logic

**Moving From Ordinary Language into Categorical Language**

Though this may come as a surprise, most people do not have conversations comprised purely of categorical language. That's right, there are sentences that are not standard form categorical propositions! However, there are techniques to assist in translating the ordinary language sentences into categorical language and arguments into categorical syllogisms. Below you'll find a rough guide to approaching the translation process using context, intuition, and general hints.

**Translation Goal:** Take regular 'ordinary language' sentences and translate into *categorical language* propositions. To do so, we must:

- ✓ Convey the same (or nearly identical) information
- ✓ Attempt to use as much of the same wording or language used in the original (to avoid too much creative liberty in expressing what the original author probably intended)
- ✓ Retain the same truth-value as the original (if that value is known)
- ✓ Work within the confines of categorical language, which means each translation must:
    - ➢ Start with the words 'all', 'no', or 'some' (to reflect the likely intended amount)
    - ➢ Use the matching copula for the quantifier ('are not' is used only for O claims)
    - ➢ Contain categories (subject and predicate terms), both part of a larger category (scope)

**A Translation Guidebook: tips for translating sentences into categorical propositions**

**Hypothetical claims and asserting existence**: universal propositions are essentially hypothetical statements while particular propositions affirm that there is *at least one* member of some group that exists.

*Example: It is a scary being if it's a zombie.*
*Translation: All zombies are scary beings.*

1.If it's a cat, then it's a mammal.

=_________________________________________________________________

2.If it's a fish, then it is *not* a dog.

=_________________________________________________________________

3. There is at least one student who is also a parent.

=_________________________________________________________________

4.There is at least one plant that is not a flower.

=_________________________________________________________________

**Non-standard predicate terms**: if there is an adjective, adverb, propositional phrase, or some other non-category at the end of the sentence, a noun or noun phrase is needed to turn that into a category. Make both terms members part of the same scope of discourse.

*Example: Matriarch elephants are majestic.*
*Translation: All matriarch elephants are majestic animals.*

1. Some juicy apples are not green.

=________________________________________________________________

2. All Subaru Impreza cars are fast.

=________________________________________________________________

3. No cats are stupid.

=________________________________________________________________

**Non-standard quantifiers**: if the sentence is talking about *every* member of a group, make a universal proposition; if it is talking about *at least one* member, translate into a particular proposition. If there is an **unstated or ambiguous quantity**, use your best judgment or context to determine the best fitting quantity.

*Example: Fairies won't appear to non-believers.*
*Translation: No fairies are things that will appear to non-believers.*

*Example: Tissues are Kleenexes.*
*Translation: Some tissues are Kleenexes.*

1. Every day you come to class is a lovely day.

=________________________________________________________________

2. Many boxed wines are gross.

=________________________________________________________________

3. There aren't any scary movies in the theater this week.

=________________________________________________________________

4. Humans are mortals.

=________________________________________________________________

5. Birds are pets.

=________________________________________________________________

**Non-standard copulas**: if the copula is not a verb in the form 'to be', you can often make the verb a noun by adding '-ers' or you can add an appropriate noun to make complete noun phrases.

*Example: A lot of people struggle with tax paperwork.*
*Translation: Some people are tax-paperwork-strugglers.*

1. Some people love music.

=_______________________________________________________________

2. Some people vote foolishly.

=_______________________________________________________________

3. No airplanes fly over the Bermuda triangle.

=_______________________________________________________________

4. All students have tuition expenses.

=_______________________________________________________________

5. A few honorable people spoke at graduation.

=_______________________________________________________________

**Unique individuals or categories with one member**: if a sentence is only referring to one member of a class, make it into a universal proposition (A or E), by saying 'All (or No) people (places, things, times) identical to (name the person, place, thing, or time)' as your subject term.

*Example: Jessica got married in Morocco.*
*Translation: All people identical to Jessica are people who got married in Morocco.*

1. Ben is a musician.

=_______________________________________________________________

2. Now is not a good time. (Make this an E statement.)

=_______________________________________________________________

3. Stephanie is not Clint's girlfriend.

=_______________________________________________________________

4. Bangkok is beautiful.

=_______________________________________________________________

‘**the only**’: when you see the phrase ‘the only’, follow these steps. Replace ‘the only’ with ‘all’; the category following ‘the only’ should also follow ‘all’. That is, the item immediately following ‘the only’ will generally become the subject term of an A.

*Example: The only good pine beetle is a dead one.*
*Translation: All good pine beetles are dead ones.*

1. The only time you’re nice to me is when you want something.

=______________________________________________________________________

2. Dogs are the only animals that pee on fire hydrants.

=______________________________________________________________________

3. The only ink that may be used on this form is blue ink.

=_______________________________________________________________________

4. Bachelorettes are the only people who should try to catch a bride’s bouquet.

=________________________________________________________________________

‘**Only**’: when you find ‘only’ alone, follow these steps: make the sentence into an ‘A’ claim and the item immediately following ‘only’ will generally become the predicate term of an A.

*Example: Only cynics doubt the system.*
*Translation: All system-doubters are cynics.*

1.Only women are mothers.

=_____________________________________________________________________

2. Only adults are allowed to vote.

=_____________________________________________________________________

3. Isabelle hates only math classes.

=_____________________________________________________________________

4. You may use this form only when you meet these conditions.

=_____________________________________________________________________

**Common scope indicators for translation** (*Gallagher*)

**People**
I'll pay $500 to *whoever* can beat me at clogging.
All people who can beat me at clogging are people I'll pay $500.

*I*'m afraid of *no one* in this room.
No people in this room are people I'm afraid of.

On defense, *someone* didn't cover their man.
Some people on defense are not people that covered their man.

**Places**
*Wherever* you go, there you are.
All places you go are places you are.

Unicorns exist *nowhere* in reality.
No places in reality are places that unicorns exist.

The party is *someplace* she's not allowed to go.
Some places identical to where the party is are not places she's allowed.

**Things**
I want *everything* I can get my hands on.
All things I can get my hands on are things I want.

*Nothing* on my hard drive is recoverable.
No things on my hard drive are recoverable things.

*Something* in my sock is giving me a rash.
Some things in my sock are things giving me a rash.

**Times**
The engine's low on oil *whenever* it grinds like that.
All times the engine grinds like that are times the engine's low on oil.

He fights and *never* gets into trouble.
No times he fights are times he gets into trouble.

My knee *sometimes* aches when a storm's coming.
Some times a storm's coming are times my knee aches.

**Ambiguous scope**: If the sentence provides a likely scope, generally we should translate accordingly (and be sure both subject and predicate terms fall under the same scope). If we're unsure of the scope, we may need more context. See page 92 for further discussion.

**Practice problems: Translating into categorical language**

Directions: Translate the following sentences into standard form categorical propositions.

1. At least one example in this booklet is not funny.

    *Answer: Some examples in this booklet are not funny examples.*

2. Some earthquakes are terrifying.

3. At least one movie is gory.

4. No mobsters are considerate.

5. There aren't any fun history courses.

6. Kelsi is an angel.

7. Aaron cries only when Darth Vader dies.

8. A few hip-hop songs are not very good.

9. Fort Collins is a great place to live.

10. Everyone at the party was ready to rock and roll.

11. All marsupials have pouches.

12. The only smartphone cases worth buying are Otterbox cases.

13. None of Billy Graham's programs are legitimate.

14. No exercise is worthless.

15. Many students were not in class last week.

16. Only the Tin Man is not affected by poppies.

17.No machines have sentience.

18.The Atkin's diet is foolish.

19.Most Philosophy instructors are old.

20.Every logic student is smart.

21.The show is on now

22.Ambeur goes wherever Jeff goes.

23.Whenever there is a rainbow, the sun is shining.

24.If you are at the castle at the center of the labyrinth, then you are at Jareth's castle.

25.Some fairies don't grant wishes.

26.Some cats get high on catnip.

27. Many arachnids are venomous.

28. She never does her homework at night.

29.Teenagers are not allowed to drink in the USA.

30.Philosophy instructors drink coffee.

31.Everywhere that Mary goes, the little lamb is sure to follow.

32.Jack's face gets red whenever he gets angry.

**Homework: Translating into categorical language** NAME:______________________

Directions: Translate the following sentences into standard form categorical propositions while retaining as much of the same meaning and wording as possible.

1. Every student loves logic.

______________________________________________________________________

2. Many campus computers are outdated.

______________________________________________________________________

3. There aren't any innocent criminals.

______________________________________________________________________

4. At least one ticket given on the Fourth of July will be for public urination.

______________________________________________________________________

5. Some illnesses cannot be treated with over-the-counter medications.

______________________________________________________________________

6. Only salmon swim upstream.

______________________________________________________________________

7. Sarah should not go that way.

______________________________________________________________________

8. Any time I do Logic homework is a great time.

______________________________________________________________________

9. Big Band songs are the only ones worth dancing to.

______________________________________________________________________

**Translating arguments into standard form categorical syllogisms**

When translating an argument into categorical language, the same principles apply from translating individual sentences. When dealing with syllogisms, there will be exactly two premises and one conclusion. Within the syllogism, there will be just three terms (nouns/noun phrases) each used exactly twice. The key is to narrow the argument enough to fit into categorical format without changing the meaning of the original argument. Following are a few steps to take as a guide to this translation.

**How to approach translating a syllogism into standard categorical format**

1. Read the entire argument. No really; read the whole argument before you begin.
2. Find the conclusion using indicator words and reasoning.
3. Think about the overall types of things being discussed, or *scope*, to help identify terms.
4. Identify your terms. Remember that there will be three terms each used exactly twice. You may need to look for synonyms and use your best judgment in finding the pairs of terms.
    a. Mold the three terms into nouns or noun phrases. It may be helpful to identify the scope.
    b. Assign a label (letter or abbreviation) for each term; you will want to make a key for this.
5. Looking at one sentence at a time, translate each using the previously determined terms. Remember to try to retain as much of the original as you can. Keep the same meaning as the given claim. Translate all three sentences into individual categorical propositions.
6. Check your translation. Each categorical proposition should be in standard form. The three terms should each be used exactly twice.
7. Put the syllogism in standard format by listing the translated premises above the translated conclusion with the major premise first and the minor premise second.
8. Analyze for validity.

**Complications with Scope Identification** *(Gallagher)*

In standard form categorical syllogisms, there are three terms each used exactly twice. These three terms, however, must be related in some way. Sometime the relation is very broad and sometimes it can be very narrow. The terms must all be talking about some common group. As we've encountered, that range of what the terms are talking about is called *the scope of discourse*; in other words, the range of the discussion. For example, if the terms found are 'cats', 'purple zebras', and 'angry sloths', then the category these three things all could fit under could be 'animals'. The larger heading or encompassing boundary could be 'animals' in this case. If the first two terms are the same and 'staplers' is the third, then the scope of discourse could be 'things'. Something that would not work would be to have terms like 'people taking logic class', ‘airplanes’, and ‘times children are napping’; in that case there would be people, things, and times.

It is possible with propositions apparently falling under some scopes that they actually make more sense under another scope. An example of this is found in the following cases of ‘If/then’ and ‘never’ statements, which may *seem* to fall under the parameter of ‘time’. In these cases, and in most propositions in which there are no scope indicators, it can be difficult to determine the scope of a proposition independent of the rest of the argument. For this reason, it *may* be advantageous to use the wording ‘occasions of’ or ‘instances of’ when *initially* translating these statements. These ‘place holders’ can then be substituted with the appropriate scope once it is determined. If, on the other hand, the scope for an argument are readily evident (as most will be in this class), then translate all propositions directly and consistently, according to the specific scope. Sometimes the same claim could be translated in a number of ‘correct’ ways. It is important at that point to use the context of the argument and intuition to translate more accurately.

*Example 1:*
‘If we can see Long’s Peak, we’re near home’ can be temporarily translated as ‘all occasions in which we can see Long’s Peak are occasions in which we’re near home’. Given further context, the intended translation can become clearer.

If we can see Long’s Peak, we’re near home.
We can see Long’s Peak *now.*
So, we’re near home. =

All times we can see Long’s Peak are times we’re near home.
All times identical to now are times we can see Long’s Peak
∴ All times identical to now are times we’re near home **Scope: times**

If we can see Long’s Peak, we’re near home.
*Wherever* this is, we see can see Long’s Peak.
So, wherever this is, we’re almost home. =

All places we can see Long’s Peak are places we’re near home.
All places identical to this are places we can see Long’s Peak.
∴ All places identical to this are places we’re near home **Scope: places**

*Example 2:*
‘Teaching never bores me’ can be temporarily translated as ‘no instances of teaching are instances of my being bored’. Given further context, the intended translation can become clearer.

Teaching never bores me.
I’m teaching *whenever* the Chair is yelling at me.
So, I’m never bored *when* the Chair is yelling at me

No times I am teaching are times I am bored
All times the Chair is yelling at me are times I am teaching
∴ No times the Chair is yelling at me are times I am bored **Scope: times**

Teaching never bores me.
If it's teaching, then it drains my life force.
So, *nothing* that drains my life force bores me.

No things identical to teaching are things that bore me.
All things identical to teaching are things that drain my life force.
∴ No things that drain my life force are things that bore me. **Scope: things**

**Translating into Categorical Syllogisms**

Consider this argument:

> Every being with sentience deserves our moral consideration. This is due to the fact that most sentient beings are beings that serve a purpose for humans, inasmuch as any being that does that deserves our moral consideration.

The goal is to *translate* the argument into a categorical syllogism. To do this, we want to retain as much of the same meaning and wording as the original argument while working within the confines of categorical language. First, it may be helpful to identify the conclusion. In the above example, the conclusion is the first sentence.

Every being with sentience deserves our moral consideration.

Translate this sentence as you would any individual sentence. Notice it starts with 'every'; that most often translates as 'all'. But all *what* are *what*? We need to make two groups or categories. In this case we have 'beings with sentience' and 'deserve our moral consideration'. These categories can then be molded into nouns or noun phrases. 'Beings with sentience' is fine because we could have a group of these; the second is not yet a noun phrase because we couldn't have a group of 'deserve our moral consideration'. We need to make that idea into a group. How could we do this? We can simply say '*being that* deserve our moral consideration' or even '*things that* deserve our moral consideration'. Now we have two of our three terms for the syllogism. At this point it may be helpful to start your 'key'. Choose a letter to assign to each term and list your created terms completely like this:

S = beings with sentience
D = beings that deserve our moral consideration

From here you can start to complete the syllogism by rewriting your conclusion into a standard from categorical proposition using your newly created key.

> All S are D.

Next we can move on to a premise. Remember that we have already found/created two of the three terms (the minor term and the major term), so we only have one more term to find/create. Let's look at the next sentence in the example.

Most sentient beings are beings that serve a purpose for humans

In this case, we have to cut through the introductory rhetoric of 'this is due to the fact that' to get to the main idea of the sentence. We see that it starts with 'most'; this most often translates into 'some'. But again, some *what*? We see 'sentient beings'. Does that sound familiar? It is synonymous with our first created term, so we can move to the rest of the sentence. We see 'beings that serve a purpose for humans'. This is already a noun phrase, so we can just add it to our key and assign a letter for the term. We have found our middle term.

*S = beings with sentience*
*D = beings that deserve our moral consideration*
P = beings that serve a purpose for humans
Now we can add to our syllogism by rewriting this premise as a standard form categorical proposition using your key.

Some S are P.

We have one remaining premise: inasmuch as anything that does that deserves our moral consideration. We already have our three terms and since they each must be used exactly twice, the two terms that must be used in this translation are D and P. In the sentence, we don't see P explicitly stated, but we can see that 'any being that does that' refers to any being that 'serves a purpose for humans'. Thus our translation becomes:

All P are D.

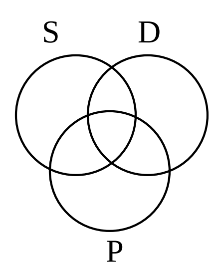
Now we can put it all together, making sure to order the premises correctly above the conclusion.

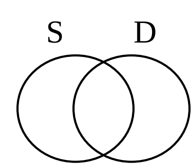
All P are D.
Some S are P.
All S are D.

*Key:*
*S = beings with sentience*
*D = beings that deserve our moral consideration*
*P = beings that serve a purpose for humans*
*Scope: beings*

Once the argument has been translated into a standard form categorical syllogism, then we can use our methods for determining the validity of the argument. You may use the three-circle Venn diagram method or the rules/fallacies method.

This syllogism AIA-1 is invalid due to the illicit minor fallacy.



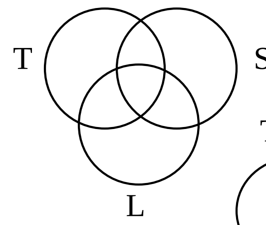



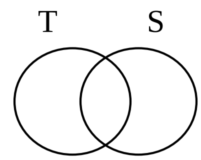
Here is another example: "Whatever it was that you smelled was some kind of animal so it must have been a skunk because the only animals that live in this area are skunks." (Salahub)

Key:
L = animals that live in this area
S = skunks
T = things that you smelled
Scope: animals or things

All L are S
All T are L.
All T are S.

This syllogism AAA-1 is valid, no fallacies committed.




**Practice problems: Translating Syllogisms in Ordinary Language** *(Gallagher/Salahub/Huff)*

**Part A:** Translate the following arguments into standard form categorical syllogisms. Follow the guide from page 95 and the translation guidebook at the beginning of this chapter.

1. Every cat is a mammal, and a few mammals are zebras, therefore at least one zebra isn't a cat.

2. Only pirates are allowed to make people walk the plank. Since Captain Gelgep is a pirate, he must be allowed to make us walk the plank.

3. Any significant computer security issue needs to be addressed at our meeting today. So, we need to talk about some USB devices that students use in our computer labs since many of these USB devices are real security concerns.

Key: Scope: issues
S = significant/real computer security issues
A = issues that need to be addressed/talked about at our meeting today
U = issues that involve USB devices that students use (in our computer labs)

4. The only valid categorical syllogism with a negative premise is one with a negative conclusion. This syllogism does not have a negative conclusion. Thus, this syllogism is not a valid syllogism containing a negative premise.

5. If you pass the first exam, then you'll pass the class. If you pass the class, then you'll be a happy person. So, there is at least one happy person who passed the first exam.

6.A few movie adaptations of novels are done properly. Most of those are the ones that stay true to the story. Thus, some movie adaptations of novels stay true to the story.

7. Only the brightest stars can be seen from Earth because the only stars that can be seen from Earth are extremely hot stars, and extremely hot stars are stars that are the brightest.

8. They never go to that club since that club doesn't serve alcohol, and the only clubs they go to serve alcohol. *(Hint: scope is 'clubs')*

9.Only things capable of meaningful speech can think. Humans must be capable of thought since they can speak.

10. Whenever it snows students miss class. Hence, it must be snowing today, for ten students missed class today.

11. Many logic students earned extra credit, even though a few logic students did not attend class on Friday. Therefore some students who earned extra credit attended Friday's class.

12. All that constitutes sensible objects is a collection of ideas. Ideas are dependent on perceivers for their existence. Therefore, physical objects exist only when perceived.

13. Some graphic images help form debate, and pornography does just that, so it must contain graphic images.

**Part B.** For each of the following, use the principle of charity to determine what proposition will complete the valid enthymematic argument. Start by identifying what is given (what parts of the argument are stated) to know what you are looking for (a premise or a conclusion). **Also, remember that a valid argument is not necessarily a sound argument.** We can consider the truth of their premises after we see the complete argument. **Translate into categorical language to help complete the enthymematic syllogisms.**

*Example: Only classy people dance on the bar at Bondi Beach House, so Martha doesn't dance up there.*

*Answer:*
*B = people who dance on the bar at Bondi Beach House*
*M = people id to Martha*
*C = classy people*

*All B are C*
*No M are C (implicit)*
*No M are B*

*Ordinary language missing premise: Martha isn't classy.*

9. Roses are red, and there aren't any violets that are red.

10. "It seems that mercy cannot be attributed to God. For mercy is a kind of sorrow." -Thomas Aquinas *Summa Theologiae*

11. "The soul through all her being is immortal, for that which is ever in motion is immortal." –Plato, *Phaedrus*

12. "Opponents of abortion claim that abortion is wrong because abortion involves killing someone like us, a human being who just happens to be very young." --Don Marquis, *An Argument that Abortion is Wrong*

13. Who controls the past controls the future. Who controls the present controls the past. —
George Orwell, *1984*

14. "Liberty means responsibility. That is why most men dread it."
-G.B. Shaw, *Maxims for Revolutionists*, 1903

15. "As a matter of fact, man, like woman, is flesh, therefore passive, the plaything of his hormones and of the species, the restless prey of his desires."
–Simone De Beauvoir, *The Second Sex*, 1949
*hint: try using these as the terms involved in the argument*
*F= things made of flesh; P=passive playthings of flesh's hormones and human species' restless prey of flesh's desires; M=men*

16. "A nation without a conscience is a nation without a soul. A nation without a soul is a nation that cannot live." —Winston Churchill

17. The law does not expressly permit suicide, and what it does not expressly permit, it forbids.
-Aristotle, *Nichomachean Ethics*

**Part C.** Choose one or more problems from part B above to **question the soundness of the argument**. What might a skeptic say about the truth of the missing premise or conclusion? Are there better or more convincing ways to argue for the same conclusions? Why or how might a premise be false and how would we convey that to an audience?

## Categorical Operations

Consider these pairs of claims:

All landlubbers are those who won't willingly take to the high seas.
No landlubbers are those who willingly take to the high seas.

Some snow days are days students don't attend class.
Some snow days are not days students attend class.

All cats are mammals.
All mammals are cats.

What is the relationship between the statements in each pair? Do they convey the same information in different ways or do they say conflicting information? Can one be derived from the other or not?

**How should we translate these statements?**

1. Most sour beers aren't aged in whiskey barrels.
2. Everyone at the party wouldn't dance.
3. None of the pirates aboard didn't drink rum.
4. Some months don't have a full moon.

There may be more than one equally acceptable solution, though the rest of the argument may influence one option over another. For example, 'most sour beers aren't aged in whiskey barrels' could be translated as 'some sour beers are not beers aged in whiskey barrels' *or* 'some sour beers are beers that aren't aged in whiskey barrels'. Either option is acceptable but we would need to pick just one. If the rest of the argument talked about beers aged in whiskey barrels then we'd probably opt for the first translation.

**Overview**

Certain operations can be performed on standard form categorical propositions to yield new propositions. It is a systematic way to create new categorical propositions from given ones. Some of these operations will deliver information that can be immediately inferred given the information in one claim or provide information that is logically deducible from other information, and others will not. Below, we'll see the process for each of these operations, an explanation of logical equivalency, and practice problems using these operations.

**Logically equivalent propositions**

Some categorical operations create propositions that are **logically equivalent**. The two propositions say the same thing but in different ways. That is, they necessarily mean exactly the same thing, they are just worded differently. For all logically equivalent propositions, they will necessarily have the same **truth value**. It will necessarily be the case that logically equivalent statements are either both true or both false, even if we are unsure of the truth value. That is, if two claims are logically equivalent, then they necessarily mean the same thing and they necessarily have the same truth value: if one is true, then the other is necessarily true, and if one is false, then the other is necessarily false.

**Propositions that are NOT logically equivalent**

When you perform a categorical operation on proposition and it *does not* yield a logically equivalent statement (with the exception of the contradiction), the two propositions are not equivalent. This means that the two propositions do not *necessarily* mean the same thing and they do not *necessarily* have the same (or opposite) truth value. The operation performed has given you a new statement, but it is *not* something that has been logically inferred.

It may be that both statements *happen* to be true or appear to say the same thing, but that fact is irrelevant because of how we got there. If you perform an immediate inference on a given statement and it yields a non-(logically equivalent) statement, then the new statement is not something we can assert. You may know (intuitively) that the new statement is really true or really false, but we cannot logically derive (or immediately infer) that information based on the given statement and the operation we performed on it to get the new statement. Anytime an operation is performed on a statement type that does not guarantee a logical equivalency, that operation is said to be 'illicit'. With that, the new claim created by the illicit operation would yield very little information to us. The truth value of the new claim cannot be achieved deductively and we must assume the truth value of the new claim would be unknown to us. For this reason, the truth value of a claim resulting from an illicit operation is said to be 'undetermined', 'U'.

*If two claims are not logically equivalent, then they do not necessarily mean the same thing and they do not necessarily have the same truth value. For these reasons, the truth value of the new claim is labeled 'U' for undetermined, as it has not been logically achieved. The operation is illicit.*

Suppose you were given the information that 'all humans are mammals' is a true statement. From this, we *cannot* determine (without using information we have not been given) whether 'all mammals are human' is true or false. Even though we *know* that the new statement is false in real life, it is not something we can logically deduce from the original statement. It may seem strange or ironic for a course entitled 'Logic', but here is where you have to put aside intuition and common sense. What we are looking for are necessitates, certainties. We want to find statements that are guaranteed to mean the same thing, not just coincidentally or occasionally. It may be helpful to use just variables in place of subject and predicate terms. Or think of replacing the subject and predicate terms to make a statement whose truth value you are unsure. When you do this, it may be easier to see what can be logically deduce and of what is uncertain.

For example, if you were given the information that 'Some giggabots are not biggabots' and you were told this was true, what could you logically infer? Could you know for certain that Some giggabots *are* biggabots? That Some biggabots are not giggabots? That Some things that aren't biggabots are not things that aren't giggabots? That Some giggabots are things that aren't biggabots? Of which of these statements could you derive the truth value with certainty? Which are statements you can logically infer?

**Categorical Operations: Conversion, Contraposition, Obverse**

There are three operations (sometimes called *immediate inferences*). These operations can only be properly performed on standard form categorical propositions. If the statements are in ordinary language, then they must be translated first. The operations are converse, contrapositive, and obverse. Some yield a logically equivalent new claim and others do not. Below are the steps for each and the information on which operations 'work' for which types of propositions.

- **Converse**

To achieve a converse of a categorical proposition, the procedure is to change the position of the subject term and the predicate term. If a conversion is performed on an E claim or on an I claim, then the new resulting claim will necessarily be logically equivalent to the previous claim. If, on the other hand, the conversion is performed on an A claim or on an O claim, then nothing can be logically inferred about the information in the new claim, as these are illicit conversions.

*Examples of logically equivalent conversions:*

- No dogs are fish. Conv → No fish are dogs.
- Some students are parents. Conv→ Some parents are students.

*Examples of illicit conversions: (these pairs of claims are not logically equivalent)*

- All cats are mammals. Conv → All mammals are cats.
- Some wines are not Pinot Grigios. Conv → Some Pinot Grigios are not wines.

- **Contrapositive**

To achieve a contrapositive of a categorical proposition, the procedure is to change the position of the subject term and the predicate term and to complement both the subject and the predicate terms. If a contrapositive is performed on an A claim or on an O claim, then the new resulting claim will necessarily be logically equivalent to the previous claim. Performing a contrapositive on an E or an I claim is an illicit contrapositive.

*Examples of logically equivalent contrapositives:*

- All cats are mammals. Contra → All non-(mammals) are non-(cats).
- Some wines are not Pinot Grigios Contra → Some non-(Pinot Grigios) are not non-wines

*Examples of illicit contrapositives:*

- No dogs are fish. Contra → No non-(fish) are non-(dogs).
- Some students are parents. Contra→ Some non-(parents) are non-(students).

- **Obverse**

The obverse is unique. An obverse can be performed on any statement type and the resulting new claim will necessarily be logically equivalent to the previous claim. The obverse is achieved by changing the quality of a claim (affirmative to negative and vice versa) and complementing the predicate term. Notice that the quantity remains the same; the quality may be detected in the quantifier or it may be found in the copula. Also notice that the subject and predicate terms have not moved and only the predicate term has been complemented.

*Examples of logically equivalent obverses: (All pairs are logically equivalent.)*

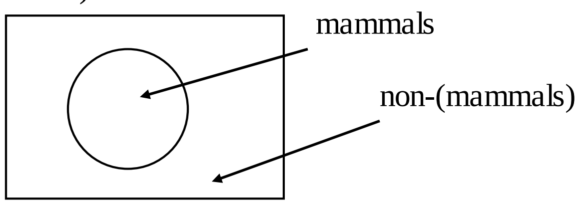
- All cats are mammals. Obv→ No cats are non-(mammals).
- No dogs are fish. Obv → All dogs are non-(fish).
- Some students are parents. Obv → Some students are not non-(parents).
- Some wines are not Pinot Grigios Obv → Some wines are non-(Pinot Grigios).

**Formal complements**
Formal complements are created by placing the prefix 'non-' in front of the term; this forms the formal complement of a term.

Examples: The complement of *mammals* is *non-mammals.*
The complement of *unicorns* is *non-unicorns.*
The complement of *white clouds* is *non-(white clouds).*
The complement of *people who eat meat* is *non-(people who eat meat).*

Note that if the term to be complemented is written as more than one word, place parentheses around the term and place 'non-' before the left parenthesis.

universe (everything there is)




A term and its formal complement should make up everything there is. That is, together they are everything of which the universe consists.

**Informal complements**
In ordinary language, we often use informal complements. Informal complements are the everyday way we talk about member outside of some group. To use these in categorical logic, we need to be aware of some things.

Examples:
An informal complement of *mammals* is *animals other than mammals.*
An informal complement of *unicorns* is *animals other than unicorns.*
An informal complement of *white clouds* is *non-white clouds.*
An informal complement of *people who eat meat* is *people who don't eat meat.*

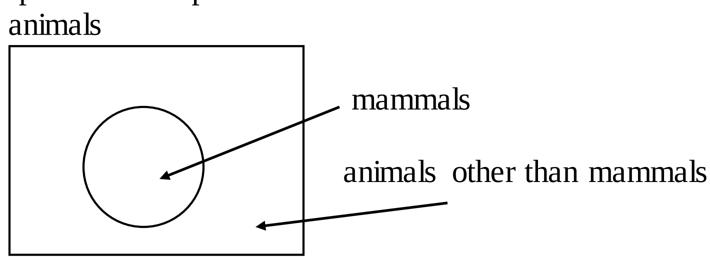
Though these may sound perfectly fine and seem to be generally sets of opposites, there is more involved in categorical logic. Remember that a term and its complement are to comprise the entire universe. Clearly 'white clouds' and 'clouds of a variety of colors' are not the only two things that make up the universe. We need instead to narrow the playing field.

**Narrowing the Scope of Discourse**
When using the informal complement, the complemented term and its informal complement do not together constitute the *entire* universe, but a smaller class of items. This smaller class, the topic of the 'discourse' or discussion, is called the *scope of discourse*, the *universe of discourse*, or the *scope of the universe*. It is important to name the scope of discourse when using informal complements in order for the claim to maintain the same meaning as intended. When diagramming, it is important to label the box around the Venn diagram to *narrow the scope of discourse*.

Examples:

- The scope of discourse of an argument containing the terms ‘mammals’ and ‘animals other than mammals’ could be ‘animals’.
- The scope of discourse of an argument containing the terms ‘unicorns’ and ‘herbivores other than unicorns’ could be ‘herbivores’.
- The scope of discourse of an argument containing the terms ‘white clouds’ and ‘non-white clouds’ could be ‘clouds’.
- The scope of discourse of an argument containing the terms ‘people who eat meat’ and ‘people who don’t eat meat’ could be ‘people’.

Both the term and its complement belong to the class, and divide up the class of animals into those that *are* mammals and those that *are not* mammals. This limits, or narrows, what types of things are included in this particular scope of the discussion.



**Practice problems: Categorical Operations**

1a. Write the **converse** of: No free societies are uneducated societies.

______________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its converse?

1b. Write the **converse** of: Some electronic devices are items which may remain on during flight.

______________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is FALSE, what can we logically infer about the truth value of its converse?

2a. Write the **contrapositive** of: All unicorns are mythical mammals.

______________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is FALSE, what can we logically infer about the truth value of its contrapositive?

2b. Write the **contrapositive** of: Some Uber drivers are not Lyft drivers.

______________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its contrapositive?

3a. Write the **obverse** of: Some emo songs are depressingly wonderful reverberations.

_____________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its obverse?

3b. Write the **obverse** of: All Summer courses are courses that will help me graduate sooner.

______________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its obverse?

3c. Write the **obverse** of: No sporks are real forks.

______________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is FALSE, what can we logically infer about the truth value of its obverse?

3d. Write the **obverse** of: Some schnozberries are not things that taste like schnozberries.

______________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is FALSE, what can we logically infer about the truth value of its obverse?

**Practice Problems: more practice with categorical operations**

Directions: For each standard form categorical proposition, provide the following information. Perform the converse, contrapositive, and obverse; indicate which are logically equivalent. Given the original truth-value, determine the truth-value of the new claim.

Example: All / Greyjoy descendants / are / people bent on realm domination. (false)
Conv → All people bent on realm domination are Greyjoy descendants. (U) NOT LE
Contra →All non-(people bent on realm domination) are non-(Greyjoy descendants). (false) LE
Obv → No Greyjoy descendants are non-(people bent on realm domination). (false) LE

1. No ninjas are pirates. (F)

2.Some hippies are not Boulder residents. (T)

3.Some predicate terms are not distributed terms. (T)

4.All snowboarding resorts are snow-capped mountains. (U)

5.No cows are tasty treats. (F)

6.All newer models of DVD players are CD players. (T)

7.No politicians are people who are always truthful. (U)

8.All sumo wrestlers are men who are large and in charge. (F)

9.Some Boy Scouts are not happy participants. (T)

10. All phrases that contain nouns are noun phrases. (F)

11.All Stargate fans are science fiction fans. (T)

12.No quantifiers are copulas. (T)

**Practice problems: Advanced application of categorical operations**

Given the original statement and the information provided, fill in the blanks. Remember, if performing an immediate inference yields a logically equivalent new statement, the derived truth-value remains the same as the original statement. If it is *not* logically equivalent, the truth value of the new statement is not something we can logically infer or derive, thus it is 'undetermined'.

*For example, if we take the converse of an E statement whose truth value is false, then the converse of that statement is LE so the derived truth-value is also false. If we take the contra of an I, that is illicit, so the derived truth-value is undetermined, 'U'.*

| **Original Proposition (w/truth-value)** | **Operation** | **New Proposition** | **Derived truth-value** |
|---|---|---|---|

1. No C are D. (F) conv ______________________________________________________ ____

2. Some A are B. (T) contra______________________________________________________ ____

3. No A are non-B. (T) conv______________________________________________________ ____

4. All A are non-B. (F) obv______________________________________________________ ____

5. Some non-A are not B.(T)conv__________________________________________________ ____

6. Some non-A are non-B.(T) obv_______________________________________________ ____

7. No A are B. (F) contra: ______________________________________________________ ____

8. All non-A are B.(F)contra______________________________________________________ ____

| | | | |
|---|---|---|---|
| 9. No non-A are non-B. (F) | __________________ | No B are A. | ____ |
| 10. Some A are not non-B. (T) | __________________ | Some A are B. | ____ |
| 11. All A are non-B. (F) | __________________ | All non-B are A. | ____ |
| 12. No non-A are B. (F) | __________________ | All non-A are non-B. | ____ |
| 13. Some non-A are not B. (T) | __________________ | Some non-B are not A. | ____ |
| 14. Some A are non-B. (F) | __________________ | Some non-B are A. | ____ |
| 15. No C are non-D. (F) | __________________ | No D are non-C. | ____ |
| 16. Some U are not Q. (T) | __________________ | Some U are non-Q. | ____ |

***Challenge:***

*17.Some A are not B. (F)* _____________ ___________________________________ *F*

*18. Some A are B. (T)* _____________ __________________________________ *U*

*19. Some S are P. (T)* __________________ ___________________________________ *T*

**Homework Problems: Categorical Operations** **NAME:____________________________**

1. Write the **converse** of the following: Some logic instructors are nerds.

___________________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its converse?

2. Write the **contrapositive** of: Some student computers are not Macintosh computers.

___________________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its contrapositive?

3. Write the **contrapositive** of: All luck dragons are dragons named Falkor.

___________________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is FALSE, what can we logically infer about the truth value of its contrapositive?

4. Write the **obverse** of: Some rainy days are cold days.

___________________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its obverse?

5. Write the **obverse** of: All people identical to William Kidd are professional pirates.

___________________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its obverse?

6. Write the **obverse** of: Some crazy motor scooters are not dirt bikes.

_________________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is FALSE, what can we logically infer about the truth value of its obverse?

7. Write the **obverse** of: No spheres found deep in the ocean are contraptions to be entered.

___________________________________________________________________________

Are these two statements logically equivalent? Yes or No

If the original is TRUE, what can we logically infer about the truth value of its obverse?

**Informal complements in syllogisms** *(Gallagher)*
For the most part, we will be using formal complements to avoid ambiguity and incorrect interpretations of an author's intended meaning. It is important to note however that in 'real life' we are given much more information when assessing arguments and claims. With that, we can make a clearer more accurate judgment of the author's intentions. Also, we do not usually speak in formal complements, so understanding what an informal complement is and how to derive it is important to your practical application of logic and reasoning.

A 'formal' complement of a term will complete the universe of discourse for all that there possibly is:

- [rocks]+[non-(rocks)]=all there possibly is in the universe
- [non-(pirates with scurvy)]+[pirates with scurvy]= all there possibly is in the universe

While comprehensive and easy to use, 'formal' complements are difficult to apply in real world situations. For instance, if we want to analyze an argument dealing only in laws, it would be counter-productive to operate in complements encompassing all that is, whether laws or not:

- [moral laws]+[non-(moral laws)]= all there possibly is in the universe

This is the case because an argument dealing with laws has no interest in columbine flowers, feldspar rocks, gravitons, or nose hairs. Also, consider what would be possible of an argument in which the complements encompassed only the specific subject matter. This is where 'informal' complements come into play. An 'informal' complement of a term will complete only the universe of discourse for what is the general subject of the argument:

- [moral laws]+[immoral laws]=all possible *laws*
- [professional racecar drivers]+[amateur racecar drivers]=all possible *racecar drivers*

In each case of 'informal' complements, the universe of discourse is limited and needs to be explicitly stated:

All moral laws are just laws.
<u>Some laws in the books are immoral laws.</u>
∴ Some laws in the books are unjust laws.

Here the universe of discourse is 'laws'. Once the universe of discourse is limited to the subject at hand, the informal complements can be identified and dealt with just as formal ones.

**M** **J**
All [moral laws] are [just laws]. (no change)→All moral laws are just laws.

**B** **non-M**
Some [laws in the books] are [immoral laws]. obv →Some laws on the books are not moral laws.

**B** **non-J**
∴ Some [laws in the books] are [unjust laws].obv →∴ Some laws in the books are not just laws.

Again, be certain that the universe of discourse is explicitly identified when using informal complements.

Note: A concern when dealing in informal complements that doesn't come up with formal complements is whether the two terms offered truly are complements of the limited universe of discourse. In other words, do the two terms encompass all that is possible within the limited universe of discourse? For instance, are [strong fighters] and [weak fighters] complements encompassing all fighters? Can there be an 'in between'? If there is room for an 'in between', such as [moderate fighters], then treating the two extremes as complements will not lead to deductive certainty.

**Practical application of immediate inferences in categorical syllogism**

Often times, logically equivalent immediate inferences will be used in categorical logic to standardize arguments. If an argument contains more than three terms and at least one of those terms is the complement of another, then we can use logically equivalent immediate inferences to reduce the number of terms in the syllogisms to three terms each used exactly twice. The objective is to achieve a standard form categorical syllogism without changing the original argument's meaning. This is why logically equivalent immediate inferences are the only option; this allows for the statements to retain the same information just said in a different way. Some problems may require multiple steps. Sometimes more than one operation may be needed for a given statement. So long as a chain of logically equivalent immediate inferences are used, as many as needed may be applied. Some problems may be more obvious than others. There may be a number of correct paths to a standardized argument, some more efficient than others. The key is to take time to do the steps of the inference correctly and to use only logically equivalent immediate inferences.

NOTE: This is not to be confused with the four terms fallacy. In the four terms fallacy, the argument *appears* to be a categorical syllogisms, but on further investigation, we find that one of the terms really means two different things throughout that argument. There is one word or phrase that *looks* the same, but really has two separate meanings. In a syllogism that contains complementary terms, the terms *do not look the same* and they should have 'opposite' or complementary meanings. We can use immediate inferences to 'get rid' of the complements and end up with three terms, each used twice, and each with one meaning throughout the argument.

Here is a reminder of the procedure for the immediate inferences along with the statement types that yield logically equivalent new claims.

- **convErsIon**: Switch the subject and predicate terms
    - E or I are LE
- **cOntrApositive**: Switch the subject and predicate *AND* complement both terms
    - A or O are LE
- **obverse**: Change the QUALITY *AND* complement the PREDICATE term
    - A or E or I or O are LE

Here is an example of how this might look. Consider the following argument:

Some M are non-P.
All non-M are non-Q.
∴Some Q are P.

To the unsuspecting eye, this may at first glance appear valid. After all, it appears the 'M' is in the subject place of an A making it distributed, all three are affirmative claims, and there is nothing distributed in the conclusion. However, something is not quite right. How would a Venn diagram look for this? How could there be just three properly labeled circles when the terms in this argument are 'M', 'non-P', 'non-M', 'non-Q', 'Q', and 'P'? There cannot be. This argument is not a standard form categorical syllogism. This is when one would need to reduce the number of terms to three terms each used exactly twice. One would not want to change the argument, however, and that is why only logically equivalent immediate inference options may be used.

Perhaps the first place to start is to determine the types of categorical propositions used in the argument. This will indicate the immediate inference choices for each statement. Though the procedure may appear overwhelming at first, remember you can just look at one claim at a time and try to eliminate the complemented terms. (There may be more efficient ways to approach an individual argument, but we will start with eliminating the complements first.)

| | | |
|---|---|---|
| Some M are non-P. | I | choices: converse or obverse |
| <u>All non-M are non-Q.</u> | A | choices: contrapositive or obverse |
| ∴Some Q are P. | I | choices: converse or obverse |

If we start with the first premise, we see that it is an I claim allowing for the converse or the obverse. Ask yourself which of those choices would most efficiently eliminate the complement in that sentence. In this case, the complement is in the predicate position. Since the converse would simply move that complement to the subject position while the obverse would complement the predicate term, the obverse is the more efficient choice.

| | | |
|---|---|---|
| Some M are non-P. | obv → | Some M are not P. |
| <u>All non-M are non-Q.</u> | | |
| ∴Some Q are P. | | |

Move on to the second premise. It is an A claim allowing for the contrapositive or the obverse. Follow the same thought process as before. In this case, the statement has a complement in both the subject and the predicate positions. Though the obverse would eliminate one of these complemented terms, it would not take care of both. The contrapositive on the other hand will eliminate both complements at one time.

| | | |
|---|---|---|
| Some M are non-P. | obv → | Some M are not P. |
| <u>All non-M are non-Q.</u> | contra→ | All Q are M. |
| ∴Some Q are P. | | |

Now when we look to the conclusion we see that is contains no complements. All that remains is to double check the work and the ordering of the premises. The rewritten standardized version of that original argument looks like this:

Some M are not P.
<u>All Q are M.</u>
∴Some Q are P.

Now that the argument is in standard categorical syllogism form, proper analysis can be completed. This argument is actually invalid. It commits the fallacies of undistributed middle and drawing an affirmative conclusion from one negative premise. Also, a Venn diagram could now be constructed correctly as the terms are three, ‘M’, ‘P’, and ‘Q’. As you progress in your understanding, see if you can find the most efficient route to standardizing the syllogism.

**Difficulty in eliminating the complements**

Sometimes it may be easier to reduce the terms to three by keeping some terms as complements. That is fine so long as the complemented version of the term in both its locations.

Example: There aren’t any cats that aren’t mammals, and every dog is a mammal, thus every animal that is not a cat has to be a dog.

If we wanted to change the informal complements to formal complements, we need to allocate a scope in which we are working. (If it is difficult to find a scope, a default can be ‘things on Earth’, ‘things’, ‘things in the universe’, or other generic scopes.)

| | |
|---|---|
| cats | = C |
| non-cats | = non-C |
| mammals | = M |
| non-mammals | = non-M |
| dogs | = D |

What larger category or group could encompass these categories, but limit the range or scope to something smaller than the entire universe? It could be ‘animals’, ‘creatures found on Earth’, ‘living beings found in Colorado’, or so forth, depending on what we think the author of the argument intended to discuss. Translated, the argument looks like this:

There aren’t any cats that aren’t mammals. = No cats are non-mammals. = No C are non-M.
<u>Every dog is a mammal.</u> = <u>All dogs are mammals.</u> = <u>All D are M.</u>
∴Every animal that is not a cat has to be a dog. = All non-cats are dogs. =All non-C are D.

Now we need to use immediate inferences to get rid of the complements.

No C are non-M.
All D are M. → cont’p All non-M are non-D.
∴All non-C are D. → Cont’p All non-D are C.

Final answer:

No C are non-M.
All non-M are non-D.
∴All non-D are C.     Scope of discourse: Animals

Now there are three terms, some of them happen to be ‘non-term’: C, non-M, and non-D.

**Practice problems: Using logically equivalent immediate inferences in syllogisms**

Part A: Use logically equivalent immediate inferences to reduce the number of terms used in the syllogism to three each used exactly twice; generally you can work to eliminate the complementary terms.

1. No A are non-B.
All non-B are non-C.
∴No C are A.

2.Some K are not non-J.
Some J are non-L.
∴Some L are not K.

3. Some P are not Q.
Some P are non-Z.
∴Some Z are not Q.

4. Some non-X are not non-Y.
No Y are non-Z.
∴Some Z are not X.

5.All B are non-P.
Some non-K are B.
∴Some K are not P.

6.No W are non-Y.
Some Y are not Q.
∴Some Q are W.

7. No non-H are G.
No G are non-J.
∴All J are H.

8.All F are non-L.
All non-F are non-I.
∴No I are L.

9.Some non-I are E.
No E are non-F.
∴Some F are not I.

10. All non-A are B.
No B are non-D
∴ Some D are not A.

Part B.Reduce the number of terms to three and then put the argument in standard form.

11.All non-(people who love immediate inferences) are non-(Philosophy graduate students).
No people who love immediate inferences are undergraduate students.
∴No undergraduate students are Philosophy graduate students.

12. Some snowing days are yucky days thus no yucky days are non-(days identical to today). In addition, all non-(snowing days) are non-(days identical to today).

13. Some peaceful protesters are not non-(dirty hippies) and some non-(dirty hippies) are vegetarians. Therefore, some non-(vegetarians) are not non-(peaceful protesters).

14. No P are non-Q. Therefore, since all K are non-P, all non-Q are non-K.

15. Inasmuch as some T are not non-H and some H are non-J, it follows that some non-J are T.

Part C. For each of the following, translate into a standard form categorical syllogism with exactly three properly labeled terms each used exactly twice. Formal and informal complements are used, so you may need to use immediate inferences (remember to use only logically equivalent inferences). Identify the scope of discourse.

16. No arguments whose premises don't guarantee their conclusion are valid arguments. So, all sound arguments are arguments whose premises do guarantee their conclusion. Inasmuch, all invalid arguments are unsound arguments. (*note: Assume the scope of discourse is 'arguments'. Can you determine if this argument is valid or invalid? Is it sound or unsound?)*

17. Every constitutional act is an act passed by congress that doesn't restrict the freedom of the people, so the U.S. Patriot Act is unconstitutional, inasmuch as the U.S. Patriot Act does restrict the freedom of the people.

18.There aren't any Spanish forces that are forces dedicated to providing security for the Iraqi people, because no Spanish forces are steadfast against terrorism and no forces that cave to terrorism are dedicated to providing security for the Iraqi people.

**More practice problems** *(Salahub)*

19. Some magazines are literary journals. Hence, at least a few magazines are poorly-written since many literary journals are not well-written.

20. I know that Angela can't enjoy Youtube.com because the only internet users who can enjoy Youtube.com are those with broadband connections and Angela doesn't have broadband.

21. Most experts on ecology are of the opinion that the use of pesticides is ecologically dangerous. In addition, any of those who have that opinion are disliked by the major chemical manufacturers. Thus, many ecology experts are disliked by them.

**For fun:**

"Use a nondescript carrying case when traveling to avoid unwanted attention." -2010 Census Bureau Employee Handbook , p.B -43

"The sample argument consists, in effect, of two premises: one which says that God exists in at least one possible world; and one which says that God exists in all possible worlds if God exists in any. It is perfectly obvious that no non-theist can accept this pair of premises. Of course, a non-theist can allow — if they wish — that there are possible worlds in which there are contingent Gods. However, it is quite clear that no rational, reflective, etc. non-theist will accept the pair of premises in the sample argument." -Stanford's encyclopedia of Philosophy

**Review for chapter four**
By the end of chapter four, you should be familiar with:

- the definitions of valid argument and invalid argument
- standard form categorical propositions and syllogisms
- the use of indicator words to find the conclusion and premises of arguments
- the common types of translation words and phrases (for example, only, the only, never, wherever, proper nouns, non-standard copulas and quantifiers, etc.)
- methods of translating from ordinary language into categorical syllogisms
- procedures for coverse, contrapositve, and obverse in categorical propositions
- uses of logically equivalent operations when translating syllogisms
- one of the two methods of determining validity covered in chapter three

**Part A**. Translate the following sentences into standard form categorical propositions.
1.TraditionalMedicinals® is the only North American tea company using medicinal grade herbs.

2.Only authorized vehicles allowed. (Don't use the word 'only' in your translation.)

3.There aren't any Logic courses offered in the summer.

4.Most stock markets are unreliable.

5.Never do that before school. (Use a 'time' parameter/scope.)

6.Every holiday that involves wearing costumes is awesome.

7.Some students don't incur debt.

8.Nuns teach. (Use a 'particular' quantity.)

9.She laughs whenever she gives up.

**Part B**. Logically equivalent operations: For each standard form categorical proposition, provide the following information. Perform the logically equivalent obverse and converse or contrapositive. Use formal complements when complements are needed. Given the original truth-value, determine the logically derived truth-value of the new claim.

1.Some bottom-shelf gins are downright delectable drinks. (true)

2. All angry mobs are groups of people who need hugs. (false)

3. No Metallica tunes are songs that should be made into elevator music. (true)

4. Some ethical dilemmas are not problems without solutions. (true)

**Part C**. Comprehensive problems: Using what we have learned so far:

a) **translate** each of the following arguments from ordinary language into a **standard form categorical syllogism**; to do so, **write out your three terms** as complete nouns or noun phrases within the same scope using assigned letters **in a key** OR use complete sentences **and** list the premises in the standard order above the conclusion,
b) where necessary, use logically equivalent operation to reduce to three terms,
c) **then analyze for validity** using either the three-circle Venn diagram or the rules method
d) **and** state whether the argument is **valid or invalid** based on your analysis.
e) **Finally,** name the **mood and figure** of your standard form categorical syllogism.

1. Insects that eat mosquitoes should never be killed. Thus, dragonflies should never be killed, inasmuch as they eat misquotes.

2. There aren't any Republicans who are Democrats. In addition, the only people who believe in vast government spending are Republicans. So, Democrats don't believe in such things.

3. Democrats want a Federal government that is too involved with the everyday business of citizens. We should be cautious of people who have that agenda. Due to this, we should be cautious of Democrats.

4.Ambeur does a million Myspace polls each day. So, because only people that do that people are bored a lot, it must be that Ambeur is bored a lot.

5. Where there's smoke there's fire, therefore there isn't fire in the cellar, since there's not any smoke there.

6. It is snowing right now, so we should be inside. For when it is snowing, we should be inside.

**ANSWERS to review problems:**

1.TraditionalMedicinals® is the only North American tea company using medicinal grade herbs."

1.All North American tea companies using medicinal grade herbs are companies id to TraditionalMedicinals

2.Only authorized vehicles allowed. (Don't use the word 'only' in your translation.)

2.All vehicles that are allowed are authorized vehicles.

3.There aren't any Logic courses offered in the summer.

3.No Logic courses are courses offered in the summer.

4.Most stock markets are unreliable.

4.Some stock markets are unreliable things.

5.Never do that before school. (Use a 'time' parameter/scope.)

5.No times to do that are times before school.

6.Every holiday that involves wearing costumes is awesome.

6.All holidays that involve wearing costumes are awesome holidays.

7Some students don't incur debt.

7.Some students are not debt-incurers. (Or Some students are not people who incur debt.)

8Nuns teach. (Use a 'particular' quantity.)

8.Some nuns are teachers. (Or some nuns are people who teach)

9.She laughs whenever she gives up.

9. All times she gives up are times she laughs.

Part B

1.Some bottom-shelf gins are downright delectable drinks. (true)
Conv, LE, Some downright delectable drinks are bottom-shelf gins. T
Contra, not LE, Some non-(downright delectable drinks) are non-(bottom-shelf gins). U
Obv, LE, Some bottom-shelf gins are not non-(downright delectable drinks). T

2. All angry mobs are groups of people who need hugs. (false)
Conv, not LE, All groups of people who need hugs are angry mobs. U
Contra, LE, All non-(groups of people who need hugs) are non-(angry mobs). F
Obv, LE, No angry mobs are non-(groups of people who need hugs). F

3. No Metallica tunes are songs that should be made into elevator music. (true)
Conv, LE, No songs that should be made into elevator music are Metallica tunes. T
Contra, not LE, No songs that should be made into elevator music are Metallica tunes. U
Obv, LE, All Metallica tunes are non-(songs that should be made into elevator music). T

4. Some ethical dilemmas are not problems without solutions. (true)
Conv, not LE, Some problems without solutions are not ethical dilemmas. U
Contra, LE, Some non-(problems without solutions) are not non-(ethical dilemmas). T
Obv, LE, Some ethical dilemmas are non-(problems without solutions). T

Part C. **Comprehensive problems:**

**1. Insects that eat mosquitoes should never be killed. Thus, dragonflies should never be killed, inasmuch as they eat misquotes.**

D = Dragonflies
K = insects that *should* be killed
M = insects that eat mosquitoes

OR

D = Dragonflies
N = insects that should NOT be killed
M = insects that eat mosquitoes

No M are K
All D are M
No D are K Valid, none

All M are N
All D are M
All D are N Valid, none

**2. There aren't any Republicans who are Democrats. In addition, the only people who believe in vast government spending are Republicans. So, Democrats don't believe in such things.**

R = Republicans
D = Democrats
S = People who believe in vast government spending

All S are R
No R are D
No D are S valid, none

**3.Democrats want a Federal government that is too involved with the everyday business of citizens. We should be cautious of people who have that agenda. Due to this, we should be cautious of Democrats.**

D = Democrats
F = those who want a Federal government that is too involved with the everyday business of citizens
C = people of whom we should be cautious

All F are C
All D are F
All D are C Valid, none

**4. Ambeur does a million Myspace polls each day. So, because only people that do that people are bored a lot, it must be that Ambeur is bored a lot.**

A = people id to Ambeur
M = people who do a million Myspace polls a day
B = people who are bored a lot

All B are M
<u>All A are M</u>
All A are B     Invalid, undistributed middle

**5. Where there's smoke there's fire, therefore there isn't fire in the cellar, since there's not any smoke there.**

S = places there is smoke     OR *'places' could all be 'times' instead, but 'where' and 'there'*
F = places there is fire     *probably indicate a type place rather than time*
C = places id to the cellar

No C are S
<u>All S are F</u>
No F are C     Invalid, illicit minor

**6. It is snowing right now, so we should be inside. For when it is snowing, we should be inside.**

N = times id to now     *'times' could all be 'places' instead, but 'now' and 'when'*
S = times it's snowing     *probably indicate a type time rather than place*
I = times we should be inside

All S are I
All N are S
All N are I     Valid, none

**Select answers to practice problems:**
2. Some earthquakes are terrifying.
**Some earthquakes are terrifying events.**
3.At least one movie is gory.
**Some movies are gory things.**
4.No mobsters are considerate.
**No mobsters are considerate people.**
5.There aren't any fun history courses.
**No history courses are fun courses.**
**No fun courses are history courses.**

6.Kelsi is an angel.
**All people id to Kelsi are angels.**
7.Aaron cries only when Darth Vader dies.
**All times Aaron cries are times Darth Vader dies.**
8.A few hip-hop songs are not very good.
**Some hip-hop songs are not very good songs.**
9.Fort Collins is a great place to live.
**All places id to Fort Collins are great places to live.**

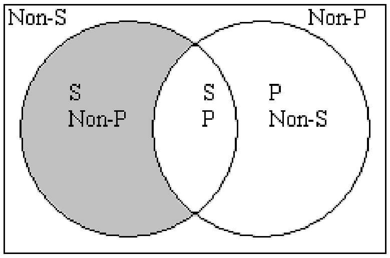
11.All marsupials have pouches.
**All marsupials are pouch-havers.**
**All marsupials are things that have pouches.**
12.The only smartphone cases worth buying are Otterboxes.
**All smartphone cases worth buying are Otterboxes.**
13.None of Billy Graham's programs are legitimate.
**No Billy Graham programs are legitimate programs.**
14.No exercise is worthless.
**No exercises are worthless activities.**

15.Many students were not in class last week.
**Some students are not people who were in class last week.**
**Some students are people who were not in class last week.**
16.Only the Tin Man is not affected by poppies.
**All things unaffected by poppies are things that are the Tin Man.**
17.No machines have sentience.
**No machines are things that have sentience.**
**No machines are sentience-havers.**
18.The Atkin's diet is foolish.
**All things id to the Atkin's diet are foolish things.**
19.Most Philosophy instructors are old.
**Some Philosophy instructors are old people.**
20.Every logic student is smart.
**All logic students are smart students.**
21.The show is on now
**All shows id to 'the show' are shows that are on now.**
**All times id to now are times the show is on.**
22.Ambeur goes wherever Jeff goes.
**All places Jeff goes are places Ambeur goes.**
23.Whenever there is a rainbow, the sun is shining.
**All times there is a rainbow are times the sun is shining.**
24.If you are at the castle at the center of the labyrinth, then you are at Jareth's castle.
**All times you are at the castle at the center of the labyrinth are times you are at Jareth's castle.**

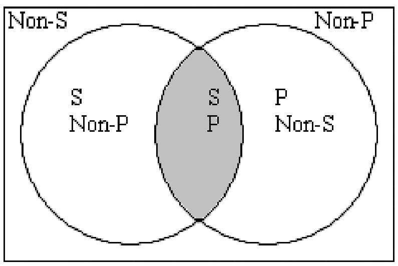
# Quick Reference Guide

## Basic Venn Diagrams

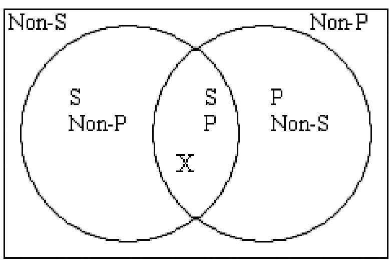
A: ALL S ARE P.



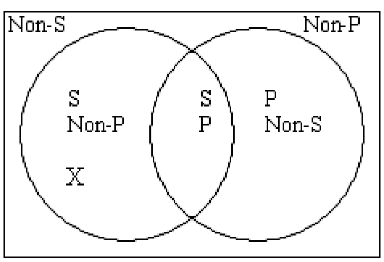

E: NO S ARE P.




I: SOME S ARE P.




O:SOME S ARE NOT P.




***Tips for basic Venn diagrams***

A: shade the area w/ subj w/o pred
E: shade the area w/both subj and pred
I: 'x' the area w/both subj and pred
O:'x' the area w/ subj w/o pred

(Note that the notation in these diagrams is for demonstration purposes; you need only label the circles and the universe.)

## Standard Form Categorical Propositions

Quantifier: All, No, Some
subj term: noun/noun phrase
copula: 'to be' verb
pred term: noun/noun phrase

**Distribution** (bold terms distributed)

A: All **subject term** are predicate term.
E: No **subject term** are **predicate term**.
I: Some subject term are predicate term.
O: Some subject term are not **p term**.

**Quantity and Quality**

| | |
|---|---|
| A: Universal Affirmative | A: **U** A |
| E: Universal Negative | E: **U N** |
| I: Particular Affirmative | I: P A |
| O: Particular Negative | O: P **N** |

**Remember:**

*All categorical propositions must be propositions; it must make sense to say it could be true or false, even if you don't *know* if it's true or false.
*All categorical propositions must begin with a standard form quantifier of ALL, NO, or SOME.
*The copula must be ARE (or for 'O' claims, ARE NOT); technically any form of 'to be'.
*The subject term and predicate term (S and P) must be NOUNS or NOUN PHRASES. (It must make sense to say 'there could be a bunch of…')

**Operations**

Conv**e**rs**i**on→ Switch subj and pred terms
C**o**ntr**a**positive→ Switch subj and pred terms and complement both
Obverse→ Change quality (aff-neg) and complement pred term (i.e., *non-P*)

If LE, then necessarily same truth-values for both claims.
If *not* LE, then unknown truth-value for new claim.

# Chapter Five
# Propositional Logic

**Introduction to propositional logic**

A proposition is a sentence with a truth-value. Even if we are unsure of or in debate about the truth-value of a given claim, we can still speak hypothetically about it. For propositional logic (sometimes called truth-functional logic or sentential logic), each proposition is represented with letter. Symbols indicate information about the proposition or show a relationship between propositions. Those symbols, or operators, are often represented by: '~', '&', 'v', and '→'.

Individual simple sentences are each represented by a letter and that is an **atomic proposition**. Here are some examples of claims with an assigned letter that represents that atomic proposition. (The letters assigned are arbitrary, though it may be helpful and intuitive to choose a letter that has some correlation to the proposition. However, due to this arbitrariness, it is important to indicate what letters represent which proposition. Here, this will be referred to as a 'key'.)

'Today is Saturday.' This is an example of a proposition. It makes sense to say it has a truth-value. We may say:

Today is Saturday. = S

Further examples of **atomic propositions** with assigned letters in a key:

It is raining now. = R
We are sitting outside. = O
Fluoride is good for the drinking water. = F
The moon is just Limburger cheese. = L

Where there is at least one atomic proposition and at least one operator, it is considered **complex**. For every complex claim, there will be one **main operator**, or the overarching truth-functional operation.

**The operators**

In propositional logic, there are five main operations though the four are emphasized. These indicate relationships involving atomic propositions. Each specific claim, regardless of how complex, will be one of these operations; that is, one of these operators is the main operator.

**Denial (or negation) ~**

Words and phrases such as 'not', 'it is not the case that', 'it is false that' can be used to indicate the denial or negation of a claim. The tilde symbol '~' is used to represent this.

Given the 'key' that we assigned above, here are some examples of the denial:
~R = It is not raining now.
~O = It is false that we are sitting outside.
~F = Fluoride is not good for the drinking water.
~L = It is not the case that the moon is just Limburger cheese.

**Conjunction &**

Words such as ‘and’, ‘but’, ‘while’ can be used to indicate a conjunction of claims. The ampersand symbol ‘&’ is used to represent the ‘and’. There are always two parts to a conjunction; those two parts are called ‘conjuncts’.

Given the ‘key’ that we assigned above, here are some examples of the conjunction:
It is raining now and we are sitting outside. = R & O
We are sitting outside but it is raining now. = O & R
Fluoride is good for the drinking water while the moon is just Limburger cheese. = F & L

**Disjunction v**

Words such as ‘or’, ‘nor’, ‘either, or’ can be used to indicate a disjunction of claims. The lowercase ‘v’ is used to represent the ‘or’. There are always two parts to a disjunction; those two parts are called ‘disjuncts’.

Given the ‘key’ that we assigned above, here are some examples of the disjunction:
Either we are sitting outside or it is raining now. = O v R
The moon is just Limburger cheese or Fluoride is good for the drinking water. = L v F

**Conditional (or hypothetical) →**

Words such as ‘if…, then…’, ‘provided that’ can be used to indicate a conditional or hypothetical claim. The arrow ‘→’ is used to represent the ‘then’ in a conditional. There are always two parts to a conditional; those two parts have different names. The name for the first part of a hypothetical (usually following the word ‘if’) is the antecedent. The name of the last part of a hypothetical (usually following the word ‘then’) is the consequent.

Given the ‘key’ that we assigned above, here are some examples of the conditional:
If Fluoride is good for the drinking water, then the moon is just Limburger cheese. = F → L
Provided that we are not sitting outside, it is raining. = ~O → R

**Truth-functions for operators**

Each of these operators (denial, conjunction, disjunction, conditional) has a truth-function based on the potential truth of their components. These functions can be displayed in truth tables. These truth-tables will be used later to complete long and short truth-tables when determining validity of given arguments or evaluating truth-functional relationships of complex claims.

Remember that each letter represents a proposition and each proposition has one of two possible truth-values in any given scenario.

Truth-tables demonstrate every possible combination of truth-values for propositions involved in a claim (or in a claim within an argument). Truth-tables should be read across, as each row displays a different possible scenario or possibility.

**Denial (or negation) ~**

Consider the relationship between a proposition and its denial. Intuitively, what kind of relationship is it? If you intuit that they are basically opposites, you are basically correct. Where a given proposition is true, its denial must necessarily be false, and vice versa.

| | *A* | **~A** |
|---|---|---|
| *1* | *T* | **False** |
| *2* | *F* | **True** |

**A proposition and its denial necessarily have opposite truth-values.**

So, reading this table across, row 1 shows that if it were the case that A is true, then ~A would necessarily be false. The other option (row two) shows that *if* A is false, ~A would be true.

**Conjunction &**

The conjunction's truth-function can also be considered intuitively. When one used 'and' in a sentence, we assume both parts will occur or are both the case. If we find that one piece is missing, it no longer makes sense to say 'this and that'. Let us look at an example. (The letters for our propositions have been assigned and labeled by underlining the propositions and indicated the e below.)

<u>It is Monday</u> and <u>we are in Logic class</u>. = M & L
M L

| | *M* | *L* | **M & L** |
|---|---|---|---|
| *1* | *T* | *T* | **True** |
| *2* | *T* | *F* | **False** |
| *3* | *F* | *T* | **False** |
| *4* | *F* | *F* | **False** |

**The only time a conjunction is true is when both conjuncts are true.**

In row one, the truth-values for M and for L have been assigned as true and true, respectively. Think about what this implies. This would mean that it really is Monday and we really are in Logic class. Now if both of these things were true, which for row one we know is the case, what is the truth-value of the whole conjunction? The answer is 'true'.

However, in rows two, three, and four at least one part of the conjunction is false according the truth-value assigned in each case. Consider what this implies. Pretend it is Saturday and we certainly aren't in Logic class (in other words, M is false and L is false), but I tell you "Hey, it's Monday and we're in Logic class!" Chances are you will not only think I am off my rocker, but you will think the conjunction false, and rightly so.

**Disjunction v**

The disjunction truth table may be difficult to grasp at first, but this is remedied by understanding what is meant by 'or'. In everyday use of the word 'or', we typically mean 'one or the other but not both'. For example, on a menu at a restaurant we may see 'with your entrée, you may have soup or salad'. Clearly the intention here is an exclusive choice we must make (or pay the extra cost). Implicit in that statement is 'you may have one or the other, but not both'.

However, typically in legal terminology, governmental forms, contracts, and so on, the 'or' does not imply exclusivity unless explicitly stated. For example, when completing income taxes, 'You may claim the LLC when you have a qualifying child or you earn less than $20,000.' This statement does not entail ineligibility for those with a qualifying child who also earn less than twenty grand. It simply means at least one criterion must be met to claim the credit, allowing for both as well.

It is important to note the relation to propositional logic symbolization here. In Latin, there are two different words for these two different meanings of 'or'. These words clarify any ambiguity in the usage. The Latin word for the exclusive 'or' which is the way we usually use the word is *aut*. However, the Latin word for the inclusive 'or' as is used in propositional logic is *vel*. What do you notice about this? The symbol for 'or' is 'v'; the word for inclusive 'or' is 'vel'! Logical, wouldn't you say? Let us look at an example.

Either <u>he is at work</u> or <u>he is ignoring my phone calls</u>. = W v I
W I

| | *W* | *I* | **W v I** |
|---|---|---|---|
| ***1*** | ***T*** | ***T*** | **True** |
| ***2*** | ***T*** | ***F*** | **True** |
| ***3*** | ***F*** | ***T*** | **True** |
| ***4*** | ***F*** | ***F*** | **False** |

**The only time a disjunction is false is when both disjuncts are false.**

As long as at least one of the disjuncts is true, then the entire 'or' claim is true. We just need to find one part to make the whole thing true. In this example he very well could be at work and ignoring my calls, or either one of the options. The truth of the disjunction would be lost if we failed to find any of the disjucts.

**Conditional (or hypothetical)** →

When learning the conditional truth table, it is important to remember the meaning of the 'if, then' claim. These claims are merely hypothetical; no assertion of the antecedent or the consequent is made. The truth table displays the truth-value of the conditional relationship under different scenarios of truth for the parts of the claim. Though we often use conditional claims in cause and effect relationships, this is not always the case. Take for example, "If President Obama is in Greeley now, then he is east of Fort Collins." Notice that being in Greeley doesn't *cause* one being east of Fort Collins. Rather, the statement suggests that if we meet the condition of being in Greeley, then we should also find ourselves in the condition of being east of Fort Collins.

Most intuitive of the four situations is the first line. If we have a true antecedent and a true consequent, then the entire conditional claim is true. If I say to you, "if you do turn in the Sudoku puzzle, then you will earn extra credit," and you actually *do* the puzzle and *earn* extra credit, the relationship in the claim I presented holds true.

Now, say I present the same claim. You, being the diligent students that you are, turn in the puzzle expecting the extra credit. Much to your dismay, however, I laugh a sinister laugh and tell you your efforts were in vain for I am not giving extra credit for the puzzle! What has happened? I have lied to you. I told you meeting condition S would entail condition E, but in meeting condition S you did not find condition E. That proposed relationship failed and the truth-value of that conditional in that situation is false.

The other two situations require us to remember that we are attempting to determine the truth-value of the claim within a given scenario. If we have a false antecedent and a true consequent, the truth-value of the conditional claim is true. Think about what this means. We did not meet the first condition yet managed to get the second. Using the example from above, just because someone did not complete the puzzle doesn't necessarily mean they didn't get any extra credit. They may have taken other extra credit options. One student's non-compliance with that path of earning extra credit does not nullify the conditional relationship for everyone else. It would still be true that those who *did* do the puzzle *still* earned extra credit, again, even if you didn't do the puzzle but earned extra credit from other options. Failure to meet condition S at some given time does not necessitate failure of the conditional relationship in question.

Here is another example: if you stick a hot poker in your eye, then you will have a booboo. Now, just because you play it smart and refuse to stick the hot poker in your eye does not necessarily make the conditional relationship false. Not meeting the antecedent's condition does not prove that the conditional relation fails. Finding a false antecedent does not necessitate a false conditional. In fact, the only way to prove a proposed conditional relationship actually fails is to meet the first condition and fail to meet the consequent.

This same explanation holds for the last scenario. A false antecedent and a false consequent still entail a true conditional relationship. It is not sufficient to fail to meet both conditions and say that the relationship fails. If you refuse to stick a hot poker in your eye and you fail to have a booboo, that doesn't change that for those who do decide to impale their eye, they will have a booboo. So, just because you *didn't* do S and *didn't* get E **does not** necessarily mean that if you *had* done S you wouldn't have earned E.

If <u>you do turn in the Sudoku puzzle</u>, then <u>you will earn extra credit</u>. = S → E
S E

| | *S* | *E* | **S → E** |
|---|---|---|---|
| ***1*** | ***T*** | ***T*** | **True** |
| ***2*** | ***T*** | ***F*** | **False** |
| ***3*** | ***F*** | ***T*** | **True** |
| ***4*** | ***F*** | ***F*** | **True** |

**The only time a conditional is false is when the antecedent is true and consequent is false.**

## Quick reference for truth-functions

| | A | ~A |
|---|---|---|
| 1 | T | F |
| 2 | F | T |

**Denial:** A proposition and its denial necessarily have opposite truth-values.

| | M | L | M & L |
|---|---|---|---|
| 1 | T | T | True |
| 2 | T | F | False |
| 3 | F | T | False |
| 4 | F | F | False |

**Conjunction:** The only time a conjunction is true is when both conjuncts are true.

| | W | I | W v I |
|---|---|---|---|
| 1 | T | T | True |
| 2 | T | F | True |
| 3 | F | T | True |
| 4 | F | F | False |

**Disjunction:** The only time a disjunction is false is when both disjuncts are false.

| | S | E | S → E |
|---|---|---|---|
| 1 | T | T | True |
| 2 | T | F | False |
| 3 | F | T | True |
| 4 | F | F | True |

**Conditional:** The only time a conditional is false is when the antecedent is true while the consequent is false.

**Quick short cut:**

If P=T, then ~P = false and if P=F, then ~P = true
T & T = true
F v F = false
T → F = false

**Well-Formed Formulas**

As we work through complex claim symbolization, it is important that we create well-formed formulas or WFFs. We aim to create 'meaningful propositions' with our logical language. Given that this is part of the truth-functional logic system, each symbolized claim has a possible truth-value; when we create WFFs, we ensure that the symbolized version of claims can be used in the truth tables.

When symbolizing complex claims, any time more than one operation occurs, parentheses need to be used and every claim will be end up being one main type of overall operation regardless of the number of operations involved in the claim. Here are some general guidelines to keep in mind:

- To ensure a WFF:
  - WFFs will never *end* with an operation symbol, only a letter (or parentheses)
  - WFFs can *begin* with a letter, tilde, or parentheses, but no other operator symbol
  - Operator symbols other than '~' cannot be next to another operator symbol
  - Parentheses must be used when there are more than two atomic claims or operations
  - A WFF will always result in *one* main kind of operation
    - Negation ~N
    - Conjunction A **&** B
    - Disjunction C **v** D
    - Hypothetical/Conditional P → Q

**Practice problems: WFFs**

A. Which of the following are well-formed formulas (i.e., meaningful propositions)?
B. For each of the *well-formed formulas*, circle the main operator.
C. For each of the *well-formed formulas*, discover its truth-value in this scenario: **A=T; B=T; X=F**

1. A & B
2. A & B v X
3. (A & B) v X
4. A & (B v X)
5. (A & B) v A & ~ B
6. (A & B) v (A & (~ B))
7. ((A & B) v A) & (~ B)
8. (A & B) → A v ~ X
9. (~A) v X
10. ~ (A & B)
11. (A ~ (A v B →) B
12. (A & ( B → X)) → ( B v X)

**Practice problems: Basic and complex claim symbolization**

Directions: Symbolize the following statements using the key below for your term variables.

**S = The sun is shining.** **E = We get to leave class early(today).**
**Q = We (will) have a quiz(today).** **F = Today is Friday.**

1. If today is Friday, then we will have a quiz.

______________________________________________________________________

2. Either we have a quiz or we get to leave class early.

______________________________________________________________________

3. We will not have a quiz today.

______________________________________________________________________

4. We get to leave class early and the sun is shining.

______________________________________________________________________

5. Today is Friday but the sun is not shining.

______________________________________________________________________

6. The sun is not shining if we have a quiz.

______________________________________________________________________

Directions: Symbolize the following statements using the key below for your term variables. These may be a little more complex. Read the statement and use parenthesizes where needed to retain the same meaning as the original statement.

7. We have a quiz and either we won't get to leave early or it is not Friday.

______________________________________________________________________

8. It is not the case that we have a quiz today but we do get to leave early.

______________________________________________________________________

9. If the sun is shining and today is Friday, then we get to leave class early.

______________________________________________________________________

10. Either it is not Friday or we get to both leave early and have a quiz.

______________________________________________________________________

**<u>Complex claim symbolization</u>**
There are certain words and phrases that can be confusing or misused in our everyday usage. Understanding how these words should be used and correctly symbolizing them into propositional logic is a good exercise in critical thinking. Also, since these words and phrases are often used in technical and legal documents, you develop a greater understanding of what you are reading. Keep in mind is that there may be multiple ways to symbolize each complex claim. We will look at a number of ways to symbolized these claims, but be aware that there may be other truth-functional equivalencies that we may not get through.

**Only if**
One little word like 'only' can alter the meaning of many sentences. Here, we find only preceding if. This will be symbolized differently than the word if alone. The key slogan for 'only if' is this: **the phrase 'only if' introduced the consequent of a conditional claim**. This slogan holds regardless of where the phrase is located in a sentence. Here are two examples.

<u>You may go out tonight</u> only if <u>you clean your room</u>.
O C

O → C

This could be read 'if you are allowed to go out tonight then I know you cleaned your room'. Note that it is not the other way around, for that changed the meaning and the relationship. Consider that incorrect symbolization: 'if you clean your room, then you get to go out tonight!' As much as we may have hoped for that to be the case as young adolescents, it is not so. One reason for this could be that you did clean your room but in the meantime your parent heard you cussing and now you are grounded. Explaining to the folks that you met the condition of cleaning your room will not change the fact that the original claim said if O then C, not vice versa.

Only if <u>you haven't claimed the Lifetime Learning credit</u> <u>may you claim the Hope credit</u>.
~L H

H → ~L

Again, notice that this really says 'if you may claim the Hope credit, then you have not claimed the LLC. You may find an IRS auditor taking interest in your tax returns if you assume this is read the other way around. This claim *does not* say that if you haven't claimed the LLC that you can go ahead and claim the Hope credit. After all, you may not be eligible for the Hope credit.

**Unless**
The shortest way to remember this symbolization is to note that **the word 'unless' can introduce a disjunct in a disjunction**. This way, the word 'unless' can simply be replaced with the word 'or' and treated as such. This may not be as intuitive since we don't typically think of the word unless mean or. However, you may find this to be the fastest way to learn the correct symbolization for 'unless'. Later we will look at comparative truth tables to demonstrate the truth-functional equivalencies of the various correct ways to symbolize a claim.

You may carry a ISI card unless you are a teacher.
C T

C v T

Perhaps more intuitive but also more complicated, **the word 'unless' can introduce the antecedent negated (in other words '~antecedent')**. Unless can be thought of as saying 'if not' and treated as a conditional.

You may carry a ISI card unless you are a teacher.
C T

(~T) → C

Here is another example with 'unless':

You cannot claim the Life Time Learning credit unless you paid tuition expenses.
~L T

'unless' can be symbolized as 'or' (~L) v T
'unless' can be symbolized as 'if not' (~T) → (~L)

This symbolization works the same whether 'unless' is in the beginning or the start of the sentence.

Unless you want to suffer from sunburn, you should wear sun block.
S W

'unless' can be symbolized as 'or' W v S
'unless' can be symbolized as 'if not' (~S) → W

**Neither/not either**
For the word 'neither', remember that it is really just saying 'not either'. We have a way to symbolize that already. This is a way of denying a disjunction. To retain the same meaning as the original claim, the entire disjunction needs to be denied, not just one disjunct. To do this, parentheses should be used around the disjunction.

You have neither homework nor a quiz today. = ~(H v Q)

**Both will not**
As you looked at the last example, you may have thought it really sounded as though the sentence said you won't have homework and you're not having a quiz. This is correct as well.

Both homework and quizzes are not happening today. = (~H) & (~Q)

**Not both**
If you can't have both, how many can you have? Well, you could have one, the other, or neither; the only situation you would not find is both together. How do we symbolize this relationship? Just as 'not either' suggested a denied disjunction, *'not both'* is a *denial of a conjunction*.

You will not have both homework and a quiz today. = ~(H & Q)

**Either not**
This too may sound similar to the previous example and indeed they are truth-functionally equivalent. You might not have one, you might not have the other, but you won't have both.

Either you won't have homework or you won't have a quiz. = (~H) v (~Q)

**Real-life examples:**
*Example: You may claim the Life Time Learning credit only if you both paid tuition expenses and have not claimed the Hope credit.*

*Here is a combination of 'only if' and 'both' and 'not'. Overall, this statement is a conditional. It happens to be a complex claim, but is remains a conditional claim. The antecedent is 'L' and the consequent is '(P & (~H))'.*

*Symbolization: L → (P & (~H))*

1."During business hours, employees may use Census Bureau-provided internet access and related computer resources for unofficial purposes only if they are on non-duty time or have received prior approval from your supervisor."
2010 Census Bureau Employee Handbook , p.B-40

2."If more than two people were killed/injured, provide that information on a separate sheet of paper or in section VIII. If no pedestrians were involved, leave item 46 blank."
2010 Census Bureau Employee Handbook , p.5-7

3.If you use abbreviations, you must use the protocol standards. However, you may use no abbreviations and write complete words.
2010 Census Bureau Employee training, paraphrase

4."If your filing status is single and at the end of 2005 you are under 65, then file a return if your gross income was at least $8,200."
irs.gov

5."Do not include social security benefits unless you are married filing a separate return and you lived with your spouse at any times during 2005."
irs.gov

6.For EIC, if you both have a child and make less than x, then you should circle 'yes'.

7.If you want to take the test, you will need to be there by 2:30, if you want the entire possible time to work on it.

8.Do not enter through this door unless you are authorized to do so.

9.You may claim the Hope Credit deduction only if you have not claimed any other tuition deductions.

10. Keep me signed in for one day, unless I sign out." Ebay.com

11. Student Loan Interest Deduction: "You can take this deduction only if all of the following apply. You paid interest in 2008 on a qualified student loan (see below). Your filing status is any status except married filing separately. Your modified adjusted gross income (AGI) is less than: $70,000 if single, head of household, or qualifying widow(er); $145,000 if married filing jointly. Use lines 2 through 4 of the worksheet below to figure your modified AGI. You, or your spouse if filing jointly, are not claimed as a dependent on someone's (such as your parent's) 2008 tax return. Use the worksheet below to figure your student loan interest deduction."
Form 1040—Line 33 page 33 IRS.GOV 1040 form instructions

12.An eclipse of the Moon can only take place at Full Moon, and only if the Moon passes through some portion of Earth's shadow. NASA website

13."If you don't recognize your site key, don't enter your password." Bank of America website

14. "Don't worry—you don't have to enter this passphrase again unless you clear your cookies, use a different browser, or change account users." --AT&T website

**Practice problems: Basic and complex claim symbolization**

Directions: Symbolize the following statements using the key below for propositions.

**S = The sun is shining.** **E = We get to leave class early (today).**
**Q = We (will) have a quiz(today).** **F = Today is Friday.**

1. It is either not a day we get to leave early or it is not Friday.

______________________________________________________________________________

2. We get to leave class early unless the sun is not shining.

______________________________________________________________________________

3. We will not have a quiz and we will not be leaving early today.

______________________________________________________________________________

4. It is not both a day we get to leave early and Friday.

______________________________________________________________________________

5. We neither have a quiz nor do we get to leave early.

______________________________________________________________________________

6. It is not that case that we have a quiz, but we do get to leave early.

______________________________________________________________________________

7. The sun is shining or there's a quiz, only if we get to leave early or today is Friday.

______________________________________________________________________________

8. We get to leave early if both the sun is shining and today is Friday.

______________________________________________________________________________

9.If we neither leave early nor have a quiz, then the sun is shining.

______________________________________________________________________________

10. Only if the sun shines will we get to leave early.

______________________________________________________________________________

Directions: Rewrite the symbolic statements into complete sentences to retain the same meaning.

11. (E v Q) → ~(S v F)

________________________________________________________________

12. F → (E v Q)

________________________________________________________________

13. (Q & E) v S

________________________________________________________________

14. ~Q v E

________________________________________________________________

15. ~Q

________________________________________________________________

**Practice problems: Basic and complex claim symbolization**

Directions: Symbolize the following statements using the key below for propositions.

**H= You do/did your homework.** **P= You can pass the class.**
**S= You do/did study.** **O= You go out tonight.**

1. You did not both study and go out.

________________________________________________________________

2. You didn't study or you didn't do your homework.

________________________________________________________________

3. You did your homework or studied.

________________________________________________________________

4. Either you study and do your homework, or you will go out tonight.

________________________________________________________________

5. You will go out tonight only if you both do your homework and study.

________________________________________________________________

6. Only if you study can you pass the class.

____________________________________________________________________

7. You will go out tonight unless you don't do your homework.

____________________________________________________________________

8. If you don't study, you cannot pass the class.

____________________________________________________________________

9. You can pass the class if you both study and do your homework.

____________________________________________________________________

10. If you neither study nor do your homework, then you cannot pass the class.

____________________________________________________________________

11. If you don't study and you don't do your homework, then you cannot pass the class.

_______________________________________________________________

**<u>Steps for symbolization of propositional logic arguments</u>**

- Read through the whole argument.
- Identify the conclusion of the argument (may be helpful to circle or underline).
- Create a key to clarify your terms (remember the letter you assign to each term represents a proposition, or a sentence with a truth-value.)
  - Symbolize each of the premises and the conclusion.
  - Use your key and the appropriate propositional logical notation to retain truth-functional equivalency to the original claim.
- Write the symbolized argument in standard form (list the premises above the conclusion).
- Analyze for validity. (Some assignments may request certain methods of evaluation that may include: long truth table, short-truth table, identify formal name or fallacy.)

**<u>Example</u>**

If you do your homework, then you'll pass the class. However, since you did not pass the class, we can conclude that you did not do your homework.

- H= You did your homework. P= You pass the class.
  - Conclusion: you did not do your homework = ~H
  - Premise: if you do your homework, then you'll pass the class. = H → P
  - Premise: you did not pass the class = ~P

H → P<br>
<u>~P___</u><br>
~H

**Practice problems: Symbolizing propositional arguments**

Directions: Symbolize the following arguments. Use the key below.

**A= Aaron goes/will go on vacation.**
**J= Jennie goes/will go on vacation.**
**M=Mike gets/will get an internship.**
**K = Krissie goes/will go on vacation.**
**L=Lindsey gets/will get an internship.**
**C=Clint gets/will get a promotion.**

1.If Clint gets a promotion, then Aaron will go on vacation. However, Aaron did not go on vacation, so it must be that Clint did not get a promotion.

2. Either Mike or Lindsey will get an internship because provided that Clint gets a promotion, at least one of them will get an internship. In addition, Clint did get a promotion.

3.Aaron goes on vacation only if Krissie does too, but Krissie goes on vacation only if Clint doesn't get a promotion. Because Clint did get a promotion, we can conclude that Aaron will go on vacation.

4.Mike is not getting an internship unless either Jennie or Krissie go on vacation. Mike will get an internship since Jennie is going on vacation.

5.Either Krissie is going on vacation or Clint got a promotion, because if Mike gets an internship, then it cannot be the case that both Clint gets a promotion and Krissie goes on vacation. Mike did get an internship.

6.If Jennie goes on vacation, then Aaron will go on vacation. However, neither of them will take vacation if Lindsey gets an internship. In addition, Lindsey will get an internship only if Mike does not. So, if Lindsay does get an internship, both Aaron and Jennie will go on vacation.

**Homework: Symbolizing arguments** **NAME:_______________________**

**Directions:**
Use the key and the appropriate propositional logical notation to retain truth-functional equivalency to the original claim to write the symbolized argument in standard or linear form.

**B= We will go bowling.** **C=We will go camping.** **S=We will go shopping.**
**X= We will spend money.** **M= We will go to a movie.** **P=We will go to a party.**
**H= We will do our homework.** **G= We will get good grades**

Example: We will go shopping and bowling; in addition, we will go to a movie. If we either go shopping or to a movie, then we will spend money. Thus, we will spend money.

S & B / M/ (S v M) → X // X OR

S&B
M
<u>(S v M) → X</u>
X

1.Either we will go to a movie or we will go to a party. Because we will not spend money, we can conclude that we will not go to a movie but we will go to a party.

2.If we go camping, then we will not go shopping. If we do not go shopping, then we will not spend money. Therefore, if we go camping, we will not spend money.

3.If we are neither going to spend money nor go to a party, then we will do our homework, because if we do our homework, then we will get good grades. In addition, we will both get good grades and go bowling.

4.We will get good grades only if we both do our homework and don't go to a party. Since we are going to a party, it follows that we won't get good grades.

5. We can conclude that we will get good grades for all of the following reasons: we won't go to a movie unless we've done our homework; we will spend money only if we go to a movie; we will neither go to a movie nor bowling; and if we either go camping or go shopping, then we will do our homework.

**Determining truth-values of complex claim in given scenarios**

Directions: Given the following scenario, determine the truth-value of the complex statements.

A = TRUE X = FALSE
B = TRUE Y = FALSE
C = TRUE Z = FALSE

1. Z → ~A

2. Z v (A → C)

3. ~X & (Y → Z)

4. ~(B v Y)

5. (X v Y) & (A → Z)

6. Y v ~(A & B)

7. (A v B) → (~C v ~B)

8. ~(Y v A)

9. (A → X) v (Z & B)

10. A → (B → Z)

11. (Z v A) v (A v Z)

12. (Z → A) v (A → Z)

13. (Z → A) & (A → Z)

14. (~C v ~B) → A

15. A & ~(X v A)

16. ~Y v A

17. ~(A v B)

18. Z → ~C

19. (B & C) v {Y → X}

20. ~(~Y v B)

21. ~{~(A & Z)}

22. B → {Y → (Z v A)}

23. (X v C) & (~A → C)

24. A → (B → C)

25. (A → B) → Z

**Long truth-table completion step-by-step example**

We will use a systematic way to set up a truth table and complete a truth table for an argument. First, identify the number of atomic propositions in the argument. This will establish the number of rows needed for the truth table.

Take for example:

P v Q / ~Q // P

Here we have two atomic propositions; 'P' and 'Q' are the atomic propositions in the argument. Take two to the number of atomic propositions to determine the number of rows. In this case $2^2$.

**$2^{(\text{\# of atomic propositions in an argument})}$ = # of rows**

In this case, we'll have four rows. If there were three atomic propositions, we'd have eight rows ($2^3$= 2 x 2 x 2 = 8).

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |

Start by listing the atomic claims across the top of your truth table starting from the leftmost column. Then list the premises and conclusion to the right of that.

| | **P** | **Q** | P v Q | ~Q | | P |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |

From there, we can systematically supply the truth-values for each atomic claim in the argument. You can start with the rightmost atomic proposition column and alternate true/false for all the rows. Then move to the next column to the left and double the number of alternating true/false for the table until you've done this for all the atomic propositions involved. Alternatively, you can start by taking half the number of rows and assigning true/false to the leftmost column (for the four rowed table, for example, the leftmost column would have two trues and then two falses). Then continue taking half of that for each column to the right.

| | *P* | *Q* | P v Q | ~Q | | P |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | | | | |
| *2* | *T* | *F* | | | | |
| *3* | *F* | *T* | | | | |
| *4* | *F* | *F* | | | | |

Fill in the premises and conclusion across the top of the truth table. Complete each column one row at a time using the given truth values for each proposition involved. Use the truth-functions for each operation to complete the table. Plug in the assigned truth-values for the propositions to each part of the argument.

Step one:

| | *P* | *Q* | P v Q | ~Q | | P |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | T | | | |
| *2* | *T* | *F* | T | | | |
| *3* | *F* | *T* | T | | | |
| *4* | *F* | *F* | F | | | |

Step two:

| | *P* | *Q* | P v Q | ~Q | | P |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | T | F | | |
| *2* | *T* | *F* | T | T | | |
| *3* | *F* | *T* | T | F | | |
| *4* | *F* | *F* | F | T | | |

Step three:

| | *P* | *Q* | P v Q | ~Q | | P |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | T | F | | T |
| *2* | *T* | *F* | T | T | | T |
| *3* | *F* | *T* | T | F | | F |
| *4* | *F* | *F* | F | T | | F |

Each row will show a different possible scenario. To determine validity, see if it is possible to have all true premises lead to a false conclusion. If so, the argument is invalid; if not, then the argument is valid.

| | *P* | *Q* | P v Q | ~Q | | P |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | T | F | | T |
| *2* | *T* | *F* | T | T | | T |
| *3* | *F* | *T* | T | F | | F |
| *4* | *F* | *F* | F | T | | F |

In this case, each time the conclusion row had a false, at least one of the premises in that row was also false. This shows that the argument is valid; it is impossible for all the premises to be true while the conclusion is false.

Take the following claim: You can pass the class only if you study. We would symbolize it as follows: P → S

The truth table for this claim is:

| | *P* | *S* | P→S |
|---|---|---|---|
| *1* | *T* | *T* | T |
| *2* | *T* | *F* | F |
| *3* | *F* | *T* | T |
| *4* | *F* | *F* | T |

This is the truth table for 'P→S'. If this were a premise in an argument, you would use the same process of completing the table as you did here. Look at the following example.

You can pass the class only if you study. P → S
<u>You study.</u> <u>S</u>
You can pass the class. P

Fill in the premises and conclusion across the top of the truth table. Complete each column one row at a time using the given truth values for each proposition involved. Use the truth-functions for each operation to complete the table. Plug in the assigned truth-values for the propositions to each part of the argument.

Each row will show a different possible scenario. To determine validity, see if it is possible to have all true premises lead to a false conclusion. If so, the argument is invalid; if not, then the argument is valid.

| | *P* | *S* | P → S | S | | P |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | T | T | | T |
| *2* | *T* | *F* | F | F | | T |
| *3* | *F* | *T* | T | T | | F |
| *4* | *F* | *F* | T | F | | F |

**<u>Reading the completed truth-table for an argument</u>**

The FORM of the previous argument is invalid. The premises do not guarantee the conclusion. Yes, it just may happen to be that all the premises and the conclusion are true (as possibility 1 shows), but that doesn't say anything about the relationship of the premises to the conclusion. There is a possible scenario where you could have all true premises leading to a false conclusion (as line 3 shows) and that POSSIBILITY alone proves the argument is INVALID.

Once a table is complete, read it one row at a time. Each row displays one possible scenario in the universe. We want to see if there are any scenarios where we might encounter a false conclusion at the same time as all true premises. If we do find a row that demonstrates that, then the entire argument is invalid. If we do not find a row with all true premises and a false conclusion, then the argument is valid.

Let's look at more examples.

- Example A:

D F

Either Aaron is dating that girl or he's just friends with her. So he must not be dating her, since they are certainly friends.

D v F
F____
∴~D

| | *D* | *F* | D v F | F | | ~D |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | T | T | | F |
| 2 | *T* | *F* | T | F | | F |
| 3 | *F* | *T* | T | T | | T |
| 4 | *F* | *F* | F | F | | T |

Invalid: There IS a possibility (line 1) that all the premises could be true while the conclusion false. (Note that finding a row with all true premises and a true conclusion does NOT entail validity.)

- Example B:

P Q R

If he drinks coffee, then he'll be up all night. If he's up all night, then he won't be up for work in time. Therefore, if he drinks coffee, then he won't be up for work in time.

P→Q
Q→R
∴P→R

| | *P* | *Q* | *R* | P→ Q | Q→R | | P→R |
|---|---|---|---|---|---|---|---|
| 1 | *T* | *T* | *T* | T | T | | T |
| 2 | *T* | *T* | *F* | T | F | | F |
| 3 | *T* | *F* | *T* | F | T | | T |
| 4 | *T* | *F* | *F* | F | T | | F |
| 5 | *F* | *T* | *T* | T | T | | T |
| 6 | *F* | *T* | *F* | T | F | | T |
| 7 | *F* | *F* | *T* | T | T | | T |
| 8 | *F* | *F* | *F* | T | T | | T |

Valid: No possibility (line) that has all true premises with a false conclusion

- Example C:

Q P

Clint must be playing pinball since if he's at the bar, that's what he does, and that's where he is.

P→Q
P
∴Q

| | *P* | *Q* | P → Q | P | | Q |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | T | T | | T |
| 2 | *T* | *F* | F | T | | F |
| 3 | *F* | *T* | T | F | | T |
| 4 | *F* | *F* | T | F | | F |

Valid: No possibility (line or row) that has all true premises with a false conclusion.

**Truth-functionally equivalent claims**

How can 'unless' be symbolized as 'or'? We don't usually speak that way, so how can it be accurate to symbolize it as such? The answer lies in the truth-function of the symbolization. This is something we would cover at length in a symbolic logic course, but we'll just address the surface level reasoning here. Consider the following example.

For the following examples, assume that we are given:

- H = You will have homework today.
- Q = You will have a quiz today.

You will have homework unless you have a quiz. (~Q)→ H OR H v Q

| | H | Q | (~Q) → H | H v Q |
|---|---|---|---|---|
| 1 | T | T | T | T |
| 2 | T | F | T | T |
| 3 | F | T | T | T |
| 4 | F | F | F | F |

**Truth-functionally equivalent claims in arguments**

Earlier we explored the truth-functional equivalency of some claims. Now consider the following example.

| | | |
|---|---|---|
| You can go out tonight unless you don't do your homework. | H → O | O v ~H |
| You did your homework. | H | H |
| You can go out tonight. | O | O |

We see that we can symbolize the argument in two different ways. So long as we've symbolized correctly, since the two are truth-functionally equivalent, the analysis of our argument should be the same for either version. If the *form* presents a valid argument, both versions should display that information.

| | *H* | *O* | H→O | H | | O |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | T | T | | T |
| *2* | *T* | *F* | F | T | | F |
| *3* | *F* | *T* | T | F | | T |
| *4* | *F* | *F* | T | F | | F |

| | *O* | *H* | O v ~H | H | | O |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | T | T | | T |
| *2* | *T* | *F* | T | F | | T |
| *3* | *F* | *T* | F | T | | F |
| *4* | *F* | *F* | T | F | | F |

Valid, no possibility of all true premises leading to a false conclusion.

Here the *argument form* is valid. This argument, regardless of what 'H' and 'O' stand for, is valid. The premises guarantee the conclusion. IF the premises are actually true in real life, then it is absolutely impossible for the conclusion to be false. The premises might *not* be true (as shown in possibilities 2, 3, and 4), but *if* they were, then the conclusion too would be with certainty.

**Practice problems: Completing long truth tables**

Symbolize the argument using propositional language. Fill in the premises and conclusion across the top of the truth table. Complete each column one row at a time using the given truth values for each proposition involved. Each row will show a different possible scenario. To determine validity, see if it is possible to have all true premises lead to a false conclusion. If so, the argument is invalid; if not, then the argument is valid. State whether the argument is valid or invalid and why.

1.

| | *A* | *B* | A v B | B & A | | ~B |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

2.

| | *C* | *D* | C → D | ~D v C | | C |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

**Practice problems: Symbolizing arguments and completing long truth tables**

Symbolize the arguments, complete the truth table, check for validity, and explain your findings.

1. If you stare into the sun, then you'll go blind. You did stare at the sun, so you're going blind.
S B

| | *S* | *B* | | | | |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

2. If you got an A on the test, then you'll pass the class. You are failing, so you didn't get an A on the test.
A P

| | *A* | *P* | | | | |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

3. She's cooking lasagna, since her parents are coming over for dinner. If her parents come for dinner, she makes lasagna.
D
L

| | *D* | *L* | | | | |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

R O

4. They own a radar detector only if they think they can outrun police. They do not own a radar detector, so they don't think they can outrun the police.

| | *R* | *O* | | | | |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

5. Either we should bike or we should walk. We shouldn't walk, so let's bike.
B W

| | *B* | *W* | | | | |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

6. Either she's really P.O.ed at me or she lost her voice. She hasn't, so she must be!
P L

| | *P* | *L* | | | | |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

*7. If <u>he says that one more time</u>, <u>I'm going to deck him</u>. That's it…I'm going to deck him!

| | *S* | *D* | | | | |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

*8. If God exists, then we would see design in the world. Because we do see design in the world, we can conclude that God must exist!

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | | | | |
| 2 | *T* | *F* | | | | |
| 3 | *F* | *T* | | | | |
| 4 | *F* | *F* | | | | |

9. J → W / ((~W) v (~K)) // J

| | *J* | *W* | *K* | J → W | ~W v ~K | | J |
|---|---|---|---|---|---|---|---|
| 1 | *T* | *T* | *T* | | | | |
| 2 | *T* | *T* | *F* | | | | |
| 3 | *T* | *F* | *T* | | | | |
| 4 | *T* | *F* | *F* | | | | |
| 5 | *F* | *T* | *T* | | | | |
| 6 | *F* | *T* | *F* | | | | |
| 7 | *F* | *F* | *T* | | | | |
| 8 | *F* | *F* | *F* | | | | |

10. B & C / C → A // ~B

| | *A* | *B* | *C* | B & C | C → A | | ~B |
|---|---|---|---|---|---|---|---|
| 1 | *T* | *T* | *T* | | | | |
| 2 | *T* | *T* | *F* | | | | |
| 3 | *T* | *F* | *T* | | | | |
| 4 | *T* | *F* | *F* | | | | |
| 5 | *F* | *T* | *T* | | | | |
| 6 | *F* | *T* | *F* | | | | |
| 7 | *F* | *F* | *T* | | | | |
| 8 | *F* | *F* | *F* | | | | |

11. Since both P and Q, we can conclude that R or P; in addition, Q only if P.

| | *P* | *Q* | *R* | | | | |
|---|---|---|---|---|---|---|---|
| 1 | *T* | *T* | *T* | | | | |
| 2 | *T* | *T* | *F* | | | | |
| 3 | *T* | *F* | *T* | | | | |
| 4 | *T* | *F* | *F* | | | | |
| 5 | *F* | *T* | *T* | | | | |
| 6 | *F* | *T* | *F* | | | | |
| 7 | *F* | *F* | *T* | | | | |
| 8 | *F* | *F* | *F* | | | | |

**Approaching complex claims in truth tables**

It may be the case that we have an argument that contains one or more complex claims. We have been symbolizing individual complex claims and completing truth tables containing basic symbolized claims, but we will need to combine these ideas.

For example, earlier we symbolized the claim 'if the sun is shining and today is Friday, then we get to leave class early' as '(S & F) → E'. If this were one premise in a truth table, we would need to determine the truth-value of that premise in each row of the truth table. How do we do this? It may be helpful to first identify the main type of operation being used. In this case, we have a conditional claim. After we determine the main operation, we can break the statement down into the two parts. For a conditional, we will have an antecedent and a consequent. In this case, the antecedent is a conjunction, 'S & F', while the consequent is just a proposition, 'E'. To determine the truth-value of the conditional, we first must determine the truth-value of its components in each row of the truth table. In other words, we need to determine the truth-value of the conjunction 'S & F' in each row first. (Basically you need to determine the truth-value within each set of parentheses first.) This is the work that would be done to determine the truth-value for this claim in this situation:

| | *S* | *F* | *E* | (S & F) → E |
|---|---|---|---|---|
| 1 | *T* | *T* | *T* | (T & T) → T = (T) → T = True |
| 2 | *T* | *T* | *F* | (T & T) → F = (T) → F = False |
| 3 | *T* | *F* | *T* | (T & F) → T = (F) → T = True |
| 4 | *T* | *F* | *F* | (T & F) → F = (F) → F = True |
| 5 | *F* | *T* | *T* | (F & T) → T = (F) → T = True |
| 6 | *F* | *T* | *F* | (F & T) → F = (F) → F = True |
| 7 | *F* | *F* | *T* | (F & F) → T = (F) → T = True |
| 8 | *F* | *F* | *F* | (F & F) → F = (F) → F = True |

Let's put this in the context of an argument. Assume the argument given is as follows:

> "If the sun is shining and today is Friday, then we get to leave class early. Because the sun is not shining, we can conclude that either we will get to leave class early or it's Friday."

To symbolize the argument, we would follow the same procedure we have been using. The end result would look like this:

> (S & F) → E / ~S //E v F

To complete a truth table for this argument, we would set it up like this:

| | *S* | *F* | *E* |
|---|---|---|---|
| 1 | *T* | *T* | *T* |
| 2 | *T* | *T* | *F* |
| 3 | *T* | *F* | *T* |
| 4 | *T* | *F* | *F* |
| 5 | *F* | *T* | *T* |
| 6 | *F* | *T* | *F* |
| 7 | *F* | *F* | *T* |
| 8 | *F* | *F* | *F* |

Then we would include our premises and conclusion to the right of the propositions.

| | *S* | *F* | *E* | (S & F) → E | ~S | E v F |
|---|---|---|---|---|---|---|
| 1 | *T* | *T* | *T* | (T) → T = **True** | **F** | **T** |
| 2 | *T* | *T* | *F* | (T) → F = **False** | **F** | **T** |
| 3 | *T* | *F* | *T* | (F) → T = **True** | **F** | **T** |
| 4 | *T* | *F* | *F* | (F) → F = **True** | **F** | **F** |
| 5 | *F* | *T* | *T* | (F) → T = **True** | **T** | **T** |
| 6 | *F* | *T* | *F* | (F) → F = **True** | **T** | **T** |
| 7 | *F* | *F* | *T* | (F) → T = **True** | **T** | **T** |
| 8 | *F* | *F* | *F* | (F) → F = **True** | **T** | **F** |

In this case, the argument is invalid as indicated by row 8, where we find it is possible to have all true premises and a false conclusion.

**Practice problems: Complex claims in truth tables**

Complete each column one row at a time using the given truth values for each atomic proposition. Use the operation's truth function to complete the table. Each row will show a different possible scenario. To determine validity, see if it is possible to have all true premises lead to a false conclusion. If so, state that the argument is invalid and name the row that demonstrate this scenario; if not, then state that the argument is valid and explain why.

1.

| | *Z* | *H* | *Q* | Z v (H & Z) | H & Q | | Z v Q |
|---|---|---|---|---|---|---|---|
| 1 | *T* | *T* | *T* | | | | |
| 2 | *T* | *T* | *F* | | | | |
| 3 | *T* | *F* | *T* | | | | |
| 4 | *T* | *F* | *F* | | | | |
| 5 | *F* | *T* | *T* | | | | |
| 6 | *F* | *T* | *F* | | | | |
| 7 | *F* | *F* | *T* | | | | |
| 8 | *F* | *F* | *F* | | | | |

Valid or invalid? How do you know?

2.

| | *C* | *K* | *M* | M → ~(C & K) | C & K | | ~(M v C) |
|---|---|---|---|---|---|---|---|
| 1 | *T* | *T* | *T* | | | | |
| 2 | *T* | *T* | *F* | | | | |
| 3 | *T* | *F* | *T* | | | | |
| 4 | *T* | *F* | *F* | | | | |
| 5 | *F* | *T* | *T* | | | | |
| 6 | *F* | *T* | *F* | | | | |
| 7 | *F* | *F* | *T* | | | | |
| 8 | *F* | *F* | *F* | | | | |

Valid or invalid? How do you know?

3.

| | *P* | *B* | *R* | P v R | ~B | R & P | | B → P |
|---|---|---|---|---|---|---|---|---|
| *1* | *T* | *T* | *T* | | | | | |
| *2* | *T* | *T* | *F* | | | | | |
| *3* | *T* | *F* | *T* | | | | | |
| *4* | *T* | *F* | *F* | | | | | |
| *5* | *F* | *T* | *T* | | | | | |
| *6* | *F* | *T* | *F* | | | | | |
| *7* | *F* | *F* | *T* | | | | | |
| *8* | *F* | *F* | *F* | | | | | |

Valid or invalid? How do you know?

4.

| | *H* | *M* | *N* | ~H & M | N | M v ~N | | H → M |
|---|---|---|---|---|---|---|---|---|
| *1* | *T* | *T* | *T* | | | | | |
| *2* | *T* | *T* | *F* | | | | | |
| *3* | *T* | *F* | *T* | | | | | |
| *4* | *T* | *F* | *F* | | | | | |
| *5* | *F* | *T* | *T* | | | | | |
| *6* | *F* | *T* | *F* | | | | | |
| *7* | *F* | *F* | *T* | | | | | |
| *8* | *F* | *F* | *F* | | | | | |

Valid or invalid? How do you know?

5.

| | *A* | *B* | *C* | A → (B & C) | ~C | ~B | | B v A |
|---|---|---|---|---|---|---|---|---|
| *1* | *T* | *T* | *T* | | | | | |
| *2* | *T* | *T* | *F* | | | | | |
| *3* | *T* | *F* | *T* | | | | | |
| *4* | *T* | *F* | *F* | | | | | |
| *5* | *F* | *T* | *T* | | | | | |
| *6* | *F* | *T* | *F* | | | | | |
| *7* | *F* | *F* | *T* | | | | | |
| *8* | *F* | *F* | *F* | | | | | |

Valid or invalid? How do you know?

6.

| | *A* | *B* | *C* | (C v A) → B | ~(B & A) | C | | A |
|---|---|---|---|---|---|---|---|---|
| *1* | *T* | *T* | *T* | | | | | |
| *2* | *T* | *T* | *F* | | | | | |
| *3* | *T* | *F* | *T* | | | | | |
| *4* | *T* | *F* | *F* | | | | | |
| *5* | *F* | *T* | *T* | | | | | |
| *6* | *F* | *T* | *F* | | | | | |
| *7* | *F* | *F* | *T* | | | | | |
| *8* | *F* | *F* | *F* | | | | | |

Valid or invalid? How do you know?

Part B: Use your knowledge of premise and conclusion indicator words to determine the conclusion. Then symbolize each premise and the conclusion using propositional logic symbols and letter for propositions. List your premises above the conclusion or in a linear fashion. Then complete a truth table and determine validity of the argument. Explain your findings.

7.It must be that not W, for we find W only if we find J. We have yet, however, to find J.

| | *J* | *W* | | | | |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | | | | |
| *2* | *T* | *F* | | | | |
| *3* | *F* | *T* | | | | |
| *4* | *F* | *F* | | | | |

Valid or invalid? How do you know?

8.Given R, it follows that S since either S or R.

| | *R* | *S* | | | | |
|---|---|---|---|---|---|---|
| *1* | *T* | *T* | | | | |
| *2* | *T* | *F* | | | | |
| *3* | *F* | *T* | | | | |
| *4* | *F* | *F* | | | | |

Valid or invalid? How do you know?

9.Both P and Q because if Q, then either P or Z; in addition, it is not the case that Z.

| | *P* | *Q* | *Z* | | | | |
|---|---|---|---|---|---|---|---|
| *1* | *T* | *T* | *T* | | | | |
| *2* | *T* | *T* | *F* | | | | |
| *3* | *T* | *F* | *T* | | | | |
| *4* | *T* | *F* | *F* | | | | |
| *5* | *F* | *T* | *T* | | | | |
| *6* | *F* | *T* | *F* | | | | |
| *7* | *F* | *F* | *T* | | | | |
| *8* | *F* | *F* | *F* | | | | |

Valid or invalid? How do you know?

**Short (or Indirect) Truth Table Method**

There is a technique that we can use to determine validity of symbolized propositional arguments. To construct a short truth table, we start with the same procedure we have used to a long truth table, except we will have only one row to complete. Start by listing your symbolized premises and conclusion across the top of a truth table (like we have been doing). Then make the conclusion false. Do so by simply assigning a false truth-value to the conclusion; this may mean determining what the truth of its components is first. Then attempt to make all of the premises true while being consistent. That is, if you have assigned the truth-value 'true' to the variable 'p', then everywhere else we find 'p', it must also be true. Following is an example.

**Short Truth Tables Procedure**

- After the argument has been correctly symbolized, list the premises across the top followed by the conclusion.
- Set up the short truth table similar to the long truth table, but have only one row and do not pre-assign truth values to the variables (i.e., for A, B, C, etc).
- Make the conclusion false; do this by assigning false as the truth-value in the conclusion column and determine how that is possible.
- Try to make all the premises true while being consistent; if you have already determined a truth-value for one of the variables, it must retain that truth-value throughout.
- State your findings; if it is possible to make all the premises true while the conclusion false, then the argument is invalid; if it is impossible to make all the premises true while the conclusion false, then the argument is valid.

*Example:* *A → B*
*~C v ~A*
*B & D*
*∴C v ~D* *Valid or invalid? Why?*

| *A* | *B* | *C* | *D* | *A → B* | *~C v ~A* | *B & D* | *C v ~D* |
|---|---|---|---|---|---|---|---|
| | | | | *? → T =True* | *~F v ?= True* | *? & T= T & T = True* | *F v ~T =False* |

*This is an invalid argument; it is possible to make all the premises true while the conclusion is false.*

**Practice problems: Short truth tables**

Directions: Given the following symbolized arguments, use the short truth table method to determine validity. State whether each argument is valid or invalid. In a sentence, explain your findings.

1. ~(A & B)
   D → ~C
   B v E
   ∴A → D Valid or invalid? Why?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |

2. B & ~A
C → (D v B)
D v E
C → A
∴ ~E Valid or invalid? Why?

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

3. A → B
B → C
C → ~D
D & E
∴ E v A Valid or invalid? Why?

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

4. A v B
C → D
D v ~B
∴ C & A Valid or invalid? Why?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

5. A → B
B → C
C → D
~D
∴ ~A Valid or invalid? Why?

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

## Quick Guide: Techniques for symbolizing complex claims

T = You will have test today.
Q = You will have a quiz today.

**NOT EITHER / NEITHER**
You have neither a test nor a quiz today.

~(T v Q)

(~T) & (~Q)

**NOT BOTH**
You will not have both a quiz and a test today.

~( T & Q)

(~T) v (~Q)

**BOTH NOT**
Both tests and quizzes are not happening today.

(~T) & (~Q)

~(T v Q)

**EITHER NOT**
Either you will not have a test or you will not have a quiz.

~T v ~Q

~(T & Q)

**ONLY IF**
You will have a quiz only if you do not have a test.

Q → (~T)

Only if we have a test will we forgo a quiz today.

(~Q) → T

**UNLESS**
We will have a quiz today unless we have a test.

Q v T

(~T) → Q

**Comprehensive Review Practice Problems**

Part A. Symbolize the following complex claims using the variables below to retain the same meaning. (Just to get you thinking conceptually about validity and soundness, what is the ACTUAL truth-value of each of these? In real life, is each of these true or false?)

V = An/This argument is/can be valid.
*~V = An/This argument is/can be invalid/an argument is not/cannot be valid.*

S = An/This argument is/can be sound.
*~S = An/This argument is/can be unsound/an argument is not/cannot be sound.*

P = An/This argument has/can have all true premises.
*~P = An/This argument doesn't have/cannot have all true premises.*

C = An argument has/can have a false conclusion.
*~C = An argument doesn't have/cannot have a false conclusion.*

1. If an argument is sound, then it is valid.

______________________________________________________________________________

2. An argument is invalid if it has both all true premises and a false conclusion.

______________________________________________________________________________

3. An argument has a false conclusion only if it is unsound.

______________________________________________________________________________

4. If an argument is invalid, then it is neither valid nor sound.

______________________________________________________________________________

5. An argument cannot be sound unless it is valid.

______________________________________________________________________________

6. Either an argument can be valid or it can be unsound.

______________________________________________________________________________

7. If an argument is valid, then it cannot have a false conclusion.

______________________________________________________________________________

8. An argument has all true premises if it is valid.

______________________________________________________________________________

9. An argument does not have all true premises unless it is valid.

______________________________________________________________________________

10. If an argument is both not valid and not sound, then it has a false conclusion.

______________________________________________________________________________

Part B. Rewrite these symbolized statements into complete English sentences to keep the same meaning. Use the key from part A.

1. V → ~(P & C)

______________________________________________________________________________

2. V v ~V

______________________________________________________________________________

3. (C & P) → ~(V v S)

______________________________________________________________________________

4. (V & P) → ~C

______________________________________________________________________________

Part C. For each of the following compound propositions, determine its truth-value. Let A, B, and C be true. Let X, Y, and Z be false. Also, for each compound proposition, what is the main operator?

1. A → ~ Y

2. ~ (A & B) v Z

3. (X v C) & ~ (A → Z)

4. (A & Y) → (A v ~ X)

5. ~(B & X)

6. ((B → X) v ~A) & Z

Part D. Use the key from part A to symbolize the argument. Then use the indicated method to determine validity. Explain your findings.

1.An argument cannot be both invalid and sound. This argument has a false conclusion. An argument has a false conclusion only if it is unsound. Thus, this argument is not sound. **(Use the short truth table method.)**

2. An argument cannot be sound unless it is valid. This argument is valid. Therefore, this argument is sound.
**(Use the long truth table method. If the argument is invalid, indicate which row demonstrates that.)**

| | *S* | *V* | | | |
|---|---|---|---|---|---|
| *1* | *T* | *T* | | | |
| *2* | *T* | *F* | | | |
| *3* | *F* | *T* | | | |
| *4* | *F* | *F* | | | |

3. If an argument is valid, then if it has all true premises, then it cannot have a false conclusion. So, this argument is both unsound and invalid, since an argument is invalid only if it has a false conclusion. In addition, this argument does not have all true premises.**(Use the short truth table method to determine validity.)**

4. This argument isn't sound since an argument can't be sound unless it is valid and this argument is not valid. **(Use the long truth table method. If the argument is invalid, indicate which row demonstrates that.)**

| | *S* | *V* | | | |
|---|---|---|---|---|---|
| *1* | *T* | *T* | | | |
| *2* | *T* | *F* | | | |
| *3* | *F* | *T* | | | |
| *4* | *F* | *F* | | | |

Part E.Complex truth tables

1.

| *A* | *B* | *C* | A → (B & C) | ~C | B v A | ~B |
|---|---|---|---|---|---|---|
| *T* | *T* | *T* | | | | |
| *T* | *T* | *F* | | | | |
| *T* | *F* | *T* | | | | |
| *T* | *F* | *F* | | | | |
| *F* | *T* | *T* | | | | |
| *F* | *T* | *F* | | | | |
| *F* | *F* | *T* | | | | |
| *F* | *F* | *F* | | | | |

Valid or Invalid? Why?

2.

| *A* | *B* | *C* | (C v A) → B | B & A | C | A |
|---|---|---|---|---|---|---|
| *T* | *T* | *T* | | | | |
| *T* | *T* | *F* | | | | |
| *T* | *F* | *T* | | | | |
| *T* | *F* | *F* | | | | |
| *F* | *T* | *T* | | | | |
| *F* | *T* | *F* | | | | |
| *F* | *F* | *T* | | | | |
| *F* | *F* | *F* | | | | |

Valid or Invalid? Why?

Part F. Symbolize the following arguments into standard propositional argument form. Then complete a short or long truth table.

1.If I leave class early, then I both disrupt the class and I miss important material. I have neither missed important material nor have I disrupted the class. So, I have not left class early.

| E | D | M | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |

OR

| E | D | M | | | | |
|---|---|---|---|---|---|---|
| *T* | *T* | *T* | | | | |
| *T* | *T* | *F* | | | | |
| *T* | *F* | *T* | | | | |
| *T* | *F* | *F* | | | | |
| *F* | *T* | *T* | | | | |
| *F* | *T* | *F* | | | | |
| *F* | *F* | *T* | | | | |
| *F* | *F* | *F* | | | | |

2.Either it's a really tiring day, or I haven't had enough coffee and I got up early. Thus, it must be a really tiring day, because I got up early.

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |

OR

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| *T* | *T* | *T* | | | | |
| *T* | *T* | *F* | | | | |
| *T* | *F* | *T* | | | | |
| *T* | *F* | *F* | | | | |
| *F* | *T* | *T* | | | | |
| *F* | *T* | *F* | | | | |
| *F* | *F* | *T* | | | | |
| *F* | *F* | *F* | | | | |

**Answers to some review problems**

Part A.

1. S → V
2. (P&C) → (~V)
3. C → (~S)
4. (~V) → ~(V v S)
5. (~S) v V  OR  (~V) → (~S)
6. V v (~S)
7. V → (~C)
8. V → P
9. (~P) v V  OR  (~V) → (~P)
10. ((~V) & (~S)) → C

Part B.

1. If an argument is valid, then it is not the case that it has both all true premises and a false conclusion.
2. An argument is valid or invalid.
3. If an argument has all true premises and a false conclusion, then it is neither valid nor sound.
4. If an argument is valid and has all true premises, then it cannot have a false conclusion.

Part C.

1. A **→** ~ Y, T→~F, T→T, TRUE
2. ~ (A & B) **v** Z, ~(T&T)vF, ~(T)vF, FvF, FALSE
3. (X v C) **&** ~ (A → Z), (FvT)&~(T→F), (T)&~(F), T&T, TRUE
4. (A & Y) **→** (A v ~ X), (T&F)→(Tv~F), (F)→(TvT), F→(T), TRUE
5. **~**(B & X), ~(T&F), ~(F), TRUE
6. ((B → X) v ~A) & Z, ((T→F) v ~T) & F, Z is a false conjunct so the whole thing is FALSE

Part D.

| | | | | |
|---|---|---|---|---|
| | | f ~t | | ~t |
| ~(~V & S) | C | C→ ~S | | ~S |
| | F, can't be T if premises two is | T | | F |

Valid, impossible to make all the premises true while the conclusion is false.

2.

| | *S* | *V* | ~S v V | V | S |
|---|---|---|---|---|---|
| *1* | *T* | *T* | T | T | T |
| *2* | *T* | *F* | F | F | T |
| *3* | *F* | *T* | T | T | F |
| *4* | *F* | *F* | T | F | F |

Invalid, row 3 shows that it IS possible to find all true premises with a false conclusion

3.

? →(F → ?)    ~f

? →(T)     ~T → T     ? & F=false

| V →(P→~C) | ~V → C | ~P | | ~S & ~V |
|---|---|---|---|---|
| T | T | T | | F |

Invalid, it IS possible to make all the premises true while the conclusion is false.

4.

| | S | V | ~V → ~S | ~V | ~S |
|---|---|---|---|---|---|
| *1* | *T* | *T* | T | F | F |
| *2* | *T* | *F* | F | T | F |
| *3* | *F* | *T* | T | F | T |
| *4* | *F* | *F* | T | T | T |

Valid, no rows with all true premises and a false conclusion

Part E.Complex truth tables

1.

| *A* | *B* | *C* | A → (B & C) | ~C | B v A | ~B |
|---|---|---|---|---|---|---|
| *T* | *T* | *T* | T | F | T | F |
| *T* | *T* | *F* | F | T | T | F |
| *T* | *F* | *T* | F | F | T | T |
| *T* | *F* | *F* | F | T | T | T |
| *F* | *T* | *T* | T | F | T | F |
| *F* | *T* | *F* | T | T | T | F |
| *F* | *F* | *T* | T | F | F | T |
| *F* | *F* | *F* | T | T | F | T |

Invalid, table shows it IS possible to find all true premises with a false conclusion

2.

| *A* | *B* | *C* | (C v A) → B | B & A | C | A |
|---|---|---|---|---|---|---|
| *T* | *T* | *T* | T | T | T | T |
| *T* | *T* | *F* | T | T | F | T |
| *T* | *F* | *T* | F | F | T | T |
| *T* | *F* | *F* | F | F | F | T |
| *F* | *T* | *T* | T | F | T | F |
| *F* | *T* | *F* | T | F | F | F |
| *F* | *F* | *T* | F | F | T | F |
| *F* | *F* | *F* | T | F | F | F |

Valid, no rows with all true premises and a false conclusion

Part F.

1.

| E | D | M | E → (D&M) | ~(MvD) | | ~E |
|---|---|---|---|---|---|---|
| *T* | *T* | *T* | T → (T&T)=T | Can’t be T while<br>premise one is T | | F |

Valid, impossible to make all the premises true while the conclusion is false.

OR

| E | D | M | E → (D&M) | ~(MvD) | | ~E |
|---|---|---|---|---|---|---|
| *T* | *T* | *T* | T | F | | F |
| *T* | *T* | *F* | F | F | | F |
| *T* | *F* | *T* | F | F | | F |
| *T* | *F* | *F* | F | T | | F |
| *F* | *T* | *T* | T | F | | T |
| *F* | *T* | *F* | T | F | | T |
| *F* | *F* | *T* | T | F | | T |
| *F* | *F* | *F* | T | T | | T |

Valid, no rows with all true premises and a false conclusion

2.Either it’s a really tiring day, or I haven’t had enough coffee and I got up early. Thus, it must be a really tiring day, because I got up early.

| R | C | E | R v ((~C)&E) | E | | R |
|---|---|---|---|---|---|---|
| *F* | *F* | | F v ((~F)&T)=T | T | | F |

Invalid, it IS possible to make all the premises true while the conclusion is false.

OR

| R | C | E | R v ((~C)&E) | E | | R |
|---|---|---|---|---|---|---|
| *T* | *T* | *T* | T | T | | T |
| *T* | *T* | *F* | T | F | | T |
| *T* | *F* | *T* | T | T | | T |
| *T* | *F* | *F* | T | F | | T |
| *F* | *T* | *T* | F | T | | F |
| *F* | *T* | *F* | F | F | | F |
| *F* | *F* | *T* | T | T | | F |
| *F* | *F* | *F* | F | F | | F |

Invalid, table shows it IS possible to find all true premises with a false conclusion

Part D. Complex symbolization and analysis

1.An argument cannot be both invalid and sound. This argument has a false conclusion. An argument has a false conclusion only if it is unsound. Thus, this argument is not sound. **(Use the short truth table method.)**

**~(~V & S)**
**C**
**C → ~S**
**~S**

f ~t ~t

| ~(~V & S) | C | C→ ~S | | ~S |
|---|---|---|---|---|
| | F | T | | F |

Valid, impossible to make all the premises true while the conclusion is false.

2. An argument cannot be sound unless it is valid. This argument is valid. Therefore, this argument is sound.
**(Use the long truth table method. If the argument is invalid, indicate which row demonstrates that.)**

**~S v V** **~V → ~S**
**V_____** **V______**
**S** **S**

| | *S* | *V* | ~S v V | V | S |
|---|---|---|---|---|---|
| *1* | *T* | *T* | T | T | T |
| *2* | *T* | *F* | F | F | T |
| *3* | *F* | *T* | T | T | F |
| *4* | *F* | *F* | T | F | F |

Invalid, row 3

3. If an argument is valid, then if it has all true premises, then it cannot have a false conclusion. So, this argument is both unsound and invalid, since an argument is invalid only if it has a false conclusion. In addition, this argument does not have all true premises.**(Use the short truth table method to determine validity.)**

**V → (P → ~C)**
**~V → C**
**~P_________**
**~S & ~V**

? →(F → ?) ~f
? →(T) ~T → T ? & F=false

| V →(P→~C) | ~V → C | ~P | | ~S & ~V |
|---|---|---|---|---|
| T | T | T | | F |

Invalid, it is possible to make all the premises true while the conclusion is false.

4. This argument isn't sound since an argument can't be sound unless it is valid and this argument is not valid. **(Use the long truth table method. If the argument is invalid, indicate which row demonstrates that.)**

| | |
|---|---|
| **~S v V** | **~V → ~S** |
| **<u>~V___</u>** | **<u>~V_____</u>** |
| **~S** | **~S** |

| | *S* | *V* | ~V → ~S | ~V | ~S |
|---|---|---|---|---|---|
| *1* | *T* | *T* | T | F | F |
| *2* | *T* | *F* | F | T | F |
| *3* | *F* | *T* | T | F | T |
| *4* | *F* | *F* | T | T | T |

Valid, no rows with all true premises and a false conclusion

**<u>ANSWERS Practice problems: Basic and complex claim symbolization</u>**

Directions: Symbolize the following statements using the key below for propositions.

**S = The sun is shining.** **E = We get to leave class early (today).**
**Q = We (will) have a quiz(today).** **F = Today is Friday.**

1. It is either not a day we get to leave early or it is not Friday.

~E v ~F or you can include parenthesis like this (~E) v (~F)

2. We get to leave class early unless the sun is not shining.

E v ~S or you could do this way S → E

3. We will not have a quiz and we will not be leaving early today.

~Q & ~E

4. It is not both a day we get to leave early and Friday.

~(E & F)

5. We neither have a quiz nor do we get to leave early.

~(Q v E)

6. It is not that case that we have a quiz, but we do get to leave early.

~Q & E

7. The sun is shining or there's a quiz, only if we get to leave early or today is Friday.

(S v Q) → (E v F)

8. We get to leave early if both the sun is shining and today is Friday.

(S & F) → E

9.If we neither leave early nor have a quiz, then the sun is shining.

~(E v Q) → S

10. Only if the sun shines will we get to leave early.

E → S

Directions: Rewrite the symbolic statements into complete sentences to retain the same meaning.

11. (E v Q) → ~(S v F)

If either E or Q, then neither S nor F.
If we either leave early or we have a quiz, then neither the sun is shining nor is it Friday.

12. F → (E v Q)

If F, then either E or Q

13. (Q & E) v S

Either both Q and E, or S.

14. ~Q v E

Either we won't have a quiz or we will get to leave early.

15. ~Q

We don't have a quiz.

**ANSWERS: Practice problems four: Basic and complex claim symbolization**
Directions: Symbolize the following statements using the key below for propositions.

**H= You do/did your homework.** **P= You can pass the class.**
**S= You do/did study.** **O= You go out tonight.**

1. You did not both study and go out.

~(S & O)

2. You didn’t study or you didn’t do your homework.

~S v ~H

3. You did your homework or studied.

H v S

4. Either you study and do your homework, or you will go out tonight.

(S & H) v O

5. You will go out tonight only if you both do your homework and study.

O → (H & S)

6. Only if you study can you pass the class.

P → S

7. You will go out tonight unless you don’t do your homework.

O v ~H or you could write it as H → O

8. If you don’t study, you cannot pass the class.

~S → ~P

9. You can pass the class if you both study and do your homework.

(S & H) → P

10. If you neither study nor do your homework, then you cannot pass the class.

~(S v H) → ~P

11. If you don’t study and you don’t do your homework, then you cannot pass the class.

(~S & ~H) → ~P

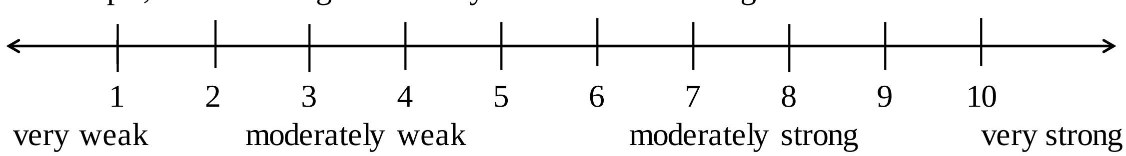
# Chapter Six
# Inductive Reasoning, Informal Fallacies, and Responding to Arguments

One of the main differences between deductive logic and inductive logic is that deductive logic deals with certainties and focuses mostly on format while inductive arguments deal with likelihood and probability and focus on content.

Inductive arguments are analyzed differently than deductive arguments. Where deductive arguments can be analyzed in terms of a rigid conception of validity, inductive arguments are evaluated in terms of 'strength'. Deductive arguments fall within the dichotomy of 'valid argument' or 'invalid argument'; there are precise tools used to determine the validity and that validity is due to the structure or form of that particular argument.

Determining the strength of an inductive argument is less of an exact science and the outcome of the evaluation may be different from reader to reader. Strength lies on a sliding scale ranging basically from very weak/highly unlikely to very strong/highly likely, and everywhere in between.

As an example, inductive arguments may lie somewhere along an evaluative scale like this:




**<u>Analysis of inductive arguments</u>**
The strength is determined based on a number of considerations. Some of these considerations are as follows.

**Likelihood that the conclusion would follow from true premises**
Assuming that the premises of a given argument are true, how likely is it that the conclusion of that argument is also true? As a reader, your job is to consider your answer to this question. *Because each reader may have a different background or know certain information, the answer may be different from reader to reader.*

**Detection of informal fallacies**
Informal fallacies may be found within inductive reasoning. If you think you have detected an informal fallacy, your job as a reader is to identify that fallacy and explain how it has been committed in this particular instance. *It is important to keep in mind that proponents of the argument may disagree and find no fallacy has been committed.* This again is where more discussion would follow from different analysis of one argument.

**Background information**
Depending on your knowledge of a particular subject or topic, you may have more background information than another person analyzing the argument. Though this supplementary information does not change the argument itself, it may influence your analysis of the argument.

**How does this work?**
Consider this argument: *"I know Sam likes deer meat and so he'll like elk meat too."* What is the conclusion? What do they use to support that claim? How well did they support it?

Here are two sample evaluations:

**Sample one:**
The conclusion of this argument is "Sam will like elk meat". The only reason given in this argument is that we know Sam likes deer meat. I have never tasted elk meat and I've never tasted deer meat. I assume that they would taste very similar because they are both wild game and the two animals are often prepared the same. For these reasons, I give this argument a strength rating of 9.

**Sample two:**
The conclusion of this argument is "Sam will like elk meat". The only reason given in this argument is that we know Sam likes deer meat. I have tasted both deer and elk meat. I, however, thoroughly enjoy deer meat but rather detest the taste of elk. I find they taste nothing alike. In addition, the way deer is prepared is often in the form of steak whereas elk is often in the form of jerky. Merely liking one does not provide enough support for me to think he will like the other. For these reasons, I give this argument a strength rating of 4.

**What do you notice?**
What do the samples have in common and where do they differ? Make some observations.

Things to note:

- the conclusion is the same for both analyses
- they have different strength ratings in part influenced by:
- background information
- prior knowledge or experiences (or lack thereof)
- despite different ratings, the key is to defend/support your analysis
- new information may or may not change your original strength *analysis*
- you are *not* changing *the argument* but you are using your information to *evaluate* the argument

**Practice Problems** *(Salahub)*
Consider each of the following inductive arguments carefully. We know that inductive arguments are those where true premises offer some degree of probability that the conclusion is true. Strong inductive arguments offer a **high** probability that the conclusion follows from true premises and weak inductive arguments offer a **low** probability that the conclusion follows from true premises. Rank each of the following inductive arguments using the previous scale. Next, offer a defense of your ranking; be specific and be ready to discuss this with the class.

As a reminder:

- Focus on the specific example
- How well do *these* reasons support the conclusion?
- Evaluate how probable it is that their premises would lead to the conclusion
- Use your knowledge, background, and understanding to support your reasons for your evaluation
- Ask: If the premises the author has provided *were true*, **how likely** is it that the conclusion would also be true?

1. Jo has taken two classes (SOC 100 and SOC 105) from Professor Shaw. She enjoyed both and earned A grades in both. So, she will like SOC 312 and earn an A grade in the class since it is taught by Professor Shaw.

2. On the way to work one very icy day, I saw lots of cars stuck on the side of the road unable to get enough traction to drive while other cars seemed to do fine. Both sets of cars were varied – large and small cars, trucks and vans, drivers of all variations. Then I realized that there was a common factor among the cars that were stuck – they were all rear-wheel drive. Rear-wheel drive must cause cars to handle poorly in icy conditions.

3. I took one ounce of water from my kitchen tap and sent it to a lab for analysis. The results showed that the sample contained no alarming levels of any harmful chemical. So, I am confident that I can drink water from my kitchen tap and none of it will have alarming levels of any harmful chemical.

4.In a random survey of 1000 Larimer County residents who are registered voters, 67% (670 people) reported that they support funding a new Arts Initiative with taxes. So, when all Larimer voters weigh in on this question during the next election we can expect that between 64% and 70% support for the Arts Initiative.

5.You have watched me flip this coin 12 times and it has come up heads every time. This next flip is very likely to come up tails.

6.Identical sets of resumes were created where the only difference was the first name of the job candidate. These resumes were sent out to real companies who were seeking job candidates and candidates with common names like “Jennifer” were called in for interviews much more often than candidates with names like “Shenique.” Clearly, having a unique name can cause a person to have difficulty getting a good job.

7.Look, it is immoral to eat meat produced by factory farming (as most beef, pork and chicken are produced). Factory farms are focused on making profits and not on the welfare of the animals – efficient practices are often excessively painful. It would clearly be wrong to cause needless physical and psychological suffering to a human just to increase profits and so it is also wrong to treat animals this way.

**Analogies in Inductive Argumentation**

Arguments can come in the form of analogies. For our purposes, we will standardize analogies in the following way.

> X and Y both have/share properties p, q, r, etc.
> <u>X has characteristic A.</u>
> Thus, Y also/probably has characteristic A.

X = the item used as the basis for the comparison
Y = the item being compared
p, q, r = the commonalities that both X and Y exhibit (characteristics, traits, properties, etc.)
A = the characteristic that Y is assumed to have and X is known to have

Once an analogy has been put into standard form, we can analyze the strength of the comparison. We want to consider a number of things when evaluating the strength.

1.How similar *are* X and Y? Are the similarities significant, superficial, important, etc.?

2.How many differences are there between X and Y? Regardless of the similarities, are these differences significant?

3.Are X and Y referring to individual items, or are they referring to larger groups that contain a number of constituents? Does this impact the comparison?

Another thing to keep in mind is that the properties (p, q, r, etc) might not be explicitly stated. In these cases it is important to articulate the properties before evaluating the analogy. This may entail a variety of analyses depending on one's knowledge of the items in discussion. Again, with inductive reasoning, there are many potentially 'correct answers'; the goal is to create the strongest reasoning and support for your analysis as possible.

Note that typically the conclusion contains the ‘Y’ term and the ‘A’ term. To determine the ‘A’ consider what characteristic the arguer is *assuming* to be the case for Y. This is some trait that the arguer does not *know* if Y has, though the arguer *does know* that X has A.

Here is an example to analyze using the argument by analogy technique.
Many of the fears people have about legally acknowledging gay marriages are similar to the fears people had 30-50 years ago about interracial marriages before such marriages were legal. In both cases, opponents argued that such marriages were wrong according to religious scripture and religious tradition. In both cases opponents argued that such marriages would negatively impact children and society in general. And, in both cases opponents argued that such marriages were abnormal and so allowing them would destroy the sanctity of marriage. Looking back we realize that these fears about inter-racial marriage were unfounded and such marriages have not had a detrimental impact on our society or on the concept of marriage. So, it is likely that the current fears many Americans have about gay marriage are also unfounded and that such marriages will not have a negative impact on society or on the concept of marriage.

**Here is another example to analyze:**
If a car breaks down on the freeway, a passing mechanic should feel no obligation to stop and render emergency roadside assistance. For similar reasons, if a person suffers from a heart attack on the street, a physician passing by should not feel obligated to render emergency medical assistance.

Mechanics and physicians both have a unique skill set, special training, and specific know-how.
<u>Mechanics have no obligation to help those in need of their skill.</u>
Thus, physicians also have no obligation to help those in need of their skill.

X = mechanics
Y = physicians
p, q, r = unique skill set, special training, specific know-how
A = lack of obligation

After you have identified the conclusion and the parts of the analogy, you can analyze the strength of the argument. Consider the similarities (pqr) both explicit and implicit. In this case, are there any significant *differences* that have not been noted? Are there important unstated differences between mechanics and physicians? Even if we do find a number of similarities, is there something unsettling about the conclusion? If so, maybe the two items in comparison are not similar enough to warrant that conclusion. The analysis of the analogy may vary based on the reader's background information, understanding, and the different findings of shared properties.

**Practice problems**
Identify the conclusion of each analogy. Then identify the parts of the analogy (the X, Y, pqr, and A). Once an analogy has been broken down, we can analyze the strength of the comparison. Use your background knowledge to assist in your analysis. Be sure to identify at least two similarities that may be explicitly stated or implicitly contained in the argument.

1.I know you like blue cheese, so you'll probably like gorgonzola. They are both fermented, soft cheeses with pungent flavoring.

> **X**=(what do we know about?)
> **Y**=(what are we concluding about?)
> **A**=(what do we know about X and conclude about Y?)
> **pqr**=(what do these two things have in common? What are at least two shared similarities?)

2.Riding a bike requires balance and coordination. Walking a tight-rope also requires these skills. For these reasons, if you can ride a bike, you'll probably be able to walk a tight-rope as well.

3. Nick is very good at Blackjack. So, he'll probably be a great poker player as well since both games involved gambling with cards.

4.Sally is going to love Art History class considering she did so well in and enjoyed graphic design class.

5.Julia enjoyed the last two Harry Potter books she read. She will probably enjoy the next one as well.

6. I have enjoyed the two Chuck Palahniuk books I have read so far. I will probably like the movie adaptations of those books too.

7. Sarah found the movie version of the Lord of the Rings trilogy drawn-out, dry, and boring so she would probably find the book versions to be the same.

8.This wasp poison can destroy an entire wasps' nest with just one spray! I bet I can use it to kill ants too. After all, ants are even smaller and weaker than wasps.

9. Alyson has killed every house plant she has ever owned. It is likely that she would not be able to care for pets either.

10.She will not swim in rivers, so she won't swim in the ocean either.

11. Texting while riding a bike is just as dangerous as doing so while driving. Texting is distracting to the operator. They can't look at their surroundings if they are looking down at their phone. And texters usually have both hands on the phone, not the handle bars or the steering wheel.

12. Someone is just as likely to get hurt texting while biking as they are texting while driving and the same traffic rules generally apply to bicyclists. For example, both can get tickets for operating under the influence or for not obeying stop signs. For these reasons, if it is illegal to text and drive, then it should be illegal to text and bike.

13.Humans and dogs share many similarities. Both have similar nervous systems and both show very similar physical reactions to painful stimuli. So, it is very likely that since humans experience pain and can suffer, dogs experience pain and can suffer.

**Further information for analogy analysis** *(Lau)*

**Example:** This novel is supposed to have a similar plot like the other one we have read, so probably it is also very boring.

**Initial analysis:** Just because the plot of novel W is similar to the plot of a boring novel V, it does not follow logically that W is also boring. Perhaps novel W is a good read despite an unimpressive plot because its pace is a lot faster and the story telling is more gripping and graphic. But if no such information is available, and all we know about novel W is that its plot is like the plot of V, which is not very interesting, then we would be justified in thinking that it is more likely for W to be boring than to be interesting.

**Specific considerations:**

- **Truth** : First of all we need to check that the two objects being compared are indeed similar in the way assumed.

For example, in the argument we just looked at, if the two novels actually have completely different plots, one being an office romance and the other is a horror story, then the argument is obviously unacceptable.

- **Relevance** : Even if two objects are similar, we also need to make sure that those aspects in which they are similar are actually relevant to the conclusion.

For example, suppose two books are alike in that their covers are both green. Just because one of them is boring does not mean that the other one is also boring, since the color of a book's cover is completely irrelevant to its contents. In other words, in terms of the explicit form of an analogical argument presented above, we need to ensure that having properties $Q_1$, ... $Q_n$ increases the probability of an object having property P.

- **Number** : If we discover a lot of shared properties between two objects, and they are all relevant to the conclusion, then the analogical argument is stronger than when we can only identify one or a few shared properties.

Suppose we find out that novel W is not just similar to another boring novel V with a similar plot. We discover that the two novels are written by the same author, and that very few of both novels have been sold. Then we can justifiably be more confident in concluding that W is likely to be boring novel.

- **Diversity** : Here the issue is whether the shared properties are of the same kind or of different types.

Suppose we have two Italian restaurants A and B, and A is very good. We then find out that restaurant B uses the same olive oil in cooking as A, and buys meat and vegetables of the same quality from the same supplier. Such information of course increases the probability that B also serves good food. But the information we have so far are all of the same kind having to do with the quality of the raw cooking ingredients. If we are further told that A and B use the same brand of pasta, this will increase our confidence in B further still, but not by much. But if we are told that both restaurants have lots of customers, and that both restaurants have obtained Michelin star awards, then these different aspects of similarities are going to increase our confidence in the conclusion a lot more.

- **Disanalogy** : Even if two objects X and Y are similar in lots of relevant respects, we should also consider whether there are dissimilarities between X and Y which might cast doubt on the conclusion.

For example, returning to the restaurant example, if we find out that restaurant B now has a new owner who has just hired a team of very bad cooks, we would think that the food is probably not going to be good anymore despite being the same as A in many other ways.

**Practice problems: complex arguments by analogy** *(Lau)*
1. We should not blame the media for deteriorating moral standards. Newspapers and TV are like weather reporters who report the facts. We do not blame weather reports for telling us that the weather is bad.

2. Democracy does not work in a family. Parents should have the ultimate say because they are wiser and their children do not know what is best for themselves. Similarly the best form of government for a society is not a democratic one but one where the leaders are more like parents.

3. In the early 17th century, astronomer Francesco Sizi argued that there are only seven planets: "There are seven windows in the head, two nostrils, two ears, two eyes and a mouth; so in the heavens there are two favorable stars, two unpropitious, two luminaries, and Mercury alone undecided and indifferent. From which and many similar phenomena of nature such as the seven metals, etc., which it were tedious to enumerate, we gather that the number of planets is necessarily seven."

**Informal fallacies**

Informal fallacies are problems found in reasoning. Often times those who are committing these fallacies are unaware of their errors or they may think their reasoning is not flawed. For these reasons, the ability to articulate why and how a particular fallacy is committed in a particular instance is very important. Following are a number of fallacies with a place for the definition, an example, and a write-up reply. The reply is an example of the way one could defend in detail the detection of a fallacy.

**First thoughts, definitions, examples, and explanations of some information fallacies**

**Directions for the following four sets of informal fallacies**

**A. For each of the following sets of informal fallacies, please do the following:**

i. Read the argument.
ii. Identify the conclusion.
iii. Determine how the arguer attempts to reach the conclusion (premises).
iv. Put on your logic skeptic hat and consider possible problems in this line of reasoning. Do your best to articulate why this reasoning is flawed using your own words and language.
v. Do this for each problem.

**B. Once you've given your first thoughts on each of the examples from the set, then:**

i. Read the set of definitions.
ii. Determine which fallacy definition seems to match up with your first impressions of the arguments. There is one example of each of the fallacy definitions provided per set.

**C. Now try to do a write-up reply for the argument.**

Address the following aspects for your **write-up replies** to informal fallacy identification:
*Which fallacy was committed by whom when they did what and why is that problematic?*

- Consider answering each question below to formulate your answer.
  - Who commits the fallacy?
  - Which fallacy is it?
  - What is the definition of that fallacy?
  - How does it happen in the example?
  - Why is this a problem? Why is this faulty reasoning? What would be a better approach or what information could make the argument stronger?
  - Be specific in your explanations.
  - Remember to focus on the example as it is. Try not to bring in veer from the information provided and instead analyze what the arguer said in the specific case.

**D. Compare and revise.**

Once you've tried your write-up replies, read the sample write-up replies to see how it compares to your first attempt. Revise as needed.

## Informal Fallacies—Set One

1. You must realize that a democratic society is by far the best thing for you. As the commander in this situation, you must understand that any opposition to the transition to democratic rule will be dealt with by the 130,000 coalition forces in your nation.

2. Mark says to his teacher: I had a tooth extracted yesterday and my hamster has been feeling under the weather. Thus, the test should be graded on a curve.

3. Anonymous editorial submission: We must support the U. S. Patriot Act. Our nation must stand as a unified whole against the tyranny of terror. We, brothers and sisters in justice, will overcome this adversity and, ultimately, be a stronger nation.

4. Molly says to her friend: College freshmen have always been subject to hazing, so there obviously can't be anything wrong with it.

5. Blog post from NightKing42: 85% of Game of Thrones fans think that Ned Stark should have lived. From this we can see that George R.R. Martin chose poorly and should have let Ned live—that many fans can't be wrong.

**Definitions: Set One**

**Appeal to force (ad baculum):** This fallacy can occur when the arguer attempts to convince others to perform some action or believe a conclusion by **threatening** them with something unwelcome, **instead of providing relevant evidence** for the principle or idea that the action is right.

**Appeal to pity (ad misericordium):** This fallacy can occur when the arguer attempts to convince others to perform some action or believe a conclusion by appealing to one's **sense of pity**, sympathy, or empathy, **instead of providing relevant evidence** or support for the conclusion or action.

**Ad populum: emotion:** This fallacy can occur when someone uses an **emotive appeal** instead to convince their audience instead of providing relevant evidence or support for the conclusion or action. Ad Populum fallacies may be considered fallacies of relevance. These kinds of fallacies rely on an audience accepting a conclusion based solely on emotive appeals (such as nationalism, elitism, etc.) to persuade an audience to accept a conclusion.

**Appeal to tradition:** This fallacy can occur when the speaker uses the **longevity or repetition** of some idea or practice to conclude that it should continue or that it ought to be the case, without providing other reasons.

**Ad populum: bandwagon:** This fallacy can occur when someone uses a **majority appeal** as the sole or main reason for their conclusion. Ad Populum fallacies may be considered fallacies of relevance. These kinds of fallacies rely on an audience accepting a conclusion relying on the incorrect assumption that majority or popularity equates to the best or correct conclusion.

## Sample Write-Up Replies: Set One

### Appeal to Force

The commander commits the appeal to force fallacy when he attempts to convince the people of Iraq that they should not oppose the transition to democratic rule by threatening people will be 'dealt with', rather than giving relevant reasons for the idea that a democratic society is by far the best thing for their nation, such as supplying data or rationale for the change.

### Appeal to Pity

Mark commits an appeal to pity fallacy when he attempts to convince the instructor that the test should be graded on a curve due to his tooth extraction and ill hamster, rather than giving relevant evidence that the test should be graded on a curve.

### Ad populum: emotion

Anonymous commits the appeal to emotion fallacy when she urges U. S. citizens to support the U. S. Patriot Act by appealing to the citizens' sense of patriotism, rather than giving relevant evidence that the Patriot Act should be supported.

### Appeal to tradition

Molly commits the appeal to tradition fallacy when the only reason she gives to support the moral acceptability of hazing is that it has always been done; no reasons relevant to morality are given.

### ad populum: Bandwagon

NightKing42 commits the fallacy of *ad populum bandwagon* when he tries to argue that "George R.R. Martin chose poorly and should have let Ned live" based solely on the claim that "85% of Game of Thrones fans think that Ned Stark should have lived". Despite the fact that we don't know where that data came from and we don't know if it is reliable, the ad populum bandwagon happens here by relying on the alleged majority of fans holding a sentiment as support for the conclusion when no relevant reasons are given; just because 85% of fans think so doesn't make it the right decision.

## Further Practice: Set One

- Consider answering each question below to formulate your answer.
  - Who commits the fallacy?
  - Which fallacy is it?
  - What is the definition of that fallacy?
  - How does it happen in the example?
  - Why is this a problem? Why is this faulty reasoning? What would be a better approach or what information could make the argument stronger?
  - Be specific in your explanations.
  - Remember to focus on the example as it is. Try not to bring in veer from the information provided and instead analyze what the arguer said in the specific case.

1.A legal marriage has always been between man and a woman, so that is the way it should stay.

2.The war in Iraq is unjustified. Over 75% of Americans believe that there is no point to us occupying the country.

3.Surely architect Norris is not responsible for the collapse of the new office building. Norris has had nothing but trouble lately. His wife left him for Vegas with all his retirement savings.

4.Do you not hear your dead parents crying out, "Have mercy upon us? We are in sore pain and you can set us free for mere pittance. We have borne you, we have trained you and educated you, we have left you all our property and you are so hard-hearted and cruel, that you leave us to roast in the flames when you could so easily release us." (from a sermon by John Terzel, selling indulgences in Germany in 1517).

**Informal Fallacies: Set Two**

1. **Sam:** We have got to prepare our homes for disaster!
**Zed:** Why? What's going on?
**Sam:** I read in the National Inquirer that aliens from Venus are on their way to invade Earth…even as we speak!

2. **A father says to his college attending daughter:** "Of course your English professors want to cut military spending and put it towards education. Who doesn't want a pay raise?"

3. **Donnie:** Don't bother listening to anything he has to say about health care reform. I mean, really; he's clearly a socialist.

4. **Sunny says to her friend Moe:** I can't believe you are going to stop supporting the circus just because some protesters told you about the mistreatment of the animals involved. They obviously don't care about the facts they are pushing on you, I mean, some of them were wearing leather shoes! How hypocritical is that?"

5. **Dave:** Vegetarians claim that omitting animals from your diet is healthy, but you know who else thought that? Hitler! I'm sure they can't have a good argument with company like that.

6. **Brad:** You really can't believe anything the media says; they've been corrupt since television news coverage started and the things they say about me just can't be true.

## Definitions: Set Two

**Appeal to inappropriate authority (ad vericundium):** This fallacy can occur when someone relies on a **questionable, unqualified, or unreliable source** as the sole or main support for the claim. Sources may be questionable if they are known to be, or suspected of, lacking expertise in that area.

**Ad hominem, circumstantial:** This fallacy can occur when the speaker **rejects** someone's argument by attacking the person/arguer by pointing out some **circumstance surrounding the person** to reject the argument instead of examining the argument itself.

**Ad hominem, abusive:** This fallacy can occur when the speaker **rejects** someone's argument by attacking the person/arguer with **name-calling or insults** instead of examining the argument itself.

**Ad hominem, tu quoque:** This fallacy can occur when the speaker **rejects** someone's argument by attacking the person/arguer by pointing out that the person's **actions are in conflict with the person's claim** to reject the argument instead of examining the argument itself.

**Ad hominem, guilt by association:** This fallacy can occur when the speaker **rejects** someone's argument by attacking the person/arguer by pointing out that the **person is associated with** some (typically undesirable) person, group, system, or idea to reject the argument instead of examining the argument itself.

**Genetic fallacy:** This fallacy can occur when the speaker **rejects** a position solely due to someone's or **something's history, origin, or source** rather than its current meaning or context.

## Sample Write-Up Replies: Set Two

### Appeal to Inappropriate Authority

Sam commits the fallacy of appeal to inappropriate authority when she tries to persuade Zed that "aliens from Venus are planning to invade Earth" simply because The National Inquirer said it was true. However, The National Inquirer is *not* an appropriate authority. The National Inquirer may be an expert at gossip and rumors, but is not a qualified authority on the truth of interplanetary communication/invasions.

### ad hominem circumstantial

"Dad, you are not even listening to her reasons for wanting to rearrange the government's allotment of money from military to education. You assume that just because she happens to be a college professor that her argument in support of education spending is invalid. There are good reasons for supporting this, such as I can get a quality education with smaller class sizes and one-on-one attention from my professors if there is more money available to hire more teachers."

### ad hominem abusive

Donnie commits the ad hominem abusive fallacy when he dismisses the other's argument by calling him a socialist as an insult rather than examining the argument itself for weaknesses.

### ad hominem tu quoque

Moe's reply to Sunny: You shouldn't reject the protesters' argument that the circus is harmful to animals without examining the argument itself. You dismissed it right away by claiming that the protesters harm animals themselves by wearing leather shoes and thus we shouldn't listen to their claim. But they may still have a good argument with strong reasons. Even if they harm animals too, that doesn't mean they can't give a good argument for *not* doing it. They have convinced me with their reasons for the conclusion, not necessarily their personal actions.

### ad hominem guilt by association

Dave uses the claim that Hitler was a vegetarian to conclude that arguments by vegetarians for vegetarianism are weak. The arguer does so by using the negativity associated with Hitler's choices to dismiss an argument for vegetarianism without looking at an argument itself.

**Genetic fallacy**

Brad commits the genetic fallacy by dismissing *anything the media says* based on the claim that televisions news coverage has a history of corruption. Regardless of the actual truth of this claim, the argument relies on the history of news coverage rather than the current context of various forms of media news coverage.

**Further Practice: Set Two**

- Consider answering each question below to formulate your answer.
  - Who commits the fallacy?
  - Which fallacy is it?
  - What is the definition of that fallacy?
  - How does it happen in the example?
  - Why is this a problem? Why is this faulty reasoning? What would be a better approach or what information could make the argument stronger?
  - Be specific in your explanations.
  - Remember to focus on the example as it is. Try not to bring in veer from the information provided and instead analyze what the arguer said in the specific case.

1.Your position that environmental issues should be more important to this administration is laughable considering I saw you throwing a cigarette butt out of your car window on your way down here.

2.In his essay History of the American Civil War, Jeffry Noland argues that the war had little to do with slavery. However, as a historian from Alabama, Noland could not possibly present an accurate account. Therefore, his arguments should be discounted.

3. Cindy: "Candidate Kerry's position on education is untenable."
Carol: "How can you say that?"
Cindy: "The guy is a self-absorbed, cruel joke of a human being."

4.Your recommendations on Iraqi policy are inconsequential. You are, after all an American and only Iraqi's should have a say in their form of government.

5.My high school art teacher says that the war will only hurt people and cost the government a lot of money, so we should not support the war.

6.Lester Brown, universally respected author of the yearly State of the World report, has said that the destruction of tropical rainforests is one of the ten most serious worldwide problems. Thus, it must be the case that this is indeed a very serious problem.

## Informal Fallacies–Set Three (Causation and Generalizations)

*Note:* The first three problems of this set of arguments contain **mistakes** regarding **cause and effect** relationships**.** Knowing these are causation fallacies, the next step is to articulate the specific kind **errors in causal reasoning** the arguments contains. The rest involve other problems.

1. **Greg:** What a shame that Bernie Sanders ran for President. His running is the only reason Trump won.

2. **Eric:** As soon as they paved more parking lots, it caused more students to drive to campus.

3. **Scott:** Women who have had more than two abortions are more likely to have cervical cancer. Therefore, having more than two abortions causes cervical cancer.

4. **Luke:** There is no way I am letting you out of the house wearing that skirt young lady. The next thing you know, you'll fetch yourself some bass player from some band and he'll leave you as soon as the test comes back positive! Are you ready to be pregnant? Is that what you want for yourself? Because I'll tell you what, young lady, I'm not ready to be a Grandpa!

5. **Darwin**: "Did you read the opinion page in the Collegian yesterday? Every single position was coming from a liberal point of view. There's just no place here for a conservative like me!"
**Paul**: "Well, what are you going to do, write a letter to the editor?"
**Darwin**: "No, I'm transferring to CU. Last time I was on Pearl Street I heard a guy talking about his new Hummer and griping about how much he was paying in taxes. That's my kind of place!"

6. **Darren:** They had no right to take Jones' gun away! Americans have the right to bear arms, after all. Sure he went insane, but Jones is an American. It's just not right.

## Definitions: Set Three

**False cause, causal oversimplification:**

This fallacy can occur when the speaker asserts that one cause is **the *only*** cause for a given effect, when in fact it is **actually one of many causes** in a causal relationship.

**False cause, confusion of cause and effect:**

Assuming that one event is the cause of another, when in fact the causal relationship is the other way around (**the effect is mistaken for the cause** in a causal relationship).

**False cause, post/cum hoc ergo propter hoc:**

This fallacy can occur when the speaker incorrectly assumes a causal relationship merely because **one event precedes the other** (one happens *after* another) or **two event happen at the same time** (one happens *with* another), when in fact there is **no causal relation**.

**Slippery slope:**

Arguing that some proposed action or event is just **the first of a series of actions or events** that will lead to some disastrous or fantastic consequence, without evidence that the series of events would follow; there is **a missing link** in the chain. Consider: Does the first step start the alleged chain of events, or is there something missing?

**Hasty Generalization/Composition:**

This fallacy can occur when the arguer draws a conclusion that **creates a general rule**, based on *too few* specific or *exceptional* cases. This can also occur by inappropriately attributing a characteristic of the components or individual **parts to the whole** thing or to the composite.

**Accident/Sweeping Generalization/Division:**

This fallacy can occur from drawing a conclusion by applying a general rule to a specific case that is an **exception to the rule or should be an exceptional case.** This can also occur by inappropriately attributing a characteristic of some **whole thing to the parts** of that thing.

## Sample Write-Up Replies: Set Three

**False cause: Causal oversimplification**

Greg commits the fallacy of false cause, causal oversimplification, when he identifies Sanders' run for president as the sole cause of Trump's being president. This could be one of many causes for Trump's election, as there were many other contributing factors, such as the public's familiarity with Trump, the majority desire for a non-Politian to be a Politian, and a following of the common trend of parties taking turns in office.

**False Cause: Confusion of cause and effect**

Eric mistakenly assumed that the increase in parking space *caused* more students to drive to campus. In fact, it was probably the other way around. The increase in student driver population probably caused the school to develop more parking areas.

**False cause: post hoc ergo propter hoc or cum hoc ergo propter hoc**

Scott commits a false cause *post hoc* fallacy when he claims that abortions cause cervical cancer. In reality, there is *no* causal connection between having an abortion and getting cancer. While the correlation may be true (higher cervical cancer rates correlated with those who have had more than two abortions), the causal link is missing. The unstated correlation may be with the higher likelihood of unprotected sex which can lead to HPV which is a leading cause of cervical cancer—the number of abortions could actually be another result of proclivity for having unprotected sex, but not a cause of cancer.

**Slippery Slope**

Luke commits a slippery slope fallacy when he argues to his daughter that her going out in a certain skirt will lead to him being a Grandpa, without giving any evidence that the series of events will occur. Probably it is unlikely that a cylindrical piece of fabric will lead to pregnancy.

**Hasty Generalization/Composition**

Darwin commits the hasty generalization fallacy by using the fact that he heard one guy on Pearl Street share certain sentiments and read one column in the opinion section of the Collegian that conflicted with his views to conclude that CU will have more like-minded individuals than CSU. The hasty generalization fallacy happens when someone uses one or a couple examples of something to make a claim that all cases are that way; in this case, he uses too few cases (two examples) to make his conclusion. Just hearing one guy in Boulder with a similar view is an insufficient sample to make that assumption about the entire population of CU. After all, that guy might not even be a CU student. Also, finding one opinion column from a liberal perspective isn't enough to say the people of the whole town share that perspective. Darwin jumps to his conclusion without enough examples to solidify his claim. This line of faulty reasoning is not okay because it can lead to the spread of false ideas and it could adversely affect the actions of someone who accepts it.

**Accident/Sweeping Generalization/Division**

Darren commits the fallacy of accident when he tries to apply the general rule that Americans have the right to bear arms, to the specific case, that this insane American, Jones, has the right to bear arms, without recognizing that Jones should be an exception to the general rule because we may have to give up some of our rights when we may endanger others.

## Further Practice: Set Three

- Consider answering each question below to formulate your answer.
  - Who commits the fallacy?
  - Which fallacy is it?
  - What is the definition of that fallacy?
  - How does it happen in the example?
  - Why is this a problem? Why is this faulty reasoning? What would be a better approach or what information could make the argument stronger?
  - Be specific in your explanations.
  - Remember to focus on the example as it is. Try not to bring in veer from the information provided and instead analyze what the arguer said in the specific case.

1.Joe: See? I told you. It's Thanksgiving and sure enough, there is a football game on television. Every time Thanksgiving season rolls around, football games are broadcast on television. Obviously Thanksgiving season causes football games to be played and broadcast.

2.Mark says, “The shades of paint you’re using are beautiful, so the painting will be as well.”

3.Darren says, “The United States is the most powerful nation on earth, so each American must be extremely powerful.”

4.Norma: I went to that restaurant once and had a terrible entrée. From this experience I conclude that nothing at that restaurant is any good.

5. “It’s amazing how quickly the crazy came out. Reminds me of when Oklahoma got rid of car inspections, claiming it would just allow people to keep more of their money. No one would drive terrible cars, surely! The day after the law went live, an unbelievable number of junkers hit the road.” –Trisha S., facebook post, November 15, 2016

6. “City officials asked ‘Wouldn’t it be great if people didn’t drive their cars so much…?’ Not content with just wishing it were so, they started implementing regulations to make driving inconvenient. One of the ways they did this was by banning drive-thru restaurants in growing areas of town via the Land Use Code. You can see the ban yourself by driving down Harmony east of College. You’ll see plenty of huge grocery stores, strip malls, normal restaurants, banks and gas stations, but no restaurants with drive-thrus…Drive-thrus were just their first target. Maybe next they’ll ban pizza delivery. Or allow only one-car garages on new houses. Or refuse to widen congested streets in order to frustrate drivers onto their bikes. Don’t underestimate the laws that can be enacted to force you to conform to an activist’s Utopian view of the future,” --David Wheat, Fort Collins, CO, opinion page, The Coloradoan, March 23, 2004, page A4.

7. People are driving their cars like maniacs tonight and there is a full moon. Obviously the full moon causes people drive carelessly.

8.Each piece of my desk weighs less than a pound and I can certainly lift a pound. So, I should have no problem lifting the whole desk.

9.The verdict rendered by the jury was reasonable and just. Thus, Robert Paulson, a member of the jury, is a reasonable and just man.

## Informal Fallacies: Set Four

1. Alyson says to Padraig, "Show me proof! I want proof that there are no unicorns! What? You have none? Then they exist, I tell you. They EXIST! Ha-ha-hahahaha!"

2. Sarah: "Yeah, you showed up for each logic class and studied all the time, and turned in all the homework, but I still got a better grade than you did!"
Jareth: "What are you talking about, I got an 'A' and you got a 'C-'!"
Sarah: "Exactly! No grade is better than an 'A', but a 'C-' is better than no grade. So a 'C-' is better than an 'A'!"

3. "Once again, another discussion about climate change without addressing the animal agriculture's effects on it. Why are fossil fuels our only concern? Our meat and dairy consumption is inhumane and a lot more destructive than our dependency on fossil fuels." – Antonio L.'s facebook post, March 2, 2017

4. Andrea: "Mom, either you let me go to the NSYNC concert or I will die!"

## Definitions: Set Four

### Appeal to Ignorance (ad ignorantiam)

This fallacy can occur from using a **lack of evidence** or proof *against* the claim as the sole line of reasoning for a claim. Can also be reversed: using a lack of evidence *for* a claim to conclude it must not be the case.

### Equivocation

This fallacy can occur by allowing a key word or phrase in an argument to **change meanings** while treating it as though it retained its meaning to reach an ungrounded conclusion.

### Straw Man

The *straw man* fallacy occurs when a speaker tries to construct an argument that is **similar** sounding to an opponent's, but they make it weak argument, in part to show how easy it is to **destroy it.**

### False Dilemma/False Dichotomy

This fallacy can occur from claiming there are only two possible options when in fact there are **more than two**.

## Sample Write-Up Replies: Set Four

### Appeal to Ignorance

Alyson commits the appeal to ignorance fallacy when she concludes that **unicorns *do* exist** based solely on a **lack of proof that they *don't*** exist; using a lack of evidence as the sole support for the contrary is problematic and textbook *ad ignoratiam*. She could have provided research and studies to show the likelihood that they could exist rather than reasoning fallaciously by attempting to shift the burden of proof. Relying on the absence of evidence *as* evidence is problematic because it unjustly shifts the burden of proof to the opposing perspective; also, it undermines our responsibility to seek the truth through research and investigation.

### Equivocation

Sarah equivocates on the term 'no grade' while trying to convince Jareth that she got a better grade than he did. In the first sense she intends it to mean 'none of any possible grade' and in the second, a 'zero grade'.

### Straw Man

Antonio commits the strawman fallacy when he represents an argument about climate change as disregarding animal agriculture's contributions to the problem. The full argument is not examined and, in part, Antonio tries to make the argument seem weak by pointing to a parallel argument that may be less widely accepted.

### False Dilemma/False Dichotomy

Andrea, you are committing the false dilemma fallacy when you assume there are only two options in this situation: death or NSYNC. In reality, there are other options, such as, you can just go cry and get over it.

## Further Practice: Set Four

- Consider answering each question below to formulate your answer.
  - Who commits the fallacy?
  - Which fallacy is it?
  - What is the definition of that fallacy?
  - How does it happen in the example?
  - Why is this a problem? Why is this faulty reasoning? What would be a better approach or what information could make the argument stronger?
  - Be specific in your explanations.
  - Remember to focus on the example as it is. Try not to bring in veer from the information provided and instead analyze what the arguer said in the specific case.

1.Bob: No one has ever proved that there is a God, so obviously God does not exist.

2.Derik: All the experts and scientists have never been able to prove that ghosts don't exist, so ghosts must be real

3. "Kind of misleading since Hilary is the one that said blacks are super predators and need to be made to hell. And the grand Dragon for the KKK is her mentor. This page is stupid. I do not see these races of people this way. Hope Trump wins. If anything, this video is racist to Trump supporters." Brittany M.'s facebook post August 26, 2016

4.We are told that prostitution is a growing problem, but that isn't the half of it! At least half of the men and women in the country today are prostitutes. They sell their bodies or their minds in jobs that are personally meaningless and socially destructive.

5.We can either stop allowing more people into this country or we can sit by and watch as we lose all of our jobs to foreign workers. We could all lose our jobs if we don't stop immigration.

6.I can't believe you kept Michael Vick on your fantasy football team; I thought you cared about animal welfare.

7. No one has ever proven that taking vitamins actually improves a person's health. Therefore, we can conclude that vitamins are simply a waste of money.

**Fun with politics!** Can you spot the informal fallacies from recent political figures? There may be more than one in each example, or maybe none at all!

1. "To just be grossly generalistic, you can put half of Trump supporters into what I call the basket of deplorables. Right? Racist, sexist, homophobic, xenophobic, Islamaphobic, you name it." –Hilary Clinton

2. In response to the statement in #1, Mike Pence said, "The truth of the matter is that the men and women who support Donald Trump's campaign are hard-working Americans, farmers, coal miners, teachers, veterans, members of our law enforcement community, members of every class of this country, who know that we can make America great again….they are not a basket of anything. They are Americans and they deserve your respect."

3. "This election is about beating back bigotry and hate. Whether it's 10% or 50%, Donald Trump and his supporters have elevated it. If you're not a bigot, her comments shouldn't offend you." --Bakari Sellers, a Clinton surrogate and CNN contributor

4. Clinton suggested that Trump supporters are either "people who are looking for change in any form because of economic anxiety" or deplorables. –CNN, September 9, 2016

5. "I said, 'Mitt cannot run. He choked like a dog.' …So now as retribution, [Romney says], 'Donald Trump shouldn't run. Bababa.' And he walks like a penguin on to the stage! You ever see this? Like a penguin! But it's all right. Who knows." –Donald Trump, May 25, 2016

**Quick Checklist for Informal Fallacies**

When trying to detect the best fitting fallacy, ask yourself the following questions for that fallacy. If you answer 'no' or it doesn't apply, consider trying another answer.

- **False cause:** Is there a stated causal relationship in the argument?
- **Hasty generalization/Composition:** Do they reason one case to all cases/the trait of one part to the whole?
- **Slippery slope fallacy:** Do they use a list of things, a chain of events, as reason for their conclusion? Is there a disconnection (a missing step) between the first step and the final result?
- **ad verecundiam:** Do they use a source's agreement as the sole reason for their conclusion? Is that source a 'good source' (i.e., reliable, credible, and relevant)?
- **ad hominem:** has someone else's argument been rejected by attacking that *person* rather than the *argument?*
- **ad ignorantiam:** Do they say there is a lack of proof or evidence?
- **Accident/Sweeping generalization/Division:** Do they reason a general rule to an exception/the trait of the whole to a part?
- **Appeal to tradition:** is the sole reason for their claim or conclusion simply the time or repetition of that thing? Is longevity the only reason given?
- **False dilemma/false dichotomy:** is there a disjunction stated in the argument?
- **ad baculum, ad misericordiam, or ad populum:** Do they use one of these emotive appeals? Is that they only reason given or used as the foundation of their argument?
- **Straw man:** has the author attacked an argument by overstating, exaggerating, or over-simplifying the argument of another?
- **Equivocation:** has a word changed meaning throughout the argument?

**Fallacy review problems: Even more informal fallacies**

Determine which fallacy most accurately describes the line of reasoning used in these examples. You can use any of the fallacies from our text. Do a write-up reply to articulate your understanding. Remember, you can argue that the line of reasoning is legitimate and no fallacy has been committed. In that case, write “no fallacy” and offer support.

1. A few minutes after Gov. Schwarzenegger gave his speech, a devastating earth quake struck southern Alaska. For the safety of other Alaskans, we must convince the governor not to make any more speeches.

2. Look at what happened as soon as Obama became president: our nation was in greater financial ruin than it had been since the Great Depression.

3. No one has ever been able to prove the existence of ESP, so we must conclude that ESP is only a myth.

4.Rudolf Hoss, commandant of the Auschwitz concentration camp, confessed to having exterminated one million people, most of whom were Jews, in the Auschwitz gas chamber. We can reasonably conclude that Hoss was either insane or a person with little moral concern.

5. I can break a single small stick in half, so I can break a whole bundle of them in half as well.

6. Ray Charles thought that Van Gogh was the best painter, so he must have been talented.

7. Sure you are driving an ambulance on the way to the same accident as I am, but you’re still getting a ticket; rules are rules and when you see lights and sirens behind you, the law requires you to pull to the side of the road.

8. You really shouldn’t listen to what Officer Dunkin has to say about raising tax dollars to support increase wages for public service workers. He obviously thinks we should have to pay more him more and he surely can’t have enough good reasons to convince me!

9. We can’t afford to give any more funding to welfare assistance programs. Those people already get all the help they need from us. They practically eat better than my family! Before you know it, hardworking people like me will quit their jobs just so they can live the easy life too. They will start popping out babies left and right so they can make a killing off their new additions. If we keep giving those beggars money, then the whole economy will go to the dumps.

10. Kobe Bryant is good basketball player, and basketball players are people, so he must be a good person.

11. I gave you my reason for doing it, but as usual you won't listen to reason. Your ignorance leads you to continue to fight me.

12. Seaman Helm was employed by the Navy, and everyone knows the Navy branch of the military receives the most money, so Seaman Helm must have made a lot of money.

13. I *cannot* break this entire bunch of sticks, so I won't be able to break any of them.

14.Surely you welcome the opportunity to join our protective organization, see? Think of all the money you will lose if you don't join our group; I'd hate to see you faced with broken windows, overturned trucks, and damaged merchandise.

15.You accuse my company of being one of the city's worst water polluters and you think we should change our ways, but your company is responsible for much more pollution than we are. After all, you own the Paper Mill who is known for discharging tons of chemical residues into the river every day.

16. If we stop allowing prayer in public schools, soon the whole nation will be filled with criminals and heathens. We all know that those who don't pray lose sight of God and when you lose sight of God you being to have sinful thoughts. Once this happens, it is only a matter of time until people start acting on those sinful thoughts. We have got to save this country while there is still hope for a peaceful, God-loving nation!

17. "Who did you pass on the road," the King went on, holding out his hand to the Messenger for some hay. "Nobody," said the Messenger. "Quite right," said the King, "this lady saw him too. So of course Nobody walks slower than you." "I do my best," the Messenger said in a sullen tone. "I'm sure nobody walks much faster than I do!" "He can't do that," said the King, "or else he'd have been here first!"--Lewis Carroll's Through the Looking Glass, excerpted from Morris Engel's With Good Reason: An introduction to informal fallacies

18.Ladies and gentlemen, today the lines of battle have been drawn. We are the true party of the American people! We embody the values that all real Americans hold sacred! We cherish and protect our founding fathers' vision that gave birth to the Constitution! We stand for decency and righteousness; for self-determination and the liberty to conduct our affairs as each of us freely chooses! In the coming election, with your help, victory will be ours.

19.World-famous paleontologist Stephen Jay Gould says that the dinosaurs were killed by a large asteroid that collided with Earth. Furthermore, many scientists agree with Gould. So, an asteroid probably did kill the dinosaurs.

20. Did you hear that three local teenagers were arrested last night on charges of drug possession? Every teenager should undergo drug testing since they're obviously all junkies.

21. The Bronco's lost the last game because it was snowing.

22. "ABC News' Sunlen Miller reports: It's turned into an unofficial ritual and, perhaps, superstition of Sen. Barack Obama, D-Ill.: playing basketball on Election Day. He played basketball the day of the Iowa caucus, and South Carolina primary, and won both contests. He did not play the day of the New Hampshire primary, and Nevada caucus, and lost. He recently said on "60 Minutes" that playing basketball is an Election Day "rule" now. At College Park, Md., home of the Maryland Terrapins, Obama almost caught basketball fever a day too early, as Tuesday is Election Day in Maryland, Virginia, and D.C."

23. "If same-sex marriage becomes legal and right, other groups will want that same right. Polygamists already are on the move to do the same. Heterosexuals and gays both! Three guys or so and women married to each other. After that, those who keep animals as a sexual preference will want to marry their dog, horse, and so on. The ACLU, Hollywood and some liberal judges have kicked God out of the schools and the Pledge of Allegiance. The media reports kids engaging in oral sex in the back of classrooms and on a school bus. That should be a concern for parents, or is it?

Entertainment is out of control. Michael Jackson's crotch-clutching has infected the girl entertainers to do the same in their routines. It is on TV for our youngsters to see. Some liberals state that the above activities make America 'progressive'. More like decay! Decay is a 'progressive' action, and if not treated and stopped, things can collapse and fall apart,"
--D.J.Flock, Fort Collins, CO, letters to the editor, The Coloradoan, Tuesday March 23, 2004, page A4.

**Homework: Informal Fallacies and Inductive Reasoning** **NAME: _______________**

Directions:
1)Read the following passage. Identify **informal fallacies** committed by the author.
2)Identify the sentence in which you found the fallacy; you may highlight/underline and number each of the four sentences to identify them.
3) **For each of the four places you've identified,** address the following aspects in a short paragraph write-up:
Address the following aspects for your write-up replies to informal fallacy identification:

- Which fallacy was committed by whom when they did what and why is that problematic? Consider answering each question below to formulate your answer.
    - Who commits the fallacy?
    - Which fallacy is it?
    - What is the definition of that fallacy?
    - How does it happen in the example?
    - Why is this a problem? Why is this faulty reasoning?
  - Be specific in your explanations.
  - Remember to focus on the example as it is. Try not to bring in veer from the information provided and instead analyze what the arguer said in the specific case.

The feminist argument that pornography is harmful has no merit and should not be discussed in college courses. I read "Playboy" magazine, and I don't see how it could be harmful. Feminists might criticize me for looking at porn, but they shouldn't talk; they obviously look at it, too, or they couldn't criticize it. Many important people, including the Presidents, writers, and entertainers who have been interviewed by the magazine and the women, who pose in it, apparently agree. Scientific studies so far have not proved that pornography is harmful, so it must not be harmful. Besides, to be harmful, pornography would either have to harm the men who read it or the women who pose in it and since they both choose these activities, they must not be harmful. Feminists should take a lesson from my parents—they don't like loud music and won't have it in their house, but they don't go around saying it's harmful to everyone or trying to prevent others from listening to it. Ever since feminists began attacking our popular culture, the moral foundation of our society has been weakened; the divorce rate, for example, continues to rise. If feminists would just cease their hysterical opposition to sex, perhaps relationships in our society would improve. If feminists insist, instead, on banning porn, men will have no freedom and no pleasure left, and large numbers of women will be jobless and will have to work as prostitutes to support themselves. In light of these consequences, feminists shouldn't be surprised if their protests are met with violence. Truly, the feminists' argument is baseless.

**Identifying and evaluating inductive analogies**
**Example:** Let me tell you why you should not vote for Obama. I hate to start by stating the obvious, but come on: the guy is clearly a socialist. The USSR was socialist. Look what happened to them. I don't want that to happen to our country, do you? As if that weren't a glaring enough problem, he is also an out of touch elitist; he went to an Ivy League school, and we know how those rich, over-educated people can be. Do we really want someone who can't relate to the needs of the people running this country? I hate to bring it up, but have you ever noticed how closely the name 'Obama' sounds like 'Osama'? Not to mention they were both Muslim. I don't think that is just a coincidence. He too will probably go on to destroy as much good as he can. My advice: unless you want to lose most of your amendment rights, don't vote for Obama.

**Find one analogy within the argument and** identify the components.

**Underline the conclusion of an analogy in the paragraph above.**

Basis for comparison term/the item they know about
(X):___________________________

Term being compared/the item they are making an assumption about
(Y):_______________________________

Similarities between X and Y (p, q, r) (known about both, explicitly stated or implicitly contained; id two or more):

_________________________________________________________________________________

_________________________________________________________________________________

Assumed characteristic/the assumption being made about Y that is known about X
(A): ______________________________________________________________________

**Evaluate the inductive argument from the paragraph above.**
State the <u>**overall**</u> **strength of the argument** using the 1-10 scale. ______

In few complete sentences, support your rating **of the overall argument** by discussing of at least one of the ways we learned in class (using your background information, informal fallacy identification, finding strength or weakness in the analogy (i.e., truth, relevance, number, etc.)), and in general consider how strongly their premises support the main conclusion.

**Responding to arguments:**
The tools we have used so far to determine whether an argument is valid or invalid are clear and concise. However, these may not be the best tool when dealing with people who have not had the privilege of taking a logic course. In an attempt to educate them on the invalidity of their arguments, we might find ourselves at a loss frantically drawing a Venn diagram or calling them out on an illicit major fallacy. Here, what may be useful is a practical approach to demonstrating an invalid argument structure outside of the technical terminology and procedure. On the other hand, we might come face to face with an unsound valid argument (a valid structure containing at least one false premise). We might have the urge to call the arguer out and question the premises, but if we can demonstrate that the argument is unsound without logical jargon, they may reconsider their line of reasoning.

In this section, there are two kinds of procedures available, both of which are often called 'counter examples'. Essentially, we can respond to invalid arguments through counter example by logical analogy and we can respond to valid unsound arguments through counter example by contradiction. Other textbooks or professors may use different verbiage for these procedures.

**Counter examples: Using *logical analogies* to demonstrate invalid argument structure**
To show that an argument is invalid beyond a reasonable person's doubt and without using technical terminology, we need an example that fits *the same argument form* as an invalid one. Remember that validity is about structure, not necessarily about actual truth-value. However, since in a valid structure it is the case that 'if the premises are true, then there is no way for the conclusion to be false', and if we find *one* case where the premises are *indeed* true and the conclusion is *indeed* false in the same form of someone's argument, then we have proven that the argument is invalid by way of counter example through logical analogy.

**Example one:**

Some former hippies are not upstanding citizens.
No upstanding citizens are government officials.
∴Some government officials are former hippies.

This argument is in the form OEI-4. This commits a fallacy so we know the form of the argument itself is an invalid form. **What fallacy is committed?**

To construct a logical analogy, we can fill in the terms to show it is clearly invalid. We tell the arguer, "Hey, so-and-so. That would be like arguing that '(logical analogy here)', which is clearly invalid."

Look at that same example but with blanks instead of words. **Find words to substitute that will make the premises true and the conclusion false.**

Some (f)__________________________ are not (u)_________________________.(true)
No (u)__________________________ are (g)_________________________.(true)
∴Some (g)_________________________ are (f)_________________________.(false)

Sometimes changing only one term can do this, and sometimes it is easier to change all three. It may take a few tries to find terms that work well. When we have an argument in non-standard form, place the counter example in the same structure the original argument was in to emphasize their mistake in reasoning.

**Potential counter for example one:**
Some (f)coffee mugs are not (u)dogs. (true)
No (u)dogs are (g)government officials (true)
∴ Some (g)government officials are (f)coffee mugs.(false)

**Example two:**
Some people are not criminals, but all people are fallible beings, so some criminals are not fallible beings.

**Is this argument valid or invalid? How do you know that?** Be sure to check for validity first since creating a logical analogy to demonstrate invalidity for a valid argument is impossible.

**Potential counter explanation for example two:**
"Look, joker. Your argument is invalid due to the illicit major fallacy. However, since you haven't taken logic, you probably don't know what that means. Let me illustrate with a logical analogy. You said that some people are not criminals and all people are fallible beings to conclude that some criminals are not fallible beings but that would be like arguing that 'Some people are not criminals, but all people are **humans**, so some criminals are not **humans**.' Hopefully you can see that way you attempted to reach your conclusion does not hold and your argument is invalid."

**Practice Problems: Logical analogies**
Translate into categorical format. Test for validity. If invalid, note the reason why and construct a counter example by logical analogy for the argument form.

1. All canned meats are scary things and Some Vienna sausages are scary things. It follows that some canned meats are Vienna sausages.

2.All movies you like are horror films and *Saw XI* is a horror film, so *Saw XI* is a movie you like.

3. All Philosophy courses are intellectually stimulating, therefore this course must be a Philosophy course since it is intellectually stimulating.

4. Only things capable of meaningful speech can think. Humans must be capable of thought since they can speak.

5. It is obvious that we will never find any illegal immigrants that are worth having in this country. Why you might ask? Well, every hard working American citizen *is* someone who is worth having in this country and we won't find an illegal immigrant who fits that criterion.

6. Using social media is a way of communicating with peers and public. Anytime we use Facebook, for instance, we open ourselves up to criticism. So when we communicate with people we may or may not know, we are subject to the criticisms that may follow.

**Counter examples: Using *contradictions* to falsify premises of valid arguments**

If an argument is valid, then if the premises are true, the conclusion must be true. This means that if you disagree with the conclusion of a valid argument, you need to either disprove it to show it to be false, or disprove one of the premises in order to show that the conclusion *may* be false. If the conclusion of a valid argument is false, so must be one of its premises. This being the case, there will be a false premise to a valid argument whether the premise is possibly false or known to be false. The only absolutely certain way to disprove a proposition is to provide its contradiction as true. *Disagree with the conclusion of the valid argument? Provide, as true, the contradiction of one of the premises.*

**Contradictions**

To formally contradict a categorical proposition, change both the quality and quantity. The two claims necessarily have opposite truth-values and their Venn diagrams would not both be able to be the case at one time.

**Contradictions:** always necessarily have opposite truth-values

- Some tax forms are not forms available at IRS.GOV website.
- All tax forms are forms available at IRS.GOV website.

- Some fish found living in lakes in Minnesota are salt water sea bass.
- No fish found living in lakes in Minnesota are salt water sea bass.

- All logic students are future LSAT test takers.
- Some logic students are not future LSAT test takers.

- No logic students are criminal justice majors.
- Some logic students are criminal justice majors.

**Give it a try! Contradict the following statements.**

1.No secret agents are people who should be trusted.

______________________________________________________________________

2. Some David Lynch films are films that should be understood in a literal sense.

______________________________________________________________________

3. Some logic classes are boring classes.

______________________________________________________________________

4. All decaffeinated coffee beverages are pointless drinks.

_____________________________________________________________________

Now consider the following example.

**Original argument:**
Academic endeavors, like attending Logic class, are just frivolous wastes of time, so coming to Logic class is just a frolicsome time-killer.

**Standard form translation:**

All academic endeavors are frivolous wastes of time/frolicsome time-killers.
<u>All times people attend Logic class are academic endeavors.</u>
∴ All times people attend logic class are frivolous wastes of time/frolicsome time-killers.

Whoa! Hold the phone. The cynic above just concluded that attending Logic class is a waste of time. I'm sure you're fuming about this conclusion, but what can we do about it? The argument is valid after all. It's a Barbara AAA-1. Are we stuck accepting this depressing conclusion?

No, we're not. Recall that the second stage of analysis for valid arguments is debating soundness. Also recall that the only time we can have a false conclusion in a valid argument is when we also find at least one of the premises also being false. We can argue that this argument, though valid in structure, is unsound and contains at least one false premise. To do so formally, we'll contradict a premise *and* provide an example to support our claim.

For example, let's look at the second premise 'All academic endeavors are frivolous wastes of time/frolicsome time-killers.' Is this true? Aren't there *at least some* things we do in academia that aren't silly, unimportant tasks? If so, this might be the premise to attack.

- **Formal contradiction:** Some academic endeavors are not frivolous wastes of time.

- **Example:** Academic endeavors lead to earning degrees, promotions in career fields, and improved understanding of complex issues that impact our daily lives. They presumably include doctoral work and scientific research which many would argue is not a waste of time and not easy.

I've demonstrated that the major premise is false by giving an example of the contradiction to the original claim, allowing for this valid argument to be unsound.

Another example:

**Mark says, "Ugh. You're taking a Logic class? That must be so boring for you since everyone knows all Logic classes are super dull."**

**Alyson replies, "What?! That's nonsense. You claim that all Logic classes are dull but that's not true. Some Logic classes are *not* dull. I mean, my Logic class this semester is super engaging and exciting, not dull at all! Maybe you wouldn't make these faulty unsound arguments if you'd take a Logic class yourself, dummy."**

Here, even though Mark's argument is valid (as shown translated and in standard form below), it could still be unsound as demonstrated in Alyson's reply illustrating a false premise. Finding a possibly false premises in the valid argument allows for a possibly false conclusion, too (perhaps *none* of the classes you are taking are boring, for example).

| | |
|---|---|
| All Logic classes are super dull | All Logic classes are dull/boring classes |
| You're taking a Logic class | Some classes you are taking are Logic classes |
| That must be so boring for you | Some classes you are taking are dull/boring classes |

Valid, no fallacies; possibly unsound, major premise could be false

**Practice problems: contradicting premises of valid arguments**

Directions: For each of the following, provide an ordinary language proposition that contradicts one of its premises and translate it into standard form in order to make the contradiction clear.

1. All military acts are terrorist acts.
All U.S. operations in Iraq are military acts.
∴ All U.S. operations in Iraq are terrorist acts.

**Formal contradiction (of a premise):**
**Example:**

2. All patriots are troop supporters.
No protesters are troop supporters.
∴ No protesters are patriots.

**Formal contradiction (of a premise):**
**Example:**

3. No pot smokers are people who contribute to society.
All Republicans are people who contribute to society.
∴ No Republicans are pot smokers.

**Formal contradiction (of a premise):**
**Example:**

4. All nerds are Doctor Who fans.
All super smart people are nerds.
∴ All super smart people are Doctor Who fans.

**Formal contradiction (of a premise):**
**Example:**

**Practice: Counter examples**

Directions: For each problem, read the argument. Rewrite the argument into a standard form categorical syllogism. Determine if the argument is valid or invalid using either the rule method or the Venn diagram method. If the argument is invalid, provide a counter example by logical analogy to demonstrate your findings. If the argument is valid, provide a counter example by contradicting one of its premises and give an example to support your claim. Please use complete sentences.

1.Every inside trader is subject to prosecution so all executives with privileged information are inside traders, because everyone who has that information is subject to prosecution.

2.Because every valid argument is a syllogism in the form AII-3, it follows that all syllogisms with two true premises are syllogisms in the form AII-3 because every syllogisms with two true premises are valid arguments.

3.No syllogisms with two universal premises are syllogisms with one true premise and one false premise. This is because there aren't any valid syllogisms with that situation. In addition, all syllogisms with two universal premises are valid syllogisms.

4. "Logic is a matter of profound human importance precisely because it is empirically founded and experimentally applied." John Dewey, *Reconstruction in Philosophy*

**Answers to select problems (Analogies)**

1.X=blue cheese; Y=gorgonzola; pqr=fermented, soft, cheese, pungent; A=like it
Conclusion: You'll probably like gorgonzola.

2.X=riding a bike; Y=walking a tight-rope; pqr=balance and coordination; A=ability to do it
Conclusion: If you can ride a bike, you'll probably be able to walk a tight-rope.

3.X=playing Blackjack; Y=playing poker; pqr=Nick, gambling, card games; A=being good at it
Conclusion: Nick will probably be a great poker player.

4.X= graphic design class; Y= Art History class; pqr=classes, arts; A=enjoy it/love it
Conclusion: You're going to love Art History class.

5.X=last two books; Y=next book; pqr=books, same author, series; A=enjoy it
Conclusion: Julia will probably enjoy the next Harry Potter book.

6.X= two books; Y=movie adaptation; pqr=Palahniuk, story lines, concepts; A=enjoy it
Conclusion: I will probably like the movie adaptations of said Chuck Palahniuk books.

7.X=movie; Y=books; pqr=story, concept; A=drawn-out, dry, and boring
Conclusion: Sarah will probably find the book versions of the Lord of the Rings trilogy drawn-out, dry, and boring.

8.X=wasp poison; Y=ant killer; pqr=bugs, small, weak; A= destruction
Conclusion: I can use this wasp poison to kill ants.

9. X=house plants; Y=pets; pqr=need care, need attention, require assistance, dependent; A=inability to care for/kill
Conclusion: Alyson would not be able to care for pets.

10.X=rivers; Y=oceans; pqr=water, swimming; A=refuse to swim in
Conclusion: She won't swim in the ocean.

11. Conclusion: Texting while riding a bike is just as dangerous as doing so while driving.
X: texting while driving Y: texting while biking A: dangerous activity
pqr: distracting to the operator, can't look at their surroundings, no hands

12. Conclusion: If it is illegal to text and drive, then it should be illegal to text and bike.
X: texting while driving Y: texting while biking A: illegal activity
pqr: just as likely cause injury, same traffic rules apply to bicyclists

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