Ira A. Fulton Schools of Engineering
Arizona State University

Engineering | School of Computing, Informatics, and Decision Systems Engineering

Course Syllabus - Spring A 2020

Mobile Computing (CSE 535)

Course Description

The goal of this course is to provide an in-depth understanding of the fundamental concepts and challenges in the area of mobile computing and study the existing and proposed solutions for these challenges from both a research and development perspective. Several topics, including mobile app development, wireless communication, mobile technology management, mobility tracking, context awareness, and programming applications on mobile systems, will be covered in this course. Course work will involve programming assignments, discussions, quizzes, and a project.

Specific topics covered include:

- Mobile programming
- Internet of Things (IoT)
- Edge and cloud computing
- Mobile networking
- Mobile information access
- Adaptive applications enabled by machine learning and AI
- Energy-aware systems
- Location-aware computing
- Mobile security and privacy

Learning Outcomes

Learners completing this course will be able to:

- Design a context-aware application.
- Identify the advantages of using context in applications.
- Explore the challenges arising due to changes in the environment in which computation is performed.
- Identify relevant environment changes and analyze their causes, such as mobility, availability of data, and resource constraints.

- Define smartness and identify salient features that distinguish smart applications from traditional ones in the context of smart city, smart grid, smart transportation, smart mobile applications, and autonomous systems, such as autonomous cars.
- Describe key features of Internet of Things (IoT) and design a distributed smart application using IoT.
- Define cloud computing, crowdsourcing, volunteer computing, and other novel variants of pervasive computing.
- Analyze nonfunctional requirements of smart mobile applications, such as safety security sustainability.
- Apply popular tools, such as machine learning, security protocols, AI, and software testing, to validate safety, security, and sustainability of smart mobile applications.
- Acquire programming skills on popular mobile platforms, such as Android.
- Develop, end-to-end, a sensor-enabled smart autonomous practical application.

Estimated Workload/ Time Commitment Per Week

Average of 15-20 hours per week

Required Prior Knowledge and Skills

Foundational concepts of:

- Networking
- Operating Systems
- Security
- Probability and Statistics
- Algorithms
- Programming (language such as Python or MATLAB)

Technology Requirements

Hardware

- Memory: At least 2GB RAM (4GB RAM recommended)
- Processor: At least 1GHz (2GHz or more recommended)
- Operating system: Windows 7 or higher / OS X v10.7 or higher

Software and Other

- Android Studio Integrated Development Environment (IDE) with the software development kit (SDK) bundle (check the System Requirements for Android Studio)
- Utilize either MatLab or Python for the programming assignments

Textbook and Readings

There is no required textbook for this course. Required course readings from the ASU IEEE Xplore research database will be provided within each week these are assigned.

Course Content

Instruction

Video Lectures
Other Videos
Readings
Live Sessions (office hours, webinars, etc.)

Assessments

Knowledge Checks (auto-graded, ungraded)
Practice and Graded Quizzes (auto-graded)
Assignments (auto-graded and/or instructor-graded)
Final Exam (proctored, auto-graded)
Team Project (auto-graded and/or instructor-graded)

Details of the main instructional and assessment elements in this course:

Lecture Videos: In each module, the concepts you need to know will be presented through a collection of short video lectures. You may stream these videos for playback within the browser by clicking on their titles or download the videos. You may also download the lecture slides that go along with the videos utilizing PowerPoint presentations, but lecture slides are not able to be provided for videos utilizing a lightboard.

Knowledge Checks: Designed to support your learning, knowledge checks are short ungraded quizzes to test your knowledge of the concepts presented in the lecture videos. You may take your time, review your notes, and learn at your own pace because knowledge checks are untimed. You may retake knowledge checks as often as you would like at any point in the course. You are encouraged to read the feedback, review your answer choices, and compare them to the correct answers. With the feedback as your guide, you may use knowledge checks as opportunities to study for other assessments and tasks in the course.

Discussion Prompts: Discussion prompts are present each week in the course. Although the course team is engaged in these discussions, the forums are spaces to clarify, support, and enrich student-to-student communication and learning.

Practice Quizzes: Each week, you are presented with one practice quiz, intended for you to assess your understanding of the topics. The practice quizzes will help prepare you for the graded quizzes and the final exam. You will be allowed unlimited attempts for each practice quiz. Each attempt may present a different selection of questions to you. There is no time limit on how long you take to complete each attempt of the quiz. These quizzes do not contribute toward your final grade in the class.

Graded Quizzes: Each week, you are presented with one graded quiz. You will be allowed one attempt for each graded quiz. To ensure academic integrity and graduate-level rigor, please be advised that, *unless otherwise noted*, there is a time limit to complete graded quizzes and tests and it may be different per assessment or course. Once you open a graded quiz or test, the timer will start and you are to complete the assessment in a single session. Resets will not be granted. In addition, questions and correct answers will not be disclosed for graded quizzes due to academic integrity purposes. Additional details regarding graded quizzes will be provided in the course. *For those of you who have taken other courses in the MCS program, this may be different than your previous learning experiences.*

Assignments: This course includes two (2) individual assignments. The assignments are provided to students in the first week of the course, so you can review what is expected and design your own learning schedules to complete the assignments on time. At the beginning of specific weeks when assignments are due, the assignments will be re-introduced and any additional materials will be provided. A submission area is provided at the end of these weeks.

Proctored Exams: You will have one (1) proctored exam, the final exam. ProctorU is an online proctoring service that allows students to take exams online while ensuring the integrity of the exam for the institution. Additional information and instructions are provided in the *Welcome and Start Here* section of the course. You *must* setup your proctoring 72 hours prior to taking your exams, so complete this early. Questions and correct answers will not be disclosed for the final exam due to academic integrity purposes.

Team Project: This course includes one (1) team project. The project is provided to students in the first week of the course, so you can review what is expected and design your own learning schedules to complete the project on time. At the beginning of the specific week when the project is due, the project will be re-introduced and any additional materials will be provided. A submission area is provided at the end of this week.

Please note that due to an increase in cohort sizes within the MCS program, automated team assignments are used to help course staff efficiently create teams for projects. We encourage

you to take this as an opportunity to collaborate with and learn from previous and new classmates.

Course Grade Breakdown

Course Work	Quantity	Percentage of Grade
Graded Quizzes	6	15%
Assignments	2	25% (12.5% each)
Team Project*	1	30%
Final Exam (proctored)	1	30%

*The team project includes 4 project milestones.

Grade Scale

You must earn a cumulative grade of 70% to earn a “C” in this course. Grades in this course will include pluses (+) and minuses (-).

A+	≥ 97%	**C+**	≥ 77% and < 80%
A	≥ 93% and < 97%	**C**	≥ 73% and < 77%
A-	≥ 90% and < 93%	**C-**	≥ 70% and < 73%
B+	≥ 87% and < 90%	**D**	≥ 60% and < 70%
B	≥ 83% and < 87%	**E**	< 60%
B-	≥ 80% and < 83%		

Course Schedule

Week/Unit	Begin Date	End Date
Week 1: Mobile Computing System Models	1/13	1/19
Week 2: Context-Aware Computing	1/20	1/26
Week 3: Mobile Programming	1/27	2/2
Week 4: Mobile Security	2/3	2/9
Week 5: Tackling Mobility for Communication	2/10	2/16
Week 6: Power and Energy	2/17	2/23
Week 7: Internet of Things (IoT)	2/24	3/1
Final Exam	2/28	3/1
Week 8: Course Wrap-Up	3/2	3/4

**Grades are due March 6, 2020. (Please see the ASU Academic Calendar for additional information.)*

Live Events - Weekly
Live Events are a valuable part of the learning experience because students can meet with the course instructor and fellow classmates to learn more about course topics and discuss assignments. If you are able to attend these Live Events, you are strongly encouraged to do so. Each live event will be recorded and embedded into the course as supplemental material.

The schedule for Live Events will be posted at the start of the course.

Virtual Office Hours - Weekly
Virtual Office Hours offer a chance for students to get their questions answered from the course instructor and/or teaching assistants. These sessions focus on providing students with the opportunity to ask in-depth questions and to explore points of confusion related to the course content: clarifications, reteaching, assessment review, etc. The Virtual Office Hours are **not** intended to address program or course design feedback, and teaching assistants do not have the authority to weigh in or make decisions regarding those items. Feedback of that nature is best addressed through the following communication channel: mcsonline@asu.edu.

Feel free to drop-in at any point during the time allotted with your questions as there will be no preset agenda during the Virtual Office Hours. These sessions will **not** be embedded into the course as supplemental material.

The schedule for Virtual Office Hours will be posted at the start of the course.

Assignment Deadlines

Unless otherwise noted, all graded work is to be submitted by 11:59 PM MST on the day they are due. Assignment due dates are noted in Coursera and in the course outline below. Graded work submitted after the scheduled due date and time will have a late penalty of 10% per day. Weekly graded quizzes and any project or assignment milestones are due at the end of each week. **Except for Week 8, course weeks will run Monday through Sunday.**

Course Outline with Assignments

Week 1/Unit 1: Mobile Computing System Models

Lesson 1: Welcome and Start Here
Lesson 2: Mobile Computing Models 1, 2, 3, 4, 5
Lesson 3: Adaptation and Smartness in Mobile Computing

Assignments

- ❏ Knowledge Checks
- ❏ Practice Quiz
- ❏ Graded Quiz
- ❏ Assignment 1 Introduction (Due by 2/9 at 11:59 PM MST)
- ❏ Assignment 2 Introduction (Due by 3/1 at 11:59 PM MST)
- ❏ Team Course Project Introduction (Part 1 due by 2/9 at 11:59 PM MST, Part 2 due by 3/1 at 11:59 PM MST)

Week 2/Unit 2: Context-Aware Computing

Lesson 1: Context Models and Context-Aware Applications
Lesson 2: BraiNet – A Framework for Cognitive Mobile Computing
Lesson 3: Mobility Models
Lesson 4: Machine Learning for Context Models

Assignments

- ❏ Knowledge Checks

- ❏ Practice Quiz
- ❏ Graded Quiz

Week 3/Unit 3: Mobile Programming

Lesson 1: Android Programming
Lesson 2: Android Multithreading
Lesson 3: Graphics Processing Unit (GPU) Programming

Assignments

- ❏ Knowledge Checks
- ❏ Team Course Project Milestone 1: Teammate Review Submission (Due by 2/2 at 11:59 PM MST)

Week 4/Unit 4: Mobile Security

Lesson 1: Mobile Banking Apps, Medical Control Apps and Safety Security Inter-relation
Lesson 2: Traditional Security Protocols
Lesson 3: Recent Trends in Mobile Security

Assignments

- ❏ Knowledge Checks
- ❏ Practice Quiz
- ❏ Graded Quiz
- ❏ Assignment 1 Submission (Due by 2/9 at 11:59 PM MST)
- ❏ Team Course Project Milestone 2: Part 1 Submission (Due by 2/9 at 11:59 PM MST)

Week 5/Unit 5: Tackling Mobility for Communication

Lesson 1: Location Management
Lesson 2: Mobile Internet Protocol (IP)

Assignments

- ❏ Knowledge Checks
- ❏ Practice Quiz
- ❏ Graded Quiz
- ❏ Team Course Project Milestone 3: Teammate Review Submission (Due by 2/16 at 11:59 PM MST)

Week 6/Unit 6: Power and Energy

Lesson 1: Difference Between Power and Energy
Lesson 2: Challenges of Measuring Power and Energy Consumptions of Mobile Applications

Lesson 3: Compare Different Application Execution Mechanisms with Respect to Power and Energy

Assignments

- ❏ Knowledge Checks
- ❏ Practice Quiz
- ❏ Graded Quiz

Week 7/Unit 7: Internet of Things (IoT)

Lesson 1: Cyber Physical Systems (CPS) – Properties, Issues and Challenges
Lesson 2: IoT Applications

Assignments

- ❏ Knowledge Checks
- ❏ Practice Quiz
- ❏ Graded Quiz
- ❏ Assignment 2 Submission (Due by 3/1 at 11:59 PM MST)
- ❏ Team Course Project Milestone 4: Part 2 Submission (Due by 3/1 at 11:59 PM MST)

Final Exam - Proctored

- ❏ The final exam will be **available February 28 at 12:01 AM MST through March 1 at 11:59 PM MST**

Week 8/Unit 8: Course Wrap-Up

Lesson 1: Course Wrap-Up

Assignments

- ❏ Optional: Portfolio Inclusion Report for ASU MCS Degree
- ❏ Course Survey

Policies

All ASU and Coursera policies will be enforced during this course. For policy details, please consult the MCS Graduate Handbook 2019 - 2020 and/or the MCS Onboarding Course.

Academic Integrity

Students in this class must adhere to ASU's academic integrity policy, which can be found at https://provost.asu.edu/academic-integrity/policy. Students are responsible for reviewing this

policy and understanding each of the areas in which academic dishonesty can occur. In addition, all engineering students are expected to adhere to both the ASU Academic Integrity Honor Code and the Fulton Schools of Engineering Honor Code. All academic integrity violations will be reported to the Fulton Schools of Engineering Academic Integrity Office (AIO). The AIO maintains records of all violations and has access to academic integrity violations committed in all other ASU colleges/schools.

Creators

Dr. Ayan Banerjee

Dr. Banerjee is an Assistant Research Professor at the School of Computing Informatics and Decision Systems Engineering, Arizona State University. His research interests include pervasive computing in healthcare and analysis, and safety verification of embedded system software. Dr. Banerjee currently focuses on data driven analysis and modeling in many different domains including diet monitoring, gesture recognition, and biological process modeling. He works closely with government agencies, such as the Food and Drug Administration, and medical agencies, such as the Mayo Clinic. Dr. Banerjee is also interested in hybrid system-based modeling and safety verification of closed loop control systems which interact with the physical environment, also known as Cyber-Physical Systems. In addition, his work includes developing management algorithms for sustainable data centers using renewable sources of energy.

Important Note: This syllabus is subject to change.