Mobile Apps/Sensing&learning
CS 5323 001C
Computer Science Department
Fall 2023

SMU®

Instructor Information

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Eric Larson is an Associate Professor in the department of Computer Science in the Bobby B. Lyle School of Engineering, Southern Methodist University. His main research interests are in machine learning, sensing, and signal & image processing for ubiquitous computing applications, in particular, for healthcare and security applications.

Course Details

Meeting Days/Times/Locations:

Start Date	End Date	Location	Meeting Day	Start Time	End Time
08/21/2023	12/04/2023	CARU0379	MW	12:30 PM	01:50 PM

Credit Hours: 3.00
Course Description: Equips students with the practical skills necessary to develop mobile applications that take advantage of the myriad sensing and control capabilities of modern smartphones. Focuses on interfacing with phone hardware, efficient computing on the phone and in the cloud using virtualized servers, and efficient analysis of the peripheral sensor streams of

today's smartphones. Students integrate real-time control and/or automation using a third-party hardware platform to interface with the mobile platform. Prerequisite: CS 1342.

Student Learning Outcomes

Learning Outcomes

This course is constructed to help students design a system capable of working within the constraints of a mobile environment. Students will hone their abilities to design mobile applications that utilize the peripheral sensors on modern smartphones (i.e., camera, accelerometer, microphone, compass, gyroscope, etc.) and utilize control mechanisms on wirelessly connected embedded devices. Finally, students will learn to communicate ideas about these technical areas effectively. Topics covered include:

- Overview of iOS programming
  - Basic iOS interface programming (objective C and swift)
- Hardware interfacing
  - Realtime image processing and tracking
  - Audio, accelerometer, gyroscope, compass
  - Continuous capture and battery life
  - Filtering and analysis of single dimensional data streams
  - Image and video capture
  - Machine learning via Mobile Devices
  - Emerging mobile health practices
  - Hardware Acceleration
- Specialized API Access
  - Core ML
  - Apple Create ML
  - Speech Recognition
  - Hand and Body Pose Estimation
  - Augmented Reality
  - Basic Game Design
- Pitching applications, story and hook

A note on similarity to EE 5/7378: The curriculum for this course has some overlap from EE 5/7378. Both courses cover basics of mobile programming and make use of embedded sensors.

This course, however, focuses less on the networking and location aspects, and instead focuses more on the use of inference and learning. We will also focus on the use of sensing in mobile health technology. In most cases these courses provide complementary material.

Other Course Descriptions

This class will equip students with the practical skills necessary to develop mobile applications that are able to take advantage of the myriad of sensing, machine learning, and control capabilities that modern smartphones offer. The course will focus on interfacing with the sensing hardware of the phone and inferring high level information from the sensors streams. Particular focus will be placed upon efficiently analyzing and controlling hardware peripherals on third party hardware, such as an embedded micro-controller. This third-party hardware platform will interface with the mobile platform and allow students to integrate realtime control/automation with the sensing learned during in the semester. This course will also cover the use of sensing and control in mobile health applications. For example, emerging standards for measuring heart rate and breathing rate from the camera and/or microphone. Additionally, we will focus on actigraphy and activity detection as it applies to wellness sensing.

Assignments will use swift, objective C, C++, and python programming languages, therefore a background in Object-Oriented programming is encouraged. Experience with objective C and swift is encouraged, but not required as a prerequisite. Students will design and construct a final project in groups of 2-3, and will demo their final project at the end of the semester during the final exam time. The course grade will be based upon bi-weekly lab assignments throughout the semester, in class assignments, the final project presentation, and the final project video. Final project presentations will be conducted during finals week. Lecture may also contain guest speakers and student groups giving short demonstrations and/or presentations.

Looking to get a head start in the course? Start coding in Xcode. Watch the free Stanford course on app development in swift. Go over to WWDC, Ray Wenderlich, or NSHipster and get some excellent examples.

Required Texts and Materials

None

Grading Policies/Grading Scale

Students will be evaluated based upon their biweekly lab assignments, their final project demonstration, and their final project report, as follows:

Lab Project Assignments:	60% of grade (5 labs @ 12% each)
Flipped (In Class) Assignments:	20% of grade (4 at 5% each)

Final Project iOS Application: 20% of grade

Grading Rubric

In all assignments specific deliverables are asked and should be completed to the best of your team's ability. Each deliverable will be worth a certain percentage of the grade and you will be graded in terms of how efficient your implementation is, how well you use proper coding styles and interface guidelines (including proper use of model-view-controller), and how comprehensible each element is integrated. Teams should make their application as memory efficient and computationally efficient as possible and use hardware acceleration. Comment code so that it is readable and immediately understandable. The sum total of the these deliverables will be 90% of the points possible for each lab assignment. Teams that complete all the project deliverables satisfactorily should expect a grade of 90%.

The remaining 10% of the points are reserved for truly exceptional work and work that is above and beyond in one or more elements of the application, incorporating elements not discussed in class and having superior performance. These are applications that, while perhaps are not ready to ship on the iTunes app store, are production quality and require minor changes to be ready for consumer use. Suggestions are given for "optional" specifications that could be completed for this 10% credit. Students taking the course at the 7000 level are required to complete these optional suggestions and 7000 students are graded accordingly.

A	A-	B+	B	B-	C+	C	C-	D	F
93.000-100.00	90.000-92.999	87.000-89.999	83.000-86.999	80.000-82.999	77.000-79.999	73.000-76.999	70.000-72.999	60.000-69.999	Else

Assignment Group Descriptions

Equipment. Note that Mac software is needed to finish the assignments. This includes the Xcode development environments, computers running OSX, iPhone 5S smartphones, and developer licenses. A limited number of assignments can be completed if students have access to a computer running OSX only (using the simulator). However, the iPhone simulator will not allow access to many onboard sensors (indeed many times the Phone can function dramatically different from the simulator when accessing real time data).

Lab Assignments (Apps). Every other week lab assignments will be submitted electronically and verified for functionality by the instructor. Lab assignments will take the form of an application that students will need to implement in groups of 2-3. Lab assignments will be turned in as a team and each team member is expected to contribute equally to the development of the app. Late labs will not be accepted.

5000 level versus 7000 level requirements: Students taking this class for 5000 level are required to complete all required specifications for each lab assignment. Students at the 7000 level must complete all optional requirements for the lab assignments. Therefore, it is recommended that all members of a given team are all 5000 level or all 7000 students. Optional items take the form of additional, more advanced specifications for the application.

Flipped Assignments. Periodically, there will be video lectures to watch before class time. After video lectures, we will use class time to complete an assignment. The specifications for the assignment will be given at the start of class and the assignment will then be turned in at the end of class (i.e., a flipped classroom). Students will work in teams and turn in the in-class assignments as a team. Come prepared to work! All team members will need to be present to receive a grade. An absence during an in-class assignment cannot be made up after the in-class assignment.

Final Project iOS Application. Students will also be working on a longer final project that will culminate in a final demonstration. Students will receive guidance on the selection of a final project, but will mostly have creative free reign to develop and evaluate a mobile sensing application. The difficulty of the final project should be on par with about two lab assignments. Final project grades will be adjusted based upon the team member contributions. Justification must be given for all team member contributions.

Final Project Presentation. During final exam time, teams will discuss the specifications of their application and demonstrate the finished application to the class. Teams should give a brief introduction of the design, and then show each design constraint from their proposal. You will answer questions as posed by the instructor and from the class. All team members must answer at least one question, although the team can choose who will answer each question. Approach this as if you were pitching the idea and selling the prototype to potential investors.

The **mother of all demos** (MOD): students will have the option to "opt out" of the final project video in exchange for a more risky "mother of all demos" demonstration. More details are given in the materials tab of this website.

Final Project Video. The Final project video should concisely explain what your product is, what value it has to offer, features, specifications, and have a tagline. Remember that engaging videos go a long way--Kickstarter pages almost always have compelling videos and often mobile based applications require videos to show the working prototypes. *Note: that you are NOT being asked to host the project on KickStarter–only to develop a marketing style ploy.*

Course Policies

Absences

Class attendance is required. Under special circumstances students may watch videos at the instructor's discretion. Zoom: Per University Policy (August 2022), Zoom will no longer be offered in lecture.

Virtual Etiquette

Zoom: Per University Policy (August 2022), Zoom will no longer be offered in lecture.

If you are joining the class via Zoom, please be respectful of the students around you. This is best exemplified through:

1. Muting yourself when not speaking
2. Turning on your video camera if you feel comfortable doing so. Please do turn on your camera if you can because this will help in your paying attention (try not to look at yourself, though, :)
3. Using the chat to ask questions or post links.
4. NOT showing or posting anything that is insensitive or inappropriate (just like being in actual class)
5. Paying attention and participating when asked.
6. Raising your hand might be difficult to see in Zoom, feel free to speak up and interrupt me if you have a burning question. I won't take it as disrespectful.
7. If you have a pet, consider having them wave at the camera (if you own cat, be sure they like you before doing this)

Cheating

Cheating of any kind such as plagiarism or direct copying is strictly prohibited and against the SMU honor code. However, collaboration is strongly encouraged. Most lab assignments can be done as a group and turned in as a group.

https://www.smu.edu/StudentAffairs/OfficeoftheDeanofStudents/StudentConduct/HonorCouncil

Generative AI will be integrated into this course

Assignments in this course have been purposefully designed to integrate Generative AI in support of the learning objectives. In class, we will discuss how Generative AI is used within this discipline, including how to navigate its potential uses and abuses, how and when to attribute sources, and other developing topics.

Title IX and Disability Accommodations

Disability Accommodations

Students who need academic accommodations for a disability must first register with Disability Accommodations & Success Strategies (DASS). Students can call 214-768-1470 or visit smu.edu/DASS to begin the process. Once they are registered and approved, students then submit a DASS Accommodation Letter through the electronic portal, *DASS Link*, and then communicate directly with each of their instructors to make appropriate arrangements. Please note that accommodations are not retroactive, but rather require advance notice in order to implement.

Sexual Harassment

All forms of sexual harassment, including sexual assault, dating violence, domestic violence and stalking, are violations of SMU's Title IX Sexual Harassment Policy and may also violate Texas law. Students who wish to file a complaint or to receive more information about the grievance process may contact Samantha Thomas, SMU's Title IX Coordinator, at accessequity@smu.edu or 214-768-3601. Please note that faculty and staff are mandatory reporters. If students notify faculty or staff of sexual harassment, they must report it to the Title IX Coordinator. For more information about sexual harassment, including resources available to assist students, please visit smu.edu/sexualharassment.

Pregnant and Parenting Students

Under Title IX, students who are pregnant or parenting may request academic adjustments by contacting the Office of Student Advocacy and Support by calling 214-768-4564. Students seeking assistance must schedule an appointment with their professors as early as possible, present a letter from the Office of the Dean of Students, and make appropriate arrangements. Please note that academic adjustments are not retroactive and, when feasible, require advance notice to implement.

Academic Policies

Religious Observance

Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. Click here for a list of holidays.

Medical-Related Absences

To ensure academic continuity and avoid any course penalties, students should follow procedures described by their instructors in order to be provided with appropriate modifications to assignments, deadlines, and exams.

Excused Absences for University Extracurricular Activities

Students participating in an officially sanctioned, scheduled university extracurricular activity should be given the opportunity to make up class assignments or other graded assignments that were missed as a result of their participation. It is the responsibility of the student to make arrangements for make-up work with the instructor prior to any missed scheduled examinations or other missed assignments. (See current Catalog under heading of "Academic Records/Excused Absences.")

Final Exams

Final course examinations shall be given in all courses where appropriate, and some form of final assessment is essential. Final exams and assessments must be administered as specified in the official examination schedule and cannot be administered or due during the last week of classes or during the Reading Period. Syllabi must state clearly the form of the final exam or assessment, and the due date and time must match the official SMU exam schedule. SMU policy states that all exceptions to the examination schedule may be made only upon written recommendation of the chair of the department sponsoring the course and with the concurrence of the dean of that school, who will allow exceptions only in accordance with guidelines from the Office of the Provost.

Academic Dishonesty

Students are expected to embrace and uphold the SMU Honor Code. Violations of the Honor Code will be acted upon in accordance with the policies and procedures outlined in the Mustang Student Handbook.

Student Support Services

Student Academic Success Programs

Students needing assistance with writing assignments for SMU courses may schedule an appointment with the Writing Center through Canvas. Students who would like support for subject-specific tutoring or success strategies should contact SASP, Loyd All Sports Center, Suite 202; 214-768-3648; smu.edu/sasp. Tutor schedules are available at smu.edu/tutorschedule.

Caring Community Connections Program

CCC is a resource for anyone in the SMU community to refer students of concern to the Office of the Dean of Students. The online referral form can be found at smu.edu/deanofstudentsccc. After a referral form is submitted, students will be contacted to discuss the concern, strategize options, and be connected to appropriate resources. Anyone who is unclear about what steps to take if they have concerns about students should contact the Office of the Dean of Students at 214-768-4564.

Mental Health Resources: Counseling Services and Teletherapy

Throughout the academic year, students may encounter different stressors or go through life experiences which impact their mental health and academic performance. Students who are in distress or have concerns about their mental health can schedule a same-day or next-day appointment to speak with a counselor by calling Counseling Services. Counselors are available at any time, day or night for students in crisis at this number: 214-768-2277 (then select option 2) They will be connected with a counselor immediately. Students seeking ongoing counseling should call the same number (214-768-2277, then select option 1) during normal business hours to schedule an initial appointment. SMU Teletherapy provides another free option for on-demand counseling and video appointments with a medical professional.

Campus Carry Law

In accordance with Texas Senate Bill 11, also known as the 'campus carry' law, and following consultation with entire University community, SMU chooses to remain a weapons-free campus. Specifically, SMU prohibits possession of weapons (either openly or in a concealed manner) on campus. For more information, please see: smu.edu/campuscarrylaw.

Course Schedule

See canvas

Canvas Course Schedule

Due Date	Assignment	Type	Points
8/30	Flipped Module One: UI	Assignment	5
9/8	Sink or Swim iOS Interface Building	Assignment	12
9/20	Flipped Module Two: Audio	Assignment	5

Due Date	Assignment	Type	Points
9/29	Audio Filtering, the FFT, and Doppler Shifts	Assignment	12
10/13	Core Motion and SpriteKit	Assignment	12
10/18	Flipped Module Three: OpenCV	Assignment	5
10/27	Core Image and OpenCV	Assignment	12
11/6	Flipped Module Four: ML as a Service	Assignment	5
11/17	Machine Learning as a Service	Assignment	12
11/18	Final Project Proposal	Assignment	0
12/8	Final Project Demonstration, Presentation, and App	Assignment	15
12/8	KickStarter / IndieGoGo Video	Assignment	5
	Github access	Discussion	0
	Looking for a Team?	Discussion	0