

CSE/EE 475 - Embedded Systems Capstone - Fall 2024

EE 542 - Advanced Embedded Systems Design

Instructor

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TAs

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Course Information:

"Lecture" and Presentation Time: 4:30-6:20pm

Location: ARC 160

Lab Time: 4:30-6:20pm

Lab Location: CSE 003E

***Note:** First day of class on 9/26, we will be meeting in ARC 160. See schedule below for location of each session.

Class email: multi_cse475a_au24@uw.edu (mailto:multi_cse475a_au24@uw.edu)

Communication: Please email the instructor and the TAs directly for any questions or use the class mailing list for general questions that you think might benefit others. We won't be using the discussion function in Canvas.

Logistics:

We will be using CSE 003E as our lab space. Please select a bench and use it for the entire quarter. Every team is required to have a weekly meeting with the instructor and TAs, which will occur during the weekly lab time. The goal of those meeting will be to gauge progress, unblock issues, and provide feedback.

Course Description:

CSE/ECE 475 (5): Embedded Systems Capstone is a joint capstone class between CSE and ECE. Unlike your traditional lecture-based CSE/ECE courses, you will be asked to work in groups on a single project that parallels the experience of working for a real company or customer. Students will prototype and build a substantial project that mixes hardware and embedded, software, and communication components. Lectures will be very limited and will be on focused on topics relating to emerging components and platforms, case studies, and other topics of interest to the class. ECE 542 also runs alongside this class as a graduate version and involves the same topics, but will include a bit more advance requirements for the project.

Prerequisites: CSE/ECE 474 or equivalent embedded systems course.

Course Goals:

- To gain appreciation for the interaction between hardware and software in embedded system design.
- To experience the development of a complete product from design to implementation.
- To present design goals and decisions as well as implementation results in both verbal presentation and written documentation.
- To have you work in a larger team than in the past to learn about coordinating such groups.

Texts:

There are no formal text books for this class.

Grading:

Students will be evaluated based on their commitment to the project (50%) and the project outcome (50%). The commitment to the project includes timely weekly project reports, showing effort, and peer evaluations. Project outcome will constitute the quality of your reports, deliverables, and final

demo/presentation. Thus, your grade will reflect the work perceived by the instructor, the TAs, your fellow students (both within and outside your group), and any mentors. Thus, if you are delivering things on time, are a strong participant on the project, and do average quality work you will receive a 3.7. To receive a 3.8+, you will have to demonstrate "distinctions" in your final demo and presentation which could include going above what was asked, implementing a set of amazing features, creating a compelling video, or doing an amazing demo just to name a few. Similarly, you can earn distinctions in your intermediate deliverables as well for stellar work. Because each project is unique, the instructor and TAs will work with you on what could constitute distinctions for your project.

You will be given feedback in the class as to your progress, so you will know where you stand. Please notify the instructor of any team issues early!

Teams:

We will form Groups of 4 based on the survey you fill out during the first week of class. You will be able to make requests for partners (we cannot accommodate all requests, however).

It is recommended that roles be assigned to each team member (group leader, treasurer, schedule manager, etc) so as to split up some of the weekly chores. There will be some presentations and written deliverables throughout the quarter (see Schedule).

Accommodations:

Just a reminder this class is conducted in-person. Students are expected to participate in the in class and lab components to fully benefit from course activities and meet the course's learning objectives. Students should only register for this class if they are able to attend in-person. When absent because of illness or other reasons, it is the responsibility of the student to inform the instructor in advance (or as close to the class period as possible in the case of an unexpected absence). For chronic absences and participation in the group project, the instructor may negotiate an incomplete grade after the 8th week, or recommend the student contact their academic adviser to consider a hardship withdrawal (known as a Registrar Drop).

Student Mental Health and Safety

While this course has high expectations for student work quality, there is enough flexibility built into the class to help balance your class loads. If you need support or are feeling overly stressed, you are welcome to reach out to us at any time. We will do our best to listen and support you, but you should also realize that we are not trained professionals in counseling. The UW Mental Health website (<https://wellbeing.uw.edu/topic/mental-health>) provides a number of options for receiving support, including self-help, workshops, remote therapy, and short-term and long-term counseling. If you are experiencing a crisis situation after hours and cannot wait until the UW Counseling Center is open, please call the Crisis Clinic at (206) 461-3222 or toll-free at 1-866-427-4747. If you are experiencing a life-threatening emergency, dial 911. If you feel unsafe, please contact UW Safe Campus at (206) 523-7233 (SAFE).

Access and Accommodations

Your experience in this class is important to us. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to us at your earliest convenience so we can discuss your needs in this course.

Religious Accommodations

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy:








<https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy> <https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/%20>

Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form:

<https://registrar.washington.edu/students/religious-accommodations-request> <https://registrar.washington.edu/students/religious-accommodations-request/>

Schedule:

T	TH	Location	Topic	Assignments (othe
	9/26	ARC 160	Introduction and organizational meeting [slides] (https://docs.google.com/presentation/d/140xW98DuqaFoGzA8Qu0JA0ITnEZR4jL-MkUUpT0l1gl/edit?usp=sharing .) Project theme: Mobile and Wearable Computing	Fill out [team assign] (https://forms.gle/hkC noon PT)
10/1		ARC 160	Project brainstorming and ideation [slides] (https://docs.google.com/presentation/d/1WSaTKBnZdEeN8vVfSoT83MhyK3jgyP6Z5N3STHrc9-o/edit?usp=sharing .)	Teams should be rec feedback (5 mins pe
	10/3	ARC 160	<i>Tutorial</i> : microcontrollers [slides] (https://docs.google.com/presentation/d/1SNO3EQvzqOo1SOPg8lEXADqhVosdlo-mFn5Aoi6spog/edit#slide=id.g2f9554a1584_0_19 .) [more slides]	[Project website] (https://canvas.uw.ed] ready (email link to

			https://docs.google.com/presentation/d/11f1oFNv2WC9GmHSy6svdX7Ktst7rDQMoxKyrAGNbJeA/edit#slide=id.p]	
10/8		ARC 160	<i>Tutorial:</i> printed circuit boards [slides  https://docs.google.com/presentation/d/11uteyAyVQ_5psx0YRtCdeiSeOrF_9yNWpt1_idfBzS4].]	Optional Altium Tuto https://washington . https://washington.z
	10/10	ARC 160	<i>Tutorial:</i> apps and software backend [slides  https://drive.google.com/file/d/1wcYJ3asjA2JDcNTJJ8IIRkGJUObINQSa/view?usp=sharing].] [code  https://github.com/QiuyueXue/475Demo].]	
10/15		ARC 160	Project proposal	[Project proposals https://canvas.uw.ed] on website (noon P
	10/17	ARC 160	<i>Tutorial:</i> on-device machine learning [slides  https://docs.google.com/presentation/d/1jIGhb8pUIGoUIrz5WKOQdCg2uF6bhqvCK-x6LBkWbL8/edit?usp=sharing].] [code  https://github.com/lichard49/ECE475_on_device_ml_tutorial/tree/main].]	
10/22		CSE 003E	Lab	[PRDs https://canvas.uw.ed] on website (noon P
	10/24	CSE 003E	Lab	
10/29		CSE 003E	Lab	[Rapid prototypes c https://canvas.uw.ed] (noon PT)
	10/31	CSE 003E	Lab	
11/5		ARC 160	Project status presentations	[Project status pres https://canvas.uw.ed]
	11/7	CSE 003E	Lab	[Peer Review 1  (due by noon PT)
11/12		ARC 160	Careers in embedded systems panel discussion	[Draft of Kickstarte https://canvas.uw.ed]
	11/14	CSE 003E	Lab	
11/19		CSE 003E	Lab	
	11/21	CSE 003E	Lab	
11/26		CSE 003E	Lab	
	11/28	N/A	Thanksgiving (no class)	
12/3		CSE 003E	Lab	
	12/5	ARC 160	Final presentation and demos	[Final Demo and Pr https://canvas.uw.ed] in class
12/10		N/A		[Final Report https://canvas.uw.ed], [Final Kickstarter https://canvas.uw.ed], [Peer Review 2  (all due noon PT)

Teams:

Team 1: <https://mforsnes.github.io/EE542-Project/index.html> ⇨ [https://urldefense.com/v3/https://mforsnes.github.io/EE542-Project/index.html_!!K-Hz7m0Vt54!ntbqN4NPa9xKxJwEYWQo6VVRgSbHibrig5_T9XA1nHK3yJXtLUwq8k2M5yD1atYeyZvqVzQlgr4rOS0fg8nn6CWMDxwmSvU\\$](https://urldefense.com/v3/https://mforsnes.github.io/EE542-Project/index.html_!!K-Hz7m0Vt54!ntbqN4NPa9xKxJwEYWQo6VVRgSbHibrig5_T9XA1nHK3yJXtLUwq8k2M5yD1atYeyZvqVzQlgr4rOS0fg8nn6CWMDxwmSvU$)

Team 2: <https://cse475team2blog.wordpress.com/> ⇨ <https://cse475team2blog.wordpress.com/>

Team 3: <https://sites.google.com/uw.edu/team3-ee475capstone/home> ⇨ <https://sites.google.com/uw.edu/team3-ee475capstone/home>

Team 4: <https://475t4.wordpress.com/> ⇨ <https://475t4.wordpress.com/>

Team 5: <https://sites.uw.edu/davide08> (<https://sites.uw.edu/davide08>)

Team 6: <https://www.energwatch.com/> ⇨ <https://www.energwatch.com/>

Team 7: <https://sites.google.com/view/cseece475-group7/home> ⇨ <https://sites.google.com/view/cseece475-group7/home>

Team 8: <https://caitlynrawlings.github.io/EmbeddedSystemsCapstone> ⇨ <https://caitlynrawlings.github.io/EmbeddedSystemsCapstone>

Team 9: <https://carbajalaustin.wixsite.com/team-9-product-devel> ⇨ <https://carbajalaustin.wixsite.com/team-9-product-devel>

Summary of all Assignments:

Project Website:

Every team is required to keep a project website. Teams can use any hosting service they like including using Wordpress. It is up to you on what you are comfortable using. Keep the website simple so it is easy for us to navigate. Make sure to document everything and put it on the website (notes, testing, debugging, pictures, weekly notebook, videos, etc). All of your deliverables will go to your project website and that's where we will be looking for updates and progress.

Weekly Lab Notebooks:

Each team is required to keep a lab notebook on their website. You will be required to update it on a weekly basis (updated by noon every Friday). This should include your designs, notes for that week, your status, your plan for that week, what each team member is doing, etc.

Project Proposal:

After forming your team, you will be required to create a project proposal and put it on your website. You will also be required to present your project idea in class for feedback, which should be a 5 minute presentation (you could just show your website or make slides, it is up to you). Your proposal must include the following details: the problem space and applications (why do we care?), example scenarios, related technology (if applicable), potential design solutions, resources you will need, and what you will try to demo at the end of the class.

Product Requirements Document (PRD):

After firming up the project idea, each team will be required to create a product requirements document (PRD) that details all the various aspects of your project. This includes a one paragraph summary of the project (basically summarize your project proposal), deliverables (what are you going to show at the end), the critical features, any performance metrics, milestones, responsibilities of each team member, materials and outside help needed, budget, risks, and how risks will be addressed. You will be asked to do this very early in the class and then update your PRD throughout the quarter. We will use the RPD to see how your end product matches your PRD, so make sure to keep it up to date. Your PRD should be on your website.

ECE 542 Students: In addition to the above above requirements, you will be required to do a research literature survey and select two research papers that are related to your project and provide a paragraph summary for each of the two papers on how they may influence the design and execution of your project. Add these to your PRD.

Rapid Prototypes:

Rapid prototypes are a way to visualize and convey your concepts without investing large amounts of capital in polished prototypes that are highly likely to change and evolve during the development process. In addition to using higher fidelity prototypes (3d printing, etc), we will ask you use to do rapid prototypes using low fidelity techniques like sketches, slides, paper mockups, foam mockups, etc.

Project Update Presentations:

You will also be asked to do a 10 minute update presentation for the class in the middle of the quarter. In this presentation, you will remind everyone on the goal of your project, describe what you aim to show at the end of the class, current state of the project, biggest remaining challenges, and a high-level overview of your system architecture. If you decide to use slides, please link them from your project website as we will not be able to switch in individual laptops in the interest of time.

Public Kickstarter -style Website

You will be asked to "market" your product by making a [Kickstarter](http://www.kickstarter.com/)  (http://www.kickstarter.com/)-style webpage. You can think of this as a public page you would give potential customers and investors. It should be aesthetically appealing, but yet informative. You should concisely explain what your product is, what value it has to offer, features, specification, and maybe even a tagline. Also remember to include some good pictures and videos go a long way. Kickstarter pages also have very compelling pictures, illustrations, or videos and often hardware projects require working prototypes. You will link this page off of your project website.



Peer reviews

You will be conducting two between and within group peer reviews during the quarter.

Final Demo and Presentation

Each team will have 15 minutes to show off your work (the timing will be strictly enforced). Remember that you want to try to describe and demonstrate all of the functionality of your project. Since you have limited time, I would highly recommend rehearsing your presentation/demo to make it flow as smoothly as possible. I would recommend that you focus on demonstrating what you have done as much as possible. Minimize the amount of slides that are used. You should considering having a teammate quickly present the goals of the project, while your other teammates setup. Have back up videos ready if the demo fails. There might be other visitors there to see what you have done.

Final Technical Report

Your final report should encapsulate the work you did for the entire quarter as a technical design document. The report should be in the [ACM double column format](https://www.acm.org/binaries/content/assets/publications/word_style/interim-template-style/interim-layout.docx)  (https://www.acm.org/binaries/content/assets/publications/word_style/interim-template-style/interim-layout.docx). Here is a [_ \(assignments/cse477_finalreport.doc\) word template](https://canvas.uw.edu/courses/1746613/files/124123098?wrap=1) (https://canvas.uw.edu/courses/1746613/files/124123098?wrap=1) on some of the basic content I expect to see in the final report. The aim of the final report is to provide details on your design decisions, details of the implementation itself, test and evaluation results to prove your design/implementation works (highlight any regulatory considerations), provide schematics and block diagrams to support the discussion, discuss the societal/ethical consideration of the work, and discuss future work and areas that need improvement. You are also welcome to use LaTeX (the template is available on the [ACM website](https://www.acm.org/binaries/content/assets/publications/consolidated-tex-template/acmart-primary.zip)  (https://www.acm.org/binaries/content/assets/publications/consolidated-tex-template/acmart-primary.zip)).

Make sure to proofread your final report. Your report will be evaluated on completeness and on the quality of the content. So make sure to be thorough. Note that just reaching to 4 pages doesn't mean it is a thorough report.

ECE 542 Students: In addition to the 4 pages described above, you will do an additional page (5 pages total) that will include a research related work section that discusses at least 3 papers and possible future research directions based on what you've learned from your project.