CS 695 / SWE 699: Software Engineering for Real-Time Embedded Systems

Spring 2023

Contact Information

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(But feel free to pop in anytime my door is open!)

Course Overview

This is a graduate course in Real-Time Embedded Software Engineering. This course is cross-listed between CS 695 and SWE 699. This course will count as an "advanced" course for the MS CS degree or as a 600-level Software Engineering elective for the MS SWE degree.

The course will predominantly be taught from a hands-on, project-based approach. There will also be a research and presentation component but these will also be focused on practical applications vs. theory.

Learning Objectives

Upon completion of this course, students should have:

- An understanding of the scope and type of real-time and embedded (RTE) software-intensive systems
- A general understanding of the overall software development processes for RTE systems, focusing on an agile framework
- Specific, hands-on knowledge of programming and testing RTE software
- An understanding of real-time operating systems
- Advanced and emerging topics will be explored as time permits. Some examples include the use of RTE systems supporting the Internet of Things or deploying machine learning algorithms on edge devices.

Prerequisites

This course assumes no prior knowledge of real-time or embedded systems. Knowledge of basic programming skills and data structures will be assumed. Programming assignments will be in C.

It is recommended that students have basic knowledge of computer systems/organization (e.g. CS 531) . Software Engineering students should have first completed the SWE foundation courses.

Course Materials

Required Text: Oshana, Robert, and Mark Kraeling. *Software Engineering for Embedded Systems: Methods, Practical Techniques, and Applications*. Saint Louis: Elsevier Science & Technology, 2019. (ISBN: 0128094486). GMU Library Link

Recommended Texts:

Kernighan, Brian W., and Dennis M. Ritchie. *The C Programming Language*. 2nd ed. Englewood Cliffs, N.J: Prentice Hall, 1988. (ISBN : 0131103628) GMU Library Link

Molloy, Derek. *Exploring BeagleBone : Tools and Techniques for Building with Embedded Linux*. Second edition. Indianapolis, IN: Wiley, 2019. GMU Library Link.

McLaughlin, Brian. The BeagleBone Black Primer. Hoboken: Pearson Education, Limited, 2019. GMU Library Link.

Required Hardware:

BeagleBone Black – I recommend the DigiKey or Mouser distributors.
You will also need a starter pack of electronic components to at least include breadboard, buttons, LEDs, jumper wires, and resistors. Something small like this will work and then you can add sensors, etc. as necessary for your term project.

Grading Policy

Quizzes	20%
Projects / Programming Assignments	40%
Presentation / Discussion	20%
Final Exam	20%

Quizzes	Most classes will have a short quiz to reinforce learning
Projects / Programming Assignments	We will have a series of programming assignments designed to give you experience with embedded systems development as well as real-time, concurrent programming. There will also be a larger term project. These can be completed individually or in groups of up to 5 students. You must remain in the same group for the duration of the semester, so pick carefully.
Presentation / Discussion	To broaden our understanding of modern RTE systems, you will research a practical application of RTE software and present to the class with a facilitated discussion. This will be done with your project group (or individually if you've chosen that option).
Final Exam	Comprehensive final exam.

Email policy:

You must use your Mason email account for all email correspondence having anything to do with your work at Mason. Federal laws protecting your privacy rights require that we only communicate student information directly to students –and use of the university email system is our only way to validate your identity. You may forward your campus email elsewhere, but we can respond only to a Mason email account.

Honor Code

You are expected to abide by the University's honor code and the CS Department's Honor Code and Academic Integrity Policies during the semester. This policy is rigorously enforced. All class-related assignments are considered individual efforts unless explicitly expressed otherwise (in writing). Group assignments are to be completed only by that group – no sharing between groups. Exams and quizzes are strictly individual efforts. Using ChatGPT or any other automated or AI-based program to complete assignments is considered cheating in the same way as copying another student's work. Review the university honor code and present any questions regarding the policies to instructor. **Cheating on any assignment will be prosecuted and result in a notification of the Honor Committee as outlined in the GMU Honor Code.**

The material provided in this course is proprietary. Uploading this material anywhere without the express permission of the instructor is strictly prohibited and a violation of the GMU Honor Code.

Disability Accommodations

Students with a learning disability or other condition (documented with GMU Office of Disability Services) that may impact academic performance should speak with me ASAP to discuss accommodations.

Safe Return to Campus

All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage.

Campus Closure or Emergency Class Cancellation / Adjustment Policy

If the campus closes, or if a class meeting needs to be canceled or adjusted due to weather or other concern, students should check Blackboard [or other instruction as appropriate] for updates on how to continue learning and for information about any changes to events or assignments.