San José State University
Computer Engineering Department

CMPE 244: Embedded Software

Section 2, Fall 2023

Course and Contact Information

Instructor:	Harry Li, Ph.D. Professor, Computer Engineering Department, San Jose State University
Office Location:	Engineering Building 267A
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Class Days/Time:	Mondays and Wednesdays, 4:30 pm – 5:45 pm, August 21st – December 6.
Office Hours:	Mondays and Wednesdays, 3:00 pm – 4:00 pm
Classroom:	Engineering Building Room 295
Prerequisites:	CMPE 180A and CMPE 180D, classified standing, or instructor consent. Artificial Intelligence or Computer Engineering or Software Engineering majors only.

Course Description

Experiments dealing with advanced embedded software programming concepts, interfacing techniques, hardware organization, and software development using embedded systems. Individual projects.

Course Format

The class uses the online conferencing system *Zoom* for lecturing, and the online learning management system *Canvas* for disseminating the instructor's announcements, teaching materials, assignments, grading results, as well as collecting students work and conducting exams/presentations. Students must have Internet connectivity with *Zoom* and *Canvas* accessibility. Students should also pay attention to the course instructor's email messages sent to the class through *MySJSU*.

Course Learning Outcomes (CLOs)

Upon successful completion of this course, students will be able to:

1. Understand how an integrated IP design works in an embedded Linux system.
2. Design and debugging an industry grade Linux Kernel Driver.
3. Design an application program to talk to the driver for verification.

Required Text & Readings

Course Materials

Instructor's teaching materials and online resources.
1. Professor's git: https://github.com/hualili/CMPE244
2. Jetson NANO Jetpack download https://developer.nvidia.com/embedded/downloads

Other Equipment / Material

1. Hardware Equipment: You may choose any one of the following options. For detailed selection information, I will cover it in the introduction session of the class. Option 1. Nvidia Jetson NANO Board with minimum 2 GB RAM; or Option 2. Pie 3B+, or Pie 4; Option 3: Nvidia Jetson Tx2 developer kit; or Option 4: LPC1769 CPU Module: https://www.mouser.com/NXP-Semiconductors/Embedded-Solutions/Engineering-Tools/Embedded-Processor-Development-Kits/Development-Boards-Kits-ARM/_/N-cxd2t?P=1z0jm4m&Keyword=LPC1769&FS=True&gclid=Cj0KCQjwqKuKBhCxARIsACf4XuHyN8WfqtQ24WGgtoMdKd6n-kI7c-YNz-r1hTcPt0ErdZN62jrMQmgaAtXZEALw_wcB or Option 5: Samsung ARM11 developer platform.
2. Linux Host Machine (Ubuntu 18.04) .

Course Requirements and Assignments

The course is built upon previous courses in this cohort program; a thorough review of CMPE200, 240, 264 materials is a must. Course works include weekly assignments, two quizzes, and a course project. Assignments, in forms of readings, problem solving, and hands-on design/implementation/verification, are aligned with topics discussed in class. Each assignment should be submitted to *Canvas* by the specified deadline. In general, success in a course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practice. This course, specifically, expects minimum of 6 hours per week to be spent outside of class.

Examination or Evaluation

Students will be evaluated based on their performance on projects/assignments and final examination, which is a culminating activity requiring creative work based on knowledge and techniques learned in this class.

Grading Policy

Grading is based on the following: 1) assignments and projects, 2) midterm and final exam. The distribution is shown below:

Assignments and projects:	30%
Midterm Exam:	30%
Final Exam:	40%
Total:	100%

Grade Determination

Final grades will be assigned based on the scales shown below:

Grade	Percentage
A plus	98 to 100%
A	92 to 97%
A minus	90 to 91%
B plus	87 to 89 %
B	81 to 86%
B minus	79 to 80%
C plus	76 to 78%
C	69 to 75%
C minus	66 to 68%
D	60 to 65%
F	Less than 60%

Classroom Protocol

1. Attend lectures.
2. Submit assignments and project reports on time.
3. Participate Demo, Show-and-tell, presentation in class.

University Policies

Per University Policy S16-9 *(http://www.sjsu.edu/senate/docs/S16-9.pdf)*, relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page (http://www.sjsu.edu/gup/syllabusinfo), which is hosted by the Office of Undergraduate Education. Make sure to visit this page to review and be aware of these university policies and resources.

CMPE 244 Fall 2023 Course Schedule

The schedule (and related contents/assignments) may subject to change with fair notice. Any changes will be announced in due time in class and on the course's Canvas site.

Course Schedule

Week	Date	Topics
1	8/21	Course orientation Introduction to Embedded Software, Selection of Target Development Platform Criteria
2	8/28	Embedded Software Core Concepts: (2.1) CPU architecture
3	9/4	Memory map, peripheral controllers, special purpose registers; CPU datasheet for initialization and configuration Kernel development environment, IDE, jetpack Introduction to Linux Kernel Space and User Space programming
4	9/11	embedded Linux kernel source distribution menuconfig and scripting
5	9/18	Embedded Linux kernel Architecture Development of customer defined driver
6	9/25	Continuation of Linux Kernel Development Development of GPP driver for the target platform
7	10/2	Development of PWM driver for the target platform
8	10/9	Development of PWM driver for the target platform Development of drivers for Industrial IoT applications by establish sensor interface
9	10/16	Development of I2C driver for the target platform
10	10/23	Multi thread for POSIX OS and Linux pthread
11	10/30	synchronization mechanism using Semaphore and Mutexes
12	11/6	synchronization mechanism using Semaphore and Mutexes
13	1113	User space programming and kernel space driver development for optic sensor interface to capture the state information of stepper motor
14	11/20	Project Progress Report and Design Review
	11/27	Project Progress Report and Design Review
15	12/4	Presentation of semester long project
16	Thursday, Dec 14 2:45-5:00 PM	*The schedule of the final exam can be found here: https://www.sjsu.edu/classes/final-exam-schedule/ The schedule is subject to change with fair notice and the notice will be made available to the class via email*