ECE 271 Microcomputer Architecture and Applications

University of Maine

Spring 2017

Course Catalog Description

Basic microprocessor concepts and assembly programming. Topics include number systems, logic and arithmetic, loops and branches, memory addressing, subroutines and stacks, exceptions, system timers, and peripheral I/O. Lec 3. Credits: 3

Prerequisites: ECE 275 Sequential Logic Systems

Course Website:

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza.

Find our class page at: https://piazza.com/maine/spring2017/ece271/home

Instructor

Dr. Yifeng Zhu
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Teaching Assistants

Monday	Kent Seneres	kent.seneres@maine.edu
Tuesday	Nicholas Levesque	nicholas.a.levesque@maine.edu
Wednesday	Nicole Lessard	nicole.jennifer.lessard@maine.edu
Thursday	Spencer Desrochers	spencer.desrochers@maine.edu

Class/Laboratory Schedule (Spring, 14 weeks)

- Lecture: MoWeFr 1:00PM-1:50PM, Nutting Hall 100
- Laboratory: MoTuWeTh 2:00PM - 4:50PM, Kepware Lab

Student Outcome and Performance Indicator

(a) ***An ability to apply knowledge of mathematics, science and engineering***

Solve mathematical and logical problems with binary values as signed and unsigned numbers, understand overflow and carry, understand the representation and arithmetic operations of fixed-point numbers, encoding and decoding assembly program codes to binary machine codes.

(c) ***An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability***

Understand the tradeoff between computation performance and energy consumption; recognize realistic constraints for embedded systems in battery supply, computation and communication limitation; recognize the limitation and potential impact of accuracy.

(e) *An ability to identify, formulate, and solve engineering problems*

Design, debug, and test assembly language codes to solve given engineering problems; use digital oscilloscopes to analyze triggering, clocking, communication protocols, and PWM signals; deploy techniques such as DAC, ADC, and motor control to perform monitoring and control; Utilize functions to simplify a complex task by decomposing it into smaller and simpler tasks; Translating a C code into assembly code, and understand the impact of various translations on computation performance.

(h) *The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context*

Understand the basic concepts and procedures of deploying embedded systems to solve real-word problems, understand the economic importance of software testing, debugging, and verification to create a bug-free application.

(k) *An ability to use the techniques, kills, and modern engineering tools necessary for engineering practice.*

Master the principal of design for test, and always perform robustness testing by using experimental under a variety of inputs and scenarios; use and program modern development boards to gain the start-of-the-art embedded system technologies; use IDE tools to master the skills of software debugging.

Required Textbooks

- *Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language*, Yifeng Zhu, 2nd Edition, ISBN 0982692633, http://www.amazon.com/Embedded-Cortex-M-Microcontrollers-Assembly-Language/dp/0982692633/

Tentative Topics (subject to change)

- Introduction to load/store computation model
- Data representation, carry & overflow
- Memory addressing, endianness, data alignment
- Fixed-point arithmetic implementation
- ARM assembly instructions: arithmetic and logic operations, memory I/Os, and flow control
- Subroutines: three approaches to pass parameters via reference, registers and stack in ARM assembly
- Mixing C and ARM assembly: C codes call assembly codes, and assembly codes call C codes.
- Hardware and software Interrupts, and interrupt service routine
- Interfacing to general-purpose I/Os, programming timer module to perform input capture and output compare
- Understanding and programming PWM output

- Interfacing analog Input and output
- Bus protocols, such as Inter-Integrated Circuit (I^2C)

Tentative Laboratory Assignments (subject to change)

- Lab 1. Interfacing with LED and Pushbutton in C
- Lab 2. LCD Display Driver in C
- Lab 3. Stepper Motor Control in C and assembly (GPIO output)
- Lab 4. Servo Motor Control (PWM)
- Lab 5: System Timer (SysTick)
- Lab 6: External Interrupt (EXTI)
- Lab 7: Timer Input Capture (Ultrasonic Sensor)
- Lab 8: Analog to Digital Converter (ADC)
- Lab 9: Digital to Analog Converter (DAC)
- Lab 10: Music Synthesizing (DAC)
- Lab 11: RGB LED
- Lab 12: Interfacing Gyro Sensor
- Lab 13: FPU
- Lab 14: DSP

Course Grading

Class Quiz and Participation	5%
Mentor Program	5%
Prelim 1	10%
Prelim 2	15%
Final Exam	20%
Laboratory	45%
Total	100%

Examinations

There will be two in-class prelims exam and one final exam. Following is the tentative schedule for the exams.

Prelim 1	Monday, February 27 (Tentative) (close book, close notes)
Prelim 2	Monday, April 3 (Tentative) (close book, close notes)
Final exam	TBD (close book, close notes)

Lab Policy

- The electronic parts of all homework and labs should be submitted to the department gitlab server (https://gitlab.eece.maine.edu/), unless specified otherwise. ***Email attachment cannot be accepted.***
- **All labs are due at the beginning of the next lab session you enrolled.**
- ***Late submission and demonstration are penalized 20% for each late day, including weekends.*** Once solutions are published, late lab work cannot be accepted for credit. In addition, to

accommodate unexpected events, **you have a total of five "free" days of late demonstration and submission without penalty for all labs except the last one**. You cannot use at most three days in the last lab assignment.

- ***In all lab assignments, student must work independently, not in a group team,*** unless it is specified as a group assignment in the lab document. If nothing is specified, you should assume that the lab should be completed independently, without any collaboration with any others.
- All your lab grades are stored in a Google spreadsheet to provide fast feedback.
- The "Quiz and Participation" will be based on your participation level in the class. You are required to attend lectures and lab briefings, deliver an appropriate amount of harassment to the instructor during the lecture. All students are expected to start homework assignments early. A sure way to get a poor evaluation is to put off asking questions about homework or lab until close to the due date.

Exam Policy

- All exams are closed book and closed note.
- No exam makeup is allowed.
- Calculators are neither required nor needed.

Academic Honesty Statement: Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

Students with Disabilities Statement: If you have a disability for which you may be requesting an accommodation, please contact Ann Smith, Director of Disabilities Services, 121 East Annex, 581-2319, as early as possible in the term.

Course Schedule Disclaimer (Disruption Clause): In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

Sexual Violence Policy:
Sexual Discrimination Reporting. The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of **sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination** involving members of the campus, **your teacher is required to report** this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

If you want to talk in confidence to someone about an experience of sexual discrimination, please

contact these resources:

- For *confidential resources on campus*: **Counseling Center: 207-581-1392** or **Cutler Health Center: at 207-581-4000**.
- For *confidential resources off campus*: **Rape Response Services:** 1-800-310-0000 or **Spruce Run**: 1-800-863-9909.
- **Other resources:** The resources listed below can offer support but may have to report the incident to others who can help:
  For *support services on campus*: Office of Sexual Assault & Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911. Or see the OSAVP website for a complete list of services at http://www.umaine.edu/osavp/