CSCE 236: Embedded Systems
Spring 2014

Instructor

Dr. Carrick Detweiler
Assistant Professor
220 Schorr Center
Department of Computer Science and Engineering
University of Nebraska-Lincoln
Lincoln, NE 68508

402-472-2449
carrick _at_ cse.unl.edu

Course Info

Spring 2014
Lecture: MWF 8:30-9:20am in Avery 110
Instructor office hours (220 Schorr):
Wednesday 9:30-10:30am, schedule online (`http://carrick.youcanbook.me/`), and by appointment

Teaching Assistants

Graduate TA: Sreeja Banerjee
Undergraduate TA: Courtney Ingersoll
Undergraduate TA: Paul Kubitschek
TA office Hours:
See Course Website

Course Description

Embedded Systems are everywhere. Every time you look at your watch, answer the phone, take a picture, or turn on the TV you are interacting with an embedded system. Embedded systems are also found in cars, airplanes, and robots. They far outnumber traditional computers (which also contain embedded processors) and it is estimated that there will be thousands of embedded devices per person by 2015 (Lisa Su, CTO Freescale Semiconductor, 2008). Learning to design and program embedded systems is a critical skill that is necessary for many industry and scientific jobs.

In this course you will learn the basics of designing, interfacing, configuring, and programming embedded systems. We will make use of the Arduino platform, which is an inexpensive, popular embedded system used by hobbyists, researchers, and in industry, to implement the techniques learned in class. By the end of the course you will have mastered the basics of embedded system design and programming. This course will help to prepare you for cutting edge careers in industry and research.

Course Website and email

The website for the course is: `http://cse.unl.edu/~carrick/courses/2014/236/`

This syllabus is subject to change, you will find the most up-to-date version of the syllabus on the course website, as well as information on readings, assignments, and projects. Please make sure to check it regularly. In addition to posting information and assignments on the course website, I will send information over email to the address you gave me at the start of the course. I expect that you will check your email on a daily basis. Please make proper arrangements if you will not be able to check your email or if your email address changes.

Prerequisites by Topics

Mastery of: processor organization, instruction set architecture, I/O Interfaces, Boolean algebra, logic equations, binary and hexadecimal number systems, fixed-point arithmetic.
Familiarity with: programming languages, interrupt processing, I/O devices, logic gates, basic floating point arithmetic, memory devices and hierarchies, assembly languages.

Textbooks

This course has a number of recommended textbooks. Most Readings are from the first two, the third is listed here for reference. The fourth is a good reference for general C programming, although there are also numerous resources available online.

Wayne Wolf, **Computers as Components, Second Edition: Principles of Embedded Computing System Design**, 2nd ed. Morgan Kaufmann, 2008.
Available in the book store or purchase online.

David Russell, **Introduction to Embedded Systems**, 2010.
Available for free download when on the UNL campus:
`http://www.morganclaypool.com/doi/pdfplus/10.2200/S00291ED1V01Y201007DCS030`. Good reference for embedded C programming. Do not print out this book, it is less expensive to order a printed copy than to print it yourself.

Edward Lee and Sanjit Seshia, **Introduction to Embedded Systems, A Cyber-Physical Systems Approach**, 2011.
Available as a free download online:
`http://leeseshia.org/` Do not print out this book, it is less expensive to order a printed copy than to print it yourself. There are no specific readings from this book, but it is a good reference for those interested in exploring some subjects further.

Brian W. Kernighan and Dennis M. Ritchie, **C Programming Language (2nd Edition)**, 1988. ISBN: 0131103628
Optional: suggested for those with little prior C programming experience

Course Platform

Each student will be given, and be responsible for, an Arduino embedded system platform and associated hardware. You will be responsible for taking care of these throughout the semester and you may be charged for damage or loss of these.

Topics Covered

Embedded System Organization: Major components in a typical embedded system, operating requirement, modes of operation, hardware/software codesigns, hardware-software trade-offs.
Microcontroller Programming: Basic structures of microcontrollers, basic features, memory interfacing, digital I/O, timers, analog interfaces, interrupt services, programming in high-level languages and assembly languages, basic data types, operators, constructs, data structures, compiler directives, power management.
I/O Interfacing Concepts: Input devices, output devices, memory mapping, bus structures, peripheral and external communication interfaces. Operating System: Design and organization of embedded and real-time operating systems, scheduling, power management, communication, debugging.

Assignments and Grading

Assignments and due dates will be announced in class. Typically, all assignments are due before the beginning of class on the day they are due. Note that many of the assignments require check-off by the instructor or TA *before* the start of class.

Your final grade will be composed of a number of components. These are:

Percentage	Assignment
25%	Homeworks
15%	In-class Labs and Participation
15%	Exam 1
15%	Exam 2
15%	Project 1
15%	Project 2

Homework

There will be a number of homeworks assigned throughout the semester. These will typically have both questions and programming components. Most often these will require demonstrating the final operation to the instructor or TA before the assignment is due during one of their regularly scheduled office hours, so please plan accordingly.

These are **individual** assignments. It is ok to discuss concepts behind the problems in the homeworks with classmates, however, you cannot do them together. If you do discuss problems with classmates or other people, you must acknowledge this on the assignment (this will not lead to any grade reduction). As a metric for what level of discussion is allowed, it is ok to meet and talk over coffee about the assignment. It is not ok to show someone your solution or to work on the details of the problems together. In addition, you should not take notes while discussing the problems. If in doubt, ask the instructor or TA questions about assignments.

Late homeworks will not be accepted.

In Class Labs

There will be a number of small group assignments that will be done during class times. Some labs may have small components that must be performed individually before the start of lab. Groups will be randomly assigned at the start of class. Your group will be graded based on what you are able to successfully accomplish during class. Homework assignments will often build on these mini-labs. If you are not in class or are not properly prepared for the lab, you will receive a zero for that lab.

Projects

There will be two projects in this class that will build on and combine the components you develop in your homeworks. The projects will involve an in-class competition where you compete with your classmates to accomplish a task. In addition, there will be an associated project report. The first project/competition will be due in the middle of the semester. The second project/competition will be due the last week of classes. Additional details will be announced in class.

Absences

Students are encouraged to attend all classes. Absences will likely lead to a reduction in the class participation grade. In addition, missing an in-class lab, exam, or project competition will result in a zero for that assignment and being absent is not an excuse for not turning in an assignment.

In very rare cases the instructor may make an exception to this policy in case of an illness or family emergency if acceptable written evidence is given and you notify me as soon as possible. Even if you are sick or leaving town on short notice you should be able to have a friend notify me that you will be missing class or an assignment.

University Writing Center

The University of Nebraska-Lincoln Writing Center can provide you with meaningful support as you write for this class as well as for every course in which you enroll. Trained peer consultants are available to talk with you as you plan, draft, and revise your writing. Please check the Writing Center website (`http://www.unl.edu/writing/`) for locations, hours, and information about scheduling appointments.

CSE and UNL Policies

The CSE Department has a Student Resource Center in Avery 13A (`http://cse.unl.edu/src`) where you can go for assistance with any of your courses.

All students enrolled in any computer science course is bound by the Computer Science and Engineering academic integrity policy:

`http://cse.unl.edu/ugrad/resources/academic_integrity.php`

You are expected to read, understand, and follow this policy.

For this course, do not plagiarize (writing or code) and make sure to properly cite any sources you use. Any cheating or plagiarism will be reported to the Chair of your department and your Dean, and will result in an F for the course.

The CSE Department has an anonymous suggestion box:

`http://cse.unl.edu/department/suggestion.php`

that you may use to voice your concerns about any problems in the course or department if you do not wish to be identified.

Disabilities

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.