Computer Architecture

CS 220
Fall 2015

Instructor   Tom Kelliher, Ph.D., Associate Professor of Mathematics and Computer Science
Office: Julia Rogers 133
Office hours: MWF 9:00–10:00am, and by appointment.
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Course Textbook and Other Resources:

1. N. Nisan and S. Schocken, *The Elements of Computing Systems: Building a Modern Computer from First Principles*. The MIT Press, 2008. Required; Also used in CS 224.

2. R. Toulson and T. Wilmshurst, *Fast and Effective Embedded Systems Design: Applying the ARM mbed*. Newnes, 2012. Recommended.

3. See the course web site for additional resources: `http://phoenix.goucher.edu/~kelliher/f2015/cs220/` (There is also a link to this site in GoucherLearn.)

Meetings   Julia Rogers 128, MWF 1:30–2:40 pm.
Starting Friday, Oct. 23 we will use JR G01 on Fridays for the hands-on mbed labs using ARM processor development boards and various I/O peripherals.

Description   Organization of contemporary computing systems: instruction set design, arithmetic circuits, control and pipelining, the memory hierarchy, and I/O. Includes topics from the ever-changing state of the art.

Prerequisite   CS 119 with a minimum grade of C–.

Learning Objectives:
At the end of this course students will be able to:

1. Explain the context of the environment in which computing systems are designed and in which they must perform. (This context includes the dimensions of power, performance, and technology.)

2. Differentiate between the components of instruction set design.

3. Distinguish between architectural and organizational features of an implementation.

4. Apply the basic techniques of compilation in translating high level language programs into assembly language programs. Specifically, achieve a deep understanding of the stack model employed by many high level languages.

5. Design datapath and control elements capable of executing a particular instruction set.

6. Categorize the various levels of the memory hierarchy.

7. Use an ARM microcontroller board and I/O peripherals to experiment with interfacing a processor to I/O peripherals.

Schedule   Note that this schedule doesn't show the mbed projects that will begin on Oct. 23.

- Aug. 31, Introduction; one day.
- Sept. 2, Boolean Logic; three days.
- Sept. 11, Boolean Arithmetic; three days.
- Sept. 18, Sequential Logic; four days.
- Sept. 28, Exam I.
- Sept. 30, Machine Language; three days.
- Oct. 7, Computer Architecture; four days.
- Oct. 16, Assembler; four days.
- Nov. 2, Exam II.
- Nov. 4, Virtual Machine I; four days.
- Nov. 18, Virtual Machine II; five days.
- One open day.

Expectations   You are expected to give CS 220 the attention it deserves as a college-level computer science course. In particular, you are expected to:

- Spend an average eight hours per week outside of class working on the course. This includes the entire range of activities from preparing for class, to completing assignments and projects that you weren't able to complete in class, to attending office hours.
- Attend class each time it meets, with all assigned preparation activities completed. During each class meeting, you are expected to pay attention respectfully, work productively, and not interrupt the learning of your classmates.
- Take initiative to seek out help in a combination of forms and channels when needed, and to be honest about when help is needed.

Registering for a four-credit class is a 12-hour-per-week commitment, four hours of which take place during our class meetings. The other eight hours are to be spent in productive, engaged work in individual and group study and in attending office hours.

Grading: **Grade Distribution**

At the conclusion of the semester, your grades will be weighted as detailed below, rounded up, and converted to a letter grade as follows: A = [92–100], A- = [90–92), B+ = [88–90), B = [82–88), B- = [80–82), etc.

Graded Work

1. Projects/Labs — You will work on the Nand2Tetris and mbed projects/labs in groups of two. Your project/lab grades will account for 50% of your final grade.

2. Exams — There will be two semester exams and a comprehensive final exam. All three exams have the same weight. The first semester exam will be on Monday, Sept. 28 and the second exam will be on Monday, Nov. 2. The final exam will be scheduled by SAS. Your exam grades will account for 50% of your final grade.

Late work will not be accepted. Turn in what you have completed to receive partial credit. Each Nand2Tetris project builds upon the previous project, but it is by no means the end of the world if you don't get a particular project working. Requests for due date extensions should be made at least 24 hours prior to the due date. Such requests should include some reflection on what caused you to need an extension as well as what you will do to avoid such causes in the future.

Academic Integrity

Academic dishonesty is detrimental to the integrity of our learning community and will not be tolerated. All of us, including me, are bound by the Academic Honor Code. The College's Academic Honor Code is available at www.goucher.edu/documents/General/AcademicHonorCode.pdf. I expect you to be familiar with its obligations and requirements.

Disabilities
If you have a documented disability you should contact the Academic Center for Excellence (ACE) to arrange for academic accommodations for the course. Carefully follow all of ACE's policies and procedures. Once you have coordinated with ACE, email me to make me aware of your accommodation. I will receive official correspondence from ACE; however, I would also like to receive an email from all students requiring accommodations for the semester. If your accommodation involves taking exams at ACE, it is your responsibility to schedule your exams with ACE. When scheduling exams with ACE, be sure to carbon copy me on any emails with ACE so that I have confirmation that everything is in order. This process is to be repeated for all exams throughout the semester.

Achieving Academic Success

If you are struggling in this or other courses, I strongly encourage you to reach out for help sooner rather than later. Proactive strategies could include contacting me directly, attending office hours, and/or taking advantage of the multitude of academic services that the Academic Center for Excellence offers. The responsibility is upon you to recognize when you need help and to take the steps necessary to succeed. Goucher College has a variety of resources available to help you succeed in your classes; use them!

Office hours are perhaps the most effective and immediate way to get help. If I must cancel office hours, you will receive warning in advance and I will schedule "make-up" office hours. You do not need an appointment for office hours; simply drop in and ask your questions. My goal in office hours is to answer your questions in such a way that you will not only get your question answered, but also strengthen your ability to answer your own questions. You

may also call my office during office hours. If you cannot make office hours due to a scheduling conflict, you may schedule time with me outside the normal office hours period. I will do my best to accommodate you.

If you don't need an immediate answer to a question, you may submit it by email. I check email several times during the day, and usually during the evening. Please note, however, that I am not available on a 24x7 basis.

The first 10 minutes of each class may be reserved for addressing the most common issues I see occurring from all of our interactions.

Student-Athletes

According to the Goucher College policy on Student-Athlete Responsibilities, if you are a student-athletes, you are expected to contact me at the beginning of the semester to request approval for absences associated with athletic events (or scheduled departure times for such events) that conflict with the regularly scheduled class meeting time. The approved absences will then be listed on a contract signed by both me and you. Additionally, it is the responsibility of the student-athlete to complete all assignments covered in class during the approved absences and to obtain all handouts, assignments, and notes from the missed class(es). Student-athletes who fail to coordinate with me prior to any class absences will not be permitted to make-up missed assignments.

Student Responsibilities in Academic Conflicts (Field trips, Performances, etc.)

According to the Goucher College policy on Academic Conflicts, if you are in a situation in which you are confronted with obligations or responsibilities (ranging from participation in field trips in the visual arts or the sciences or rehearsals or performances in the performing arts to extra-curricula activities at which students are representing the College such as model senate events or varsity athletic contests) that conflict with regularly scheduled academic classes, you are expected to contact me at the beginning of the semester, or as soon as the conflict is known, to request approval for absences that conflict with the regularly scheduled class time. The approved absences will then be listed on a contract signed by both me and you. Additionally, it is your responsibility to complete all assignments covered in class during the approved absences and to obtain all handouts, assignments, and notes from the missed class(es). Students who fail to coordinate with me prior to any class absences will not be permitted to make-up missed assignments.