Computer Architecture

CS 220
Fall 2025

Instructor Tom Kelliher, Ph.D., Associate Professor of Computer Science
Pronouns: he/him/his
Office: Julia Rogers 133
Office hours: M–F 10:30 am–11:30 am, drop-in when my office door is open, or email to request an 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*, 2nd ed. The MIT Press, 2021. Required; Also used in CS 224.
2. See the course web site for additional resources: `http://phoenix.goucher.edu/~kelliher/f2025/cs220/` (There is also a link to this site in Canvas.)

Meetings Julia Rogers 128, TuTh 1:30–3:20 pm.

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 your 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. Effectively use various concurrency control measures in multi-threaded programs.

Schedule Refer to Canvas and the course web site on phoenix for the schedule.

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 — The Nand2Tetris projects and concurrency labs are to be completed individually. Your project/lab grades will account for 60% 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 Sept. 25th and the second exam will be on Nov. 6th. The final exam will be on Dec. 17th. Your exam grades will account for 40% of your final grade.

Keep in mind that each Nand2Tetris project builds upon the previous project. This means that you can't "skip" a project and move on to the next project.

Course Mechanics

Class attendance is one of the prerequisites to successfully completing a class. Therefore, class attendance is required. If you miss more than six classes during the semester, for any reason, your final grade will be reduced by one letter grade. There is no exemption from this policy for field trips, athletic events, illness, etc. These six days should be more than enough to accommodate these events.

I will start class promptly at the scheduled time. You are responsible for arriving to class, and being ready to start class, at the scheduled time. If you arrive late, it is your responsibility to find out what you missed from one of your classmates. Chronic lateness to class, and chronic partial absences from class, will be factored into the six missed days of class.

The project and lab assignments are to be done individually, but discussions with your classmates, or internet research, about concepts and approaches are strongly encouraged. The rule of thumb is that you may discuss or research concepts and approaches, but when it comes time to write the code, it needs to be written by you alone. Anything else is plagiarism, as defined in Goucher's Honor Code.

Project and lab assignments have due dates shown in Canvas. If the unforeseen happens, such as an illness or a family emergency, you are responsible for contacting me as soon as possible to discuss if a due date extension is warranted. Late assignment submissions will be penalized 5% per day. Weekends (Saturday and Sunday) count as one day. Fall break and Thanksgiving break do not count. Submissions more than three days late will not be accepted.

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. I expect you to be familiar with its obligations and requirements. For advice on how to interpret the Academic Honor code in my class, see Integrity in My Computer Science Courses.