

ECE 201: Computer Architecture (Spring 2020)

Lectures: Packard Lab 208, 10:45am – noon MW

Instructor: Prof. Zhiyuan Yan, Rm. 406A, Packard Lab, yan@lehigh.edu
Office hour: Before the classes. E-mail in advance if consultation at a different time is needed.

TA: Ning Lyu, Rm. 401, Packard Lab, nil418@lehigh.edu
Office hour: 4-5pm on Tuesdays and Fridays

Objectives: This course is an intensive introduction to the fundamentals of computer architecture. We will discuss the basic design, or *architecture*, of computing hardware. Computer systems involve architecture design at many levels. We will focus on the instruction set architecture (ISA) level (the interface between the software and computing hardware) and the microarchitecture level (the computing hardware itself). We will also examine to some extent, the level above the instruction set (the programming language level) and the level below the microarchitecture (the logic gate level) in order to deepen our understanding of computing systems.

Prerequisite: ECE 33, or the equivalent.

Textbook: David A. Patterson and John L. Hanessey, *Computer Organization and Design: The Hardware/Software Interface*, 5th edition, Morgan Kaufmann, 2013.

Recommended textbooks:

Harold S. Stone, *High-Performance Computer Architecture*, 3rd edition, Addison Wesley

Andrew Tanenbaum, *Structured Computer Organization*, 4th Edition, Prentice Hall, 1999,

P. J. Ashenden, *The Student's Guide to VHDL*, Morgan Kaufmann, 1996.

Grading: Machine Problems = 20 % (Note: due at the start of classes on the due dates, late turn-ins are not accepted)
Two in-class exams (tentatively scheduled on Wednesday 02/19 and Wednesday 04/01), 20 % each
In-class exercises = 5 %
Homeworks = 5 %
Final exam = 30 % (Time and place TBD)

You need to notify me as early as possible in advance if you have to miss any of the exams, and an oral exam will be given in that case.

Disabilities: If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center 212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

Academic Integrity: Note that all work turned in must be your own work. If plagiarism is detected, you will get zero credit for the work turned in.

Equitable Community: Lehigh University endorses The Principles of Our Equitable Community (<http://www4.lehigh.edu/diversity/principles>). We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

Topics: The following are approximately the topics this course will cover

- Introduction to Computer Architecture
- From Algorithms, to programs, to ISA, to design
- Instruction Set Architectures (ISA)
- Various Instruction Formats
- Floating Point Arithmetic
- Performance Evaluation – Basic Principles
- Datapath Design
- Control Unit Design
- Pipelining, and pipeline optimization
- Pipeline control
- Branch prediction, data forwarding
- Cache memory hierarchy
- Cache memory architectures
- Virtual memory design
- RISC vs CISC
- The notion of thread in SW and HW
- Introduction to advanced microarchitectures
- Interconnects and their trade-offs
- Bus system design
- I/O and secondary storage
- Revisiting Performance: limitations and opportunities
- Multiprocessing and Parallel Processing, dictated by power consumption
 - Other environmental impacts of the computer industry
- ILP, Superscalars and superpipelining
- Dynamic instruction issue architectures
- Embedded systems, DSPs, and SOC