

**Department of Electrical and Computer Engineering
The University of Texas at Austin**

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Course Outline ECE460N, ECE382N.1

August 26, 2024

August 26: Lecture 1: Intro to the course. Levels of Transformations. Basic architectural choices. Science of Tradeoffs.

August 28: Lecture 2: Intro/focus (continued). Tradeoffs, Latency and Bandwidth, Role of Parallelism, Role of Speculation, Overview of Quantitative Insights, Role of the Architect, Alternative Design Points.

August 29: 4th class day, last day to add a class without permission.

August 29,30: First Discussion Session. Bookkeeping, overview, expectations, PL0, Intro/Focus

Programming Lab 0 is due, Sunday night, September 1, 11:59pm. (The program itself will be empty. The purpose of the assignment is to make sure we are on the same page re: using the system.)

September 2: Labor Day, no class.

September 4: Lecture 3: Intro (continued). LC-3b ISA.

September 5,6: Discussion Session. The ISA, Assembly Process, PL1.

September 9: Lecture 4: Intro (continued)

September 11: 12th class day, last day to drop a class without permission.

September 11: Lecture 5: Intro to Instruction Set Architecture, with examples taken from several diverse ISAs. ISA tradeoffs. Detailed discussion of LC-3b, with Assembly language

constructs. The Assembler, how it works.

September 12,13: Discussion Session. The ISA, Design of the assembler, PL1.

Programming Lab 1 is due, Sunday night, September 15, 11:59pm. (Write a program in LC-3b Assembly Language. Write an Assembler. Assemble the program you have written.)

September 16: Lecture 6: The ISA (continued).

Problem set 1 due before class, September 18. (Emphasis: ISA, microarchitecture basics, the Assembly Process)

September 18: Lecture 7: The ISA (continued). x86, RISC V.

September 19,20: Discussion Session. Design of the Instruction level simulator of the LC-3b.

Programming Lab 2 is due Sunday night, September 22, 11:59pm. (Write a program in C that simulates at the instruction cycle level the baseline LC-3b ISA. Test your simulator with the output of the assembler for the application program written in Programming Lab 1.)

September 23: Lecture 8: Microarchitecture, LC-3b data path, state machine, microsequencer, two-level microprogramming, Wilkes' Diode Matrix, Choice of ASICs, FPGAS, EMT instruction for enhanced performance.

September 25: Lecture 9: The ISA (continued).

September 26,27: Discussion Session. Design of the clock-cycle accurate LC-3b, Microarchitecture basics, PL3

September 30: Lecture 10: Microarchitecture (continued). Microarchitecture Tradeoffs, Enhancing Performance. Pipelining, and its implications. Scoreboarding and its limitations.

October 2: Lecture 11: Microarchitecture Enhancements. (Out of order Execution, the Tomasulo Algorithm). Branch Prediction, other mechanisms for handling conditional

branches. The HEP. The notion of Process, the unit of work managed by the Operating System, and its implications on Interrupts/Exceptions and on Virtual memory.

October 3,4: Discussion Session. Out of order execution, Branch Prediction, Prepare for first midterm.

Problem set 2 due before class, October 7. (Emphasis: out-of-order execution, branch prediction, process, physical memory), I/O, Process)

October 7: Lecture 12: Review or catch-up.

October 9: Lecture 13: Exam 1

October 10,11: Discussion Session. Go over first exam, PL4

Programming Lab 3 is due, Sunday night October 13, 11:59pm. (Finish the clock-cycle-level Simulator for the LC-3b. Test it on the application program written in Programming Lab 1.)

October 14: Lecture 14: Physical Memory. SRAM, DRAM, NVM. Interleaving, Unaligned accesses.

October 16: Lecture 15: Physical Memory (continued).

October 17,18: Discussion Session. Physical Mem, PL4

October 21: Lecture 16: Virtual memory, page tables, TLB, VAX model, IA32 model, Translation and Protection, contrast with segmentation.

October 23: Lecture 17: Virtual memory (continued).

October 24,25: Discussion session: Virtual Memory, PL4

Problem set 3 due before class, October 28. (Emphasis on Physical Memory, Virtual Memory.)

October 28: Last day an undergraduate can Q-drop , withdraw, change to pass/fail

October 28: Lecture 18: Virtual Memory (continued).

October 30: Lecture 19: Cache memory.

October 31, November 1: Discussion session: Cache, Virtual Memory, PL4

Programming Lab 4 is due Sunday night, November 3, 11:59pm. (Add state, data path, and microsequencer to handle interrupts and exceptions)

November 4: Lecture 20: Cache memory (continued).

November 6: Lecture 21: Integer Arithmetic.

November 7,8: Discussion Session: Prepare for second midterm Exam

Problem set 4 due before class, November 11. (Emphasis on Cache, Integer arithmetic)

November 11: Lecture 22: Floating point arithmetic and the IEEE Standard. Instruction formats, Gradual underflow, Rounding modes, NaNs, Floating Point Exceptions.

November 13: Lecture 23: Exam 2.

November 14,15: Discussion Section: Go over second midterm, PL5

Programming Lab 5 is due Sunday night, November 17, 11:59pm. (Add state, data path, and microsequencer to handle Virtual memory)

November 18: Lecture 24: Input/Output. Asynchronous/Synchronous, Arbitration, Transaction.

November 20: Lecture 25: Single-thread parallelism – SIMD, Vectors, VLIW vs Wide Issue, DAE, HPS, Data Flow.

November 21,22: Discussion Session: I/O, single-thread parallelism

November 25: Last day a graduate student can change to credit/no-credit.

November 25-29: No class, Thanksgiving break.

December 2: Lecture 26: Intro to Multithreaded parallelism and Multiprocessing, Amdahl's Law, Speed-up, efficiency, Interconnection networks, Cache Coherency, Memory Consistency.

December 4: Lecture 27: Multithreaded parallelism and Multiprocessors (continued).

December 5,6: Discussion session. PL6, multiprocessing, Review of the course, Prepare for Final exam.

Programming Lab 6 is due Monday afternoon, December 9, 5pm. (Pipelined implementation of the LC-3b)

December 9: Lecture 28: Last class, free for all!

Problem set 5. To be used as a study guide for the final exam, not to be turned in.

December 10-11: Study days.

December 12-14,16: Final exams.

Final exam: Friday, December 13, 7-10pm.

Last Names A to H in UTC 4.122

Last Names I to O in UTC 4.124

Last Names P to Z in UTC 4.132

Please note: The Registrar has the right to change the dates of the final exams. Please keep checking the Registrar's web site and our announcements to be sure when the final exam will be given.