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

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Course Outline
January 9, 2023

**January 9:** Lecture 1: Intro to the course. Levels of Transformations. Basic architectural choices. Science of Tradeoffs.

**January 11:** 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.

**January 12,13:** First Discussion Session. Bookkeeping, overview, expectations, PL0, Intro/Focus. Most importantly, Programming Lab 1.

> **Programming Lab 0** is due, Sunday night, January 15, 11:59pm.
> (The program itself will be empty. The purpose of the assignment is to make sure we are all on the same page re: using the system.)

**January 16:** Martin Luther King, Jr. Day: No class.

**January 18:** Lecture 3: Intro to Instruction Set Architecture, with examples taken from many diverse ISAs. ISA tradeoffs. Detailed discussion of LC-3b, with Assembly language constructs. The Assembler, how it works.

**January 19,20:** Discussion Session. The ISA, Assembly Process, PL1.

> **Programming Lab 1** is due, Sunday night, January 22, 11:59pm.
> (Write a program in LC-3b Assembly Language. Write an Assembler. Assemble the program you have written.)

**January 23:** Lecture 4: Microarchitecture, LC-3b data path, state machine, microsequencer, two-level microprogramming, Wilkes' Diode Matrix, Choice of ASICs, FPGAS, EMT instruction for enhanced performance

**January 25:** Lecture 5: Microarchitecture, continued. Microarchitecture Tradeoffs, Enhancing Performance. Pipelining, and its implications. Scoreboarding and its limitations.

**January 26,27:** Discussion Session. PL2, Microarchitecture.

> **Programming Lab 2** is due Sunday night, January 29, 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.)

**January 30:** Lecture 6: Microarchitecture Enhancements. (Out of order Execution, the Tomasulo Algorithm)

**February 1:** Lecture 7: Microarchitecture Enhancements, continued. Branch Prediction, other mechanisms for handling conditional branches. The HEP.

**February 2,3:** Discussion Session. (Emphasis on microarchitecture, PL3)

**February 6:** Lecture 8: Integer Arithmetic

**February 8:** Lecture 9: Floating point arithmetic and the IEEE Standard. Instruction formats, Gradual underflow, Rounding modes, NaNs, Floating Point Exceptions.

**February 9,10:** Discussion Session. (Emphasis on Arithmetic, PL3)

**February 13:** Lecture 10: Microarchitecture continued. Microarchitecture Enhancements. (Out of order Execution, the Tomasulo Algorithm)

> **Programming Lab 3** is due, Tuesday night, February 14, 11:59pm. (Finish the clock-cycle level Simulator for the LC-3b. Test it on the application program written in Programming Lab 1.)

**February 15:** Lecture 11: Microarchitecture Enhancements continued. (Out of order Execution, the Tomasulo Algorithm, Branch Prediction). The notion of process.

**February 16,17:** Discussion session. Discuss Out-of-order execution.

**February 20:** Lecture 12: Integer arithmetic

> **Problem set 1** due before class, February 20. (Emphasis: ISA, microarchitecture) Please submit your student information sheet with the first problem set.

**February 22:** Lecture 13: Physical Memory

**February 23,24:** Discussion Session. Go over Physical Memory, PL4

**February 27:** Lecture 14: Physical Memory, continued.

> **Problem set 2** due before class, February 27. (Emphasis on Process, Physical Memory.

**March 1:** Lecture 15: Exam 1

**March 2,3:** Discussion Session. Go Over Exam 1

**March 6:** Lecture 16: Virtual Memory

> **Programming Lab 4** is due Tuesday night, March 7, 11:59pm. Add state, data path, and microsequencer to Lab 3 in order to handle interrupts and exceptions.

**March 8:** Lecture 17: Virtual Memory, continued.

**March 9,10:** Discussion Session. (Emphasis on Virtual Memory, PL5)

**March 13 to 17:** Spring break. No class.

**March 20:** Lecture 18: Physical memory

**March 22:** Lecture 19: Physical memory, continued.

**March 23,24:** Discussion Session. (Physical and Virtual Memory, PL5)

> **Problem set 3**, due before class, March 27. (Emphasis on Physical Memory, Virtual Memory)

**March 27:** Lecture 20 Cache memory

**March 29:** Lecture 21: Cache memory, continued.

**March 30,31:** Discussion session: Cache Memories, PL5

> **Programming Lab 5** is due, Sunday night April 2, 11:59pm. (Add state, data path, and microsequencer to handle Virtual memory)

**April 3:** Lecture 22: Input/Output. Asynchronous/Synchronous, Arbitration, Transactions.

**April 5:** Lecture 23: Floating point arithmetic.

**April 6,7:** Discussion Session: Prepare for second midterm Exam

> **Problem set 4**, due before class, April 10.

**April 10:** Lecture 24: Single-thread parallelism. SIMD, Vectors, VLIW vs Wide Issue, DAE, HPS, Data Flow.

**April 12:** Lecture 25: Exam 2.

**April 13,14:** Discussion Session: Go over second midterm, PL6

**April 17:** Lecture 26: Intro to Multiprocessing, Amdahl's Law, Speed-up, efficiency, Interconnection networks, Cache Coherency, Memory Consistency.

**April 19:** Lecture 27: Multiprocessing, continued.

**April ??:** Lecture ??: (If there is time) Pot Pourri – Measurement methodology, GPUs, Spatial computing, RISC, Intro to Intellectual Property.

**April 20,21:** Discussion session. PL6, multiprocessing, Review of the course, Prepare for Final exam.

**April 24:** Lecture 28: Last class, free for all!

**Programming Lab 6** is due, Monday afternoon, April 24, 5pm. (Pipelined implementation of the LC-3b)

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

**Final exam:** Probably Friday, April 28, 7-9pm.

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.