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

EE 306, Fall, 2015
Yale Patt, Instructor
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Course Outline
August 26, 2015

August 26: Lecture 1. Overview of EE 306.

- The computer -- a complex system organized in levels of interpretation.
- The computer -- a universal computational device; given enough time and space it can do anything any other computational device does.
- Abstraction: a good thing, after you understand what you are abstracting
- Hardware or Software

August 27,28: Discussion Session. Orientation to the UT system, tools. login, email

August 31: Lecture 2. Bits and operations on bits.

- The bit as a unit of information.
- Encoding of bits: Binary numbers (integer data type, ASCII characters.
- Negative numbers, 2's complement representation, sign-extension.
- Other data types: floating point, ascii.
- Hex representation of binary numbers.
- Arithmetic operations on numbers. ADD, SUB. [Note that x+x = left shift].
- Logical operations on bits. AND, OR, NOT.

September 2: Lecture 3. Bits and operations on bits (continued).

September 3,4: Discussion Session. Emphasis on Chapters 1,2, problem set 1.

September 7: Labor Day. University closed. No class.

Problem set 1, due before class, September 9.

September 9: Lecture 4. Basic Logic Structures.

- The transistor as a switch.
- Basic Gates (AND, OR, NOT).
- Truth table representations.
- Any arbitrary function can be built out of these gates (no attempt at minimization.

Just an awareness exercise).
- full ADDER, MUX, DECODER.
- Basic storage element (Gated RS latch).
- A register

September 10,11: Discussion Session. Emphasis on Chapter 3, problem set 2.

September 14: No lecture. Expanded office hours.

September 16: Lecture 5. Basic logic structures (continued).

September 17,18: Discussion Session. Emphasis on Chapter 3.

Problem set 2, due before class, September 21.

September 21: Lecture 6. Memory and Finite State Machines
- A logic circuit to implement a small piece of memory (perhaps 2**2 x 3)
- Concept of memory: address space, addressability
- The notion of state (one of the most important concepts in engineering)
- State diagram, Next State table, State Assignment
- Implementation example: sequential machine

September 23: No lecture. Expanded office hours.

September 24,25: Discussion Session. Emphasis on Chapter 3.

September 28: Lecture 7. Introduction to Von Neumann model.
- The basic structure of the Von Neumann model, showing the basic flow.
- Instruction = opcode, operands
- Encoding of instructions and data
- Instruction cycle (Fetch, Decode, EA, Fetch data, Execute, Store result)
- Organization of memory
- Address space, addressability revisited (MAR, MDR)

September 30: Lecture 8. ISA Specification of the LC-3
- instruction formats
- operate, data movement, and control instructions
- LD/ST (also, indirects)
- control (condition codes: N,Z,P)
- The datapath necessary to implement the LC-3
- I/O via the TRAP instruction [Keyboard in, screen out]
- Simple examples in LC-3 machine language

October 1,2: Discussion Session. Prepare for first midterm.

Problem set 3, due before class, October 5.

October 5: Lecture 9. Review for midterm.

October 7: Lecture 10. **Exam 1**.

October 8,9: Discussion Session. Introduction to the LC-3 Simulator and Programming Lab 1.

October 10,11: Go to Dallas or catch up on sleep. Nothing due next Monday.

October 12: Lecture 11. A more sophisticated LC-3 program (cf. Chapters 5,6).

- Problem Solving (stepwise refinement, systematic decomposition, etc.)
- Debugging (setting breakpoints, single-step, deposit, examine, etc.)
- The control structure of a stored program (sequential, conditional, iteration)
- A detailed example in machine language
- Example will include entering data via the keyboard (input) and displaying results on the monitor (output).

October 14: Lecture 12. Moving up a level, Assembly Language and the Assembler.

- Going from higher to lower level: interpretation vs. translation
- Translation: what do assemblers and compilers do?
- Hand assemble programs from earlier lectures.
- Revisiting the character count problem

October 15,16: Discussion Session. Emphasis on program 1, and review of the Simulator

Programming Lab 1 due, 11:59pm, October 18.

October 19: Lecture 13. Intro to Data Structures (abstract data types).

- Stacks, queues
- Sequential allocation

October 21: Lecture 14. Data structures, continued.

- Sequential storage vs. a linked list
- Update vs access

October 22,23: Discussion Session. Emphasis on Problem set 4

Problem set 4, due before class, October 26.

October 26: Lecture 15. Subroutines (JSR/RET). The stack.

- Saving/restoring state
- Success/failure mechanisms

October 28: Lecture 16. Trees.

October 29,30: Discussion Session. Emphasis on program 2.

Programming Lab 2 due, 11:59pm, November 1.

November 2: Lecture 17. Physical I/O.

- Asynchronous activity
- Memory mapped vs. special I/O instructions
- Program control vs. device (interrupt) driven
- Device registers (KBDR, KBSR, DDR, DSR)
- Synchronization via the ready bit.
- Interrupt enable bit
- I/O Service Routines

November 4: Lecture 18. Physical I/O, continued.

November 5,6: Discussion Session. Prepare for Exam 2.

Problem set 5, due before class, November 9.

November 9: Lecture 19. Review for Exam 2.

November 11: Lecture 20. **Exam 2.**

November 12,13: Discussion Session. Emphasis on program 3.

Programming Lab 3 due, 11:59pm, November 15.

November 16: Lecture 21. The TRAP instruction.

November 18: Lecture 22. Interrupt processing.

November 19,20: Discussion Session. Emphasis on program 4.

Programming Lab 4 due, 11:59pm, November 22.

November 23: Lecture 23. The Calculator Example (pulling a lot together).

November 25: Lecture 24. Special lecture -- to be announced.

November 26-29: Thanksgiving Day recess. Enjoy the holiday.

November 30: Lecture 25. Pot pourri

- Parallelism. The latest hot button!
- Preview of coming attractions: The ARM ISA

December 2: Lecture 26. Any OTHER questions!

December 3,4: Discussion Session. Last discussion session before final exam.

Programming Lab 5 due, December 4, 5pm.

Problem set 6, not to be handed in, use for final exam preparation.

December 11: **Final Exam**, 7 to 10pm. (according to the Registrar's Course Schedule, which **he can change**.)

Programming Labs:

- 1st programming Lab (machine language) -- Due: October 18, 11:59pm.
- 2nd programming Lab (assembly language) -- Due: November 1, 11:59pm.
- 3rd programming Lab (assembly language) -- Due: November 15, 11:59pm.
- 4th programming Lab (assembly language) -- Due: November 22, 11:59pm.
- 5th programming Lab (assembly language) -- Due: December 6, 5pm.

Problem Sets:

- 1st problem set, (emphasis on Chapters 1,2). Due: just before class, September 9.
- 2nd problem set, (emphasis on Chapter 2,3). Due: just before class, September 21.
- 3rd problem set, (emphasis on Chapter 4,5). Due: just before class, October 5. (Note: exam on October 7)
- 4th problem set, (emphasis on Chapter 7). Due: just before class, October 26.
- 5th problem set, (emphasis on Chapters 8,9). Due: just before class, November 9. (Note: exam on November 11)
- 6th problem set, (emphasis on Chapter 10). Not to turn in.