Schedule and Topics

P&H = Patterson and Hennessy Course Textbook
C-Lang = Kernighan and Ritchie (C Programming Language) Course Textbook
AD-OS = Arpaci-Dusseau, Operating Systems: Three Easy Pieces Course Textbook

** All lecture videos found on Panopto folder on Sakai
** Supplemental reading PDFs found in Resources/Readings folder on Sakai.

Introduction (1.5 lectures: 0.75 week)
Recorded zoom lectures: Lecture 1 and beginning of Lecture 2
Lecture slides: Introduction

- Course overview
- Computing and systems overview

Foundation Knowledge: Representing information (2 lectures: 1 week)
Reading Assignment: P&H Ch. 2.4, Ch. 3.5 (till p. 202 only) before Thursday lecture on Jan 21st.
Lecture slides: Representing Information
Supplemental Reading: binary_math_and_signed_representations
Recorded zoom lectures: Lecture 2, Lecture 3, Lecture 4, and beginning of Lecture 5.

- Numeric and non-numeric data representations
- Unsigned and signed number representations (2's complement)
- Floating point number representation (IEEE 754)
- Integer arithmetic operations

Software Part I: Programming concepts (4 lectures: 2 weeks)
Reading Assignment: P&H Ch. 2.2, 2.3 by Thursday lecture on Feb 4th.
C-Lang Ch. 2, 4, 5, 6 by Thursday lecture on Feb 11th.
Lecture slides: Programming Concepts
Supplemental Reading: Systems_and_Linking and mips_cheat_sheet
Recorded zoom lectures: Lecture 5, Lecture 6, Lecture 7, Lecture 8, Lecture 9, Lecture 10, Lecture 11

- Language abstraction (high-level, assembly, and machine code)
- Machine level representation: MIPS instruction set
- C language: Variables, variable scope, functions, and activation records
- Interface (.h file) vs. implementation (.c file)
- Pointer variable and pointer arithmetic
- Libraries: Static and dynamic
- Putting it all together: Compile, assemble, link, and load

Hardware Part I: Memory organization and management (4 lectures: 2 weeks)
Reading Assignment: P&H Ch. 5.1-5.3 by March 2nd (before lecture)
P&H Ch. 5.7 by March 9th (before lecture)
Lecture slides: Memory Organization

Supplemental Reading: Memory Supplement, Virtual Memory, and Cache Supplement (Section 13.4)
Recorded zoom lectures: Lecture 12, Lecture 13, Lecture 14, Lecture 15, Lecture 16, Lecture 17

- Hierarchy overview (registers, physical, cache, file)
- Physical memory design (addressing, byte order, alignment)
- Cache design (direct mapping and fully associative)
- Virtual memory design (single-level page table and pages)
- Virtual to physical address translation (memory management unit)

Hardware Part II: Circuit design (4 lectures: 2 weeks)
Reading Assignment: P&H App. B.1-B.3 by March 25th (before lecture)
P&H Ch. 3.1-3.2 and App. B.5 by March 30th (before lecture)
P&H App. B.7-B.12 and Ch. 4.2 by April 1st (before lecture)
Lecture slides: Circuit Design
Supplemental Reading: Logic Functions and Gates, Boolean Algebra, Standard Boolean Expression Formats
Exercise Questions: Logic Boolean Algebra and Synthesis
Recorded zoom lectures: Lecture 18, Lecture 19, Lecture 20, Lecture 21, Lecture 22, Lecture 23

- Logic gates, Boolean algebra, truth tables, and sum of product format
- Application circuits (add, shift, decode, and multiplex)
- Data storage circuits (registers and physical memory)
- 5-stage central processing unit (CPU) overview: MIPS architecture

Software Part II: Operating system fundamentals (5 lectures: 2.5 weeks)
Reading Assignment: AD-OS Chapters 4, 6, and 7 by April 15th
AD-OS Chapter 5 by April 22nd
Lecture slides: Operating Systems
Supplemental Reading: Process Scheduling
Recorded zoom lectures: Lecture 24, Lecture 25, Lecture 26

- Basic overview: process creation/scheduling and hardware management
- Process model and memory (heap, stack, data, text)
- Process scheduling and associated algorithms
- Process control (fork, exec, and wait)
- Dynamic memory allocation (malloc and free)
- Input/Output (I/O) and redirection (stdin, stdout, stderr)

Software Part III: Network programming (optional) (2 lectures: 1 week)
Due to time constraints, will not have enough time to cover this material ☹

- Process communication (i.e., network socket)
- Data packet, network layer, and protocol overview
- TCP an IP protocol formats
- Packet inspection (using libpcap)