

Course Syllabus: Comp 411 – Computer Organization

Topics Covered:

- History of the development of the digital computer
- Information theory and digital representations of data
- Computer system organization
- Instruction set architecture (ISA)
 - Instruction types, registers, addressing modes, and load/store architectures
- Instruction sequencing, conditional branches, and subroutines
 - Procedure linkage, activation records, stacks, and low-level support for recursion
- Structure of assembly language programs
- Architectural support for high-level languages
- From high-level to machine language
 - Roles of compilers, assemblers, linkers and loaders
- Digital processing elements
 - Why binary? Processing bits using transistors. Combinational digital logic. Digital arithmetic circuits, adders, barrel-shifters, multipliers, and floating point. Digital storage, memory, latches, and flip-flops. Clocked sequential digital logic, state machine implementation
- Design and organization of a one-instruction-per-clock computer
- Techniques for improving computer performance
 - Pipelining and interleaving. Pipelining's impact on the ISA and system architecture. Pipeline hazards, interlocks, and branch delay slots. Improving memory performance with caches
- Virtualizing and sharing computers
 - Memory management, virtual memory. Time-sharing and process management.
Motivate the need for an operating system
- Multi-core and parallel processing

Learning Objectives:

- To demystify the inner workings of computers.
- Appreciate the concepts of instruction sets and the nature of machine translation.
- To understand computer system architecture.
- Understand how the concepts of abstraction and modular design translate from software to hardware and back to software.
- Learn how computer organization influences high-level languages, and vice versa.
- Prepare students for more in-depth study of advanced computer systems
 - compilers, operating systems, networking, security, and software engineering

Course Organization:

- The course meets three times a week; twice in lecture, and once in a self-paced laboratory session.
- There are 6 problem sets to reinforce the materials covered in lectures and labs. The problem sets are due approximately 2-3 weeks after they are issued. No late problem sets are accepted. However, the lowest of the 6 problem-set scores are dropped. The problem sets account for 25% of the final course grade.
- There are 10 laboratories roughly once per week. All labs include a pre-lab exercise to be completed before the lab period. Labs self-paced and check-off based. Lab check offs are due at the end of the lab period. The lowest of the 10 lab scores is dropped. Labs account for 25% of the final course grade.
- Two quizzes will be held during scheduled laboratory sessions, and the quiz date will be announced at least two weeks in advance. Each quiz is worth 15% of the final course grade.
- A comprehensive final examination will be held at a time scheduled by the university registrar, and it will account for the remaining 20% of the final course grade.