## CS 401 - Computer Architectures Spring 2021

This is an introductory course on the architecture and organization of computer hardware.

**Catalogue Data:** The emphasis in this course will be the basic concepts and techniques that are fundamental for modern computers such as datapath design, pipelining, memory hierarchy, cache, and virtual memory. ARM architecture is chosen to explain these fundamental concepts. Topics include: Instruction set design, computer arithmetic, controller and datapath design, cache and memory systems, input-output systems, interrupts and exceptions, pipelining, performance and cost analysis, computer architecture history, and a survey of advanced architectures.

**Prerequisite:** The class is open to any undergraduate students, who have previously taken CS 303 – Logic and Digital System Design - and scored minimum grade of D.

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Schedule:	Tuesday 13:40 – 15:30, (Lecture)
	Wednesday 12:40 – 13:30, (Lecture)
	Friday 8:40 – 10:30, (Lab/Recitation Section)
	TBA, (Instructor Office Hours)
	Wednesday 17:30 – 19:30, (TA Office Hours)

**Textbook:** John L. Hennessy & David A. Patterson. Computer Organization and Design: The Hardware Software Interface, Morgan Kaufmann Publishers, Inc.

**Exam Dates:** Midterm: TBA Final: will be scheduled by SR

## **Tentative Outline**

- Introduction: Computer Abstractions, Technology, Terminology, and History.
- The Role of Performance: Definition, Measurement and Metrics, Comparison
- **Instructions:** Operations of the Computer Hardware, Operands, and Representation of the Instructions, Procedures, and Addressing.
- **Computer Arithmetic:** Signed and Unsigned Numbers, Addition and Subtraction, Logical operations, ALU Construction, Multiplication, Division, Floating Point Arithmetic.
- **Datapath and Control:** Building the Datapath, Single-cycle and Multicycle Implementations, Control Design and Microprogramming, Exception Handling.
- **Pipelining:** Pipelined datapath, Pipelined Control, Data hazards and Forwarding, Pipeline Stalls, Branch Hazards, Exceptions, Superscalar and Dynamic Pipelining.
- **Memory Hierarchy:** Memory Hierarchy, The Basics of Cache, Measuring and Improving Cache Performance, Virtual Memory.
- I/O: I/O Performance Measures, Types and Characteristics of I/O Devices, Buses, Interfacing I/O Devices to the Memory, Processor, and Operating System
- Multiprocessor Systems

## **Tentative Grading**

- HW (Total 3 or 4) 15%
- Lab (Total 3 or 4) 15%
- Term Project 10%
- Midterm exam 25%
- Final exam 35%