

# CS 401- Computer Architectures

## Spring 2022 - 2023

### Instructor Information

*Name:* Atıl Utku Ay  
*Office:* FENS L026  
*Email:* utku.ay@sabanciuniv.edu  
*Office Hours:* Wednesday 09:30 – 11:30  
*Zoom Link:* <https://sabanciuniv.zoom.us/j/6515639138?pwd=L1YxRk0wQndyUVpyamNkKONqbGtUdz09>

### Schedule

*Lectures:* Tuesday 09:40 - 11:30 will be streamed from FENS G035  
Thursday 10:40 - 11:30 will be streamed from FENS G035  
*Lab:* Thursday 11:40 - 13:30 will be streamed from FENS G035

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. MIPS 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.

### 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**

### Textbook

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

### Exam Dates

*Midterm:* TBA (possibly 8<sup>th</sup> or 9<sup>th</sup> week of the term)

*Final:* will be scheduled by SR

### Tentative Grading

- Midterm Exam 15%
- Final Exam 55%
- Term Project 12%
- Lab (Total 3(±1)) 8%
- Homeworks (Total 4(±1)) 10%

(Midterm Exam Grade/Final Exam Grade) cannot be greater than 2. Otherwise, your midterm grade will be given by the instructor after an additional oral exam.

In order to pass the course, the Final Exam and the overall grades of the students must be at least 25 and 40, respectively. The other letter grade boundaries will be determined by the instructor at the end of the term.

Midterm Exam will be held online. Final Exam will be held in-person.

### Make-up Policy

- There will be no make-up for homeworks, labs, term project and quizzes. Students automatically get 0 (zero) from the respective assignment grade if any of them is missed.
- Make-up is only allowed for the midterm and final examinations to those with an official report and to those with an official permission notice from the university on the date of the exam in question.
- Make-up examinations may be written and/or oral.

## Plagiarism Policy (Academic Integrity)

Plagiarism means presenting someone else's work as yours. This is a very serious and ethical problem. A plagiarized work may or may not be a verbatim copy of another submission. Verbatim copies are of course plagiarized ones. However, if a submission is derived from another one by partially changing some parts, this action is also plagiarism. When a plagiarism case is detected, sanctions are applied to all parties regardless of the actual source of the submission. These sanctions are as follows:

- For the midterm/final examinations,
  - students directly fail the course, even in the first offense.<sup>1</sup>
- For the homeworks, labs and term project,
  - for the first time, all plagiarized submission owners receive 0,
  - the second time, the student fails the course automatically.<sup>2</sup>

---

<sup>1</sup> Additionally, the case will be referred to the Dean's Office for disciplinary action. This course does not tolerate any breach of academic integrity (more info on <https://www.sabanciuniv.edu/en/academic-integrity-statement>)

<sup>2</sup>See footnote 1