# CS 2340.004 Computer Architecture
# Spring 2025
# Syllabus (Version 1)

## Course Information

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| *Course Number/Sections:* | CS 2340.004 |
| *Course Title:* | Computer Architecture |
| *Term:* | Spring 2025 |
| *Days & Times:* | Monday & Wednesday: 1pm - 2:15pm & Make up time slots |
| *Location:* | ECSW 1.365 |

## Professor Contact Information


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| *Professor:* | Dr. Yvo G. Desmedt |
| *Office Phone:* | (972) 883-4536 [1] |
| *Email Address:* | Yvo.Desmedt@UTDallas.edu **(not efficient: see further)** |
| *Office Location:* | ECSS 4.411 |
| *Office Hours:* | Monday 2:30pm-3:30pm and by appointment (see further for details) |


### Grader

Arya Thorat Arya.Thorat@UTDallas.edu will be the grader in this course. Other information, such as office hours and office location will be provided by the grader later on.

## Course Prerequisites

(CE 1337 or CS 1337) with a grade of C or better or equivalent and (CE 2305 or CS 2305) with a grade of C or better. (Same as SE 2340)

- CE 1337 or CS 1337, with a grade of C or better or equivalent, and
- CE 2305 or CS 2305, with a grade of C or better. (Same as SE 2340)

## Course Description

This course introduces the concepts of computer architecture by going through multiple levels of abstraction, and the numbering systems and their basic computations. It focuses on the instruction-set architecture of the MIPS machine, including MIPS assembly programming, translation between MIPS and C, and between MIPS and machine code. General topics include performance calculation, processor datapath, pipelining, and memory hierarchy.

## Course Goals and Objectives

Computers have different components. Understanding these in details and how they work and program them is an essential aspect of computer science.
The learning objectives include:

[1] This is no longer a real telephone, but has been replaced by MS Teams.

- be able to write a fully functional, stand-alone medium size assembly language program (e.g. a basic Telnet client)
- have an ability to represent numbers in and convert between decimal, binary, and hexadecimal and perform calculations using 2's complement arithmetic
- understand the basic model of a computer including the datapath, control, memory, and I/O components
- be able to program efficiently in an assembly level instruction set, including the use of addressing modes and data types
- understand the role of compilers, assemblers, and linkers and how programs are translated into machine language and executed
- be able to demonstrate comprehension of a pipelined architectures including datapath and hazards
- understand the memory hierarchy including caches and virtual memory
- be able to demonstrate comprehension of computer performance measures and their estimation.

## Required Textbooks and Materials

*Computer Organization and Design* **MIPS Edition** - *The Hardware/Software Interface*, Patterson and Hennessey, Morgan-Kaufmann, 2021, 6th Edition.

## Grading Policy

The grade depends on the understanding of the material covered in class and on the correctness of answers to questions on quizzes and on homeworks.

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| announced and unannounced quizzes: | 10% |
| assignments: | 15% |
| first exam: | 10% |
| second exam: | 20% |
| third exam (cumulative): | **35%** |
| Term Project: | 15% |

The third exam will be on May 7. Other exam dates will be announced well in advance.

### Your letter grade

*Dynamic curving* is used, which works as follows:

> at the end of the semester, all total grades, i.e., numbers, are sorted. The difference between the sorted grades is computed. The biggest differences are used as decide the grades, i.e., students whose total number grade is almost the same, end up with the same letter grade.

**Advantages:**

- if a student has 90.1% and another has 89.9%, they both end up with the same letter grade.
- if an exam is much harder than the instructor estimated, then all (most) students get lower grades. However, it has minimal impact on the letter grade of the students.
- the approach compensates automatically for having a lenient or tough grader.

### Warning

Some of the questions and homeworks might be difficult. To compensate for this, the instructor does not require students to obtain 70% to get a C grade.

Students not doing well will receive an e-mail after the 1st quiz. Moreover, statistics about each quiz will be revealed to the students.

## Required Course Materials

It is assumed you are familiar with the PC environment, can create and edit text files, run programs, etc.

Makeup quizzes will not be given except for documented emergencies or other extreme circumstances.

## Installing software

You will need to install software. For more information, see Appendix.

## Course & Instructor Policies

**Class attendance:** students *must* attend class. Students who have a medical reason, or other valid emergency reason are exempt.

Besides the textbook, personal notes and other references are used during the class presentations. Although there is a significant overlap with the textbook most material will be presented in a didactic way, some different from the textbook. **Students who regularly attend class may do better on quizzes.**

**e-mail:**

UTD's move to Microsoft's Outlook, resulted in several complains from students. Microsoft states:

> Email messages in your Microsoft Outlook 2010 Inbox and other mail folders can be organized by date and arranged by Conversation. When Conversations is turned on, messages that share the same subject appear as Conversations that can be viewed expanded or collapsed. You can quickly review and act on messages or complete Conversations.

To turn this off (and get the by date option), see:

https://support.office.com/en-us/article/View-email-messages-by-conversation-0eeec76c-f59b-4834-98e6-05cfdfa9fb0

The instructor strongly recommends students to use the date option, i.e., turn Conversation off.

**Homework and Programming Assignments:**

- **assignments:** Homework and programming assignments may be given via eLearning or via e-mail.
- **returning assignments:** Whether students need to return assignments via eLearning or in-person in class, will be decided by the TA/grader.
- **Late work policy:** Students who return their assignment too late will be penalized as follows:
  - If a student is late, but turns the solution to the assignment in before the start of the next class the student's grade will be multiplied with 0.9.
  - If a student waits longer, then the student receives no credit! The assignment will be corrected.

## Academic Integrity

**Copy-pasted code, even with variable name changes, is not acceptable.**

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in the student's scholastic work.

Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings.

Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.

## Recommendations

Related to:
**Assignments:** students are strongly encouraged to make as many homeworks and programs as possible. **Warning: Students copying other students homeworks and/or programs will be ill prepared for the quizzes**. To avoid this, students should make their own homework. This will also allow the TA/grader to figure out the progress (or lack) being made by the student.
**Retaking the class:** Students who are retaking this course should study *significantly more* than when taking this course the first time.

## Class Recordings

Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly **prohibited from audio and video recording any part of this course**, except that snapshots of the blackboard, or of the screen, are allowed. Such snapshots may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these university requirements is a violation of the Student Code of Conduct.

## Academic Calendar

Material covered will be added to the course website as the semester progresses.

## Topics Covered

- Components of a computer system: processor, main memory, input and output devices, storage devices.
- MIPS assembly language and MARS simulator.
- Processor performance: performance metric (execution time), how to evaluate and compare processor performance.
- Number bases (binary, decimal, hexadecimal) and conversion between them

- Data representation in binary
  - Integer, signed and unsigned, 2-complementary representation
  - Text, string, character, ASCII table
  - Floating-point numbers
  - Multimedia (sound, graphic and video, sophisticated coding, e.g. MP3, MP4)
- MIPS instructions representation in binary
  - R-type
  - I-type: data transfer (lw and sw), and branching (beq and bne)
  - J-type: j and jal instruction
  - How to assemble an assembly language instruction into binary for all 3 instruction types (R, I, and J)
- MIPS instruction set
- Support for subroutines
  - Stack
  - jal and jr instructions
- Addressing modes
- System software: OS, assembler, linker, loader.
- Integer arithmetic
- Floating arithmetic
- Input & output (e.g. memory-mapped I/O, DMA)
- Interrupt and exception
- Datapath of a processor: ALU, register file, sign extender, etc...
- Control signals and control unit
- Exploiting parallelism
  - Temporal: pipelining, pipelined datapath
  - Spatial: multiple issue
  - Advanced instruction-level parallelism: speculative execution
- Memory hierarchy
- Hardware cache (L1, L2 and L3)
- Virtual memory

## Student Conduct & Discipline

The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, A to Z Guide, which is provided to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3, and in Title V, Rules on Student Services and Activities of the university's Handbook of Operating Procedures. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/882-6391).

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. The student is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

## Email Use

Due to massive spam Email is no longer an efficient way to communicate. Therefore, students are *discouraged* to e-mail the instructor. Better ways to communicate with the instructor, are during office hours.

Due to the massive spam, students sending e-mail should not expect an immediate reply. A reply may be given in class, or by e-mail typically *several days to a week* after the student sent the e-mail.

Moreover, email raises some issues concerning security and the identity of each individual in an email exchange. **The instructor considers email from students** *only* **if it originates from a UTD student account**. E-mail sent from Gmail, Hotmail, etc., will likely bounce. UTD furnishes each student with a free email account that is to be used in all communication with university personnel.

## Office Hours

Office hours will be held in-person. Note that office hours may be canceled occasionally.

## Withdrawal from Class

The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

## Student Grievance Procedures

Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's Handbook of Operating Procedures.

In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the

instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called *the respondent*). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the deal will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.

Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

## Incomplete Grade Policy

As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of F.

## Disability Services

The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.

The contact information for the Office of Disability Services is:
The University of Texas at Dallas, SU 22
PO Box 830688
Richardson, Texas 75083-0688
(972) 883-2098 (voice or TTY)

Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance.

It is the student's responsibility to notify the professor of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.

## Religious Holy Days

The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax

under Section 11.20, Tax Code, Texas Code Annotated. The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment. If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or the designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

# A Download Java

You will need to download Java for your platform by going to this website
https://www.oracle.com/java/technologies/downloads/
Download Java before you go to the next step to install MARS.

# MARS RISC Assembler/Simulator

The programs will be in assemblylanguage for the MIPSprocessor. This course uses the MARS MIPS assemblerand simulator. MARS will be available, free, for download from eLearning.

The MARS simulator can assemble MIPS assembly language source files, load and run them with a user's console window for input/output,and debug them if they do not work properly.

### Special instructions on how to install MARS onto a MAC

Some Mac users have had trouble getting MARS to run.
Josh Brown, a former student, suggested to:

> You need to allow Full Disk Access in your System Preferences inmacOS. Click here to see that you need to search for 'JavaLaunchera.pp'. This is an issue due to macOS changes with security management.To give Full Disk Access to JAR files on macOS:

- Go to System Preferences.
- Click on Security and Privacy.
- Search for 'Full Disk Access'.
- Click on the lock at the bottom left to be able to make changes.
- Click on the'+'icon at the bottom left of the FDA panel and a Finder prompt will appear.
- Go to System/Library/CoreServices/JavaLauncher.app
- Select the JavaLauncher.app and click 'Open'

You should be able to access files through your Java application. This helped to fix my issue with MARS MIPS not saving files properly on my laptop. You can also watch this video:

https://www.youtube.com/watch?v=rifYIagXuBU