

CSE 2312: Computer Organization and Assembly Language Programming
Fall 2013
University of Texas at Arlington

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Section Information: CSE 2312-002 (85233)

Course Website: <http://www.taylorjohnson.com/class/cse2312/f13/>

Time and Place of Class Meetings: Nedderman Hall 111 (NH111), Tuesdays/Thursdays 2pm-3:20pm

Description of Course Content: Computer organization from the viewpoint of software, including: the memory hierarchy, instruction set architectures, memory addressing, input-output, integer and floating-point representation and arithmetic. The relationship of higher-level programming languages to the operating system and to instruction set architecture are explored. Some programming in an assembly language.

Prerequisites: All students are expected to have passed the courses CSE 1320 Intermediate Programming and CSE 1310 Introduction to Computers and Programming or an equivalent before attending this course. Students are expected to have working experiences with software development.

Student Learning Outcomes: The objective of this course is to introduce computer science and engineering students to the architecture, organization, and low-level (assembly) programming of computing systems. At course conclusion, students should be able to:

- Define components of a computer system, such as input/output devices, memory, processors, etc. and subcomponents thereof
- Define different types and levels of computer systems, such as instruction set architectures, virtual machines, microcontrollers, RISC, CISC, etc.
- Compute and compare basic performance metrics of programs on different architectures and levels
- Convert between binary and decimal representations, binary and character encodings like ASCII, real numbers and floating-point approximations, and perform manipulations of these information representations (arithmetic, etc.)

- Write, assemble, and execute assembly language programs to solve problems
- Write assembly programs using different endianness, addressing modes, stack features, and other architecture and ISA specific features

Required Textbooks and Other Course Materials: Andrew S. Tanenbaum, *Structured Computer Organization*, 6th Edition. Prentice-Hall, Inc., 2012. (Main Textbook)

Kip Irvine, *Assembly Language for Intel-Based Computers*, 6th Edition, Prentice-Hall, Inc., 2011. (Optional)

Paul A. Carter, *PC Assembly Language*, July 2006. (Optional; Free PDF Available)

Descriptions of major assignments and examinations: Coursework for roughly the first half of the course will include homework assignments and a midterm exam covering roughly chapters 1, 2, and 5 of the textbook. The second half of the course will include fewer homework assignments, but several programming assignments in assembly language, and a final exam covering chapter 7, appendices A and B, and supplementary material on ARM processors (in lieu of appendix C). Approximate due dates of assignments are shown below in the course schedule.

Attendance: Students are strongly encouraged to attend lectures and come to office hours.

Other Requirements: Exams will be closed book, but students will be allowed to bring a two-sided sheet of letter-size paper. Students are expected to check the course website for updates to the course schedule throughout the semester.

Grading: Grade percentages will be calculated based on the following weights:

- Homework: 25%
- Programming Assignments: 35%
- Midterm Exam: 20%
- Final Exam: 20%

Letter grades will be determined based on the following ranges:

- $100 \geq A \geq 90$
- $90 > B \geq 80$
- $80 > C \geq 70$
- $70 > D \geq 60$
- $60 > F \geq 0$

The instructor reserves the right to move the thresholds down based on the distribution of final percentages, but they will not move up (e.g., if a grade percentage is between 90 and 100, this will receive an A). Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels.

Make-Up Assignments and Exams: If you miss an exam or quiz due to unavoidable circumstances (e.g., health), you must notify the instructor in writing via email as soon as possible and request a makeup approval. If it is a planned (non-emergency) absence, you must inform the instructor ahead of time! Do NOT ask for make-ups if you do not complete

something due to travel (except when you are required to travel to represent the university or department on official business, but request at least 3 days ahead of the due date or exam time).

Grade Grievances: Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current undergraduate catalog (see: http://wweb.uta.edu/catalog/content/general/academic_regulations.aspx#19).

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://wweb.uta.edu/aao/fao/>).

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA)*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Academic Integrity: Students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at www.uta.edu/resources.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as “lecture,” “seminar,” or “laboratory” shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, which is located to the east side of Nedderman Hall. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist handicapped individuals.

Course Schedule:

The instructor for this course reserves the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course.

All readings refer to Tanenbaum unless otherwise noted. All assignment dates are approximate, so please verify all dates on the course website.

- 8/22: Introduction
- 8/27: Structured Computers (Reading: Chapter 1)
- 8/29: Computer Components (processors, memory, etc.)
- 9/3: Quantifying Computer Components (metrics like processor clock speed, memory sizes, etc.)
- 9/5: Virtual Machines, Hypervisors, and Hardware Emulation (HW1 Due; Reading: Chapter 2)
- 9/10: CPUs, GPUs, MCUs, and SoCs
- 9/12: Memory and Caches
- 9/17: Secondary Memory (HW2 Due)
- 9/19: Instruction Set Architectures (Reading: Chapter 5)
- 9/24: Memory Addressing
- 9/26: Midterm Exam (Chapters 1, 2, and part of 5)
- 10/1: Instruction Types
- 10/3: Flow of Control, Traps, Interrupts
- 10/8: Input and Output
- 10/10: Machine Language and Binary Numbers (HW3 Due)
- 10/15: Binary Arithmetic (Reading: Appendix A)
- 10/17: Floating-Point Numbers (Reading: Appendix B)
- 10/22: ARM Assembly Language
- 10/24: Emulation using QEMU and ARM (HW4 Due)
- 10/29: ARM Overview and Registers (Reading: ARM ISA)
- 10/31: Assembly Language Programming and Debugging with gdb (Reading: Chapter 7)
- 11/5: Assembly Process (PA0 Due)
- 11/7: Linking and Loading
- 11/12: Registers
- 11/14: Assemblers (PA1 Due)
- 11/19: Stack and Subroutines
- 11/21: Summary of Basic Instructions
- 11/26: Loops and Boolean Operations (PA2 Due)
- 11/28: Thanksgiving Holiday (no classes)
- 12/3: Final Review Class
- 12/10: Final Exam (2:00pm-4:30pm)