

CSE 2312 – Computer Organization and Assembly Language Programming

Spring 2018

Instructor: Darin Brezeale, ERB 648
Office Hours: TuTh, 1:30pm–3pm (or anytime my door is open)
Contact: darin.brezeale@uta.edu (best way to contact me)
I don't have a phone in my office, but in case of an emergency you can call the CSE department at 817-272-3785.
Website: <http://omega.uta.edu/~darin>
Section: 002: MoWeFr, 11:00am–11:50am, ERB 129
Hardware/Software: We will be using the Raspberry Pi as the development hardware. There will be assignments using ARMv7 assembly and possibly C and Java.

Course Description: 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. Prerequisite: CSE 1320.

References: While I will assign homework, I don't plan to assign specific problems from any particular book. I will use the following books as references:

- Eben Upton, Jeffrey Duntemann, Ralph Roberts, Tim Mamtora, and Ben Everard. *Learning Computer Architecture with Raspberry Pi*. John Wiley & Sons, Indianapolis, IN, 2016
- Nicholas Carter. *Schaum's Outline of Computer Architecture*. McGraw-Hill, New York, NY, 2001
- David A. Patterson and John L. Hennessy. *Computer Organization and Design: The Hardware Software Interface*. Morgan Kaufman, San Francisco, CA, ARM edition, 2016
- Carl Hamacher, Zvonko Vranesic, Safwat Zaky, and Naraig Manjikian. *Computer Organization and Embedded Systems*. McGraw-Hill, New York, NY, 6th edition, 2011
- Bruce Smith. *Raspberry Pi Assembly Language: RASPBIAN Beginners*. CreateSpace Independent Publishing Platform, 3rd edition, 2013. More information can be found at <http://www.brucesmith.com>.

Homework Policy: I'm a strong believer that the best way to learn to do something is to actually do it, so you should expect plenty of homework. Calculators will not be allowed on exams, so you probably should not become dependent on them when doing your homework. Using a calculator to check your work is fine; having the calculator do all of the work isn't.

Grading Policy: There will be four exams plus weekly homework assignments. Your final grade will be calculated as $\min(\text{homework average}, \text{exam average})$ where the homework average is the arithmetic mean of the homework grades and the exam average is the arithmetic mean of the exam grades.

Homework can be submitted up to 24 hours late at a cost of 50%. The cost is the same no matter when in the 24 hour period you finally submit the homework.

If your lowest exam grade is one of the first three exams, then I will replace that exam grade with the grade you receive on the final exam. This will only be applied to one exam (in case of a tie) and will not be applied if you receive a grade of zero on an exam due to cheating.

No make-up exams will be given except for emergencies (in the instructor's opinion). Poor planning or forgetfulness on your part won't be considered an emergency. I never give extra credit work nor will any grades be dropped. Final grades are based on the ranges of A: 88–100, B: 78–87, C: 68–77, D: 58–67, F: 0–57. I round to the nearest integer, so 87.4 is a B and 87.5 is an A.

As someone taking an engineering course, I assume that you can 1) keep up with the grades I provide to you and 2) can calculate your current grade in the course.

Important Dates:

Monday, September 4	MLK Day
Wednesday, January 17	first day of class
Wednesday, February 21	exam 1
Wednesday, March 21	exam 2
Wednesday, April 11	exam 3
see UTA schedule for your section	final exam

Attendance: At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students academic performance, which includes establishing course-specific policies on attendance. However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients begin attendance in a course. UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

As the instructor of this section, I will not take attendance except when required to determine if you have attended the class. While attendance of the lectures is not required, you should not expect me to catch you up if you choose not to come to class nor is not attending the lectures necessarily good for your grade.

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://www.uta.edu/aao/fao/>).

Disability Accommodations: UT 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), The Americans with Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. 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 disability. Students are responsible for providing the instructor with official notification in the form of a letter certified by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting: The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Non-Discrimination Policy: The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.

Title IX: The University of Texas at Arlington (University) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.

Academic Integrity: Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlingtons 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 in their courses by 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 universitys 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 students suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct/>.

Electronic Communication Policy: 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>.

I send out a lot of emails, so check your email regularly. Note that while I am fine with communicating via email in general, I don't like receiving emails asking for grades and probably won't respond to any emails asking for grades.

Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

Student Feedback Survey: At the end of each term, students enrolled in face-to-face and online classes categorized as lecture, seminar, or laboratory are 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 via the SFS database is aggregated with that of other students enrolled in the course. Student anonymity will be protected to the extent that the law allows. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week: For semester-long courses, 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; there are exits located east and west of this room. 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 individuals with disabilities.

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 <http://www.uta.edu/universitycollege/resources/index.php>.

Schedule: Here are the topics that I plan to cover and the order in which I intend to cover them. Note that this is tentative and therefore can change.

References to *Schaum's Outline of Computer Architecture* by Nicholas Carter are listed as NC and references to *Computer Organization and Design, ARM edition* by Patterson & Hennessey are listed as PH.

1. introduction [NC 1, PH 1.1]
2. introduction to Raspberry Pi
3. review of bits, base conversions, signed vs unsigned numbers [PH 1.1]
4. arithmetic for computers [NC 2, PH 3.1–3.5]
5. introduction to Raspberry Pi
6. instruction set architecture (ISA) [NC 5]
7. complex instruction set (CISC) versus reduced instruction set (RISC)
8. introduction to ARM assembly
9. basic computer components (CPU, memory, disk)
10. the idea of parallelism
11. the power wall [PH 1.7]
12. the switch from uniprocessors to multiprocessors [PH 1.8]
13. performance [NC 1.6–1.8, PH 1.6]
14. pipelining [NC 6, PH 4.5]
15. SRAM vs DRAM [NC 8]
16. cache [NC 9, PH 5.3]
17. cache structures: direct mapping cache, fully associative, and set associative [NC 9, PH 5.4]
18. cache performance [NC 9, PH 5.4]
19. reliability measures [PH 5.5]
20. error correcting codes (ECC) [PH 5.5]
21. redundant array of inexpensive disks (RAID) (PH 5.11)
22. virtual machines [PH 5.6]
23. virtual memory [NC 10, PH 5.7]
24. multicore multiprocessors [NC 12, PH 6.5]

ARM assembly topics

1. introduction
2. displaying R0 using `echo $?`
3. arithmetic – addition, subtraction, multiplication
4. bitwise operators
5. multiply via shift
6. debugging with gdb
7. status register
8. branch instructions
9. conditionals
10. loops
11. load/store
12. addressing modes
13. post-index addressing
14. strings
15. read from `stdin`, write to `stdout`
16. load a byte
17. big endian vs little endian
18. the stack
19. updating stack pointer
20. using stack to swap values
21. subroutines and the link register