CSE2312 Computer Organization and Assembly Language Programming
Spring 2024
(subject to change prior to the first day of class)

Instructor Information

Instructor:
Jason Losh, Ph.D.

Office Number:
ERB 649

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Faculty Profile:
https://mentis.uta.edu/explore/profile/jason-losh

Office Hours:
Office hours will be prior to class (in the classroom) and by appointment for maximum flexibility.

Teaching Assistants:
Todd Rosenkranz, todd.rosenkrantz@uta.edu

Course Information

Section Information:
005

Time and Place of Class Meetings:
TTh 5:30-6:50pm (TBD)
This is a 100% face-to-face course. This is not an online course.

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. Prerequisite: CSE 1320.

Student Learning Outcomes:
Upon successful completion of this course, students will have knowledge of:

- Range, and size of integer and boolean variable types
- Basis for 2's compliment encoding of signed integers, ALU signed/unsigned agnostic design
- ALU operating including flag operation
- ALU register interface in the CPU
- Arithmetic, logical and shift operations in the ALU
- Load/store interface between registers and memory
- Memory addressing modes (direct, indirect, indirect indexed, …)

- Flow control instructions and loops in the ALU, relation to for/while loops in C
- Configuring Rpi for SSH
- AAPCS register and calling conventions
- Writing mixed C / assembly programs
- Using the GNU compiler, assembler, linker, and debugger
- Detailed knowledge of ARM arithmetic, logical, load/store, and program flow instructions
- Effects of packing on performance and memory size
- Full decrementing stack design and the stack pointer
- IEEE-754 floating point number range, dynamic range issues, and memory storage
- Pipelined vs non-pipelined processors
- Cycle-exact calculation of pipeline timing
- Interrupts
- Memory virtualization and paging (heap fragmentation, security implications)
- Virtual machines
- Cache memory

Class Web Page:
Additional files will be provided as needed on the course web site at http://ranger.uta.edu/~jlosh/.

Communication:
All class-wide communication by the instructor, including distribution of homework sets, will occur via the class listserv. If you are enrolled prior to the first day of class, you will be added to the listserv automatically. If you add on or after the first day of class, please sign up for the CSE2312-L listserv by sending an e-mail from your UTA e-mail account to listserv@listserv.uta.edu from your UTA e-mail account (no subject line needed) and the command SUBSCRIBE CSE2312-L as the message body. You will then receive an e-mail from the listserv server to which you must acknowledge to join the listserv with "OK" in an e-mail.

Textbooks and Other Course Materials:
Raspberry Pi Operating System Assembly Language, 4th ed., Bruce Smith, CreateSpace Independent Publishing Platform, ISBN 978-0648098737. Cost is around $20.00.

All students are required to have a Raspberry Pi 3b/3b+/4b (with appropriate accessories to power it and make it work) for the following courses: CSE 1106, 2312, 4342, and 4352. We coordinate between the instructors of these courses to ensure that a single purchase can be re-used for all of these courses to minimize your costs. The cost is between $120 and $180.

Most students buy a kit with the single board computer board, case, power supply, fan, hdmi to micro-hdmi cable, micro SD card with the 32-bit OS pre-installed, and accessories to save a lot of time. Many students in the past have purchased a kit from Canakit, but this is not an endorsement. Please plan to order a RPi kit as soon as possible, as many University students buy a similar board for their courses. Any of the memory sizes for the RPi 4b kits will work for these courses.

In addition, students will need the following components at home to work with the Raspberry Pi directly:
USB keyboard and mouse (will be provided for the labs in the labs)
Monitor accepting HDMI or DVI and a proper HDMI to DVI cable

Alternatively, instead of using an monitor, SFTP and SSH access from a PC is possible with an Ethernet cable after configuration.

Current computer recommendations are available at
https://www.uta.edu/academics/schools-colleges/engineering/students/student-computer.

Major Assignments and Examinations:
Quiz 1 (Thursday, January 25)
Quiz 2 (Thursday, February 8)
Test 1 (Thursday, February 15)
Lab 1 (Tuesday, February 27)
Quiz 3 (Thursday, February 29)
Quiz 4 (Thursday, March 21)
Test 2 (Thursday, March 28)
Lab 2 (Tuesday, April 9)
Quiz 5 (Thursday, April 11)
Quiz 6 (Thursday, April 25)
Comprehensive Departmental Final (Thursday, May 2 at 5:30 – 8 pm)
Quizzes, tests, and the final are given on campus. There are no makeups.

Technology Requirements:
The students will need a Raspberry Pi setup as described above to solve homeworks and complete the lab assignments.

Grading Information

Grading:

- Grade scale: A (90-100), B (80-89), C (70-79), D (60-69), and F (0-59)
- Grade calculation: Test 1 (30%), Test 2 (30%), Quiz Average (40%)
- The instructor reserves the right to make reasonable changes in performance evaluation as needed.
- The instructor also reserves the right to make substantial changes in the structure of the course if the modality of the course must be changed.
- Any request for re-grading must be submitted to the teaching assistant within one week of the completion of grading. If, after requesting a re-grade from the teaching assistant and getting a response, you may refer the case to the instructor if you think further action is needed.

Expectations for Out-of-Class Study:

As a general rule of thumb, for every credit hour earned, a student should spend 3 hours per week studying outside of class. Hence, for this 3-credit course, a minimum expectation of 9 hours of study is expected in addition to the time spent in class.

Tests:

- To ensure that all students are treated equally and given the same time to prepare for the exam, no makeup will be provided for any test missed.
- If you know you are going to miss a test, you can request an advance test given 1 week prior to the normally scheduled time for the exam, with the understanding that any curve applied to the test taken at the official test time will not apply to the advance test, since the content of that test will be unique.
- Tests are on-campus.
- Failure to submit your exam by the end time announced in class will result in a grade of zero.
- A single piece of paper (front and back) with handwritten notes is allowed.
- A calculator without data storage (except a single value) is allowed.
- Tests are based on lecture material, homework problems, example test questions and topics, review session topics, and practical knowledge learned during the compilation and assembly of the computer programs.

- Our goal is to return the graded Test 1 and 2 within one week (or within two weeks for a student testing in an alternative testing center).

Quizzes:

- No makeup will be provided for any quiz missed.
- The lowest quiz grade will be dropped.
- Quizzes are on-campus
- Failure to submit your quiz by the end time announced in class will result in a grade of zero.
- A single piece of paper (front and back) with handwritten notes is allowed
- A calculator without data storage (except a single value) is allowed.
- Our goal is to return the graded quiz within one class day (or within three class days for a student testing in an alternative testing center).

Homework:

- Homework is assigned to help you master the student educational outcomes required for the course. It is important to work the homework so that you will perform well on the quizzes, exams, and in subsequent courses.
- Due to the presence of web sites that provide solutions to homework sets, homework will be assigned but not collected. A solution will be provided by the grader around the suggested due date for the homework.

Labs:

- Labs are individual assignments. Discussing lab topics is allowed, but the submissions must be unique. Sharing of code is not allowed.
- You should complete and submit each lab assignment by 11:59pm on the due date. There is a 20% reduction in credit for each week day that the lab assignment is late.

Course Schedule

The anticipated lecture order is as follows:

S24 Date	Lecture Topic	Due
TUE (1/16)	Syllabus uintN_t decimal to/from binary, binary to hex	
THU (1/18)	intN_t decimal to/from binary Explanation of why 2's compl simplifies ALU ALU block, args in, result, flags out, operation in Unary vs binary operations n-bit processor explained and relation to arg size	
TUE (1/23)	Closed space and basis for C and V flags ALU operations and the flags (V,C,N,Z) AND/OR/Shift	
THU (1/25)	Registers as a concept, register file Register-alu interface	Q1
TUE (1/30)	RPi setup for headless, headed configuration Procedure calling convention (AAPCS) hello, add32, add64 examples (mention BX LR returns to the caller)	
THU (2/01)	1-11 to 1-20 walkthrough RPI programs:	

	Shift32	
TUE (2/06)	RPI programs: andor32, is_even, is_positive, is_mult_of_x (many methods)	
THU (2/08)	RPi programs: Stress importance of a good test isGtU32 (errant way with n,z; Show failed test, then use c,z flags and HI) isGtS32 (with GT flag)	Q2
TUE (2/13)	Review for Test 1 Rpi programs: getConstants (encoding of literal – not on test) m = n ROR 2s, where n is an 8-bit number and S is a 4-bit number encoded into the 12-but operand2 field)	
THU (2/15)	-	Test 1
TUE (2/20)	Comment on good tests for Lab 1 Load-store interface Show architecture of load-store [Register] as Source of Address LDR/STR commands How z=x+y in C is ldr x,y + add + str z Load opcodes LDR, LDRSH, LDRH, LDRSB, LDRB Store opcodes STR, STRH, STRB Endianess	
THU (2/22)	More complicated [reg, reg], [reg, reg << #2] options Rpi programs: Mem (read/write unsign/sign 8, 16, 32b ints GDB with mem example: gdb x/1dw, x/1xw, x/1tw (binary) Show endianness Constants example	
TUE (2/27)	Flow control explained: B,BL,BX,Bcond Rpi programs: count_ones, bros (except string function)	L1 Due
THU (2/29)	Rpi programs: strlen, strfind,strfindn strfindn using R4, so explain why is must be Preserved as part of register convention	Q3
TUE (3/05)	Rpi programs: strCat, strMid	
THU (3/07)	Rpi programs: uint32ToBinary (used in bro.s), binaryToUint32	
TUE (3/19)	Rpi programs: sum (with crowd sourced solution)	
THU (3/21)	Rpi programs: arrays (dot product and scale)	Q4

TUE (3/26)	Review for Test 2	
THU (3/28)	-	Test 2
TUE (4/02)	Structures with default C align and pack Stress importance of saving project settings (pragma push pack)	
THU (4/04)	Encoding floating point numbers, loss of accuracy	
TUE (4/09)	Rpi programs: float, double, sumF64, meanF64	L2 Due
THU (4/11)	Pipelining and calculating cycle-exact timing	Q5
TUE (4/16)	Virtual memory (mapping PM to VM, page file) Advantages: Security, heap fragmentation, Alloc more than PM Virtual machines	
THU (4/18)	Stack, heap, location of variables in memory PUSH/POP, auto C variables	
TUE (4/23)	Cache, AMAT calculation	
THU (4/25)	Hardware demos Interrupts Putting it all together: Looking at compiled C code in assembly	Q6
TUE (4/30)	Review for Final	
THU (5/02)	-	Final @ 5:30

The instructor reserves the right to make changes in the schedule as needed as the class progresses.

The official dates for registration, census, and dropping are available at www.uta.edu/acadcal.

Academic Integrity

This information is copied from http://www.uta.edu/conduct/academic-integrity/index.php.

The University of Texas at Arlington strives to uphold and support standards of personal honesty and integrity for all students consistent with the goals of a community of scholars and students seeking knowledge and responsibility. Furthermore, it is the policy of the University to enforce these standards through fair and objective procedures governing instances of alleged dishonesty, cheating, and other academic/non-academic misconduct.

Scholastic dishonesty includes, but is not limited to, cheating, plagiarism, and collusion on an examination or an assignment being offered for credit. Each student is accountable for work submitted for credit, including group projects.

- Cheating
    - Copying another's test or assignment (added note: remember this includes homework!)
    - Communication with another during an exam or assignment (i.e. written, oral or otherwise)
    - Giving or seeking aid from another when not permitted by the instructor
    - Possessing or using unauthorized materials during the test
    - Buying, using, stealing, transporting, or soliciting a test, draft of a test, or answer key

- Plagiarism
    - Using someone else's work in your assignment without appropriate acknowledgment
    - Making slight variations in the language and then failing to give credit to the source
- Collusion
    - Without authorization, collaborating with another when preparing an assignment

Institution Information

UTA students are encouraged to review the below institutional policies and informational sections and reach out to the specific office with any questions. To view this institutional information, please visit the Institutional Information page (http://www.uta.edu/provost/administrative-forms/course-syllabus/index.php) which includes the following policies among others:

- Drop Policy
- Disability Accommodations
- Title IX Policy
- Academic Integrity
- Student Feedback Survey
- Final Exam Schedule

Additional Information

Face Covering Policy:
While face coverings are not mandatory, all students and instructional staff are welcome to wear face coverings while they are on campus or in the classroom.

Attendance:
At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator of 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 must 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 Canvas. This date is reported to the Department of Education for federal financial aid recipients.

In this course, attendance in-class, on campus is expected.

Emergency Exit Procedures:
Should we experience an emergency event that requires evacuation of the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, do not take an elevator but use the stairwells instead. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Academic Success Center
The Academic Success Center (ASC) includes a variety of resources and services to help you maximize your learning and succeed as a student at the University of Texas at Arlington. ASC services include supplemental instruction, peer-led team learning, tutoring, mentoring and TRIO SSS. Academic Success

Center services are provided at no additional cost to UTA students. For additional information visit: Academic Success Center. To request disability accommodations for tutoring, please complete this form.

Emergency Phone Numbers

In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381.