CSE2312 Computer Organization and Assembly Language Programming
Spring 2020

Instructor Information

Instructor:
Jason Losh, Ph.D.

Office Number:
ERB 649

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Faculty Profile:
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Office Hours:
Monday 1:15-2:15pm, Wednesday 1:15-2:15pm, and by appointment. Additional hours will be added as needed as the semester proceeds.

Graders:
Grader contact information will be sent to the course listserv after assignments are made.

Course Information

Section Information:
002, 003

Time and Place of Class Meetings:
Section 002: TTh 5:30-6:50pm, ERB 129
Section 003: TTh 7:00-8:20pm, ERB 129

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

- Configuring Rpi 3b+ for SSH
- AAPCS register and calling conventions
- Writing mixed C / assembly programs,D
- 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 designs
- Cycle-exact calculation of pipeline timing
- Interrupts
- Memory virtualization and paging (heap fragmentation, security implications)
- Linux dev/mem operation with memory virtualizion on RPi 3b+

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. 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.

Canvas will be used for homework submission to the Grader and for viewing your Test 1, Test 2, and homework grades.

Textbooks and Other Course Materials:
Raspberry Pi Assembly Language RASPBIAN Beginners, 3rd ed., Bruce Smith, CreateSpace Independent Publishing Platform, ISBN 978-1492135289 (required)

Computer Organization and Design – The Hardware/Software Interface, ARM Edition, David A. Patterson and John L Hennessy, Morgan Kaufman Publishers, ISBN 978-0-12-801733-3 (not required)

All students are required to have a Raspberry Pi 3 (with appropriate accessories to power it and make it work) for both CSE2100 and CSE2312 Sections 002 and 005.
The CanaKit Raspberry Pi 3 kit has been used by many students in the past and is recommended: https://www.amazon.com/CanaKitRaspberry-Complete-Starter-Kit/dp/B01C6Q2GSY/.
Students do not need to buy the above kit, however they need to at least have a Raspberry Pi 3 motherboard, power supply, and 16GB or larger (32GB is better) and reader for your PC.
In addition, students will need the following components at home to work with the Raspberry Pi 3 natively:

- 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. You can use the lab in ERB 126/127 to configure your device.

Major Assignments and Examinations:
Test 1: Thursday, March 5
Test 2: Thursday, April 30
Homework: 4 assignments distributed through the semester

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 (35%), Test 2 (35%), Homework (30%)
- The instructor reserves the right to make reasonable changes in performance evaluation as needed.
- Any request for re-grading must be submitted to the Grader within one week of the completion of grading.

Tests:

- Tests are open-book, open-notes, calculators allowed.
- No makeup will be provided for any test missed.

Homework:

- Plan to submit your homework online at least two hours before the deadline to mitigate any potential connectivity issues.
- Homework that is submitted late will be assessed a 50% penalty.
- Homework late by more than 48 hours will not be accepted.
- Homework is an individual assignment. Discussing homework is allowed, but the submissions must be unique. Sharing of code is not allowed.

Course Schedule

- Integer Numbers (1.5 hrs)
- ALU and Flags (1.5 hrs)
- Bitness of Processor, ALU Register Interface (1.5 hrs)
- Load/store interface, addressing modes, endianness (4 hrs)
- Instructions and Fetch Logic, Basic Program Flow (2 hrs)
- Configuring the Raspberry Pi (static IP, SSH) (1.5 hrs)
- ALU Opcodes (1.5 hrs)
- Flow control Opcodes (1.5 hrs)
- Using the GDB debugger (0.5 hrs)
- Calling convention (1 hr)
- MOV/MOVN/LDR for constant encoding (1 hr)
- Arrays of characters and integers (3 hrs)
- Bit operations, string to/from integer conversion (1 hr)
- Calling subfunctions, register saving convention, PUSH/POP (1 hr)
- Floating-point numbers and encoding (1 hr)
- Floating point examples (2 hrs)
- Comparison of 8088 and ARM7TDMI architectures (1 hr)
- Pipeline and cycle-accurate timing analysis (2 hrs)
- Virtualization, page tables/faults, memory fragmentation issues, memory security (2 hrs)
- Interrupts (2 hrs)
- Cache (4 hrs)

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 acknowledgement
    - 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

Safety Rules for ERB 126 and ERB 127 Labs:

Scope:

- All UTA safety rules and regulations must be followed.
- These rules are in addition to UTA lab safety rules.
- In the event that a rule contained below is in conflict with UTA lab safety rules, the UTA safety rules shall supersede.

General rules:

- Students can only be in the lab when a graduate teaching assistant (GTA), faculty member, or staff member is present.
- Students should be professional at all times in the lab.
- Food and drinks are not allowed in the lab at any time.
- When leaving the bench, turn off all lab equipment and unplug soldering irons.
- When leaving the bench, make sure that all cables, tools, and soldering equipment are properly stored in the correct location.
- Please ensure that the lab is kept in a neat and tidy manner.
- Please pick up any loose wires or parts on the bench and floor before leaving the lab. There is a push broom and dust pan in both rooms.
- Note any hazards observed in the lab to the GTA, faculty, or staff member immediately.
- For test equipment incorporating multi-language menus, such as oscilloscopes, please return the language to English before leaving the bench.
- When returning parts that are not consumables, make certain that the parts are returned to the correct drawer. If you are not certain, please leave them with the GTA, faculty member, or staff member.
- Students should store backpacks and similar items in a way that does not create a trip hazard to others.

Personal protective equipment (PPE):

- Safety glasses must be worn at all times when using the soldering irons or using cutting tools, such as diagonal cutters, in the lab.

Soldering irons:

- Soldering must be performed in the labs only at the soldering benches.
- Soldering irons should be used with care, while wearing safety glasses, and only after receiving training.
- When soldering and removing parts, or reworking a board, please use special care to ensure that solder is not splattered.
- Soldering irons must be placed back in their soldering station holder when not soldering to prevent the chance or injury or fire.
- Please keep the soldering station sponges wet when cleaning the iron tip but ensure that water is not spilled on the floor creating a slip hazard.
- Use the soldering iron smoke absorber fan units when soldering. Use them in the horizontal position to prevent directing air flow across the table to another use.
- Some solders can contain lead, so wash hands thoroughly after using the soldering irons. No eating or drinking is allowed in the lab, as previously stated.
- No self-contained butane soldering irons are permitted.

Hand tools:

- Hand tools must be used with care and only when safety glasses are being worn.
- Diagonal cutters in particular can create tension on the wires during the cutting process, ejecting the loose wire, so please use special care.

Small powered rotary tools:
Short use of powered cutting tools such as “Dremel” or small drill/driver can only be used at the soldering tables using a backup board to prevent damage to the tables.
You must wear safety glasses.
You must remove jewelry, necklaces, and lanyards and tie back long hair.
For extended machining tasks, please use the designated Makerspace areas that are designed to handle the additional safety requirements and dust inhalation hazards instead.

Electrical hazards:
The labs for these classes use voltages of 30V or less, but care must always be shown in using electrical circuits, regardless of the voltage.
Do not use voltages of more than 30V unless approved in writing by the instructor.
Do not modify the wiring or attempt repair of any lab equipment.
Most of the lab equipment operates from 120V AC, which is a lethal voltage. Never pull on a cord to unplug it as this can cause damage to the strain relief and insulation,potentially resulting in exposed conductors.
Please notify the GTA, faculty member, or staff member and stop using the equipment immediately if you see nicks or damage to a power cord.

Computers:

- Students should not install any software on the lab computers without approval of the GTA, faculty member, or staff member.
- Students should not remove any of the cables on the computer and the monitor on the bench.
- For external connection, an HDMI cable is provided at each workstation for configuring Raspberry Pi and similar computer hardware. This cable should not be disconnected from the monitor.

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

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. As the instructor of this section, 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.

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.

Student Success Programs:
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 by appointment, drop-in tutoring, etutoring, supplemental instruction, mentoring (time management, study skills, etc.), success coaching, TRIO Student Support Services, and student success workshops. For additional information, please email resources@uta.edu, or view the Maverick Resources website.

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