

**CSE 2312: Computer Organization
and
Assembly Language Programming
Fall 2016**

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Or if you see door open, just come in

Section Information: CSE2312-001/002

Time and Place of Class Meetings: Tue/Thr Sec-001 - 3:30 - 4:50 pm, ERB 131
Sec-002 - 2:00 - 3:20 pm SH 332

Graduate Teaching Assistant:

Section 001

Name: Shangeetha, Ravichandran Susseelaa

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Section 002

Name: Mark Havens

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Office Hours: ERB 551, Tue – 5:00 – 6:00 pm / Wed – 3:00 – 5:00 pm / or by appointment

Lab Rooms with QEMU and ARM Software: ERB 124, 125, and 131

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 is 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.
- Define different types and levels of computer systems, such as instruction set architectures, device level architectures, 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:

- David A. Patterson and John L. Hennessy, [Computer Organization and Design ARM Edition: The Hardware/Software Interface](#), Morgan Kaufmann, March 2016 (Required, Main Textbook; [Book Website](#))
- Quick-EMUlator (QEMU): [Overview](#), [Homepage](#)
- ARM and Thumb-2 Instruction Set [Quick Reference Card](#)
- ARM [Instruction Summary](#)
- ARM [Register Names](#)
- ARM [Memory Map \(See Section 4.1, 32-bit memory map\)](#)

Optional Textbooks and Additional References:

- Pete Cockerell, [ARM Assembly Language Programming](#)(Online)
- Introduction to ARM Assembly [Web Course](#)
- Stack Overflow: [ARM Assembly Suggestions](#)
- ARM [Floating Point Register Names](#)
- ARM [Directives](#)
- ARM [Condition Codes](#)
- ARM [Detecting Overflow of Arithmetic Operations \(Addition\)](#)
- ARM [Detecting Overflow of Arithmetic Operations \(Multiply\)](#)
- ARM [Conditional Execution](#)
- ARM [versatilepb Manual](#)
- ARM [PrimeCell UART \(PL011\) Manual](#)
- ARM [Floating Point Instructions](#)
- GNU ARM [Assembler \(as\) Manual](#)
- [ARM gcc](#)
- Andrew S. Tanenbaum, [Structured Computer Organization, 6th Edition](#). Prentice-Hall, Inc., 2012.
(Optional; focuses primarily on x86)

- Kip Irvine, [Assembly Language for Intel-Based Computers, 6th Edition](#), Prentice-Hall, Inc., 2011.
- (Optional; focuses on x86)
- Paul A. Carter, [PC Assembly Language](#), July 2006. (Optional; focuses on x86; [Free PDF Available](#))
- Any student can optionally subscribe (for a fee) to the [zyBook](#) website to practice hands on programming in Assembler. Follow the instruction below to subscribe:
 - Sign up at [zyBooks.com](#)
 - Enter zyBook code **UTArlingtonCSE2312KashefiFall2016**
 - Click Subscribe

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 3 of the Patterson and Hennessy textbook. The second half of the course will include fewer homework assignments, but several programming assignments in assembly language, and a final exam cover roughly chapters 4 and 5 of the Patterson and Hennessy textbook. In class or online quizzes and discussions will make up a portion of the grade. Approximate due dates of assignments are shown in the course schedule.

Attendance:

At The University of Texas at Arlington, taking attendance is not required. Rather, 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, students are strongly encouraged to attend lectures (particularly due to some graded in class quizzes), come to office hours, and make use of all available educational resources. 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.

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	25%
• Quizzes and Participation	10%
• Midterm Exam:	20%
• Final Exam:	20%
=====	=====
Total	100 %

Letter grades will be determined based on the following ranges:

Final Grade =	$0.25 \times \text{HW} + 0.25 \times \text{PA} + 0.10 \times \text{Quiz} + 0.20 \times \text{Mid_Exam} + 0.20 \times \text{Final_Exam}$
A	90 -100%
B	80 - 89 %
C	70 - 79%
D	60 - 69%

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 Grievance:

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 [here](#)).

The first step is as follows. If you do not believe a grade on a particular assignment is correct, you may appeal the grade in writing (by email) within 5 days. Grade appeals must be appealed to the appropriate GTA first, then to the instructor if necessary.

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 Policy: 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 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 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 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. Additional information is available at <https://www.uta.edu/conduct/>.

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>.

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. Students’ 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. 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.

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, or view the information at www.uta.edu/resources.


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.

Tentative Schedule & Homework Assignments

CSE 2312 Sec 001/002 Fall 2016

Week	Date	Reading	Topic	Assignment & HWs
1	08/25 ~ 01/27	Ch.1	<ul style="list-style-type: none"> • Introduction • Structured Computers 	Installation of VM machine & QEMU and gdb
2	08/29 ~ 09/03	Ch.1	<ul style="list-style-type: none"> • Computer Components: Processors, Memory, Input/output. • Quantifying Computer Components: Metrics like Clock Speed, Memory Sizes, etc. 	Installation of VM machine & QEMU and gdb Homework 1 Assigned
3	09/05 ~ 09/10	Ch.2	<ul style="list-style-type: none"> • Operations of the Computer HW • Operands of the Computer HW • Instruction Set Architectures • Data and Instruction Types • Assembly Language, Directives 	Homework 1 Due Homework 2 Assigned
4	09/12 ~ 09/17	Ch.2	<ul style="list-style-type: none"> • Assembly Language, Directives • Basic ARM Examples • Procedures, recursive Procedures • Flow of Control 	Homework 2 Due Homework 3 Assigned
5	09/19 ~ 09/24	Ch.3	<ul style="list-style-type: none"> • Data Representation in Computer Systems • Arithmetic for Computers • Floating Point Numbers • Memory Addressing Modes • Endianess 	Homework 3 Due Homework 4 Assigned
6	09/26 ~ 10/01	Ch.4	<ul style="list-style-type: none"> • Processor Fundamentals • Overview of Pipelining • Processor Pipeline Introduction • Parallelism via Instruction 	Homework 4 Due
7	10/03 ~ 10/08	Mid-Exam	<ul style="list-style-type: none"> • Mid-term Review • Midterm Exam • Mid-term post review 	No Assignments
8	10/10 ~ 10/15	Ch.5	<ul style="list-style-type: none"> • Exploiting Memory Hierarchy • Memory Technology • The Basics of Caches • Dependable memory • 	Programming 1 Assigned
10	10/17 ~ 10/22	Ch.5	<ul style="list-style-type: none"> • Virtual Machine • Running ARM programs in QEMU • Debugging ARM programs with gdb <ul style="list-style-type: none"> – Procedures – Recursive Procedures • Debugging QEMU with gdb 	Programming 1 Due Programming 2 Assigned
11	10/24 ~ 10/29	Ch.4	<ul style="list-style-type: none"> • Debugging ARM programs with gdb <ul style="list-style-type: none"> – Procedures – Recursive Procedures • Debugging QEMU with gdb 	Programming 2 Due Programming 3 Assigned

12	10/31 ~ 11/05	Ch.4	<ul style="list-style-type: none"> • ARM Memory Map Details, Linking and Loading • Interrupts, Traps, and I/O: Focus on Output 	Programming 3 Due Programming 4 Assigned
13	11/07 ~ 11/12		<ul style="list-style-type: none"> • More I/O (Focus on DMA) 	Programming 4 Due Programming 5 Assigned
14	11/14 ~ 11/19		<ul style="list-style-type: none"> • Advanced Flow of Control • Computer Organization Review using ARM as an Example 	Programming 5 Due
15	11/21 ~ 11/26		Thanksgiving holiday 	Review & Practice
16	11/28 ~ 12/03	Review	<ul style="list-style-type: none"> • More GDB Debugging and Combining C and Assembly 	Last day of classes
17	12/05 ~ 12/07	Final Exam	Dec. 15, 2016	Sec 001 (2:00-4:30 pm)
		Final Exam	Dec. 13, 2016	Sec 002 (2:00-4:30 pm)