EE6313/4312 Advanced Microprocessor Systems

Fall 2022

(subject to change prior to the first day of class)

Instructor Information

Instructor:

Jason Losh, Ph.D.

Office Number: ERB 649

Office Telephone Number: +1 817-272-3785 (CSE Department)

Email Address:

jlosh@uta.edu

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

Office Hours:

Office hours will be held before and after each class, since this time is most convenient to students. Office hours are also available by appointment.

Teaching Assistants:

Due to the requirement that this syllabus be posted 30 days before the beginning of classes, no TA information is available. This will be given out during the first day of class and is not part of the syllabus.

Course Information

Section Information:

001

Time and Place of Class Meetings:

MW 2:30-3:50pm. ERB 131 This is a 100% face-to-face course. This is not an online course.

Description of Course Content:

Study of the advanced microprocessor architectures including 32/64-bit RISC and CISC families of microprocessors will be compared based on detailed architectural analysis of the selected devices. Topics include: address/instruction pipelines, burst cycles, memory caching and cache coherency issues, register renaming, speculative instruction execution and other performance-oriented techniques. Prerequisite: EE5313 or EE4312.

Student Learning Outcomes:

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

- CPU Design: ALU, Registers, Memory Interface, Control Unit
- Instruction Set Attributes: Minimalism, Orthogonality, RISC/CISC
- Predication, Speculative Execution, and Out of Order Execution
- Protected Operating System Basics
- Privileged v. Unprivileged Operation
- Multitasking Operating Systems

- Pipelining: Design, Hazards, Stall/Forwarding Resolution
- Parallelism and Superscalar Architectures
- Cache Memory Design: Mapping, Miss/Hit, Replacement, Write-back Strategies
- Virtual Memory: Paging, Segmentation, Translation and Look-aside Buffers
- High-speed I/O Design, Modern Protocols: PCIe, SATA

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 CSE6313-L listserv by sending an e-mail from your UTA e-mail account to <u>listserv@listserv.uta.edu</u> from your UTA e-mail account (no subject line needed) and the command SUBSCRIBE CSE6313-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:

No textbook will be required for this course. Extensive references, datasheets, application notes, and class notes will be provided on the course web site at <u>http://omega.uta.edu/~jlosh/</u>.

Major Assignments and Examinations:

Project 1: Wednesday, October 19 Project 2: Wednesday, November 30

Technology Requirements:

The computer must also have word processing, spreadsheet, and drawing productivity tools for creation of the project submissions.

Grading Information

Grading:

- Grade scale: A (90-100), B (80-89), C (70-79), D (60-69), and F (0-59)
- Grade calculation: Project 1 (50%), Project 2 (50%)
- 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 working outside of class. Hence, for this 4-credit course, a minimum expectation of 12 hours of study is expected in addition to the time spent in lecture.

Projects:

- Each project is expected that it will take approximately 80 hours to complete.
- Projects teams will consist of 1 or 2 students only. Work should not be shared between teams.

Course Schedule

The anticipated lecture order is as follows:

- Differences between Harvard and von Neuman architectures (0.5 hrs)
- Differences of microcontroller and microprocessor architectures (0.5 hrs)
- Comparison of standard microprocessor and digital signal processor memory bus and ALU architectures (0.5 hrs)
- ALU design, ALU-register interface in load-store architectures (1.5 hrs)
- Fetching and control logic (3 hrs)
- Instruction set design as a function of selected architecture (1 hr)
- Instruction encoding (1 hr)
- Register-memory interface (1 hr)
- Complete 4-stage pipeline design (5 hrs)
- Hazards and techniques to mitigate: stalling, data forwarding, speculation (2 hrs)
- Predication, Speculative Execution, and Out of Order Execution (1.5 hrs)
- Superscalar and VLIW (1.5 hrs)
- Instruction-level parallelism (1 hr)
- Thread-level parallelism, multiprocessor, multicore designs (3 hrs)
- Multitasking Operating Systems (2 hrs)
- Security aspects, protected operating systems, concept of privilege (1.5 hrs)
- Virtualization of memory and paging (2 hrs)
- Cache controller design (6 hrs)
- High-speed I/O busses and design issues (1.5 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.

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 <u>Institutional Information</u> 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. Attending tests and laboratories in person is required.

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: <u>Academic Success Center</u>. To request disability accommodations for tutoring, please complete this <u>form</u>.

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