CSE4372 RISC Processor Design
CSE5392 Topics in Computer Science
Spring 2025

As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course.

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Instructor Information

Instructor Name
Jason Losh, Ph.D.

Office Location
ERB 649 (office hours will be held in the ERB 121-126 lab area)

View Campus Map

Office Phone 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.

Communication Guidelines
Communication with me outside class should be through e-mail. I will respond to emails on M-Th within 24 hours in most cases.

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 CSE4372-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 CSE4372-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.

Course Information

Section Information
Section 4372-001 and 5392-072

Course Delivery Method
This course is 100% face-to-face in person.

For a full definition of the course modalities, please visit the Course Modalities page.

Time and Place of Class Meetings
TTh 5:30-6:50pm, ERB 129

This is a 100% face-to-face course. This is not an online course.

Time Zone
This course operates on Central Time. All times listed for class meeting times, exams, and assignment deadlines are in Central Time.

Description of Course Content
Design of a RISC processor, based on RISC-V and custom instruction set architectures with implementation on an FPGA target for test and verification.

Prerequisites
C or better in CSE 3442 or 5400.

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

1. CPU Design: ALU, Registers, Memory Interface, Control Unit
2. RISC-V Architecture and RV32IZmmul ISA
3. On-chip and SDRAM Memory Access from FPGA
4. Pipeline Design
5. Data, Structural, and Control Hazards
6. Stall/Forwarding Resolution
7. RISC Implementation on FPGA

Textbooks and Other Course Materials
No textbook will be required for this course.

Required Textbooks and Materials
An FPGA board will be checked out to student for use.

Recommended Course Materials
Extensive references, datasheets, application notes, and class notes will be provided on the course web site at http://ranger.uta.edu/~jlosh/.

Descriptions of major assignments and examinations

Labs: 6-8 labs spread across the semester
Project: Tuesday, April 29

Labs:

- Labs are individual assignments. Discussing lab topics is allowed, but the submissions must be unique. Sharing of code is not allowed.

Project:

- Projects are individual assignments. Discussing project topics is allowed, but the submissions must be unique. Sharing of code is not allowed.
- Interim deadlines will occur as part of the lab exercises.
- Extra work will apply to CSE 5392 students.

Expectations for Out-of-Class Study

For every credit hour earned, a student should spend 3 hours per week working outside of class. Multiply the number of credit hours for the course by 3 to determine study hours. A 3-credit hour course would require 9 additional study hours per week.]

Beyond the time required to attend each class meeting, students enrolled in this 3 credit-hour course should expect to spend at least an additional 9 hours per week of their own time in course-related activities, including reading required materials, completing assignments, preparing for exams, etc.

Technology Requirements

The computer and OS must be capable of running GNU cross-compiler tools for the RISC-V. Ubuntu is used in the labs and lectures.

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

Visit the UTA Libraries Technology page for a list of items that can be checked out or used at the library.

Recording of Classroom and Online Lectures

Faculty maintain the academic right to determine whether recording of classroom and online lectures is permitted by students. Recordings of classroom lectures, if permitted by the instructor or pursuant to an ADA accommodation, may only be used for academic purposes related to the specific course and may not be used for commercial purposes or shared with non-course participants except in connection with a legal proceeding.

As the instructor of this course, I elect to prohibit recording of classroom or online lectures.

Other Requirements

N/A

Graded Assignments & Values

Assignment Name		Value (pts or %)
Labs	All	50 pts
Project	All	50 pts
	Total	**100 pts**

Students are expected to keep track of their performance throughout the semester which Canvas facilitates and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels; see “Student Support Services,” below.

Final Grade Calculation

Range (pts or %)	Letter Grade
90-100	A
80-89	B
70-79	C
60-69	D
0-59	F

Make-Up Exams & Late Work Policy

No late work will be accepted.

Extra Credit Policy

Extra credit may be available as part of projects.

Grades & Feedback Timeline

Projects:

- The projects will consist of hardware construction and firmware development and it is expected that it will take approximately 90 hours to complete in total.
- All 3 projects are individual assignments. Discussing project topics is allowed, but the submissions must be unique. Sharing of code is not allowed.
- An interim deadline for hardware construction will apply.
- While the lecture content of this course is shared across multiple courses, students enrolled in a graduate course will have additional project components assigned.

Grade Grievances

Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current University Catalog Grades and Grading Policies.

University & Course Policies

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 (https://resources.uta.edu/provost/course-related-info/institutional-policies.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

N/A

Attendance

Attending class sessions is a critical predictor and indicator of student success. The University of Texas at Arlington does not recognize a single attendance policy but encourages faculty to establish class-specific policies on attendance. In this course, attendance in-class, on-campus is expected. Attending tests and laboratories in person is required.

The U.S. Department of Education requires that UT Arlington have a mechanism in place to verify Federal Student Aid recipients' attendance in courses. UT Arlington instructors are expected to report the last date of attendance when submitting students' final course grades; specifically, when a student earns a course grade of F, instructors must report the last date a student attended their class. For on-campus classes, last date of attendance can be based on attendance rosters or on academic engagements—a test, participation in a class project or presentation, or Canvas-based activity. Online or distance education courses require regular and substantive online interaction and participation. Students must participate in online course activities in Canvas to demonstrate attendance; logging into an online class is not sufficient by itself to demonstrate attendance. The last date of attendance is reported to the U.S. Department of Education for federal financial aid recipients.

Generative AI Use in This Course

The use of Generative AI (GenAI) in course assignments and assessments must align with the guidelines established by the instructor. Unauthorized use of GenAI could result in breaches of academic integrity. Instructors bear the responsibility of clearly delineating the permissible uses of GenAI in their courses, underscoring the importance of responsible and ethical application of these tools.

The UTA Office of Community Standards articulate the university's stance on academic integrity and scholastic dishonesty. These standards extend to the use of GenAI. Unauthorized or unapproved use of GenAI in academic work falls within the scope of these policies and will be subject to the same disciplinary procedures.

As the instructor of this course, I have adopted the following policy on Student use of GenAI:

Approach	Description
Prohibition of GenAI Use	In this course, the focus is on the development of independent critical thinking and the mastery of subject-specific content. To ensure that all submitted work accurately reflects personal understanding and original thought, the use of Generative AI (GenAI) tools in completing assignments or assessments is strictly prohibited. This policy supports our commitment to academic integrity and the direct measurement of each student's learning against the course's Student Learning Outcomes (SLOs). Any work found to be generated by AI will be subject to academic review.

Academic & Wellness Resources

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 (https://www.uta.edu/student-success/course-assistance). To request disability accommodations for tutoring, please complete this tutoring request form (https://www.uta.edu/student-success/course-assistance/tutoring/request).

The English Writing Center (411LIBR)

The Writing Center offers **FREE** tutoring in 15-, 30-, 45-, and 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Register and make appointments online at the Writing Center (https://uta.mywconline.com). Classroom visits, workshops, and specialized services for graduate students and faculty are also available. Please see Writing Center: OWL (http://www.uta.edu/owl) for detailed information on all our programs and services.

Academic Plaza

The Library's 2nd floor Academic Plaza (http://library.uta.edu/academic-plaza) offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library's hours (https://library.uta.edu/hours) of operation.

UTA CARE Team

UT Arlington is committed to the safety, success, and well-being of our students. To support our community, UTA has created a CARE Team, which is a dedicated group of campus professionals responsible for helping students who could benefit from academic, emotional, or psychological support, as well as those presenting risk to the health or safety of the community. If you know of someone experiencing challenges, appearing distressed, needing resources, or causing a significant disruption to the UTA community, please submit a CARE Referral by visiting the Behavior Intervention Team (https://www.uta.edu/student-affairs/dos/behavior-it) page. You may also submit a referral for yourself if you would like additional support.

NOTE: If a person's behavior poses an immediate threat to you or someone else, contact UTA Police at 817-272-3303 or dial 911. If you or someone you know needs to speak with a crisis counselor, please reach out to the MAVS TALK 24-hour Crisis Line (https://www.uta.edu/student-affairs/caps/crisis)at 817-272-8255 or the National Suicide and Crisis Lifeline (https://988lifeline.org/) at 988.

Student Services

Everything you need to make the most of your time as a student (and beyond) is all on campus. Below are a few resources to get you started.

- Student Services Home
- Student Access and Resource (SAR) Center
- Military and Veteran Services
- Health Services
- Counseling and Psychological Services (CAPS)
- Activities and Organizations
- Recreation

Librarian to Contact

Each academic unit has access to Librarians by Academic Subject (https://libraries.uta.edu/research/librarians) that can assist students with research projects, tutorials on plagiarism and citation references as well as support with databases and course reserves.

Safety Information & Resources

Lab Safety Safety Rules for ERB 121-127 and 132 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 teaching assistant (TA), faculty member, or staff member is present.
- Students should be professional at all times in the lab.
- Food is not allowed in the lab at any time. Drinks, including those in sealed container, is not allowed in the lab. The only exception to this rule in the marked tables in ERB 125.
- When leaving the lab, all work surfaces and floors should be clear of breadboards, cables, wires, and tools prior to leaving.

- 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.
- Note any hazards observed in the lab to the TA, 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 TA, faculty member, or staff member.
- Students should store backpacks and similar items in a way that does not create a trip hazard to others. In ERB 126 and 127, there are cabinet spaces at the base of the benches for this purpose.

Soldering irons:

- Soldering must be performed in the labs only at the soldering benches. Never solder in dorm rooms.
- 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 (air exits upward) to prevent directing air flow across the table into the face of another user.
- Some solders can contain lead, so wash hands thoroughly after using the soldering irons. No eating or drinking is allowed at the soldering benches. The green solder spools in the lab generally indicate a lead-free solder.
- No self-contained butane soldering irons are permitted.
- Wear appropriate personal protection equipment (PPE).

Chemicals and lasers:

- In labs where chemicals or lasers are used, students and faculty must receive the appropriate safety training prior to working in the lab.
- In labs with chemicals, consult the safety data sheet (SDS) folder for information.
- Wear appropriate personal protection equipment (PPE) at all times.
- If transferring chemicals to secondary containers, clearly mark the contents of the container. Specially, a label with spelled out chemical name and hazards is required. Also, for water bottles, label as “not for human consumption on the bottle.” A green dot can also be attached to indicate that the chemical is not hazardous.

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.
- Wear appropriate personal protection equipment (PPE).

Power tools:

- Short time use of small powered cutting tools such as a drill/driver can only be used at the soldering tables using a backup board to prevent damage to the tables.
- For extended machining tasks, please use the designated Makerspace areas that are designed to handle the additional safety requirements and dust inhalation hazards.
- Wear appropriate personal protection equipment (PPE).
- Jewelry, necklaces, and lanyards should be removed.
- Long hair should be tied back to prevent being caught in the tool.
- For labs with drill presses, band saws, laser cutters, CNC machines, and similar equipment, students must take the appropriate safety trainiafng prior to using the equipment.

Electrical hazards:

- The labs for these classes generally use voltages of 32V or less, but care must always be shown in using electrical circuits, regardless of the voltage.
- Do not use voltages of more than 32V 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 electrical conductors.
- Please notify the TA, faculty member, or staff member and stop using the equipment immediately if you see nicks or damage to a power cord or other hazardous conditions.

Computers:

- Students should not install any software on the lab computers without approval of the TA, faculty member, or staff member.
- Students should not remove any of the cables on the computer and the monitor on the bench.
- In some labs, an HDMI cable is wired into each workstation for configuring Raspberry Pi and similar computer hardware. This cable should not be disconnected from the monitor.

No device connected to the wired network of a lab should also have a WiFi connection enabled as this represents a security risk. This includes both personal student laptops and activating WiFi direct on printers.

Face Covering Policy

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.

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, which is located to the left. 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.

MavAlert System

The MavAlert system sends information in case of an emergency to cell phones or email accounts of subscribed users. Anyone can subscribe to MavAlerts at Emergency Communication System (https://www.uta.edu/uta/emergency.php).

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

Course Schedule

Class Date(s)	Topic(s)	Materials	Assignments Due
Week 1-7	Lab 1-4, Project	• GNU cross-compiler toolchain, ELF files, Machine code extraction • System Verilog examples • RISC-V RV32IZmmul ISA • RISC-V RV32I 4-stage Pipeline Design (IF/ID-RR/EX-M/WB) • ALU design and RISC-V func3/func7/opcode to ALU control mapping • RV32I compatible register file (parallel rs1 read, rs2 read, writeback) • Inferring On-chip M9K memory (and common synthesis errors with async reads) • Initializing memories with program data and constants with bit-streams • PC counter design (linear code flow for now) • I-memory and instruction word fetching • Immediate sign-extension and control unit signals from instruction word • Register read (no data forwarding from WB for now) • ALU args solely from registers and immediates (no data forwarding from WB or EX for now) (no PC jump/branch calculations in ALU for now) • ALU control from f3/7/op and ALU output • Expanding ALU operation for address generation • Expanding ALU for PC calculations	Various dates

Class Date(s)	Topic(s)	Materials	Assignments Due
Week 8-15	Labs 5-8, Project	• Adding Zmmul and Zicsr support • Data memory and support for 8-, 16-, and 32-bit signed and unsigned data r/w • Register writeback from memory or ALU operation • Data forward from WB stage to RR stage • Data forward from WB stage and EX stage to EX stage • Stall generation (when all else fails) • Branch unit and branch argument forwarding from WB, M, and EX stages • Flush logic	Various dates