ECE 422 Reliable and Secure Systems Design

Winter 2024 - January 08 to April 12

Class time: Monday, Wednesday, Friday 12:00-12:50 Location: ETLC E2-002

Instructor:

An Ran Chen, PhD
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Donadeo Innovation Centre For Engineering 11-366
Office Hours: MWF 13:00 - 13:30 (by appointment)

Course Description:

*3 (fi) (either term, 3-0-0) Causes and consequences of computer system failure. Structure of fault-tolerant computer systems. Methods for protecting software and data against computer failure. Quantification of system reliability. Introduction to formal methods for safety-critical systems. Computer and computer network security.

Prerequisites: CMPUT 301.
Corequisite: ECE 487.
Credit may be obtained in only one of CMPE 420 or ECE 422

Course synchronous and asynchronous content delivery schedule:

TA Information:

Ronald Unrau rcunrau@ualberta.ca
Zhijie Wang zhijie.wang@ualberta.ca

Course Objectives & General Content:

This course will introduce students to software system reliability engineering and computer security, in two six-week modules.

In the system reliability module, we will examine the similarities and differences between reliability engineering for hardware systems and for software systems, and techniques for achieving software reliability. Software fault tolerance mechanisms will be the main focus.

In the computer security module, we will examine the potential threats to computer system security, and controls for protecting computer systems against both malicious and non-malicious compromise. By its nature, computer security extends beyond the domain of software, and encompasses the entire environment in which a computer system is embedded. Therefore, this module will examine both software and non-software threats and controls.

Learning Outcomes:

By the end of this course, students should be able to:

1. Determine the reliability of a system, either from analysis of its components and their interactions, or by fitting a known model to observed reliability data.
2. Design a fault-tolerant software component to deliver specified services.
3. Analyze the security of a built system, synthesize plausible controls for any identified weaknesses, and evaluate the costs and benefits of each proposed control.
4. Design a software system to securely perform specified tasks.

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Project 1 Deliverable		Wednesday, January 24, 2024	5%
Project 1 Final Report		Wednesday, February 7, 2024	15%
Project 2 Deliverable		Friday, March 15, 2024	10%
Project 2 Final Report		Monday, April 8, 2024	15%
Midterm Exam		Tentative - Monday, February 26, 2024	25%
Final Exam		Tentative - Friday, April 19, 2024	30%

The Faculty recommended grade point average for a 400 level course is 3.1. Instructors have the leeway to deviate from this average and can assign grades based on their own scheme. All grades are approved by the department chair (or delegate). The office of the Dean has final oversight on all grades.

Term Work

All term work solutions will be posted no later than the last day of classes. All term work will be returned to students by the final day of classes, with the exception of major term work due in the last week of classes. The latter will be returned by the day of the final examination or the last day of the examination period if there is no final examination in the course as per university policy; instructors will make accommodations to return these term work. It is the responsibility of the student to pick up all their term work at the specified time and place. Any unreturned term work, shall be retained and then shredded six months after the deadline for reappraisal and grade appeals. Final examinations will be kept for one year as required by university guidelines and the Government of Alberta's Freedom of Information and Protection of Privacy Act.

Calculator Policy

There is no calculator policy in this course; students are free to use the calculator they wish for all assessments.

Text and References (Mandatory):

1. Marteen van Steen, Andrew S. Tanenbaum, "Distributed Systems", 4rd edition version 01, distributed-systems.net, 2023. https://www.distributed-systems.net/index.php/books/ds4/

2. C.P. Pfleeger, S.L. Pfleeger, J. Margulies, “Security in Computing, 5th Ed.”, Pearson Education, 2015.

3. Heather Adkins, Betsy Beyer, Paul Blankinship, Piotr Lewandowski, Ana Oprea, Adam Stubblefield, “Building Secure and Reliable Systems: Best Practices for Designing, Implementing, and Maintaining Systems”, O'Reilly Media, 2020. https://sre.google/books/building-secure-reliable-systems/

Text and References (Recommended):

1. Betsy Beyer, Chris Jones, Jennifer Petoff and Niall Richard Murphy, “Site Reliability Engineering: How Google Runs Production Systems”, O'Reilly Media, Incorporated, 2016. https://research.google/pubs/site-reliability-engineering-how-google-runs-production-systems/

2. Israel Koren and C. Mani Krishna, “Fault-Tolerant Systems”, Elsevier, 2010. Available online: UofA Library

Website:

eClass

Previous Examples of Evaluative Materials:

Sample exam questions will be made available on eClass.

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit http://www.deanofstudents.ualberta.ca/ for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

COURSE CONTENT ECE 422 LEC B1 - Winter 2024 - RELIABLE SECURE SYSTEMS DESIGN

Week	Starting	Topics	Notes
Week 1	January 8, 2024	DevOps Site Reliability Engineering	
Week 2	January 15, 2024	Reliable and Fault-Tolerant Design	
Week 3	January 22, 2024	Software Redundancy Information Redundancy	Project 1 Deliverable Due
Week 4	January 29, 2024	Hardware Redundancy Time Redundancy Dining Philosophers Problem	
Week 5	February 5, 2024	Secure Design and Authentication	Project 1 Final Report Due
Week 6	February 12, 2024	Access Control and Encryption	
Week 7	February 19, 2024	**No classes**	Reading week
Week 8	February 26, 2024	Programs and Programming	Midterm Exam
Week 9	March 4, 2024	Web-User Side	
Week 10	March 11, 2024	Networks	Project 2 Deliverable Due
Week 11	March 18, 2024	Database	
Week 12	March 25, 2024	Writing Secure and Reliable Code	
Week 13	April 1, 2024	Testing for Reliability and Security	
Week 14	April 8, 2024	Monitoring and Investigating for Reliability and Security	Project 2 Final Report Due
Week 15	April 15, 2024	**No classes**	Final Exam

UNIVERSITY AND FACULTY POLICIES

COURSE OUTLINE POLICY

The policy about course outlines can be found in Course Requirements, Evaluation Procedures and Grading of the University Calendar, see https://calendar.ualberta.ca/

RESPECT AND PROFESSIONALISM

The Faculty of Engineering is committed to fostering and protecting an equitable, inclusive, and respectful work and study environment in line with University of Alberta policies and professional engineering industry standards. University is an opportunity for students to explore areas of interest and to potentially pursue a career in a specific field. The Faculty of Engineering prepares students to uphold industry standards to become a Professional Engineer (P. Eng). Respect, professionalism, and accountability must be upheld within the Faculty of Engineering.

Harassment and discrimination are serious issues that have a negative effect on culture and therefore the Student Conduct Policy states that no student shall discriminate against or harass any person or group of persons. The Faculty expects an environment free of harassment, discrimination, and bullying. Please refer to the Definitions for Discrimination, Accommodation and Harassment.

SAFETY DURING LEARNING ACTIVITIES

In all Faculty of Engineering courses, labs, seminars or other learning activities, safety is of paramount importance. In some cases, laboratory work in a program requires high standards for risk management to keep potential hazards safely under control. Anyone found to be unable to function safely, due to intoxication, harassment or discriminatory behaviour, or other reasons, in the class, lab, seminar or other learning activity may be asked to leave or be removed for their and the safety of other participants and instructors in alignment with the Student Code of Behaviour or Student Conduct Policy. As members, or prospective members, of the engineering profession, it is your responsibility to identify and inform the proper authorities of an unsafe work/learning environment.

AUDIO/VIDEO RECORDING

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Only those items specifically authorized by the instructor may be brought into the exam facility. The use of unauthorized personal listening, communication, recording, photographic and/or computational devices is strictly prohibited. Students should refrain from bringing any unauthorized electronic device into an examination room, including cell phones, high tech watches, high tech glasses or other such devices.

ACADEMIC INTEGRITY

Students at the University of Alberta must follow, in its entirety, the **Code of Student Behavior.** Failure to know the Code is not an acceptable excuse for breaking the Code.

If you have not already done so, make sure you review the Code, which is found here along with other resources: https://www.ualberta.ca/natural-applied-sciences/portfolio/education/academic-integrity-and-discipline.html

Engineering students studying in the province of Alberta should also follow the **Code of Ethics** by The Association of Professional Engineers and Geoscientists of Alberta (APEGA), which is found here: https://www.apega.ca/members/legal-obligations

The Code of Student Behavior should not be too hard to follow. Listen to your instructor, be a good person, and do your own work, as this will lead you toward a path to success. Failure to follow the Code can result in a grade of 'F' for the course, a transcript remark, suspension, and even expulsion from the university.

"Integrity is doing the right thing, even when no one is watching" C.S. Lewis

Engineering at Alberta

NEED HELP?

There are a lot of services available to students on campus and in Edmonton, and sometimes it's hard to know where to go. While this isn't a comprehensive list, the services shown here should at least give you some ideas about where to start. If you're still not sure, check out the services just beneath this box—they'll give you the guidance you're looking for.

DON'T KNOW WHERE TO GO?

Student Service Centre

The U of A's central hub to find the right help for your needs.
uab.ca/ask

24/7 HELP

Empower Me (international)
1-833-628-5589

Edmonton Distress Line
780-482-4357 (HELP)

WELLNESS

Wellness Supports
Free 1:1 support for students in the areas of housing, finances, academics, personal wellness, life skill development, family dynamics, system navigation, and any area of life where there is a desire to invite change.
P: 780-492-1619 | E: wellness@ualberta.ca
M-F, 8:30am-4:30pm (Sep-April), 8:00am-4:00pm (May-Aug)

Counselling and Clinical Services
Free, short-term, appointment-based counselling and psychiatric services. Also offers drop-in workshops. Book an initial consultation.
P: 780-492-5205 | M, R, F, 8:00am-4:00pm; T, W, 8:00am-7:00pm

Interfaith Chaplains' Association
Get guidance, care, and support, whether or not you identify with a particular faith. Make an appointment.
P: 780-492-0339 | E: interfaithchaplains@ualberta.ca

The Landing
Offers drop-in support on matters of gender and sexual diversity.
P: 780-492-4949 | E: thelanding@su.ualberta.ca | M-R, hours vary

Peer Support Centre
Anonymous, confidential help from trained students. By appointment only.
P:780-492-4268 | E: psc@su.ualberta.ca | M-F, 9:00am-8:00pm

Sexual Assault Centre
Free, anonymous, and confidential drop-in counselling.
P: 780-492-9771 | E: sexualassaultcentre@ualberta.ca
M-F, 9:00am-8:00pm

University Health Centre
An on-campus health clinic that provides medical services to staff, students, and their spouses and children.
P: 780-492-2612 | E: hws@ualberta.ca | M-F, 8:30am-4:00pm

ACADEMIC

Engineering Student Services
Drop-in, first-come, first-served advising.
E: enggadvising@ualberta.ca

Engineering Student Success Centre
Drop-in tutoring for first-year courses.
E: dessc@ualberta.ca

Academic Success Centre
Many services to maximize your academic success. E: success@ualberta.ca | M-F, 8:30am-4:30pm

Academic Accommodations
Connects students with disabilities to accommodations. E: arrec@ualberta.ca
M-F, 8:30am-4:30pm

Office of the Student Ombuds
Call for complex problems and conflict mediation.
P: 780-492-4689 | E: ombuds@ualberta.ca

FINANCIAL

Student Service Centre
For awards and other funding supports.
uab.ca/ask

Campus Food Bank
Many food support options available. E: info@campusfoodbank.com

SOCIAL

Unitea
Arrange a time to socialize with a peer.
E: unitea@ualberta.ca

BearsDen
U of A webpage. Find student groups, local events, and volunteer opportunities.

WORRIED ABOUT SOMEONE?

Helping Individuals at Risk (HIAR)
If you're worried about someone because of the things they've been saying or doing, or there's a noticeable change in their behaviour (often in multiple ways), contact HIAR, who will protect your confidentiality and help decide how best to support the person.

780-492-4372
hiarua@ualberta.ca

CONFIDENTIAL SUPPORT

Office of Safe Disclosure and Human Rights

The OSDHR advises confidentially on sensitive issues you may not feel comfortable solving on your own. Contact the OSDHR if you want to get help or to make a report while keeping your privacy.

780-492-7357
osdhr@ualberta.ca