

COURSE SYLLABUS

CMPT 434: COMPUTER NETWORKS

Catalogue Description

The principles and practice of computer networking, focusing on the Internet and its structure, protocols, and applications. Topics include network applications and programming, reliable data transfer, flow and congestion control, routing, multimedia networking, local area networks, security, and network management.

Prerequisite: CMPT 332.
Students with credit for CMPT 424 may not take this course for credit.

Class Time & Location: M W F, 9:30-10:20, Arts 214
No Tutorials

Website: Moodle

Instructor Information

Instructor: Derek Eager

Contact: Email: eager@cs.usask.ca
Office Phone: 4899

Office Hours: Location: Thorv 281.2
Hours: feel free to drop by my office anytime, or make appointment via email

Course Overview and Objectives

This course provides a comprehensive survey of the design and organization of computer networks. After beginning with some background on the fundamentals of data communication and communication infrastructures, and on socket programming, the course will largely follow a bottom-up approach, covering protocols for reliable data transfer, multiple access protocols, layer 2 networks, routing, congestion control, quality of service, and transport layer protocols, before finally looking at some important applications and the cross-cutting issues of network security. The principles we discuss will be made concrete through study of existing systems, most notably the Internet and its structure, protocols, and applications.

Assignments will involve both programming (specifically, **socket programming using C on Linux**) and non-programming problems. There will also be a group project that can take the form of either a critical survey of a current issue in networking research, or an implementation.

After completing this course, students should be able to:

- Define and describe the layered structure of a typical networking architecture.
- Design and potentially implement network protocols.
- Describe the components of network addressing in IPv4 and IPv6 and how addresses are used in routing and forwarding.
- Implement applications using reliable and unreliable socket communication.
- Compare and contrast the various approaches to multiple-access communication channels.
- Describe the organization of wireless networks and the support for mobile users.
- Implement, simulate, and/or evaluate methods of congestion control with respect to issues of performance and fairness.
- Compare and contrast how frames/packets are delivered between hosts and switches/routers at the data link and network layers.
- Evaluate the need for and effectiveness of error detection/correction mechanisms in different network

contexts.

- Determine the role and appropriate use of encryption and decryption algorithms in network applications.
- Describe the purpose of different message types in application layer protocols.
- Compare and contrast different approaches to quality of service in networks carrying time-sensitive data.

Student Evaluation

There will be three equally-weighted assignments, involving both programming (specifically, socket programming using C on Linux) and non-programming problems. Likely approximate due dates for the assignments are late January, mid-February, and mid-March. There will also be a group project that can take the form of a critical survey of a current issue in networking research or an implementation or experimental study of some kind, with in-class presentations during the last week of classes, and the final report due April 5th. Due dates are strict – if an extension is required for some special reason (e.g. medical), the instructor must be contacted as soon as feasible. A midterm exam will be held in early March. The midterm exam and the three-hour final exam will be closed book, with no electronic devices permitted.

Grading Scheme

Assignments (3)	20 %
Project	20 %
Midterm Exam	15 %
Final Exam	45 %
Total	100%

Final Exam Scheduling:

The Registrar schedules all final examinations, including deferred and supplemental examinations. Students are advised not to make travel arrangements for the exam period until the official exam schedule has been posted.

Note: All students must be properly registered in order to attend lectures and receive credit for this course.

Textbook Information

Lecture notes will be posted, as well as links to various on-line resources. There is no required textbook, but the following book is a recommended reference for many of the concepts we will cover:

Computer Networks (5th edition), Andrew S. Tanenbaum and David J. Wetherall, Pearson, 2011.

Another recommended book on computer networks is:

Computer Networking (6th or 7th edition), Jim Kurose and Keith Ross, Pearson, 2013 (6th edition) / 2017 (7th edition).

Lecture Schedule (all timings approximate)

1. Background (1.5 weeks)
Transmission media, limits on achievable data rate, digital modulation, communication infrastructures, socket programming.
2. Basics of Point-to-Point Data Transfer (1 week)
Protocols for reliable data transfer, error detection and correction, point-to-point data transfer at the link

layer, end-to-end argument.

3. Multiple Access Protocols and Layer 2 Networks (1.5 weeks)
Classes of multiple access protocols, Ethernet, link layer switching, 802.11, Bluetooth, RFID/NFC, LPWAN.
4. Network Layer (3 weeks)
Datagram vs. virtual circuit networks, routing, congestion control, quality of service, network layer addressing in the Internet, IP, routing in the Internet, Software Defined Networking.
5. Transport Layer (1.5 weeks)
Internet transport protocols, TCP connection establishment and release, data transfer in TCP, TCP congestion control, current problem areas with conventional TCP, new protocols.
6. Application Layer (1.5 weeks)
DNS, email, the Web, streaming media, content delivery, P2P, blockchain.
7. Network Security (1.5 weeks)
cryptography, digital signatures, message digests, public key management, authentication, security in the Internet, social issues.

Policies

Recording of Lectures

Students may record lectures if desired.

Late Assignments/Project

Due dates are strict – if an extension is required for some special reason (e.g. medical) the instructor must be contacted as soon as possible.

Missed Assignments/Project

Students who do not submit anything for an assignment or the project by the due date (possibly as extended by the instructor) will receive a grade of zero for it.

Missed Examinations

1. Students who miss an exam should contact the instructor as soon as possible. If it is known in advance that an exam will be missed, the instructor should be contacted before the exam.
2. "A student who is absent from a final examination due to medical, compassionate, or other valid reasons, may apply to the College of Arts and Science Undergraduate Student's Office for a **deferred** exam. **Application must be made within three business days of the missed examination** and be accompanied by supporting documents." (<http://artsandscience.usask.ca/undergraduate/advising/strategies.php>)

Incomplete Course Work and Final Grades

"When a student has not completed the required course work, which includes any assignment or examination including the final examination, by the time of submission of the final grades, they may be granted an extension to permit completion of an assignment, or granted a deferred examination in the case of absence from a final examination.

Extensions past the final examination date for the completion of assignments must be approved by the Department Head, or Dean in non-departmentalized Colleges, and may exceed thirty days only in unusual

circumstances. The student must apply to the instructor for such an extension and furnish satisfactory reasons for the deficiency. Deferred final examinations are granted as per College policy.

In the interim, the instructor will submit a computed percentile grade for the class which factors in the incomplete coursework as a zero, along with a grade comment of INF (Incomplete Failure) if a failing grade.

In the case where the student has a passing percentile grade but the instructor has indicated in the course outline that failure to complete the required coursework will result in failure in the course, a final grade of 49% will be submitted along with a grade comment of INF (Incomplete Failure).

If an extension is granted and the required assignment is submitted within the allotted time, or if a deferred examination is granted and written in the case of absence from the final examination, the instructor will submit a revised assigned final percentage grade. The grade change will replace the previous grade and any grade comment of INF (Incomplete Failure) will be removed.

A student can pass a course on the basis of work completed in the course provided that any incomplete course work has not been deemed mandatory by the instructor in the course outline and/or by College regulations for achieving a passing grade." (<https://policies.usask.ca/policies/academic-affairs/academic-courses.php>)

For policies governing examinations and grading, students are referred to the Assessment of Students section of the University policy "Academic courses: class delivery, examinations, and assessment of student learning" (<https://policies.usask.ca/policies/academic-affairs/academic-courses.php>)

Academic Honesty

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals section of the University Secretary Website and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct (<https://www.usask.ca/secretariat/student-conduct-appeals/StudentAcademicMisconduct.pdf>) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals (<https://www.usask.ca/secretariat/student-conduct-appeals/StudentNon-AcademicMisconduct.pdf>) Academic honesty is also defined and described in the Department of Computer Science Statement on Academic Honesty (<https://www.cs.usask.ca/students/academic-honesty/index.php>).

For more information on what academic integrity means for students see the Student Conduct & Appeals section of the University Secretary Website at:

<https://www.usask.ca/secretariat/student-conduct-appeals/forms/IntegrityDefined.pdf>

Examinations with Access and Equity Services (AES)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Access and Equity Services (AES) if they have not already done so. Students who suspect they may have disabilities should contact AES for advice and referrals. In order to access AES programs and supports, students must follow AES policy and procedures. For more information, check

<https://students.usask.ca/health/centres/access-equity-services.php>, or contact AES at 306-966-7273 or aes@usask.ca.

Students registered with AES may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through AES by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES.

Student Supports

Student Learning Services

Student Learning Services (SLS) offers assistance to U of S undergrad and graduate students. For information on specific services, please see the SLS web site <https://library.usask.ca/studentlearning/>.

Student and Enrolment Services Division

The Student and Enrolment Services Division (SESD) focuses on providing developmental and support services and programs to students and the university community. For more information, see the students' web site <https://students.usask.ca>.

Financial Support

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact Student Central (<https://students.usask.ca/student-central.php>).

Aboriginal Students Centre

The Aboriginal Students Centre (ASC) is dedicated to supporting Aboriginal student academic and personal success. The centre offers personal, social, cultural and some academic supports to Métis, First Nations, and Inuit students. The centre is also dedicated to intercultural education, bringing Aboriginal and non-Aboriginal students together to learn from, with and about one another in a respectful, inclusive and safe environment. Students are encouraged to visit the ASC's Facebook page (<https://www.facebook.com/aboriginalstudentscentre/>) to learn more.

International Student and Study Abroad Centre

The International Student and Study Abroad Centre (ISSAC) supports student success in their international education experiences at the U of S and abroad. ISSAC is here to assist all international undergraduate, graduate, exchange and English as a Second Language students and their families in their transition to the U of S and Saskatoon. ISSAC offers advising and support on all matters that affect international students and their families and on all matters related to studying abroad. Please visit <https://students.usask.ca> for more information.