

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 or CME334 or CME451 may not take this course for credit..

Class Time & Location: M W F, 9:30-10:20, Arts 104

Website: Canvas

Instructor Information

Instructor: Derek Eager

Contact: Email: eager@cs.usask.ca

Office: Thorv 281.2

I am usually able to respond to emails received during the day (8:30 am to 4:30 pm) on weekdays (Monday to Friday) within a few hours, depending on other commitments. Emails received during the evening may not be responded to until the following weekday morning; emails received on a weekend may not be responded to until the following Monday.

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 an implementation-based group project.

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. **Tentative** due dates for the assignments are January 22nd, February 10th, and March 3rd. There will also be an implementation-based group project, with tentative due dates for the project proposal of February 24th and final project submission of March 31st. 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. An in-class in-person midterm exam will be held during our scheduled class time (9:30-10:20 am) on Friday March 7th. A three-hour in-person final exam will be held during a time slot that will be assigned in the University final exam schedule. The midterm exam and the final exam will be closed book, with no electronic devices permitted, and will include a mix of short-answer question types.

Grading Scheme

Assignments (3)	25 %
Project	15 %
Midterm Exam	20 %
Final Exam	40 %
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 (April 7th through April 30th inclusive) until the official exam schedule has been posted.

Note: All students must be properly registered in order to participate in 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 recommended:

Computer Networks (6th edition), Andrew S. Tanenbaum, Nick Feamster, and David J. Wetherall, Pearson, 2021.
[\(U. of S. bookstore link\)](#)

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, IoT.
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.

University of Saskatchewan Grading System (for undergraduate courses)

Exceptional (90-100) A superior performance with consistent evidence of

- a comprehensive, incisive grasp of the subject matter;
- an ability to make insightful critical evaluation of the material given;
- an exceptional capacity for original, creative and/or logical thinking;
- an excellent ability to organize, to analyze, to synthesize, to integrate ideas, and to express thoughts fluently.

Excellent (80-90) An excellent performance with strong evidence of

- a comprehensive grasp of the subject matter;
- an ability to make sound critical evaluation of the material given;
- a very good capacity for original, creative and/or logical thinking;
- an excellent ability to organize, to analyze, to synthesize, to integrate ideas, and to express thoughts fluently.

Good (70-79) A good performance with evidence of

- a substantial knowledge of the subject matter;
- a good understanding of the relevant issues and a good familiarity with the relevant literature and techniques;
- some capacity for original, creative and/or logical thinking;
- a good ability to organize, to analyze and to examine the subject material in a critical and constructive manner.

Satisfactory (60-69) A generally satisfactory and intellectually adequate performance with evidence of

- an acceptable basic grasp of the subject material;

- a fair understanding of the relevant issues;
- a general familiarity with the relevant literature and techniques;
- an ability to develop solutions to moderately difficult problems related to the subject material;
- a moderate ability to examine the material in a critical and analytical manner.

Minimal Pass (50-59) A barely acceptable performance with evidence of

- a familiarity with the subject material;
- some evidence that analytical skills have been developed;
- some understanding of relevant issues;
- some familiarity with the relevant literature and techniques;
- attempts to solve moderately difficult problems related to the subject material and to examine the material in a critical and analytical manner which are only partially successful.

Failure <50 An unacceptable performance

Course Policies

The academic courses policy applies (<https://policies.usask.ca/policies/academic-affairs/academic-courses.php>).

Use of Generative AI Tools

Any use of Generative AI tools (e.g., ChatGPT) for the course assignments or the project is prohibited and constitutes academic misconduct.

Recording of Lectures

Students may record lectures if desired. More information on class recordings can be found in the Academic Courses Policy (<https://policies.usask.ca/policies/academic-affairs/academic-courses.php#ClassDelivery>).

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. Midterm exam: Students who miss the midterm exam should contact the instructor as soon as possible. If it is known in advance that the midterm will be missed, the instructor should be contacted before the exam.
2. Final exam: “A student who is absent from a final examination for medical reasons (such as illness) or compassionate reasons (such as the illness of a child or death of a loved-one) is responsible for contacting the Undergraduate Student Office to request a [deferred examination](#). The application must be initiated within **three business days** of the missed examination and must be accompanied by documentation (letter from a doctor, etc.). The form and supporting documentation must be returned within 5 days of the initial request.” (<https://programs.usask.ca/arts-and-science/policies.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>)

Copyright

Course materials are provided to you based on your registration in a class, and anything created by your professors and instructors is their intellectual property, unless materials are designated as open education resources. This includes exams, PowerPoint/PDF slides and other course notes. Additionally, other copyright-protected materials created by textbook publishers and authors may be provided to you based on license terms and educational exceptions in the Canadian Copyright Act (see <http://laws-lois.justice.gc.ca/eng/acts/C-42/index.html>).

Before you copy or distribute others' copyright-protected materials, please ensure that your use of the materials is covered under the University's Fair Dealing Copyright Guidelines available at <https://library.usask.ca/copyright/general-information/fair-dealing-guidelines.php>. For example, posting others' copyright-protected materials on the open web is not covered under the University's Fair Dealing Copyright Guidelines, and doing so requires permission from the copyright holder.

For more information about copyright, please visit <https://library.usask.ca/copyright/index.php> where there is information for students available at <https://library.usask.ca/copyright/students/rights.php>, or contact the University's Copyright Coordinator at copyright.help@usask.ca or 306-966-8817.

Integrity

The University of Saskatchewan is committed to the highest standards of academic integrity (<https://academic-integrity.usask.ca/>). Academic misconduct is a serious matter and can result in grade penalties, suspension, and expulsion. Students are expected to act with academic integrity. Students are encouraged to complete the Academic Integrity Tutorial to understand the fundamental values of academic

integrity and how to be a responsible scholar and member of the USask community (tutorial link: <https://libguides.usask.ca/AcademicIntegrityTutorial>). Students can access campus resources that support development of study skills, time and stress management, and ethical writing practices important for maintaining academic integrity and avoiding academic misconduct.

Students are expected to be familiar with the academic misconduct regulations (<https://governance.usask.ca/student-conduct-appeals/academic-misconduct.php#About>).

- Definitions appear in Section II of the academic misconduct regulations.
- The academic misconduct regulations apply regardless of type of assessment or presence of supervision during assessment completion.
- Students are advised to ask for clarification as to the specific expectations and rules for assessments in all of their courses.
- Students are urged to avoid any behaviour that could result in suspicions of cheating, plagiarism, misrepresentation of facts. Students should note that posting copyrighted course materials (e.g., notes, questions, assignments or exams) to third party websites or services or other forum or media without permission is an academic or non-academic misconduct offense.

Non-academic offenses are dealt with under the [Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals](#).

Access and Equity Services (AES) for Students

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 at any time. Those students who are registered with AES with mental health disabilities and who anticipate that they may have responses to certain course materials or topics, should discuss course content with their instructors prior to course add / drop dates. In order to access AES programs and supports, students must follow AES policy and procedures. For more information or advice, visit <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

See <https://library.usask.ca/studentlearning/> and <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>).

College Supports

Students in Arts & Science are encouraged to contact the [Undergraduate Student Office](#) and/or the [Trish Monture Centre for Student Success](#) with any questions on how to choose a major; understand program requirements; choose courses; develop strategies to improve grades; understand university policies and procedures; overcome personal barriers; initiate pre-career inquiries; and identify career planning resources.

Gordon Oakes Red Bear Student Centre

The [Gordon Oakes Red Bear Student Centre](#) is dedicated to supporting the personal, social, cultural, and academic success of Métis, First Nations, and Inuit students.

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/international/issac.php> for more information.

Land Acknowledgement

I would like to acknowledge that the Saskatoon campus of the University of Saskatchewan is on **Treaty Six Territory** and the **Homeland of the Métis**. We pay our respect to the First Nation and Métis ancestors of this place and reaffirm our relationship with one another. I would also like to recognize that some may be attending this course from other traditional Indigenous lands. I ask that you take a moment to make your own Land Acknowledgement to the peoples of those lands. In doing so, we are actively participating in reconciliation as we navigate our time in this course, learning and supporting each other.