

# ECE361H1: Computer Networks I – Fall 2022

**Description:** This is a course for third- and fourth-year undergraduate students in Electrical and Computer Engineering. You will learn about both the logical and physical designs of computer networks. Main topics include layered architectures, TCP/IP protocol suite, application layer protocols, ARQ, TCP reliable stream service, congestion control, packet switching, shortest path algorithms, Internet routing, error control, medium access control, LANs, wireless networks, network security, and socket programming.

## **Textbook:**

Required: J. F. Kurose and K. W. Ross, *Computer Networking: A Top-Down Approach*, 8th Ed., Pearson, 2020.

Recommended additional reading: A. Leon-Garcia and I. Widjaja, *Communication Networks: Fundamental Concepts and Key Architectures*, 2nd Ed., McGraw-Hill, 2004

## **Instructor:**

Prof. Ben Liang

Office: BA4122/Zoom

Email: liang(AT)ece.utoronto.ca

<http://www.comm.utoronto.ca/~liang>

Office hours: Primarily through Piazza; individual meetings by appointment

## **Lectures:**

Mondays 13:00 - 14:00; KP108

Tuesdays 14:00 - 15:00; KP108

Thursdays 13:00 - 14:00; SF3202

## **Tutorials:**

TUT 01: Mondays 12:00 - 13:00; BA1200

TUT 02: Mondays 12:00 - 13:00; BA1220

## **Labs:**

PRA 01: Wednesdays 12:00 - 15:00; GB251

PRA 02: Wednesdays 12:00 - 15:00; GB251

PRA 03: Thursdays 15:00 - 18:00; GB251

## **Teaching Assistants:**

Mahdi Attaran, m.attaran(AT)mail.utoronto.ca

Hossein Bijanrostami, hossein.bijanrostami(AT)mail.utoronto.ca

MohammadReza Ebrahimi, mr.ebrahimi(AT)mail.utoronto.ca

Ehsan Etesami, ehsan.etesami(AT)mail.utoronto.ca

Paridhika Kayal, paridhika.kayal(AT)mail.utoronto.ca

Alireza Keshavarzian, alireza.keshavarzian(AT)mail.utoronto.ca

Morteza Moghaddassian, m.moghaddassian(AT)mail.utoronto.ca

Ali Parchekani, a.parchekani(AT)mail.utoronto.ca

## **Course Website:**

The course website is at Quercus. Homework, handouts, grades, and announcements will be

posted here. Students are required to check it regularly for new information. Please make sure you have a valid email address listed, since the professor and TAs may use it to contact you.

### Have a Question?

In general, all questions related to the course material, programming assignments, and homework should be posted on Piazza, so that everyone can benefit from the answer. Email correspondence should be limited to administrative issues such as handling a missed programming assignment or homework.

### Homework:

Homework problems will be assigned weekly. They will be collected and graded on Quercus.

### Tutorials:

In tutorials, your teaching assistants will cover homework problems, take questions from students, and present extended examples or applications. Your learning experience will be much more productive if you attempt to solve the homework assignment problems *before* each tutorial.

**Tutorials begin in the week of September 19.**

### Wireshark Labs:

There will be 5 mini-labs using Wireshark. You will use your own computer to conduct the experiments. They will be graded on Quercus.

### Programming Labs:

The lab sessions will take place in GB251. All students will work in teams of 2 members. You should form teams from the same lab session. All lab projects will be marked in session.

**Important: please find a lab partner *before* the first lab session.** The TAs will use all available tools to check for similarities in lab reports and programming codes between teams. No plagiarism will be tolerated. **Programming labs begin in the week of September 19.**

### Grading Components:

Homework: 10%

Wireshark Labs: 5%

Programming Labs: 15%

Midterm Exam: 30% (evening of Wednesday, October 26)

Final Exam: 40%

### Tentative Lecture and Tutorial Schedule:

Date	Topic	Reading	Tutorial
This is a tentative schedule subject to change. Please follow in-class announcements for updates.			
<b>September 5, 2022</b>		<b>WEEK 0</b>	
September 5, 2022		Read 1.1	No Tutorial
September 6, 2022			
September 8, 2022	Course intro, Internet, protocol		
<b>September 12, 2022</b>		<b>WEEK 1</b>	
September 12, 2022	Network edge, access networks, physical media	Read 1.2 - 1.4	No Tutorial
September 13, 2022	Network core, routing, switching, network of networks		
September 15, 2022	Delay, loss, throughput		

<b>September 19, 2022</b>		<b>WEEK 2</b>	
September 19, 2022	Protocol layers, encapsulation, network security	Read 1.5 - 1.7, 2.1	Week 1 homework
September 20, 2022	History of the Internet		
September 22, 2022	Application layer, sockets, APIs		
<b>September 26, 2022</b>		<b>WEEK 3</b>	
September 26, 2022	The Web, HTTP	Read 2.2 - 2.4	Week 2 homework
September 27, 2022	HTTP, email, SMTP, IMAP		
September 29, 2022	DNS		
<b>October 3, 2022</b>		<b>WEEK 4</b>	
October 3, 2022	P2P, video streaming	Read 2.5, 2.6, 3.1 - 3.3	Week 3 homework
October 4, 2022	Transport layer, multiplexing		
October 6, 2022	UDP, checksum		
<b>October 10, 2022</b>		<b>WEEK 5</b>	
October 10, 2022	<a href="#">Thanksgiving Day: University Closed</a>	Read 3.4	No Tutorial (Thanksgiving)
October 11, 2022	Reliable data transfer		
October 13, 2022	Go-back-N		
<b>October 17, 2022</b>		<b>WEEK 6</b>	
October 17, 2022	Selective repeat	Read 3.4, 3.5	Weeks 4 and 5 homework
October 18, 2022	TCP connection, TCP flow control		
October 20, 2022	Congestion control		
<b>October 24, 2022</b>		<b>WEEK 7</b>	
October 24, 2022	TCP congestion control	Read 3.6, 3.7, 4.1	Week 6 homework
October 25, 2022	<a href="#">No lecture; break for midterm exam</a>		
October 27, 2022	Network layer, data and control planes		
<b>October 31, 2022</b>		<b>WEEK 8</b>	
October 31, 2022	Network layer data plane, router	Read 4.2, 4.3	Week 7 homework
November 1, 2022	Buffering, packet scheduling		
November 3, 2022	IP		
<b>November 7, 2022</b>		<a href="#">Engineering Fall Study Break</a>	
November 7, 2022			
November 8, 2022			
November 10, 2022			
<b>November 14, 2022</b>		<b>WEEK 9</b>	
November 14, 2022	NAT, IPv6	Read 4.3, 5.1, 5.2	Week 8 homework
November 15, 2022	Network layer control plane, link-state routing		
November 17, 2022	Distance-vector routing		
<b>November 21, 2022</b>		<b>WEEK 10</b>	
November 21, 2022	OSPF, BGP, ICMP	Read 5.3, 5.4, 5.6, 6.1 - 6.3	Week 9 homework
November 22, 2022	Link layer, error control		
November 24, 2022	Multiple access		
<b>November 28, 2022</b>		<b>WEEK 11</b>	
November 28, 2022	MAC, ARP, Ethernet	Read 6.4, 7.1, 7.3.1 - 7.3.4	Week 10 homework
November 29, 2022	Switch		
December 1, 2022	Wireless LAN		
<b>December 5, 2022</b>		<b>WEEK 12</b>	
December 5, 2022	Cellular network	Read 7.4.1 - 7.4.3, 7.4.5	Week 11 homework
December 6, 2022	<a href="#">No lecture</a>		
December 8, 2022	<a href="#">Fall Study Day</a>		

## **Inclusivity Statement:**

You belong here. The University of Toronto Engineering commits to all students, instructors, staff, alumni and partners that you can learn, create and participate in a welcoming, healthy and respectful environment. In this class, the participation and perspectives of everyone is invited and encouraged. The broad range of identities and intersections of identities within an inclusive team environment will help you achieve academic success. You can read the evidence for this approach here:

<https://www.weforum.org/agenda/2019/04/business-case-for-diversity-in-the-workplace/>.

You are not alone. You are invited to talk to anyone in the Faculty that you feel comfortable approaching, including your professor, teaching assistant, academic advisor, any staff member, the Engineering Equity Diversity & Inclusion Action Group, a culture or identity club or group, or a U of T Equity Office.

**Academic Advisors:** <https://undergrad.engineering.utoronto.ca/first-year-office-2/first-year-office-team/>

**Engineering Equity, Diversity & Inclusion Action Group & Clubs:** [www.uofteng.ca/edi](http://www.uofteng.ca/edi)

**U of T Equity Offices:** <https://hrandequity.utoronto.ca/inclusion/equity-offices/>

You have rights under the Ontario Human Rights Code that protect you against all forms of harassment or discrimination, including but not limited to acts of racism, sexism, Islamophobia, anti-Semitism, homophobia, transphobia, ableism and ageism. Engineering denounces unprofessionalism or intolerance of any kind, whether in person or online, on or off-campus. If you experience or witness any of these behaviours, please tell someone so we can help with resources and resolution. Engineering takes these reports extremely seriously. You can confidentially disclose directly to Marisa Sterling, P.Eng, Assistant Dean, Diversity, Inclusion and Professionalism.

**Phone:** 416.946.3986

**Email:** [disclosure.engineering@utoronto.ca](mailto:disclosure.engineering@utoronto.ca)

**Submit confidential disclosure form:** [www.uofteng.ca/disclosure](http://www.uofteng.ca/disclosure)

**Ontario Human Rights Code:** <http://www.ohrc.on.ca/en/students%E2%80%99-handouts/fact-sheet-1-ontario-human-rights-code>

## **Statement on Academic Accommodations:**

The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, visual impairments, chronic health conditions, addictions, D/deaf, deafened or hard of hearing, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation the University of Toronto recommends that students register with Accessibility Services as soon as possible. Register at:

<https://studentlife.utoronto.ca/service/accessibility-services-registration-and-documentation-requirements/>

We know that many students avoid seeking help because they feel that they should not need “unfair advantages.” The purpose of academic accommodation is not to give an unfair advantage, but to help remove an unfair disadvantage. It may feel difficult to ask for help, but it can make all the difference during your time here.

**Phone:** 416-978-8060

**Email:** [accessibility.services@utoronto.ca](mailto:accessibility.services@utoronto.ca)

### **Mental Health Statement:**

Engineering at the University of Toronto is a demanding program. The workload and the frequency of assignments and tests can be challenging to balance and can feel overwhelming. As a result, students can find themselves experiencing physical and/or mental health issues which impact their academic performance and overall well-being.

If you find yourself feeling distressed and in need of more immediate support resources, consider reaching out to the counsellors at **My Student Support Program (MySSP)** ([www.uoft.me/myssp](http://www.uoft.me/myssp)) or visiting **U of T Engineering’s Urgent Support – Talk to Someone Right Now** webpage (<https://uofteng.ca/talknow>).

If you are encountering challenges that significantly affect your academic performance and overall wellbeing, there are a variety of free and confidential supports that can help you. As a U of T Engineering student, you have a **First-Year Advisor** ([www.uoft.me/fyo](http://www.uoft.me/fyo)), a **Departmental Upper-Year Undergraduate Advisor** ([www.uoft.me/engadvisors](http://www.uoft.me/engadvisors)), or a **Departmental Graduate Administrator** ([www.uoft.me/gradadmin](http://www.uoft.me/gradadmin)) who can advise on personal matters that impact your academics. You can find helpful people, services and resources like these listed on the **U of T Engineering Mental Health & Wellness webpage** ([www.uofteng.ca/mentalhealth](http://www.uofteng.ca/mentalhealth)).

A small selection is also included here:

- Accessibility Services ([www.studentlife.utoronto.ca/as](http://www.studentlife.utoronto.ca/as))
  - On-Location Accessibility Advisor ([www.uofteng.ca/onlocationaccessibility](http://www.uofteng.ca/onlocationaccessibility))
- Health & Wellness ([www.healthandwellness.utoronto.ca](http://www.healthandwellness.utoronto.ca))
  - On-Location Health & Wellness Engineering Counsellor ([www.uoft.me/wellnessadvisor](http://www.uoft.me/wellnessadvisor))
- Registrar’s Office (<https://uoft.me/eng-registrar>)
- U of T Engineering’s Learning Strategist ([www.uoft.me/englearningstrategist](http://www.uoft.me/englearningstrategist))
- U of T Engineering’s Mental Health Programs Officer ([www.uofteng.ca/mentalhealth#MHPO](http://www.uofteng.ca/mentalhealth#MHPO))
- U of T Engineering’s Scholarships & Financial Aid Office and Advisor ([www.uoft.me/engfinance](http://www.uoft.me/engfinance))

We encourage you to access these resources as soon as you feel you need support; no issue is too small.

### **Land Acknowledgment:**

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.