

Introduction to Internetworking

CS 353, Fall 2024

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Course Description

CS 353 takes a top-down approach to explore how networks operate and how network applications are written. We study how popular distributed systems such as video streaming, content distribution networks (CDNs), and cloud computing systems work in the application layer. We explore how these applications transfer data between their components and end users over the Internet using transport layer protocols such as TCP and UDP. We go deeper to understand what keeps the transport layer running; specifically, we look at how packets are routed and how routers work. Finally, we dive one more layer down to understand how the link layer transfer packets using Ethernet. In addition to cutting through the layers and covering the basics, we learn about the state-of-the-art topics in networking such as datacenter networks and software-defined networking (SDN).

From a practical point of view, we learn what sockets are and how to use them. And we write code. We write code to implement various protocols, to build client-server applications, HTTP proxies, and video distribution applications, reliable transport, and software routers.

Catalog Description

Global Internet: design principles, layering, protocol design/analysis. Networked applications, Internet structure/architecture, Protocols for transport/congestion control, network layer/routing, link layer/MAC.

Learning Objectives

In this course, we will understand the fundamentals of networking and the architecture of the Internet. We will examine in detail each layer of the Internet's networking stack, taking a top down approach. The course will include lectures, four assignments, a mid-term and a final.

Prerequisite(s) CSCI 201

Co-Requisite (s) None

Class Information:

- Location: MRF 340
- Time: TTh 12-1:50pm

Discussion Section:

- Location: Online
- Time: Fr 11-11:50am

TA: TBD

For the assignments, students are expected to be proficient in C and C++ as well as Python.

Concurrent Enrollment None

Readings and Lecture Schedule

Lectures cover material from the following textbook:

Computer Networking: A Top-Down Approach, by Jim Kurose and Keith Ross, 8th Edition, Pearson.

You can rent a copy from Pearson, or rent a hard copy or purchase a Kindle version from Amazon, or rent a hard copy from Vital-Source. The ISBNs are: Print rental: 9780136681557, Pearson+ access: 9780135928615.

Lectures

Table 1 describes the approximate schedule for covering this material. A **Slack Day** in the schedule indicates a day set aside to catch up on the lecture schedule. If we're caught up on all the material before then, we will have no lecture on that day.

Discussion Section

During the discussion sections, we will cover supplementary material helpful for understanding the lectures as well as material helpful for completing the assignments. Table 2 describes the approximate schedule for the discussion sections.

Course Elements and Grading

The class will include **four** assignments and **three** quizzes, listed below. Table 3 shows the grade breakdown for assignments and quizzes.

Assignments You will complete four programming assignments that will expose you to programming network applications, video and content distribution, reliable transport and router design.

In-class quizzes These will each cover about one third of the class contents. Students will take these quizzes in-class using Gradescope. There is **no** final examination for the class.

Assignments

About half the grade for the class is reserved for four programming assignments that complement the conceptual material presented in

Week of	Tuesday	Thursday
Aug 26	Introduction	Overview
Sep 2	Protocol Layering	HTTP and the Web
Sep 9	DNS and CDNs	Video and Cloud
Sep 16	Transport Layer	TCP Basics
Sep 23	Flow and Congestion Control	Quiz 1
Sep 30	More Congestion Control	Network Layer and IP
Oct 7	IP Routers	Fall Recess
Oct 14	Mid-term Review	Mid-term
Oct 21	Routing Fundamentals	Intra-AS Routing
Oct 28	Inter-AS Routing	Quiz 2
Nov 4	BGP	SDN
Nov 11	Link Layer	Switched LANs
Nov 18	Wireless Networking	Datacenter Networking
Nov 25	Slack Day	Thanksgiving
Dec 2	Slack Day	Quiz 3

Table 1: Lecture Schedule

Week of	Friday
Aug 26	1: Socket Programming
Sep 2	2: Performance Metrics
Sep 9	3: Recap and DNS
Sep 16	4: HTTP Request/Response
Sep 23	5: Assignment 2 Overview
Sep 30	6: TCP Practice Questions
Oct 7	7: Congestion, IP
Oct 14	Fall Recess
Oct 21	8: Assignment 3 review
Oct 28	9: Routing/BGP
Nov 4	No Discussion
Nov 11	10: Assignment 4
Nov 18	11: Link Layer
Nov 25	12: Wireless/Datacenters
Dec 2	Thanksgiving
	No Discussion

Table 2: Discussion Section Schedule

Assignment 1	10%
Assignment 2	15%
Assignment 3	15%
Assignment 4	15%
Quiz 1	15%
Quiz 2	15%
Quiz 3	15%

Table 3: Grading Breakdown

the lectures and help students more deeply understand networking (Table 4).

Assignment 1 is to be completed individually, the remaining assignments will be done in groups of 2 or 3 students. We will release all four assignments in the first week of class. Table 4 describes the deadlines for the assignments (**midnight** of the specified date).

	Assignment	Due Date
1	Sockets, Mininet, & Performance	Sep 18
2	Video Streaming via CDN	Oct 9
3	Reliable Transport	Nov 9
4	Designing a Static Router	Dec 6

Table 4: Assignment Deadlines

Grace Days Five times during the semester, a student may extend the due date of a programming assignment by twenty four hours without needing prior permission. These are known as "grace days."

Please note that grace days are in place of "excused late" submissions, not in addition to. If you request additional grace days from the instructor, you must have a documented reason for each grace day used to accompany your request.

Note: There is no grace period. Even if you submit a few minutes after the deadline, you will need to use a grace day (even if the wireless network in your dorm room is down or you have a github issue, etc.). It is your job to be on time and not cut it too close. Remember Murphy's Law and leave time for things to "go wrong."

Quizzes

All three quizzes will be for **60 minutes** each. Table 1 lists the dates of the quizzes. On each day, we will promptly start the quiz at 12pm.

Quizzes will include multiple-choice questions as well as short-answer questions. These questions will test your basic understanding of the material and require you to apply what you have learned to hypothetical situations. Each quiz will cover about a third of the material.

For all quizzes, you will answer questions online using Gradescope. You may use a laptop, tablet or smartphone to answer these questions.

Letter grades

Final letter grades will be determined using a modified curve. I will assign grades of C and D or below to individuals who do not perform satisfactorily in the class.

We will not assign incompletes unless it is for a documented medical reason (in accordance with USC policy).

Statement on Academic Conduct and Support Systems

Academic Integrity

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, compromises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once

a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems

Counseling and Mental Health (213) 740-9355 – 24/7 on call. Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline 988 for both calls and text messages – 24/7 on call. The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) (213) 740-9355(WELL) – 24/7 on call. Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) (213) 740-5086. Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment (213) 740-5086 or (213) 821-8298. Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) (213) 740-0776.

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention (213) 740-0411. Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion (213) 740-2101. Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call. Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call. Non-emergency assistance or information.

Office of the Ombuds (213) 821-9556 (UPC) / (323-442-0382 (HSC). A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice (323) 442-2850 or otfp@med.usc.edu.

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.