Sample syllabus - students receive detailed syllabus at the beginning of the semester they are enrolled in the course.

CS 498 Cloud Networking

Course Description

Computer communication networks are among the most important and influential global infrastructures that humanity has created. The goal of this course is to provide a foundational view of communication networks, with a focus on networks enabling modern hyperscale cloud computing.

In the first part of this course, we'll study the principles upon which the Internet and other computer networks are built, and how those principles translate into deployed protocols. In the second part of this course, we build on those principles to learn how to build a network infrastructure that provides the agility to deploy virtual networks on a shared infrastructure, that enables both efficient transfer of big data and low latency communication, and that enables applications to be federated across countries and continents.

Topics will include: switching; intradomain routing; the Internet Protocol and interdomain networking; reliability, flow control, congestion control, and their embodiment in TCP; quality of service; network applications; cloud network requirements and traffic patterns; data center network architecture; virtualized and software-defined networks; and wide-area connectivity. The course will involve a significant amount of Unix-based network programming and assumes familiarity with C or C++. Two shorter programming projects employ Python. Students will implement realistic network protocols, and gain the perspective of real-world networking challenges through interviews with industry professionals and academic researchers.

Course Prerequisite

- Fluency with C or C++ required
- Knowledge of Python is helpful, but a willingness to learn a small amount of Python during the course is sufficient

Course Goals

By the end of the course, you will be able to:

- Understand the layered architecture of the Internet, including how the capabilities and limitations of each module enable functionality and allow the flexibility to evolve.
- Understand the components of the fast-path data plane of multi-hop and multi-domain networks.
- Construct distributed routing algorithms to solve the control challenges of single-domain and interdomain networks.
- Gain fluency in end-to-end transport algorithms that provide higher-level reliability and performance capabilities, based on simpler lower-layer functions.
- Determine which lower-layer network protocols and components are appropriate for a wide variety of given application requirements.

- Describe common attacks and apply appropriate defenses at multiple layers of the Internet architecture.
- Gain practical experience with network programming by using and implementing realistic network infrastructure protocols and software, including routing protocols and TCP.
- Understand the network stack of a cloud network – network virtualization, physical interconnection of servers, routing, congestion control, and application-level techniques.
- Emulate a (small) cloud network and evaluate its performance.
- Write simple software-defined networking applications.
- Engineer networked applications for higher performance and reliability.
- Follow the latest research in cloud networking from industry and academia and understand its context.

Textbook

There is no required textbook, but a recommended text is: “Computer Networks: A Systems Approach,”, by Larry L. Peterson and Bruce S. Davie (5th ed., 2011).

Course Schedule

Week		Topics
1		Internet Architecture, Network Performance goals, life of a data stream from space
2		Data plane of packet switching: forwarding tables and queues; Control plane routing algorithms and protocols: distance vector, link state, and the OSPF protocol
3		Architectural principles applied to internetworking; Internet addressing (IPv4 and v6, subnetting, NAT); Address management: ICMP, ARP, DHCP, and DNS.
4		MP Work Week
5		Border Gateway Protocol (BGP); Interdomain Internet structure and policies.
6		Reliable connection abstraction: establishment, loss recovery, sliding window algorithm, flow control; Congestion control; In-network support for congestion control: fair queueing, active queue management (CoDel), and explicit feedback (ECN).
7		Crypto basics, certificate authorities; Firewalls; Attacks: DNS cache poisoning, BGP hijacking, DDoS, botnets; What's beyond: specialized domains and advanced research.
8		MP Work Week
9		MP Work Week
10		Application and traffic patterns; Physical network structure;
11		Routing and traffic engineering; Host virtualization; Congestion control
12		Introduction to SDN architecture; Network virtualization in VL2; Network virtualization in VMware NSXSDN in inter-data center networking
13		THANKSGIVING BREAK, NO CLASS
14		Inter-data center networking; CDNs; Client connectivity; Application layer techniques;
15		MP Work Week
16		Final Exam

Assignment Deadlines

For all assignment deadlines, please refer to the Course Deadlines, Late Policy, and Academic Calendar page.

Grading Distribution and Scale

Grading Distribution

Your final grade will be calculated based on the activities listed in the table below. Your official final course grade will be listed in Enterprise. The course grade you see displayed in Coursera may not match your official final course grade.

Assignment	Percentage
Graded Quizzes	10%
Programming Assignments	60%
Proctored Exams	30%
Total	100%

Grading Scale

Total	Grade
90 - 100	A (A-, A, A+)
80 - 89	B (B-, B, B+)
70 - 79	C (C-, C, C+)
60 – 69	D (D-, D, D+)
Below 60	F

Student Code and Policies

A student at the University of Illinois at Urbana-Champaign is a member of a university community of which all members have at least the rights and responsibilities common to all citizens, free from institutional censorship; affiliation with the University as a student does not diminish the rights or responsibilities held by a student or any other community member as a citizen of larger communities of the state, the nation, and the world. See the University of Illinois Student Code for more information.

Academic Integrity

All students are expected to abide by the campus regulations on academic integrity found in the Student Code of Conduct. These standards will be enforced and infractions of these rules will not be tolerated in this course. Sharing, copying, or providing any part of a homework solution or code is an infraction of the University's rules on academic integrity. We will be actively looking for violations of this policy in homework and project submissions. Any violation will be punished as severely as possible with sanctions and penalties typically ranging from a failing grade on this assignment up to a failing grade in the course, including a letter of the offending infraction kept in the student's permanent university record.

Again, a good rule of thumb: *Keep every typed word and piece of code your own*. If you think you are operating in a gray area, you probably are. If you would like clarification on specifics, please contact the course staff.

Disability Accommodations

Students with learning, physical, or other disabilities requiring assistance should contact the instructor as soon as possible. If you're unsure if this applies to you or think it may, please contact the instructor and Disability Resources and Educational Services (DRES) as soon as possible. You can contact DRES at 1207 S. Oak Street, Champaign, via phone at (217) 333-1970, or via email at disability@illinois.edu.