



Information Sciences Institute

Joseph Touch

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EE/CS450

SPECIAL SECTION

EE/CS 450: Computer Networking

3 Units

A First-Principles Approach to Computer Networking

Fall 2016

Class: Tu/Th 2:00pm-3:20pm VHE 217

Discussion: Fr 9:00-9:50am WPH 102

Dr. Joe Touch

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General Information

NOTE: This section is using a new approach that was introduced in a special section of EE/CS450 for the first time in Spring 2015. It differs from other past EE/CS 450 as well as other current sections.

Location: VHE 217 (Tu-Thu class) / WPH 102 (Fr discussion) [NOTE: there is NO "quiz section" for this class section]

Discussion forum: **Piazza** (contact the TA to be enrolled if you have not already been invited)

Instructor: **Dr. Joe Touch**

Office: PHE 414 during scheduled campus office hours (also USC/ISI 1130N by appointment only)

Office hours: On campus at PHE 414 Thursday 3:30-4:30pm (also at USC/ISI by appointment only), during the regular semester only.

Contact info: touch@isi.edu, 310-448-9151

Teaching Assistant: TBA

Office: TBA during scheduled hours ("by appointment" locations as coordinated separately)

Office hours: TBA or by appointment

Contact info: **TBA**

Grader: TBA

Contact info: **TBA**

IT Help:

Contact **USC IT Services**.

Course Description

Network architectures; layered protocols, network service interface; local networks; long-haul networks; internal protocols; link protocols; addressing; routing; flow control; higher level protocols.

NOTE: This section is using a new approach that was introduced in a special section of EE/CS450 for the first time in Spring 2015. It differs from other past EE/CS 450 as well as other current sections, as described below:

"You told me to go back to the beginning... so I have."

- Inigo Montoya, quoting Vizzini's advice, from the movie 'the Princess Bride'

Vizzini was right: when in doubt, it can be useful to revisit origins. This is a special section of EE450 based on a new "first principles" approach to computer networking based on fundamental principles that evolved from USC/ISI's experience developing virtual networks and recursive networking.

Past approaches focus on a protocol architecture that was developed in the 1970s by the international organization of telephone companies (the ITU) called Open Systems Interconnect (OSI). The OSI model was never widely deployed, yet it remains the basis of our network teaching. It describes a seven-layer architecture, but why those seven? Why exactly seven?

Most computer networking texts explore past and present examples of networks by either assembling them bottom-up or disassembling them top-down. This section of EE450 goes beyond construction and destruction towards fundamental understanding.

Join us for this special section
to go beyond the OSI stack
and answer "WHY"...

Learning Objectives

Prerequisites: Junior standing, CS or EE major, ability to program in C or C++. This course is NOT recommended for those without a CS or EE background. This course assumes programming knowledge including data structures and interactions between I/O and timeouts.

(Note: EE/CS450 duplicates credit in CSCI353, so CSCI353 MUST NOT have already been taken)

Co-Requisites: none

Concurrent Enrollment: Friday 9-9:50am discussion section (recommended but not required)

NOTE: The discussion section is that it is a "group chat" with the TA and other students. It is **not** intended to extend classtime, and NO NEW MATERIAL will be covered there. If you have a schedule conflict for the discussion, please contact the instructor.

Recommended Preparation: Review Unix C programming, especially data structures and interactions between I/O and timeouts.

Course Notes

Grading type: Letter grades

On-line: [USC Blackboard](#)

Technological Proficiency and Hardware/Software

Students are expected to be proficient in Unix C programming. This course assumes programming knowledge including data structures and interactions between I/O and timeouts.

Computer access is provided by USC; alternatively, students may use their own computers for programming assignments.

Required Readings and Supplemental Material

Suggested:

Shannon/Weaver, The Mathematical Theory of Communication (any edition)

Supplemental:

Peterson/Davie, Computer Networks: A systems approach (any edition). Readings will be cited from the Fifth Edition; students are responsible for locating the corresponding material in other editions.

Description and Assessment of Assignments

Programs and homework assignments are posted to Blackboard.

Homework assignments are submitted in person on paper in class to the instructor on the date due or e-mailed directly to the grader if remote or late.

Description

Homeworks - generally due one week after being assigned:

HOMEWORK	Material	Assigned	Due (class start)
1	Topics 1,2.1,2.2	Thur, Sep 1	Thur, Sep 8
2	Topics 2.3,2.4,3	Thur, Sep 22	Thur, Sep 29
3	Topics 5,6	Thur, Nov 3	Thur, Nov 10

Programming - generally due two weeks after being assigned:

Program	Topic	Assigned	Due (class start)
1	Protocol machine	Thur, Sep 8	Thur, Sep 22
2	Naming and relaying	Thur, Oct 20	Thur, Nov 3
3	Intralayer mechanism performance	Tue, Nov 15	Thur, Dec 1

Assessment

Homeworks and programming assignments are to be completed individually. Homeworks will include multiple choice, true/false, and essay questions, and are graded according to predefined metrics. Programming assignments will be graded based on an evaluation of running code.

Grading

15% Homeworks (3 assignments, 5% each)
 15% Programming (3 assignments, 5% each)
 30% Midterm exam (in-class, tentatively scheduled on Oct. 6; EXCEPTIONS ONLY PER UNIVERSITY POLICY)
 40% Final exam (on-campus, as scheduled by USC, EXCEPTIONS ONLY PER UNIVERSITY POLICY)

NOTE: USC schedules the final exam. The exam will occur when they schedule it, and is subject to their rescheduling.

Assignment Submission Policy

Homeworks and programming assignments will be submitted via **USC Blackboard**.
 Homeworks/programs due at the start of class on the date indicated.
 No extensions except as per USC policy. Assignments can be turned in late with 20% penalty per day.

Additional Policies

Midterm and final exams

Midterms and final exams must be taken on campus on the scheduled date except as per documented USC policy. Note that certain exceptions require advance notice.

NOTE: USC schedules the final exam. The exam will occur when they schedule it, and is subject to their rescheduling.

Incompletes

Incompletes will not be granted except as per documented USC policy.

Course outline (subject to change)

There are no required assigned readings. Students should refer to Shannon/Weaver and Peterson/Davie as references.

Lecture notes are posted here after each lecture.

Note that these slides are available ONLY from USC IP addresses. You must be on-campus or using a VPN into USC to access them.

1. Introduction

- AUG 23 #01 - 1.1 Background
- AUG 25 #02 - 1.2 Performance and efficiency (Peterson/Davie Sec 1.5, optionally)

2. Communication

- AUG 30 #03 - 2.1 Communication as shared state (Shannon/Weaver, optionally)
- SEP 1 #04 - 2.2 The imperfect channel (Peterson/Davie Sec 2.1, 2.4, optionally)
- SEP 6 #05 - 2.3 Encodings (Peterson/Davie Sec 2.2, optionally)
- SEP 8 #06 - 2.4 Protocols as two-party interactions (Peterson/Davie Sec 5.2.3, 9.1, 9.4.2, optionally)

3. Networking

- SEP 13 #07 - 3.1 Multiparty (Peterson/Davie Sec 4.2.1, optionally)
- SEP 15 #08 - 3.2 Sharing 1 (Peterson/Davie Sec 1.2.2-1.2.3, optionally)
- SEP 20 #09 - 3.3 Sharing 2 (Peterson/Davie Sec 2.6-2.7, optionally)
- SEP 22 #10 - 3.4 Relaying (Peterson/Davie Sec 3.1-3.2, 3.4, 6.2, optionally)

4. Layers

- SEP 27 #11 - 4.1 Common translation (Peterson/Davie Sec 3.2, optionally)
- SEP 29 #12 - 4.2 The need for naming and resolution (Peterson/Davie Sec 3.2, optionally)
- OCT 4 #13 - review
- OCT 6 - MIDTERM

5. Naming

- OCT 11 #14 - 5.1 Layer traversal and naming
- OCT 13 #15 - 5.2 Resolution (Peterson/Davie Sec 3.2.6, 9.3.1, optionally)
- OCT 18 #16 - 5.3 Sockets - naming inside and out (Peterson/Davie Sec 1.4, 5.2.7, optionally)
- OCT 20 #17 - 5.4 Automatic naming (Peterson/Davie Sec 3.2.7, 4.1.3, optionally)

6. Recursion

- OCT 25 #18 - 6.1 Recursion and layering
- OCT 27 #19 - 6.2 Walking the DAG
- NOV 1 #20 - 6.3 Routing protocols (Peterson/Davie Sec 3.3, 4.2.2, 4.3.2, 9.4.1, optionally)
- NOV 3 #21 - 6.4 Forwarding as tail recursion

7. Intra-layer Issues

- NOV 8 #22 - 7.1 Intralayer optimizations
- NOV 10 #23 - 7.2 Intralayer examples (Peterson/Davie Sec 2.5, 6.3, 5.2.4-5.2.6, optionally)
- NOV 15 #24 - 7.3 More intralayer examples and issues (Peterson/Davie Sec 5.3, 7.1, optionally)
- NOV 17 #25 - 7.4 Security (Peterson/Davie Sec 8, optionally)

8. History

- NOV 22 #26 - 8.1 OSI and the cake
- NOV 29 #27 - 8.2 The Internet and the short stack

9. New Concepts

- DEC 1 #28 - Emerging Issues
- Dec 12 - FINAL MONDAY, 4:30-6:30pm (same location as class unless announced otherwise, as scheduled by USC)

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism - presenting someone else's ideas as your own, either verbatim or recast in your own words - is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standards <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/>. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct/>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity <http://equity.usc.edu/> or to the Department of Public Safety <http://capsnet.usc.edu/departments/departments-public-safety/online-forms/contact-us>. This is important for the safety whole USC community. Another member of the university community - such as a friend, classmate, advisor, or faculty member - can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs http://sait.usc.edu/academicssupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information <http://emergency.usc.edu/> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.