CSci551 Syllabus—SP2015, Friday Section

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November 20, 2014

Class meets Fridays, 3pm to 5:50pm, beginning Jan 6 and ending May 1. We do not have classes during Spring break. The date and time of the final is Friday, May 8, 2-4pm.

Changes: This syllabus may be updated over the semester. The most recent version can always be found at piazza.

2015-1-1: no changes yet.

Obtaining these papers: All of these papers are available from the CSci551 piazza in PDF format. Because they are copyrighted they are available only for classroom use.

Please register on Piazza, and go to https://piazza.com/class/i1qta967iq25zc or search cask551–Yu on piazza.

The primary source of content for the class is these papers, so you will want to download and read them. Downloaded they take up about 95MB storage.

Class Pace: We will usually go over two or three papers per day, although sometimes more. The syllabus is designed to be slightly front-loaded, with the intent that we will run a paper or two (or sometimes a full class) behind for part of the semester.

Primary and Supplemental Papers: There are two groups of papers. We will discuss primary papers in class. The concepts and details from primary papers are fair game in exams. On the other hand, supplemental will not be discussed in class, and you are not required to know details from those papers for exams (although the concepts might, since they are networking papers). You are encouraged to read the supplemental papers if you’re interested in an area. (Supplemental papers will also appear on homework 1.)

I am happy to take questions about either primary or supplemental papers in class or office hours.

Other class activities: This syllabus lists exams and papers. You should also expect a class project, typically in three parts (A, B and C), and several homework assignments (often 4, but at least 3 and no more than 6). Dates for these will be given as the semester progresses.

Please note that the class dates are when you are expected to have read the papers. At times during the semester we will probably be behind a couple of papers, but you are encouraged to stay with this syllabus for reading.

1 Reference and background

Supplemental:

All of the textbooks are optional. Peterson and Davies and Keshav provide an overview of some of the topics we talk about. They provide helpful background and are generally broader
and more consistent in their coverage of networking, but less deep on the subjects we cover in class.

General background about networking: [Peterson00a]


Sockets programming (useful for the project): [Stevens03a]


(The Stevens TCP/IP Illustrated books are also excellent references relating the RFCs to the BSD code, but are less useful for class.)

Class 1 (Jan. 16):

Primary: Tips for reading papers: [Hanson99a, Keshav07]


Another viewpoint of paper reading [Jamin03a]


Finding and judging new ideas: [Heilmeier92a]


No paper, but we will review and discuss: General networking, network addressing.

2 Design principles

Class 2 (Jan. 23):

Primary: The Internet architecture: [Clark88a]


and see the commented version: Clark13a.pdf

TCP/IP: [Cerf74a]

Naming: [Saltzer82a]


The end-to-end argument: [Saltzer81a]


*Supplemental:*
How “tussles” affect network architecture: [Clark02a]


3 Software Defined Networking

Minlan is away. TA will give the lecture. Tutorial on Mininet.

Class 3 (Jan. 30):
Managing an enterprise network (OpenFlow Origins): [Casado09a]


Managing Google’s WAN: [Jain13a]


*Supplemental:*
Information-centric networking: [Jacobson12a]


Programming SDNs: [Foster13a]

4 Interdomain Routing

Class 4 (Feb. 6):

Primary:

Review of routing. (Will use class notes, plus please review your EE450 work.)

BGP introduction: [Caesar05a]


Routing stability and oscillation (plus a taste of queueing theory): [Shaikh00a]


Routing outages, results, and causes: [Wang06b]


Path inflation: [Spring03a]


Supplemental:

Synchronization problems in routing (but also applies much wider): [Floyd94b]


5 Internet Topology and Traffic

Class 5 (Feb. 13):

Primary:

Network topology: [Oliveira08a]


Measuring ISP topologies: [Spring02a]

Packet-level network dynamics: [Paxson99b]


Changes to the network traffic mix: [Labovitz10c]


Supplemental:
Routing hierarchy and policy: [Gao01b]


Delay-tolerant networking: [Fall08a]


Classic cases where policy choices in peerings result in oscillations: [Griffin99a]


6 Transport protocols, Congestion Control, and Queue Management

**Class 6** (Feb. 20):
Primary: TCP and congestion control: [Jacobson88a]


Congestion control from first principles: [Ramakrishnan90a]


Modeling TCP: [Padhye98a]


Early drop with CoDel: [Nichols12a]

Supplemental:
[Cerf74a]

[Cerf74a] see above.

Congestion control by exhaustive computer search: [Winstein13a]


Class 7 (Feb. 27): TCP follow-up. XCP and other transport protocols. Queue management. Fair queueing.

Primary:
Active queue management, such as fair queueing: [Demers89a]


XCP and non-TCP congestion control: [Katabi02a]


Cubic TCP: [Ha08a]


Multipath TCP: [Wischik11]


Supplemental:
Random early detection: [Floyd93a]


7 Midterm

Class 8 (Mar. 6): midterm exam We will first cover papers that’s left over in the class. Answer questions you have about previous papers. The midterm exam will be the second half of the class period.
8 Wireless and Mobile Networking

Class 9 (Mar. 13):

Primary:
MAC protocols: [Bharghavan94a]


Non-IP routing in sensor networks: [Intanagonwiwat00a]


Mobile (cellular) networks: [Huang13a]


Supplemental:
Wireless propagation characteristics: [Aguayo04a]


Wireless security: [Borisov01a]


Wireless software radios: [Bahl09a]


9 Spring Break

Spring break and no class on Mar. 20.

10 Network Security

Class 10 (Mar. 27):

Primary:
Onion routing (TOR): [Dingledine04a]

Spam and anti-spam: [Levchenko11a]


Routing security: [Lychev13a]


Supplemental:

Denial of service attacks: [Hussain03b]


Worm propagation: [Staniford02a]


End-to-end encryption: [Popa14a]


(Note that, in this class, we intentionally do not do the cryptographic side of network security. There is coverage of that material in CSci555, Graduate Operating Systems, and most of CSci530, Security Systems, is about that.)

Unfortunately there is not time to talk about security and network protocols in CSci551. CSci555 provides a good coverage of security from an operating systems perspective; see the papers by Voydock and Kent and Needham and Schroder there.

11 Content Delivery Networks, Distributed Hash Tables

Class 11 (Apr. 3):

Primary:

Efficient peer-to-peer storage: [Stoica00a]

Akamai networks: [Nygren10a]


*Supplemental:*
Freenet and anonymous peer-to-peer file sharing: [Clarke02a]


Privacy built over BitTorrent in OneSwarm: [Isdal10a]
Quality of service and admission control: [?]
Lighter-weight QoS: [?]


### 12 Network virtualization

**Class 12 (Apr. 10):**

Internet Virtualization: [Anderson05a]


Data center virtualization: [Koponen14a]


### 13 Cloud Computing

**Class 13 (Apr. 17):**

Primary:

While most of the class focuses on protocols that connect things, this class focuses on how one builds data services that can sit at one end of the connection, often the “inside” of the cloud. For more work in this direction, see CSci555 (graduate operating systems) and distributed computing.

Building large-scale services [Fox97a]


Data-parallel processing with map/reduce: [Dean04a]

Spark: [Zaharia12a]


14 Data Center Networks

Class 14 (Apr. 24):

Minlan is away. TA will give the lecture.

Primary:

Topology: [Greenberg09a]


Datacenter traffic: [Benson10a]


Datacenter TCP: [Alizadeh10a]


15 Network Verification

Class 15 (May. 1):

Header-space analysis: [Kazemian12a]


VeriFlow: [Khurshid13a]

16 Multicast Routing, Transport, and Applications

Multicast was a major push in networking in the 1990s, and it is standardized, deployed, and used in some niches. However a glut of bandwidth and technical challenges dealing with state (most protocols required per-multicast-group state in routers) means that wide-area IP multicast does not seem to have prospered. The techniques developed in multicast are interesting, worth understanding, and used by some. But as of FA2014, they are all supplemental.

Supplemental:
Multicast routing (flood-and-prune, rendezvous): (for [Deering88b], please read only sections 1–4, pages 85–103): [Deering88b]


Reliable multicast and SRM: (for [Floyd97c], please read only through section 7.1, page 15) [Floyd97c]


File distribution and coding: [Byers98a]


Multimedia: [Bolot94a]


17 Privacy and Ethics

Supplemental:
Network data collection and differential privacy: [McSherry10a]


18 Other Topics: Hardware and Software in Routers and Devices

These are topics we cannot cover but that are considered in some similar network courses. All these materials are supplemental.

Supplemental:
Router design: [Partridge98a]

Router software (Click): (NEW-FA2014) [Kohler00a]


Optical networking: [Mukherjee00a]


RFID-inspired energy harvesting networks: (NEW-FA2014) [Liu13a]


19 Final Exam

The final exam is Monday, May 8, 2pm–4pm.