CSci551 Syllabus—FA2013, Tuesday and Thursday Section

Ethan Katz-Bassett

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Class meets Tuesdays and Thursdays, 5pm to 6:20pm, beginning August 27 and ending December 5. Thanksgiving break (for my class) is November 28. The date and time of the final is Thursday December 12 4:30-6:30pm.

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

2013-08-26: no changes yet

Obtaining these papers: All of these papers are available from the CSci551 Moodle site (see URL above) in PDF format. Because they are copyrighted they are available only for classroom use. The Moodle site is only available to students with class-specific accounts to enforce this; to get an account, go to http://www-bcf.usc.edu/~katzbass/cs551.html and follow the instructions, or contact the professor or TA if the instructions do not work.

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.

A good option for handling the paper is to get some kind of an e-reader. Several class members and professor John Heidemann did that last year. You need something that can display 8.5x11 inch PDF files comfortably. Android tables work well and several PDF annotators are available (Professor Heidemann uses RepliGo PDF Reader, which is a nice annotator as well). An iPad works well, and several PDF readers and note-taking programs are available (for example, iAnnotate). Others have used a small Kindle, which worked adequately if you can tolerate only seeing half a page at a time. The large Kindle (DX) is good for reading, but its software may not support note taking over PDF at all. Please let me know if you have any other suggestions.

Printing out the papers is also tried and true, and note taking with pencils works well. If you print the papers out, I strongly encouraged you to use a double-sided printer. You will need a 3-inch binder if you keep them that way. (If you have to pay for printing, you may find it cheaper to get together with other students to print one copy and photocopy additional ones.)

Some of the papers were scanned. These tend to have large (2–5MB) PDF files, and may look slightly fuzzy when printed. Some of the papers may not display well in Acrobat on the screen, but they all should look reasonable when printed.

In SP2005 we tried making hardcopies of the papers available to students. Unfortunately, USC requires that we charge for these (to recover the duplication costs), and the copyright owners (ACM, IEEE, etc.) insist that if there is any charge, then they must get a copyright fee. The total fee for the entire paper set was well over $250, and it was still more than $100 even if the optional papers were eliminated. For this reason I do not plan to make hardcopies available.

In this syllabus, I indicate “new” by papers relative to John Heidemann’s section of CSci551 from last year. (There will be other variations between my section and sections taught by other professors.)
Class Pace: We will usually go over two or three papers per week, 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 week) behind for part of the semester.

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

I am happy to take questions about either primary or supplementary 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. The syllabus lists the papers per week, rather than per class, even though the class meets twice a week. Since the papers in a week are generally related, and we may discuss multiple papers together, I encourage you to read all papers for a week before the first class meeting of the week. 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

Supplementary:
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.)

Week 1 (Aug. 27 and 29):
Primary: Tips for reading papers: [Hanson99a]


Another viewpoint of paper reading [Jamin03a]

What to look for in systems papers: [Levin83a]


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

## 2 Design principles

**Week 2** (Sept. 3 and 5):

No paper, but will discuss: BGP routing.

Primary: The Internet architecture: [Clark88a]


Naming: [Saltzer82a]


The end-to-end argument: [Saltzer81a]


No paper, but we will review and discuss: data marshaling, packet formats and encoding, SOAP and REST.

**Supplementary:**

How “tussles” affect network architecture: [Clark02a]


Ways to design the next Internet? [Anderson05a]


## 3 Unicast Routing

**Week 3** (Sept. 10 and 12):
Review of unicast and distance vector routing. (Will use class notes, plus please review your EE450 work.)

Routing stability and oscillation: [Shaikh00a]


Routing outages, results, and causes: [Wang06b]


Path inflation (NEW FA2013): [Spring03a]


Supplementary:

BGP route convergence time: [Labovitz00a]


Supplement with detailed BGP information: [Stewart99a]


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


Effects of of network outages, and detecting them in odd data sources: [Turner10a]


Week 4 (Sept. 17 and 19):

Primary:

Network topology (NEW FA2013): [Oliveira08a]


(The following paper is out of order, but it’s pulled forward to support the class project.)

Project background: [Stoica00a]

*Supplementary:*
Routing hierarchy and policy: [Gao01b]


Delay-tolerant networking: [Fall08a]


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


4 Transport protocols, Congestion Control, and Queue Management

Week 5 (Sept. 24 and 26):

Primary: TCP and congestion control: [Jacobson88a]


Congestion control from first principles: [Ramakrishnan90a]


Modeling TCP: [Padhye98a]


*Supplementary:*
An early academic paper on TCP, prompting the 2004 Turning Award to its authors: [Cerf74a]


An alternative, delay-based approach to detect congestion (more recent “FAST TCP” builds on this much earlier work): [Brakmo94a]

TCP extensions for a datacenter (NEW FA2013): [Alizadeh10a]


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


Early drop with CoDel: [Nichols12a]


XCP and non-TCP congestion control: [Katabi02a]


Supplementary:
Random early detection: [Floyd93a]


Router buffer sizing: [Beheshti08a]


5 Wireless and Mobile Networking

Week 7 (Oct. 8 and 10):

Primary:
MAC protocols: [Bharghavan94a]


Non-IP routing in sensor networks: [Intanagonwiwat00a]

Wireless propagation characteristics: [Aguayo04a]


Supplementary:

DSR, an ad hoc routing protocol: [Johnson96c]


TCP interactions with wireless: [Balakrishnan97c]


Wireless security (NEW FA2013): [Borisov01a]


Wireless software radios: [Bahl09a]


6 Midterm

Week 8 (Oct. 15 and 17): midterm exam on Oct. 17

The midterm exam will be on Oct. 17. We will spend Oct. 15 finishing up the material from earlier weeks.

7 Modeling Network Traffic

Week 9 (Oct. 22 and 24):

Primary:
Self-similarity in LAN traffic: [Leland94a]

And in WAN and web traffic: [Crovella97a]


Datacenter traffic (NEW FA2013): [Benson10a]


Supplementary:
Interactions between network traffic and topology: [Labovitz10c]


Packet-level network dynamics: [Paxson99b]


8 Cloud Computing

Week 10 (Oct. 29 and 31):

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. For more in this direction, see CSci555 (graduate operating systems).

Building large-scale services [Fox97a]


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


9 Data Center Networks and Software Defined Networking

Optimizing a datacenter network: [Greenberg09a]

Running an enterprise network (Ethane, a parent of OpenFlow): [Casado09a]


Supplementary:
Middle boxes and cloud computing: [Sherry12a]


OpenFlow, a descendant of Ethane: [McKeown08a]


Data-center electrical usage: [Qureshi09a]


Evaluation of Cloud computing: [Li10a]


Data center topology/routing co-design: [Liu13b]


10 Network Architecture Past and Future: Quality of Service, Differentiated/Integrated Services, and Information-Centric Networking

Week 11 (Nov. 5 and 7):

Primary: Quality of service and admission control: [Shenker95a]


Google’s use of Software Defined Networking for traffic engineering (NEW FA2013): [Jain13a]

Information-centric networking: [Jacobson09a]


Supplementary:
Lighter-weight QoS: [Stoica03a]


Use of QoS and differentiated services: [Davie03a]


11 Network Security

Week 12 (Nov. 12 and 14):

Primary:
Spam and anti-spam: [Levchenko11a]


Onion routing (TOR): [Dingledine04a]


Supplementary:
Also possible BGP and spam (NEW FA2013): [Ramachandran06a]


Denial of service attacks: [Hussain03b]


Spam in Twitter: [Thomas11a]

Worm propagation: [Staniford02a]


(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.

12 Peer-to-peer and Content Delivery Networks

**Week 13** (Nov. 19 and 21):

Primary:

*(Here is the correct location for [Stoica00a].)*

Efficient peer-to-peer storage: [Stoica00a]

[Stoica00a] see above.

BitTorrent (NEW FA2013): [Piatek07a]


Content-delivery systems (NEW FA2013): [Saroiu02b]


*Supplementary:*

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

**S34. [Clarke02a]** Ian Clarke, Theodore W. Hong, Scott G. Miller, Oskar Sandberg, and Brandon Wiley. Protecting free expression online with Freenet. *IEEE Internet Computing*, 6(1):40–49, February 2002.

Novel routing with DHTs: [Caesar06a]


(This paper should be with routing, but we’ll talk about it here because it assumes background about Chord.)

11
13 Catch up and Thanksgiving Break

Week 14 (Nov. 26):

No class on Nov. 28, due to Thanksgiving break. We will either spend Nov. 26 catching up, as needed, or we will add an additional related paper to cover.

14 Multicast Routing, Transport, and Applications

Week 15 (Dec. 3 and 5):

Primary:

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]


Supplementary:

File distribution and coding: [Byers98a]


Multicast at the application layer: [Chu02b]


Multimedia: [Bolot94a]


15 Privacy and Ethics

Primary:

Ethics of data collection (NEW FA2013): [Bailey12a]

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


16 Other Topics: Router and Hardware Design

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

Supplementary:  
Router design: [Partridge98a]  


Optical networking: [Mukherjee00a]  


17 Final Exam

The final exam is Thursday December 12 4:30-6:30pm.