CSci551 Syllabus—FA2012, Friday Section

John Heidemann

August 20, 2012

Class meets Fridays, 9am to 11:50am, beginning August 31 and ending December 7. Thanksgiving break (for my class) is November 23 and the stop period does not intersect classroom days. The date and time of the final is Monday, Dec. 17, 11am–1pm.

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

2012-08-20: 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.isi.edu/~johnh/cs551.html and follow the instructions, or contact the professor or TA.

You are encouraged to download and print the papers. Downloaded they take up about 95MB storage. They are the primary written source of material for class, so you will need to get them, read them, and I strongly encourage you to take notes on them.

A good option for handling the paper is to get some kind of an e-reader. Several class members and the professor did that last year. You need something that can display 8.5x11 inch PDF files comfortably. An iPad works well, and several PDF readers and note-taking programs are available. I use and recommend iAnnotate. An Android tablet should work well as well, but I don’t know of any direct experience (please let me know if you have some!). I have used a small Kindle. It works adequately if you can tolerate only seeing half a page at a time. The large Kindle (DX) is good for reading, but my experience was that its software doesn’t 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 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 my section of CSci551 from last year. (There will be other variations between my section and sections taught by other professors.)

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, 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. 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.)

Class 1 (Aug. 31):
Primary: Tips for reading papers: [Hanson99a]


Another viewpoint of paper reading [Jamin03a]


What to look for in a paper: [Levin83a]

2 Design principles

Class 2 (Sept. 7):
Primary: The Internet architecture: [Clark88a]


Naming: [Saltzer82a]


The end-to-end argument: [Saltzer81a]


No paper, but review: data marshalling, packet formats and encoding, SOAP and REST. (No paper, but we will cover the material with class notes.)

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


Ways to design the next Internet? [Anderson05a]


3 Unicast Routing

Class 3 (Sept. 14):
Primary: Review of unicast and distance vector routing. (Will use class notes, plus please review your EE450 work.)

Potential routing problems: [Labovitz00a]


Routing stability and oscillation: [Shaikh00a]
Routing outages, results, and causes: [Wang06b]


Supplementary:
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]


4 Transport protocols, Congestion Control, and Queue Management

Class 5 (Sept. 28):
Primary: Congestion control from first principles: [Ramakrishnan90a]

TCP and congestion control: [Jacobson88a]


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]


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


Random early detection: [Floyd93a]


XCP and non-TCP congestion control: [Katabi02a]


*Supplementary:*
Router buffer sizing: [Beheshti08a]


Bufferbloat (when buffers are too big) (NEW FA2012): [Gettys12a]

5 Differentiated and Integrated Services

Class 7 (Oct. 12):
Primary: Quality of service and admission control: [Shenker95a]


Lighter-weight QoS: [Stoica03a]


Supplementary:
Resource reservation and RSVP: [Zhang93a]


Use of QoS and differentiated services: [Davie03a]


6 Midterm

Class 8 (Oct. 19): *midterm exam* The midterm exam will be half of the class period, with lecture the other half.

7 Wireless and Mobile Networking

Class 9 (Oct. 26):
Primary:
MAC protocols: [Bharghavan94a]


DSR, an ad hoc routing protocol: [Johnson96c]

Non-IP routing in sensor networks: [Intanagonwiwat00a]


Wireless propagation characteristics: [Aguayo04a]


Supplementary:
TCP interactions with wireless: [Balakrishnan97c]


A survey of sensor net research: [Heidemann04a]


Wireless software radios: [Bahl09a]


8 Modeling Network Traffic

Class 10 (Nov. 2):
Primary:
Self-similarity in LAN traffic: [Leland94a]


And in WAN and web traffic: [Crovella97a]


Supplementary:
Interactions between network traffic and topology: [Labovitz10c]
9 Large Scale Services and Cloud Computing

Class 11 (Nov. 9):

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]


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


Supplementary:

OpenFlow, a descendant of Ethane (NEW FA2012): [McKeown08a]


[Freedman04a]

[Freedman04a] NOT IN .BBL.

Evaluation of Cloud computing: [Li10a]

10 Multicast Routing, Transport, and Applications

Class 12 (Nov. 16):

Primary:

Multicast routing (flood-and-prune, rendezvous): [Deering88b]


Reliable multicast and SRM: [Floyd97c]


File distribution and coding: [Byers98a]


Supplementary:

Multicast at the application layer: [Chu02b]


Layered multicast, congestion control, and multimedia/video: [McCanne96a]


Multimedia: [Bolot94a]


Correction 2011-11-09: was previously listed as [Bolot98a].

11 Thanksgiving Break

Thanksgiving break and no class on Nov. 26.

12 Network Security

Class 13 (Nov. 30):

Primary: Denial of service attacks: [Hussain03b]

Spam and anti-spam: [Levchenko11a]


Onion routing (TOR) (NEW FA2012): [Dingledine04a]


Supplementary:
Spam countermeasures: [Xie08a]


Spam in Twitter (NEW FA2012): [Thomas11a]


[Moore03a] NOT IN .BBL.

Subverting routing with prefix hijacking: [Ballani07a]


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.

13 Peer-to-peer storage

Class 14 (Dec. 7):
Primary:
Efficient peer-to-peer storage: [Stoica00a]


BitTorrent: [Bharambe06a]


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


Novel routing with DHTs: [Caesar06a]


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

14 Current topics

Primary:
Middle boxes and cloud computing (NEW FA2012): [Sherry12a]


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


Enterprise network fault diagnosis: [Kandula09a]


Peer-to-peer traffic loads and self-similarity: [Gummadi03a]

15 Other Topics

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

15.1 Router and hardware design

Supplementary:

Router design: [Partridge98a]


[Anwer10a]

[Anwer10a] NOT IN .BBL.

Optical networking: [Mukherjee00a]


15.2 Datacenter Networking

Supplementary: Optimizing a datacenter network: [Greenberg09a]


Data-center electrical usage: [Qureshi09a]


16 Final Exam

The final exam is Monday, December 17, 11am–1pm.