EE E4710 - An Introduction to Network Engineering
Course Information

Professor Dan Rubenstein Fall 2004

Course Resources

Contact Information		
	Dan Rubenstein (Instructor)	Tianbai (Richard) Ma (TA)
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Office Hours	Tu 4-5pm, W 11am-12pm or by appt.	M 2:30-3:30pm, Th 4:30-5:30pm

Course URL: http://www.cs.columbia.edu/~danr/4710

Course meeting time / location: 9:10 am - 10:25 pm on M,W in Mudd 1024

Pre-Requisites

Probability (e.g., SIEO 3658). Communication Theory (e.g., ELEN 3701) recommended

Description

Topics: Covers theoretical fundamentals of network engineering. Topics include theoretical underpinnings of the physical layer; design, protocols and analysis of the data-link layer and medium access sublayer; design, routing algorithms and prefix addressing for the network layer, and evaluation of congestion control and connection setup/teardown algorithms for the transport layer.

Grading

Your grade consists of:

20% **Homework:** Unless otherwise specified, homework will be due one week after it is assigned and should be turned in by beginning of class. At that time, a physical copy of the assignment must be received. If you will not attend class on that day, you should slide the homework under my office door (CEPSR 816) or in my mailbox (Mudd 1312) by 9am on the day it is due. Before class but after 9am, I will collect the homeworks from my office and mailbox. E-mailed/faxed homework and late assignments **will not** be accepted unless approved in advance. Approval will only be given under extreme circumstances. You are expected to produce your work in a timely manner. CVN students have an extra 48 hours to turn in homework.

You may discuss and work on questions with other students in the class. However, you should write your solutions on your own. In other words, if I were to later ask you to re-derive one of your homework solutions or to solve a similar problem when you were without your friends, you should be able to do so or have a clear understanding of how to approach the problem. This can only be learned by doing, so you should do your homework.

35% **Mid-term:** 10/13 in-class, closed book, no calculators.

45% **Final:** Date TBD, closed book, no calculators.

A note on exams: I am more interested in your gaining an understanding of and developing an intuition for **why** certain rules, laws, and techniques hold and are used. I am less interested in your ability to memorize these rules, laws and techniques and blindly apply them without intuition as to why they work. Thus, I will try to design the midterm and final questions to test your understanding of the concepts, not your memorization skills. I realize that some memorization will undoubtedly be required, but hopefully the memorized concepts will be those that can be re-derived via your intuition.

A note on effort: Your grade will mainly be a reflection of how you perform on the midterm and final. Homework grades don't have much of an effect, as long as homework is turned in (i.e., most students typically get most of the problems right). **You should do the homework so that you learn the material.** If you find yourself copying or getting solutions from someone else without putting in the effort of solving them yourself, you'll probably find yourself doing poorly on the exams. You won't get much sympathy from me if you come crying to me at the end of the term that you did well on the homework yet poorly on the midterm and final.

If you are worried about doing poorly on the midterm and final, despite the fact that you do follow the material, my advice is to be proactive: show me that you understand the material. Be active in class, come to office hours and show me what you have done on the problem and where you are finding the concepts confusing. I highly value such participation. However, coming to office hours and just listening to me does not demonstrate your knoweldge of the material.

Reading / Texts

You should do the assigned reading **before** class.

- **Required:** Dimitri Bertsekas and Robert Gallager *Data Networks (2nd ed.)*, Prentice Hall, 1992. ISBN 0-13-200916-1.
- **Additional (optional):** James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach Featuring the Internet*, Addison-Wesley, 2000. ISBN 0-20-147711-4
- **Additional (optional):** Andrew S. Tanenbaum, *Computer Networks* (3rd ed.), Prentice Hall, 1996. ISBN 0-13-349945-64.
- **Additional (optional):** Alberto Leon-Garcia and Indra Widjaja, *Communication Networks: Fundamental Concepts and Key Architectures*, McGraw-Hill, 2000. ISBN 0-07-022839-6.
- **Additional (optional):** Srinivasan Keshav, *An Engineering Approach to Computer Networking*, Addison-Wesley. ISBN 0-201-63442.
- **Additional (optional):** Jean Walrand and Pravin Varaiya, *High Performance Communication Networkse* (2nd ed.), Morgan Kaufmann, 1999. ISBN 1-55860-574-6.
- **Additional (optional):** Jean Walrand, *Communication Networks: A First Course (2nd ed.)*, McGraw-Hill, 1998. ISBN 0-256-17404-0.

Computing Accounts

The course does not require computing facilities or computing accounts.

Cheating

In short: don't do it. Be warned now - I take cheating very seriously. If you are caught cheating on the midterm or final, you will fail the class and I will likely take additional action which can result in your suspension or expulsion from Columbia. It's not worth putting yourself in this position.

If a grade is that important to you then you should be putting in the extra effort, i.e., reading the book, coming to office hours, etc.

You must use common sense about when to collaborate / use notes / calculators, etc. If you are unsure of a policy, you should ask me or the TA first *before* doing something you (and I) might consider unethical. Both I and the TA will be putting a lot of time into teaching you this course. Our goal is to teach you the material. Grades on homeworks, midterms, and finals are not only a means to evaluate you, but also a means to force you to learn the course material.

If you do your own work but facilitate someone else's cheating, you run a risk of getting in trouble as well. This is because you run the risk of having me determine who copied from whom. If you feel that someone is pressuring you to help them in a way that makes you uncomfortable, come talk to me / send me e-mail. You should feel free (and actually I would encourage you) to

- Discuss homework problems / give hints / work together through a part of a problem that you are stuck on
- Study for the midterm / final together

Student Feedback

I'm always looking for ways to improve the course. If you have any comments or criticism about the course, or find any mistakes or misleading facts / comments in the lecture, please feel free to contact me. This includes comments on the material being covered, teaching style, pace of the class, workload, etc. I will try and accommodate, but I can't make any promises...

Syllabus and Schedule

Schedule subject to change...

Date	#	Topics/chapters covered	Reading (before class)	Assigned	Due
9/8	1	Intro / Internet Protocol Stack	Chapter 1		
9/13	2	Probability refresher: discrete		HW #1 (due 9/20)	
9/15	3	Probability refresher: continuous			
9/20	4	Physical Layer		HW #2 (due 9/27)	
9/22	5	Datalink Layer: Error Detection and Correction	Chapter 3-3.3		
9/27	6	Datalink Layer: stop & wait, sliding window and their analysis	Section 2.3	HW #3 (due 10/4)	HW #2 (solutions)
9/29	7	Datalink Layer: Medium Access sublayer, collision avoidance: TDMA, FDMA, CDMA			
10/4	8	Network Layer: Shortest path routing algorithms	Chapter 4-4.2, 4.4		HW #3 (solutions)
10/6	9	**Prof. Rubenstein out of town: NO CLASS**			
10/11	10	Network Layer: Distance Vector and Link State			
10/13	11	**MIDTERM EXAM**			
10/18	12	**Prof. Rubenstein out of town: NO CLASS**			
10/20	13	**Prof. Rubenstein out of town: NO CLASS**			
10/25	14	Network Layer: Multicast, Tunneling			
10/27	15	Network Layer: Addressing (CIDR)	Chapter 5-5.2		
11/1	16	**Election Day: NO CLASS**			
11/3	17	Network Layer wrapup		HW #4 (due 11/10)	
11/8	18	Transport Layer: reliability			
11/10	19	Transport Layer: congestion control			HW #4 (solutions)
11/15	20	Transport Layer: congestion control II (AQM)		HW #5 (due 11/22)	
11/17	21	Transport Layer: multimedia (jitter control, ...)			
11/22	22	Transport Layer: Multicast group concept		HW #6 (due 11/29)	HW #5 (solutions)
11/24	23	Transport Layer: Fairness I (TCP, max-min)	Chapter 2.4-2.6		
11/29	24	Transport Layer: Fairness II (proportional)		HW #7 (due 12/6)	HW #6 (solutions)
12/1	25	Transport Layer: wrapup			
12/6	26	Application Layer: DNS model	Chapter 2.9, Chapter 6		HW #7 (solutions)
12/8	27	Application Layer: P2P model		HW #8 (due 12/13)	
12/8	28	Large-scale phenomena: self-similar traffic, heavy-tailed distributions			
12/13	29	Catch-up/review			HW #8 (solutions)
TBD		**Final Exam**			