

CS 544 – Computer Networks - Syllabus

Spring 2011-2012

Professor Mike Kain

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Email: Michael.Kain@Unisys.com

Office hours: Before and after class; other times as needed.

Online chat/office hours to be posted via WebCT/BBVista; I'm always available via e-mail.

Office: UCROSS 133 (with Bill Mongan)

Teaching Assistant:

Ann Marie Schilling (amveca@yahoo.com).

Please put CS544 in subject of emails (so that we can recognize them immediately).

Class Time:

Section 001 (class): Mondays 6:00pm – 9:00pm; Room: UCROSS 153

Section 900 (online): WebCT/BlackBoard.

We'll have an online chat during class time for online students to interact with the lecture section.

Course Goals:

- An in-depth understanding of computer networks and computer networking models,
- To show through theory and example how computer networks operate,
- To understand the complexities and various issues that networking protocols must address to ensure correct service,
- To understand the security implication and requirements of network protocols,
- To understand the other influences on computer networks, such as business, social, criminal, and legal influences & influences that computers have on these subjects.

Course Objective:

The goal of this class is to examine computer networks in great detail using several networking models (TCP/IP, OSI, and ATM) and to use these models to break down the problem of computer networking, examine each layer and its duties and responsibilities. We'll also analyze networking protocols and understand how they are successfully designed and implemented. We'll use the Internet and other examples to illustrate the theory and operation of each layer.

The student will be graded on how well they understand the theory of computer networks and can illustrate through examples via the exams, as well as perform protocol analysis, design, and implementation.

Student Prerequisites:

The student must also be proficient in C/C++ or Java programming and should be proficient on an operating system (a Linux environment is available for those who don't have another). Socket programming as well as system use will be required for this semester's term project and will be the student's responsibility to learn. Acceptance of other languages is up to the discretion of the professor. Students should ask before implementing in another language.

Textbooks:

Data Communication and Networking, 5th edition [in syllabus as F5], by Behrouz A. Fourouzan (McGraw Hill), Copyright 2012. ISBN-13 978-0-07-337622-6 (ISBN 0-07-337622-1). (<http://catalogs.mhhe.com/mhhe/viewProductDetails.do?isbn=0073376221>).

Data Communication and Networking, 4th edition [in syllabus as F4], by Behrouz A. Fourouzan (McGraw Hill), Copyright 2007. ISBN-13 978-0-07-296775-3 (ISBN 0-07-296775-7). (<http://catalogs.mhhe.com/mhhe/viewProductDetails.do?isbn=0073250325>).

Additional readings are from ***Design and Validation of Computer Protocols*** [in syllabus as Spinroot], by Gerard J. Holzmann (Prentice Hall), Copyright 1991. ISBN 0-13-539925-4. Available online at <http://spinroot.com/gerard/popd.html>

Other Recommended Textbooks:

These books are not required for the course, but may help with related materials and understanding of concepts (so, if you can get to one or more, it can help understand concepts):

Data and Computer Communications, 9th edition, by William Stallings (Prentice Hall), Copyright 2011. ISBN-13: 978-0-13-139205-2. (<http://www.pearsonhighered.com/educator/product/Data-and-Computer-Communications/9780131392052.page>)

Cryptography and Network Security, 5th edition, by William Stallings (Prentice Hall), Copyright 2011. ISBN-13: 978-0-13-809704-4. (<http://www.pearsonhighered.com/educator/product/Cryptography-and-Network-Security-Principles-and-Practice/9780136097044.page>)

Computer Networks, 5th edition, by Tanenbaum and Wetherall (Prentice Hall), Copyright 2011. ISBN-13: 978-0-13-212695-3. (<http://www.pearsonhighered.com/educator/product/Computer-Networks/9780132126953.page>)

Grading:

Term Paper (Protocol Analysis)	10%
Term Paper (Protocol Design):	10% #
Term Project (Protocol Implementation)	20% #
Midterm Examination	25%
Final Examination	25%
Peer Evaluation	10%

An A grade is a score of 85% or higher.

A B grade is a score from 70% to 84.99%.

A C grade is a score from 60% to 69.99%.

A D grade is a score from 50% to 59.99%

An F grade is a score below 50%.

There will be one midterm exam and the final exam which will be given online. Exam questions will be mostly essay questions. The final exam will be comprehensive but will stress the material after the mid-term.

Discussions will be part of the class – topics will be a part of each class to encourage students to think about computer networking and their affect on society, business, and other areas. These will follow from the class discussion.

The term group projects (protocol design and implementation) are group assignments.

Students will be placed into groups of 3 or 4 for these assignments. The group should turn in one submission along with a description of which students accomplished the pieces of the submission (each team member's contribution to the assignment). If there are discrepancies in the work distribution, anyone can email me privately to resolve. Students will be placed into groups by the 3rd week or so (after the drop/add period). Group makeup will be totally random with very little movement. Each team member will grade each other member as part of the semester grade.

Late Policy:

I expect all assignments (homework and the term papers) to be handed in on time. All requests for extra time must be handled before the day that the assignment is due and will be accepted or denied individually. In most circumstances, extra time will not be granted. Points will be deducted for each day that assignments are late.

How This Class Will be Run:

I usually teach the class in two halves per day. I start class at 6:05pm and usually take a break around 7:20 for 10 minutes. I then teach from 7:30pm to approximately 8:30pm or later (depending on class material). I am usually available before and after class for questions.

Academic Integrity:

With regard to the exams, you must do all of the work assignments for grading individually. Copying the solutions of others and plagiarizing copyrighted work is expressly forbidden. Only your notes and the textbook are allowable references for the exam. Using other materials (online or not) is expressly forbidden. Penalties for violation of this will range from a grade of zero on the exam to a grade of F for the course, effective immediately, and will always be accompanied by a letter to the Office of the Dean reporting the charge of plagiarism. If anyone has any questions about what constitutes plagiarism, please see me ASAP. I take this subject **VERY** seriously.

With regards to the team assignments, each team is to do the work individually (no interaction with other teams). You may consult with the professor and teaching assistant for guidance and evaluation of your ideas, but your submission should be your own. Copying or using copyrighted or open source work is expressly forbidden.

By registering for this course, each one of you is explicitly making the following pledge of honesty: "I understand that all tests, exams, and homework handed in for grading in this course are to be done individually (unless otherwise stated). All homework and other assignments handed in under my name are individual efforts: I am to solve, design, and develop these assignments myself. I understand that it is permissible to discuss with the teaching assistant or the professor. However, the final submission will be my own work. I will not copy anyone else's written work, or any copyrighted work, nor will I have anyone other than myself prepare any portion of my work. Copying of the solutions of others is expressly forbidden. I will not allow any other person to create, nor to copy, any part of any assignment handed in with my name on it."

Class Outline:

April 2 (Week 1) – Begin class; Introduction to networks; Definition of layers, services, interfaces, protocols (definitions and major pieces), DFAs, common themes. Sublayers, security and QoS. OSI, TCP/IP & ATM Reference Models. Ethernet/Wireshark. The Big Picture: Social, Business, & Legal effects of Networks. Online discussion: The Internet as a Utility? Reading:

- F5: Chapter 1 (concentrate on 1.4 & the concept of protocol), Chapter 2, Chapter 14.4.
- F4: Chapter 1 (concentrate on 1.4 & the concept of protocol), Chapter 2, Chapter 18.2 (pgs 529-535);
- Spinroot: Chap 1, & Chapter 8.1 & 8.2.

April 9 (Week 2) – Network APIs (sockets), network order, session layers. Recap design & protocol components. Components of a good protocol (and a good session layer protocol). Recap (quickly) socket algorithms (TCP, UDP, Server & client). Network APIs (sockets), network order. Sample session protocols (HTTP, FTP, DNS, BitTorrent, and more). Online discussion: Net Neutrality. **Term Paper #1 (Protocol Analysis) assigned.**

Reading:

- F5: Chapter 25, 26.
- F4: Chapter 23.1, 25-27.

April 16 (Week 3) – Transport Layer – services and duties; QoS; Sliding Window Protocols (SWP/ARQ). TCP & congestion control (Reno, Tahoe, Vegas). Online discussion: Social Interaction.

Term Paper #2 (Protocol Design) assigned. Groups will have been assigned by now.

Reading:

- F5: Chapters 23, 24.
- F4: Chapters 23, 24.1-24.4, 11.4 and 11.5.

April 23 (Week 4) – Other transport layers: UDP, SCTP, DCCP, NORM. Security implications of known transport protocols. Review for midterm examination. Online discussion: Marketing.

Term Paper #1 (Protocol Analysis) due. Online: Continue Protocol Design paper.

Reading: See website for URLs.

April 30 (Week 5) – **Midterm Examination (online from April 28th through May 5th).**

Term Project (Protocol Implementation) assigned. Protocol Design paper can be turned in early. Early group feedback period.

May 7 (Week 6) – Network Layer services & basic duties; virtual circuits & datagrams; routing algorithms (static & dynamic); routing tables, tunnelling; VPNs; subnetting, congestion control. Online discussion: Business implications. **Term Paper #2 (Protocol Design) due.**

Reading:

- F5: Chapters 8.1 – 8.3, 18.1 – 18.3, 20.
- F4: Chapters 8.1 – 8.3, 22, 20.4.

May 14 (Week 7) -- **[Mike will be out of town; Ann Marie Schilling will be guest lecturer]** Network Layer in ATM and the Internet (IPv4 [ARP, ICMP, IGMP, RIP, OSPF, etc.] and IPv6 [Neighbor Discovery, Router Discovery, MLD]). QoS across the Internet. Network layer in ATM; flows. Online discussion: Criminal, Law, & Jurisdiction. **Protocol Design paper to be returned this week.**

Reading:

- F5: Chapters 18.4 – 18.5, 19, 22.
- F4: Chapters 19-21, 24.5 – 24.9.

May 21 (Week 8) – Data Link Layer: Introduction, basics & services; QoS and what it takes; Point to point protocols; Shared media protocols; contention; persistence; performance; collision-free protocols. CSMA/CD & CSMA/CA. Data Link Layer examples: IEEE 802.3 & topologies; Fast Ethernet, Gigabit Ethernet, 10GB, 40/100GB, LLC, MAC, Bridges, self-learning. 802.1q VLANs. ATM, wireless protocols (802.11b/g/n). Link Layer authentication & security. NAC. Online discussion: Data Privacy.

Reading:

- F5: Chapters 9, 10.4, 11-13, 15.1, 15.2.
- F4: Chapters 11-15, 18.2, 18.3

May 28 (Week 9) – No class (Memorial Day)

June 5 (Week 10) – Network security (security at all layers of networking); common terms, attacks, security protocols (SSL, Kerberos, IPSec). Link Layer Security (802.1ae), Protocol fuzzing, Stack Integrity Checkers. Security analysis of protocols. Online discussion: The future of the Internet. **Term Project (Protocol Implementation) due. Review for final examination.**

Reading:

- F5: Chapters 31-32.
- F4: Chapters 30-32.

June 12 (Week 11) – Final examination (online from June 10th through 16th).