CS 438 (ECE 438) - Communication Networks

Instructors:

In recent semesters, this class has been taught by Robin Kravets and Constantine Polychronopoulos. It has also been previously taught by Steve Lumetta and Philip Godfrey.

Prerequisites:

The official prerequisites are: CS 241 or ECE 391, and one of ECE 313, MATH 461, and MATH 463.

When to Take It:

Most students who take this class do so as Juniors or Seniors; it is offered every semester. Taking ECE 391 or CS 241 beforehand is a good idea because the class discusses a lot of algorithms that involve some element of parallelism, some of which are typically implemented at the OS level; moreover, the class is taught in C, so having the extra C programming experience from ECE 391 or CS 241 is helpful. The other prerequisite - a probability class - is also be helpful, but all that is really necessary is a good understanding of simple probabilities and a willingness to self-study some of the more complicated probability concepts, such as Markov processes, and exponential and poisson random variables; students who take one of the probability classes concurrently will learn most of the necessary probability material before it is needed. Some small bits of the material in this class are review from ECE 110, ECE 210 and ECE 290, such as error detecting and correcting codes and Nyquist's theorem.

Class Content:

This class covers a lot of material. Essentially, the class is programming-centric view of networks that covers the 7-layer OSI model, starting at the bottom layer and moving up. The class begins with the Physical layer, briefly talking about encoding information onto signals and modulation; moving on to the data-link layer, framing and error detecting and correcting codes (such as parity bits, Hamming codes and CRCs). At this point, the class begins discussing of shared media, covering various approaches to media access control protocols, with aloha, ethernet, wireless, and FDDI's token-ring protocols as examples. Next, bridged networks and switched networks are discussed. The class then dives into routing protocols - specifically, the distance vector and link-state methods. Finally reaching the core of the network layer, the course dives into internetworking, talking about IPv4, IPv6, IP address assignment, CIDR, subnetting, and NATs. Border Gateway Protocol is discussed, as well as DNS. After this discussion of how the internet works, the class moves on to the transport layer, discussing how to implement reliable, in-order end-to-end protocols, with TCP as the prototypical example; the class also discusses congestion control and congestion avoidance, and the various solutions attempted by different TCP implementations. At the end of the semester, the class briefly discusses quality of service, performance analysis, and network security.

Work:

The workload for this class may vary depending on the professor; when taught by Robin Kravets in Spring 2012, this class had a very substantial workload for a technical elective. The class has both homework assignments and MPs. In recent semesters, there have been 4 homeworks - approximately one a month. Each assignment is fairly long, covering a lot of material and often taking 10+ hours each to complete, mainly because of their length and breadth. Additionally, there are typically a few MPs in this class; in Spring 2012, there were 3: the first MP was implementing a simple Google Talk client, leveraging existing libraries; the second MP was the most complicated, in which students had to implement their own distributed routing protocol which ran in a simulated network. The third and final MP required reliably transferring a file, which essentially involved implementing a TCP-like protocol. The second and third MPs are typically done in pairs, but for the second MP each student had to write their own routing protocol, and only shared code for the network simulation.

The class has a midterm and a final. The difficulty of the exams will depend on the instructor, but given the sheer amount of material covered, it is easy to spend a lot of time studying for the exams, especially for the final. The book for the class covers everything found in lecture and more, but it is advisable to use lecture slides & homeworks for review since the book is not a quick read.

Life After:

Students who enjoy this class might also like CS 425 (Distributed Systems), which discusses applications that can be built on top of networks. For those interested in Wireless Networks, ECE 439 (CS 439) is the logical next step. Additionally, one could choose to continue studying networking at the graduate level, with classes such as CS 538 (Advanced Computer Networks), CS 525 (Advanced Distributed Systems), and ECE 567 (Communication Network Analysis). Students interested in security should consider CS 460 (Security Laboratory), CS 461 (Computer Security I) and CS 463 (Computer Security II).