COMP SCI 358 Data Communications and Computer Networks - Spring 2012
Course web site: [http://www.uwgb.edu/shayw/courses/358]
Meeting times: MW 8:00-9:20 in MAC 225; Also 8:25-9:20 on Fridays Jan 27, Feb 3, and Feb 10.
The course will NOT meet during the week beginning March 19, the week after spring break.

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Office Hours: MW: 9:30-10:30; If you can't make this time please contact me for an appointment. There are other times I can meet with you.
Prerequisites: COMP SCI 257Software Design II; COMP SCI 241 Discrete Mathematics I (C or better in both)
Text: Data Communications and Networking, 4th edition by Behrouz Forouzan

Books on reserve:
Understanding Data Communications and Networks (3rd edition) by W. Shay
Computer Networking: A Top Down Approach (5th edition) by Kurose and Ross

Course
The field of data communications and computer networks is an incredibly exciting and dynamic area. It is also an area in which a single course can barely scratch the surface. Indeed, there is enough material here to justify an entire major field of study (even a career). Consequently, the problem I face is deciding what to cover. As the course title indicates, I have divided the course into two main areas of study: data communications and computer networks. I will spend about 1/3 of the course on issues related to communications and about 2/3 on topics related to network protocols. However, be aware that some topics can fall into either area. In any case, the best I can hope for is to provide a solid introduction to a variety of topics in these fields mixing some theory with applications and articulating many possibilities for further study. Toward this end, the goals I have defined are to provide you with a solid introduction to the following:

Data Communications
- The theory of digital and analog signals and how each can be used to carry information.
- Modulation techniques allowing digital data to be carried over analog signals and the theory that relates bit rates to signal frequencies.
- Some commonly used data compression techniques and areas in which each is most applicable.
- Methods used to detect cases where signal noise has introduced errors into a data transmission.
- Description of commonly used encryption methods.

Networks
- The need for layered protocols and how those layers interact.
- Client/server programming model and experience in setting up client/server programs using sockets.
- Low level protocols used by devices to gain access to shared media.
- End-to-end protocols through which two entities can exchange information accurately and efficiently.
- Security issues. Encryption, secure web sites, authentication, attacks, firewalls.
- Local Area Network (LAN) protocols, primarily the evolution of Ethernet into its current form.
- Protocols and hardware used to connect multiple LANs.
- Routing strategies used in complex networks.
- Quality of Service (QoS) issues related to video and audio streaming.
- The most commonly used protocol in the world and the basis for the Internet: TCP/IP.

Course requirements include three exams and various assignments. At least one of the assignments will implement a client-server protocol for which you will write two different programs which run on two different computers and follow a protocol to communicate with each other using sockets.

As I stated before, the amount of material in this field is immense and there are so many opportunities for further study. Consequently, the final requirement is to write a paper or project covering some aspect of communications or networks that we have not covered or to expand on a topic we have. Requirements for the paper are listed on another document which I will distribute later.

Syllabus (Give or take a week and subject to minor changes depending on time)

Week	Topic
1	Introduction to computer networks and communications; standards organizations; Layered protocols. Chapters 1-2.
2	Client/Server model; Socket programming. Notes and Demo programs.
3	Physical layer and media: electrical, optical, and wireless communications (Chapter 7); analog and digital signals, frequency, amplitude, phase, bandwidth, Nyquist theorem-noiseless channels, Shannon's result-noisy channels (Chapter 3-selected topics); Digital transmission, NRZ, self-clocking, multilevel, block coding, pulse code modulation, parallel, serial, synchronous, and asynchronous transmission (Chapter 4);
4	Digital-Analog conversions, modulation and demodulation; frequency, amplitude, and phase shift keying; quadrature amplitude modulation (Chapter 5); Modems, cable modems, DSL technology (Sections 9.2-9.5). Frequency and time division multiplexing; Digital carriers, T Lines, ~~spread spectrum~~ (Sections 6.1-6.2)
5	Data compression: Huffman codes; run length, relative, arithmetic, and Lempel-Ziv encoding. MPEG, JPEG, MP3 compression (Shay text - Chapter 5)
6	Error detection/correction: parity; checksums, cyclic redundancy checks (Chapter 10).
7-8	Encryption and decryption. Caesar, poly-alphabetic, and transposition ciphers; One time pads, Data encryption standard (DES), Triple DES, Rijndael and the Advanced Encryption Standard (AES). Key distribution and protection, Diffie-Hellman key exchange, Clipper Chip (Chapter 30 + notes).
8-9	Public key encryption and message authentication: RSA algorithm (chapter 30); hash functions, message digests, Secure Hash Algorithm (SHA), digital signatures (Chapter 31); SSL (Secure Socket Layer) and TLS (Transaction Layer Security); X.509 certificates, Pretty Good Privacy, Firewalls, virtual private networks, Denial of Service (DOS) attacks (Chapter 32 + notes)
10	Flow control: Xon/Xoff, unrestricted, stop and wait protocols; sliding window protocols: Go-back-n sliding and Selective repeat; Data Link Control protocols (Chapter 11)
11	Contention protocols, Aloha, carrier sense multiple access, collision detection/avoidance, token passing (Sections 12.1-12.2); Local area networks, IEEE 802.3 Ethernet standards, cable specifications, Fast Ethernet, Gigabit Ethernet, 10-gigabit Ethernet (Chapter 13); Wireless LAN standard (Section 14.1).
12	Connections: bridges; repeaters; switches, hubs, routing tables, route learning, spanning tree algorithm, Switched Ethernet, virtual LANs (Chapter 15); network layer routing: Bellman-Ford algorithm, hierarchical routing, link-state routing, border gateway protocols; Routing Information Protocol, router design. (sections 22.1-22.3; Shay text chapter 10)
13	TCP/IP: IP packets, classful and classless addressing, subnetting, network address translation, IPv6, address resolution protocol (chapters 19-20, section 21.1); TCP: connection management, flow control (Section 23.3); UDP (section 23.2)
14	Presentation and wrapup

GRADING: Three exams: 20% each; Paper: 15%; Assignments: 25%
The final exam is scheduled for Monday May 7, 2012 from 8:00 - 10:00. **PLEASE NOTE**: This date is known many months in advance and must be taken as scheduled. Any activities such as work schedules, vacations, trips, etc. must be planned around this date. **No Exceptions!**

NOTE: This course satisfies an upper division writing emphasis requirement. In compliance with those requirements a term paper is required, all programs must be fully documented, and any non-programming assignments must be well written. The grade will reflect that. Also, part of each exam will consist of essay questions which will be graded in part on quality of writing.