# CSS 432:  Network Design

## Course Description:

This course examines methods for designing and managing LANs and WANs theoretically and practically. The topics covered include the OSI architecture, data link networks, packet switching, routing, TCP/UDP, flow control, congestion control, network security, and application protocols such as DNS, SMTP, FTP, and HTTP. The course is largely oriented to network programming and experiments. You will be given programming assignments, some followed by performance evaluation.  These will include topics such as sockets (socket, connect, write, writev, bind, listen, accept, signal, fcntl, and read ).

## Work Load and Grading:

| Course Work | Percentage | Grades | Approximately Corresponding Numeric Grade |
|---|---|---|---|
| Assignment 1 | 10% | 90s | 3.5 - 4.0 |
| Assignment 2 | 10% | 80s | 2.5 - 3.4 |
| Assignment 3 | 10% | 70s | 1.5 - 2.4 |
| Assignment 4 | 10% | | |
| Term Project | 15% | 60s | 0.7 - 1.4 |
| Research | 5% | | |
| Quizzes | 20% | | |
| Final Exam | 20% | | |

## Textbooks:

*Computer Networking:  A Top Down Approach.  7th Edition.*
*https://www.pearson.com/us/higher-education/program/Kurose-Computer-Networking-A-Top-Down-Approach-7th-Edition/PGM1101673.html (Links to an external site.)Links to an external site.*

If you buy the 6th edition because it is cheaper/used, that is ok too.   The 7th edition removes some of the older content and focuses on more modern networking applications.  It also addresses the emerging trend of separating the Network layer into the Control Plane and the Data Plane, so I do recommend it if the price difference isn't too significant.

# References:

- *Beej's Network Programming Guide* (Links to an external site.)Links to an external site.
- *Computer Networks* (Links to an external site.)Links to an external site., 5th Edition, Andrew S. Tanenbaum, Prentice Hall, 2011
- *Internetworking with TCP/IP Principles, Protocols, and Architectures, Volume 1* (Links to an external site.)Links to an external site., 5th Edition, Douglas E. Comer, Prentice Hall, 2006
- *TCP/IP Illustrated, Volume 1 The Protocols* (Links to an external site.)Links to an external site., W. Richard Stevens, Addison-Wesley, 1994

## Some Programming Textbooks:

The following books are useful for system and network programming.

- *Effective TCP/IP Programming -- 44 Tips to Improve Your Network Programs,* (Links to an external site.)Links to an external site. Jon C. Snader Addison-Wesley, 2000.
- *Advanced Programming in the UNIX Environment,* (Links to an external site.)Links to an external site. W. Richard Stevens, Addison-Wesley, 1992.
- *Unix Network Programming, Volume 1,* (Links to an external site.)Links to an external site., 3rd Version W. Richard Stevens, Addison-Wesley, 2003.

## Course Goals:

The overall goal of CSS 432, "Network Design" includes:

- To learn theoretical and practical methods that are used to design and manage LANs and WANs,
- To experimentally and mathematically understand the effectiveness of the networking techniques through your programming assignments and exercises.
- Design a network protocol

You need to work in the Linux laboratory, (UW1-320) for testing and evaluating the performance of your assignment programs. Your report must include a large amount of discussions and considerations about results you obtained.

## Assignments:

Assignments will be updated on the course webpage when they are assigned. They will likely involve the following topics though:

1. Program 1: exercises socket communication and evaluates its performance.
2. Program 2: implement part of the HTTP application level protocol as a client and server.
3. Program 3: analyzes several TCP aspects
4. Program 4:  Implement Networking layer functionality

5. Term project: Design and Implement a multiplayer network game and design the underlying protocols
6. Research: Identify and analyze innovative research papers from top tier journals and/or conferences.

## Quizzes and Exams:

There will be frequent quizzes throughout the course in lieu of a midterm exam. There will be approximately 8-10 quizzes and each one will take about 10 minutes and consist of a few questions. Quizzes will be given at the beginning of class on Wednesdays. I will arrange for you to take quizzes **beforehand** if you have a legitimate excuse for missing a class. These quizzes will either cover material from your required reading or from the material that we have already covered in class. I will note which one prior to each quiz. There will be a final comprehensive exam for the final.

## Topics covered and tentative 432 schedule:

| Week | Topics | Chapters | | Additional Information |
|---|---|---|---|---|
| 0 | Foundation | 1.1-1.3 | | |
| 1 | | 2.7-2.8;1.4-1.8 | | |
| | Applications | 2.1-2.4 | | |
| 2 | | 2.5-2.6 | | |
| | End-to-End Protocols | 3.1-3.4 | | |
| 3 | Congestion Control | 3.4-3.5 | | |
| | | 3.6-3.8 | | |
| 4 | Network Layer: Data Plane | 4.1-4.3 | | |
| | Network Layer: Control Plane | 5.1-5.4 | | |
| 5 | SDN | 4.4, 5.5 | | |
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| 6 | Data Link Layer and Multiple Access | 6.1-6.3 | | |
| | Switched LANs, Link Virtualization | 6.4-6.7 | | |
| 7 | | | | |

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|---|---|---|---|---|
| | Wireless Networks and Multiple Access | 7.1-7.3 | | |
| 8 | Cellular Internet and Mobility | 7.4-7.5 | | |
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| 9 | Network Security | 8.1-8.3 | | |
| | | 8.4-8.9 | | |
| 10 | Presentations | | | |
| | | | | |
| 11 | Final Exam | | | |