COMP 4300 – Computer Networks

Course Description

Calendar entry

This course examines the principles of computer networks, including network architectures, algorithms, protocols, and performance. May not be held with the former COMP 3720 or the former COMP 4720 or ECE 3700. Prerequisite: COMP 3010 and COMP 3430.

General Course Description

Coming into this course you've had the opportunity to write code that uses sockets to build clients, servers, and peers. In doing so you've been able to treat sockets as a black-box that lets you send messages between applications running on any two computers connected by a network. Now it's time to open that box.

In this course we'll go all the way down to the hardware and see how we reliably transfer messages between two connected computers. Building on that capability we'll move on to the different algorithms and protocols we use to pass messages from computer to computer as they traverse the Internet to reliably get from source to destination. Including when we introduce the wireless devices we use every day. Throughout it all we'll be comparing the performance of the algorithms and protocols to gain a better ability to assess and choose the solutions best suited to the problem at hand.

In addition to these core aspects of networking, a specific offering of this course may select from any number of interesting network related topics. Please see an offering's course website for details.

Detailed Prerequisites

Before entering this course, a student should be able to:

- Use a messaging protocol such as http to communicate between applications running on distinct computers.
- Design and implement a messaging protocol.
- Implement a peer-to-peer application that is both scalable and reliable.
- Write code that uses sockets to communicate via tcp and udp.
- Write code that directly manipulates memory through pointers and address arithmetic.
- Perform a statistical analysis of a dataset.

- Explain how device driver code interacts with hardware and an Operating System to provide I/O functionality to applications.

Core Course Goals

By the end of this course students will:

- Discover how network hardware and software are organized to provide local and global communications.
- Use probability theory to analyze and measure network performance.
- Build a sliding window protocol to provide reliable communications between two points on a network.
- Discover how messages are routed between nodes in a network and across the Internet.
- Discover the use of broadcast and multicast messaging to manage a network.
- See how peer-to-peer algorithms are applied to the problems of broadcast and multicast messaging.

Core Learning Outcomes

Networking Fundamentals

Students should be able to:

1. Explain the 7-layer model, the responsibilities of each layer, and how the layers interact.
2. Explain the TCP/IP layered model.
3. Demonstrate how the TCP protocols manage connection-oriented communications.
4. Compare and contract TCP/IP with the 7-layer model.
5. Explain the roles of routers, switches, and bridges in building physical networks.
6. Apply probability theory to the analysis of performance measures such as re-transmission rates, expected traffic/wait time, and network utilization/throughput.

Data Links

Students should be able to:

1. Explain the difference between synchronous and asynchronous communications.
2. Design and implement state machines for sending and receiving framed messages.
3. Compare and contrast automatic repeat request (ARQ) flow control algorithms such as stop-and-wait, go-back-N, and selective repeat.
4. Implement a sliding window based ARQ protocol.
5. Determine the timeout needed to correctly detect and handle messaging error conditions.

6. Compare and contrast a data link layer sliding window protocol with the TCP sliding window protocol.

Routing

Students should be able to:

1. Compare and contrast adaptive versus non-adaptive routing algorithms.
2. Apply Dijskstra' algorithm define individual routing tables for a set of nodes/routers in a pre-defined network represented by a weighted graph.
3. Explain how the Border Gateway Protocol (BGP) routes packets between Autonomous Systems on the Internet.
4. Explain how BGP updates reachability information to adapt to change.
5. Compare and contrast flooding and spanning tree broadcast algorithms.
6. Compare and contrast group-shared tree and source-based tree multicast algorithms.
7. Demonstrate how a multicast message would propagate through a network when using a multicast algorithm such as Reverse Path Forwarding.

Additional Topics in Networks

Along with the core learning outcomes listed above, the instructor can choose from some of the following to supplement their offering of the course. The instructor is also free to include network related topics of current interest that are not listed here.

- Wireless networking
- Congestion control
- Simulating networks
- Network security
- Streaming media
- Mobile routing
- Sensor networks