

CS 455 Computer Communications and Networking

Section 001 Fall 2019: Monday 16:30 - 19:10, Sandbridge Hall 107

Last Revised 9-10-2019

Professor: Dr. J. Mark Pullen
Mail drop: CS Dept, 4301 Engineering Building
Office hours Mondays 14:00 to 16:00; also by appointment any mutually convenient time
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Current Catalog Description

Data communications and networking protocols, with study organized to follow layers of Internet Protocol Suite (TCP/IP family of protocols). Topics include role of various media and software components, local and wide area network protocols, network performance, and emerging advanced commercial technologies.

Textbook

* Larry Peterson and Bruce Davie, Computer Networks, A Systems Approach, 5th Edition, Morgan-Kaufmann
* Pullen, Understanding Internet Protocols, Wiley, 2000 (out of print; available online to CS455 students)

References

Stallings, Data and Computer Networks 9th Ed. Prentice-Hall, 2010 (older editions also useful)

Course Outcomes

1. Explain basic electrical engineering principles that enable communication at the physical layer
2. Demonstrate an understanding of wired and wireless data link layer protocols for shared medium and point-to-point communication
3. Demonstrate an understanding of the graph theory concepts required for unicast and multicast routing
4. Demonstrate an understanding of distributed routing protocols
5. Describe how protocols and applications use ARQ algorithms for distributed reliability
6. Demonstrate an understanding of end-to-end transport layer protocols and basic Web protocols
7. Explain basic concepts in cryptography and networking security protocols.
8. Illustrate fundamental understanding of networking by programming portions of the network protocols stack.
9. Demonstrate a basic understanding of performance analysis for computer networking
10. Demonstrate a basic working vocabulary of data communications and networking terminology

Prerequisites by Topic

Grade of C or better in CS 310 (Data Structures)

Grade of C or better in CS 367 (Computer Systems and Programming)

Grade of C or better in STAT 344 (Probability and Statistics for Engineers and Scientists)

These will not be waived nor accepted as co-requisites; however equivalent study or experience elsewhere may be accepted at the instructor's discretion.

Major Topics Covered in the Course

1. OSI 7-layer model
2. Flow/error control
3. Medium access control
4. Ethernet
5. Routing
6. Multicasting
7. Internet architecture
8. TCP/UDP protocols
9. Multimedia networking and the WWW
10. Security

The grading breakdown is as follows:

- * 10% Homework
- * 40% Projects
- * 20% Midterm exam
- * 30% Final exam

Project: Requires basic Java programming skill. We will use the Java Network Workbench 2 (JNW2), software developed at GMU that simulates a protocol stack and displays the results, using a text interface. Students will create modules for Internet stack layers and run them in the JNW2 environment, as described in the text by Pullen. JNW2 will be available for download through the CS455 Moodle page <http://disted.c4i.gmu.edu>. Well commented code must be submitted for grading via an upload link on the Moodle page. Student problems with the project are to be addressed to the TA, who will refer them to the instructor if needed. There will be an option for pair programming on the project.

Project credit breakout: DLC1, DLC2, DLC3, LAN1, WAN1, WAN2, TRN1, TRN2 five points each; extra credit assignments LAN2 and WAN3 five points each.

Missed exams must be arranged with the instructor BEFORE the exam date.

Homework will be due at beginning of class, either uploaded to Moodle or submitted on paper.

All assignments are due by start of class on assigned date. Late assignments lose 10% per class credit. No project submission will be accepted after first reading day (12/9/2019).

All students are expected to abide by the Honor Code as stated in the GMU catalog and [elaborated for Computer Science](#). Students should be aware that their submissions may be checked by plagiarism detection software.

Grading is proficiency-based (no curve), cutoffs will be in the vicinity of (but not higher than) A 93; A- 90; B+ 87; B 83; B- 80; C 70; D 60.

Extra credit is available by doing assigned extra project work; however, no student who fails the final exam will receive a grade higher than C, regardless of extra credit earned.

SYLLABUS (subject to revision) date and topic/readings in Peterson text/project assignment

8-26 Course introduction; network concepts; 7-layer and 5-layer models; data comm basics / Sections 1.1 to 1.4 / JNW2 Setup introduced

9-2 Labor Day holiday; no class

9-9 Physical layer: analog and digital telecommunications / Section 1.5, 2.1, 2.2 / Project DLC1: bit stuffing introduced

9-16 Data compression, security principles, integrity, appropriate use / Sections 2.3, 2.4 & 7.2 / Project DLC2: CRC introduced

9-23 Data link control; discrete event simulation / Section 2.5 / Project DLC3: ARQ introduced; Project DLC1 due;

9-30 Local area networks / Sections 2.6 and 2.7 / Project LAN1: CSMA/CD LAN introduced; Extra-credit project LAN2: Token-Passing LAN introduced; Project DLC2 due

10-7 mid-term exam (covers first five lectures)

10-15 NOTE: THIS IS A TUESDAY Network Layer: WANS, X.25, routing / Chapter 3 except Section 3.3 / Project WAN1 introduced; Project DLC3 due

10-21 no class – work on projects; prof at NATO meeting

10-28 Internet Architecture (IPv4); Metcalfe's Law; IPv6 / Section 3.3, Chapter 4 / Project WAN2: Dijkstra Routing introduced; Extra-credit project WAN3: Bellman-Ford Routing introduced; Project LAN1 due; extra-credit project LAN2 due

11-4 Queueing basics; transport layer: TCP and UDP / Chapter 5 & Sections 6.1 to 6.4i / Project WAN1 due; Projects TRN1 and TRN2: Reliable Transport introduced

11-11 Multicast, multimedia and ATM networking / Chapter 4; Section 6.5; Chapter 7 / Project WAN2 due

11-18 Network security and network management / Chapter 8 / Project TRN1 due

11-25 Higher layer protocols / Chapter 9 / Project TRN2 due

12-2 recorded mini-course in WebApps programming by prof, via Moodle-MISTC

12-9 Extra credit project WAN3 due; no homework or project work accepted after 16:30 on this day

12-16 Final exam (comprehensive) / all chapters listed above / *Exam location: classroom*

Course communication: we will use email extensively. Students are responsible to read GMU email accounts daily. Announcements will be sent to the class email list, which consists of GMU email accounts.

Course notices and assignments will be provided via email using GMU accounts only. Course materials (for example, homework solutions) will be available through the course Moodle page, <http://disted.c4i.gmu.edu>. Students are responsible for assigned readings and all material outlined in lecture slides.

Lectures will be captured in recordings that will be available to students registered in CS455.

University Requirements

[Honor Code Statement](#).

Students with Disabilities

If you have a documented learning disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with the Office of Disability Services (SUB I, Rm. 222; 993-2474; www.gmu.edu/student/drc) to determine the accommodations you need; and 2) talk with prof to discuss your accommodation needs.