

**CS 535  
(Section B1)  
PSY B51**

**Tuesday 6 – 8:45 pm  
Fall 2020**

**Course Description:** This course provides a robust understanding of networking. It teaches the fundamentals of networking systems, their architecture, function and operation and how those fundamentals are reflected in current network technologies. Students will learn the principles that underlie all networks and the application of those principles (or not) to current network protocols and systems. The course explains how layers of different scope are combined to create a network. There will be a basic introduction to Physical Media, the functions that make up protocols, such as error detection, delimiting, lost and duplicate detection; and the synchronization required for the feedback mechanisms: flow and retransmission control, etc. Students will be introduced to how these functions are used in current protocols, such as Ethernet, WiFi, VLANs, TCP/IP, wireless communication, routing, congestion management, QoS, network management, security, and the common network applications as well as some past applications with unique design solutions. Prereq: MET CS 575 and MET CS 201. Or instructor's consent. Restrictions: This course may not be taken in conjunction with MET CS 625 or MET CS 425 (undergraduate). Only one of these courses can be counted towards degree requirements.

**Office Hours:** I will not be on campus, so office hours can be quite flexible. Contact me by email and we will set up a time. I am frequently available.

Read and familiarize yourself with this whole document, not just the schedule.

**Schedule**

08 Sep	Introduction and Overview Networking as IPC	Tanenbaum Chapter 1 PNA Preface PNA Chap 6 pp.192-232
15 Sep	Principles of Protocols I	T-Chap 3 PNA Chap 2 & Chap 3 pp 57 – 85
22 Sep	Principles of Protocols II Basic Physical Layer	T-Chap 2
29 Sep	Ethernet and other Media Assembling Some Pieces Access Control	T – Chap 2.3 – 4, Chap 4,
06 Oct	Considering Multiple Systems Multiple Systems with relays Routing and Relaying The Network Layer	T – Chap 5 Except 5.3-5.4 pp 390-423. PNA Chap 3 pp 85 – 95

13 Oct	NO CLASS –	
20 Oct	Naming and Addressing	PNA Chap 5 Skip “Background on Naming and Addressing” unless that interests you.
27 Oct	Mid-Term	
03 Nov	“End-to-End” Error Control TCP/IP and the Internet Traffic Management Congestion Control PROJECT OUTLINES DUE	T – Chap 6 except 6.4.2, 3.  T -Chap 5.3,4
10 Nov	Lessons in Application Design Current Applications	PNA Chap 4. T-Chap 7, Chap 6.4.2 – 3
17 Nov	Applying What We Have Learned How Networks Work PNA Chapter 7. Name Resolution Systems Network Management	   PNA Chap 4. pp 132 - 135. PNA Chap 4 pp. 123 – 129
24 Nov	Security Mechanisms I Security Mechanisms II	 T-Chap 8
01 Dec	Project Presentations	
08 Dec	Project Presentations	
15 Dec	Final Exam? Or University Date, potentially 22 Dec	

### Textbooks

There are no good networking textbooks. With one exception, they are all written for a trade school, not a university, and they are full of errors. I have found Tanenbaum the least objectionable. I will be posting readings from my book *Patterns in Network Architecture* and possibly other pieces I have written. These will provide a basis for the principles of networking and Tanenbaum for some of the details about what is out there today. I guarantee that this is not an ordinary networking course. (We won’t use all of *Patterns* in class, but I will also post the parts we don’t use if you are interested. They might provide ideas for a project.)

Tanenbaum, A; Wetherall, D.; Feamster, N. **Computer Networks**, 6<sup>th</sup> Ed Pearson, 2020.

**Class:** The Schedule indicates the readings for each class. It will be best if you have read the material before class. (However, I know how that works as the pressures of the semester mount.) All lecture slides will be posted the day before class. (If not, yell, I have screwed up.) There will be a homework assignment at class time. (If not, yell, I screwed that up too!) ;- ) I assign homework to get you to think about the concepts and develop a “feel for the issues.” Searching the Web for answers, won’t accomplish that,

and it will show up in the exams. In class I will lecture based on the book. There is a lot of well-established material in this field that must be covered and we will. But at the same time we will consider these results in the current context. We will go over homework in class. I may ask one of you to explain the homework questions.

### **COVID-19 Policies.**

**Where are you?** First and foremost, if you have said you will attend remotely please let me know if you are not in the Boston area or more importantly, not in the Eastern US Time Zone. **This is important!**

**Classroom Rotation:** Everyone has indicated that they won't be in the classroom, so this is not an issue.

**Tips on Remote Learning.** The University's "Tips on Remote Learning" will be posted in Course documents with this Syllabus. It is recommended reading.

**Compliance:** All students returning to campus will be required, through a digital agreement, to commit to a set of [Health Commitments and Expectations](#) including face coverings, symptom attestation, testing, contact tracing, quarantine, and isolation. The agreement makes clear that compliance is a condition of being a member of our on-campus community.

You have a critical role to play in minimizing transmission of COVID-19 within the University community, so the University is requiring that you make your own health and safety commitments. Additionally, if you will be attending this class in person, you will be asked to show your [Healthway](#) badge on your mobile device to the instructor in the classroom prior to starting class, and wear your face mask over your mouth and nose at all times. If you do not comply with these rules you will be asked to leave the classroom. If you refuse to leave the class, the instructor will inform the class that they will not proceed with instruction until you leave the room. If you still refuse to leave the room, the instructor will dismiss the class and will contact the academic Dean's office for follow up.

Boston University is committed to offering the best learning environment for you, but to succeed, we need your help. We all must be responsible and respectful. If you do not want to follow these guidelines, you must participate in class remotely, so that you do not put your classmates or others at undue risk. We are counting on all members of our community to be courteous and collegial, whether they are with classmates and colleagues on campus, in the classroom, or engaging with us remotely, as we work together this fall semester.

### **Course Mechanics**

- **Attendance** – I don't take attendance. You are all adults and responsible for yourselves. There is material I will cover in class that may be on the exam that is not in the book or the lecture slides. Of course, with the current situation all lectures will be recorded and you can listen to them at your convenience. (Remote teaching is hard enough, I do appreciate the company and the questions rather than talking to the air.) ;- ) If something comes up, that is out of the ordinary and requires you to miss class, please let me know.
- **Grading:** The course will be based on homework (20%), exams (40%) and projects (40%). Homework and projects are expected to be submitted by their due dates. Late submission grades will be scaled accordingly. Exams will be open book, open notes.
- **Homework:** There will be approximately eight homework assignments. Homework will be due at the beginning of class the week after it was assigned. (Exams and holidays may modify that slightly.) Homework may be submitted in class or via Dropbox on Blackboard. (Email is okay, but has proved unreliable. Hence, dropbox is preferred.) (Don't use spaces or “#” in file names submitted to Dropbox. The Blackboard programming staff weren't that good.) Also file names should be more descriptive than “homework1” or “hw1”. You aren't the only one submitting homework! ;- )

Late homework will be penalized as appropriate. You are encouraged to work together to learn the material and to discuss approaches to solving homework problems. However, *you must come up with and write up the solutions on your own.*

**Nota Bene:** With homework being 20% your grade, it does not affect your grade much. The purpose of the homework is to help you ensure that you understand the material. Cutting and pasting answers from the web may be quick and you may get a good grade, but it won't matter much if you haven't understood the material and don't score well on the exams. If I find you copying from Tanenbaum's answers or other blatant examples, that homework will get a zero. A second time, it will be reported as plagiarism to the University. The University does not go easy on such infringements.

## Administration

- **Office Hours:** Before or after class is best. I will generally be on campus well before class. Contact me by email if you wish to see me before class.
- **Email:** You are required to periodically check your email for unexpected occurrences like errors in assignments, cancellations, etc. Check blackboard frequently as well.. Questions via email are always good. If the question/answer has general interest, I will answer you but probably ask you to bring it up in class; if the solution is very involved, we may need to go over it in person.
- **Course Web Site:** We will use Blackboard (blackboard.bu.edu). I will use it to post class notes, lab and homework assignments, homework solutions, and other course information.

- **Incompletes:** Incompletes will only be granted in accordance with university policy, which (broadly) requires a major crisis near the end of the semester.
- **Course Notes:** Class notes will be posted before the class. You are encouraged to annotate them during class.
- **Academic Honesty:** Please read the university academic code of conduct. If something is not clear, then ask. In particular, plagiarism is regarded as a serious offence and students engaging in this activity will be reported. If you use a source, cite it. . (Not related to academic Honesty, but germane. I do not consider wikipedia an authoritative source on any subject. It may be used to find more primary sources or cite it to illustrate opinions. But it cannot be considered definitive.)
- **In Class Distractions:** Please turn off cell phones and close laptops at the start of class. If you must text during class, please leave the class to do it. If you need to leave the class to text, there is no need to return to the class.
- **Instructor Errors:** Don't be shy! If you see me make a mistake, please let me know right away. If you are not sure, that's even better – it will give me a chance to clarify something. Class lecture is a test to see if you are listening. ;-)

### **Keys to Success in this (and most other) Course(s)**

***Attendance!*** Coming to class is important. Some of the material (and much of the perspective) in this course will be found nowhere else.

***Do the readings!*** Work out the examples as you read. If you do not believe that you completely understand something, try inventing and solving your own problems. If that doesn't work, come see me! And we will figure it out.

***Take notes!*** In particular, print out the course notes ahead of time and annotate them during class.

***Participate!*** Ask questions; talk with your fellow students. Be active.

***Keep up!*** Before each class, read over the notes from the previous class.

***Allocate enough time!*** Much of the material is time-consuming to master. There is a big difference between “kind of” understanding a subject and “really” understanding it.

***How do you know that you know the material?*** A good metric is whether you would feel comfortable standing in front of a class explaining it. Another is whether you think that you could explain it to a job interviewer!

### **(Not So) Picky Things I REALLY Care About**

- **Punctuality.** Please come to class on time. Unfortunately, unlike coming late to a movie, coming in late to class distracts the presenter as well as the presentees. Unfortunately, given some of you are coming from work and Boston traffic being

what it is, this may be hard. Let me know if you *can't* make it. We will assume you are coming!

- **Preparation.** Come to class prepared. If you haven't reviewed new terminology, etc. it makes it very difficult to follow what's going on. (The six Ps: Proper Preparation Prevents Poor Performance)
- **Presence.** Frankly, I don't care. If you can pass the exams without coming to class that is fine. (I know I shouldn't say this. But it was our attitude when we were in school so I can't in all honesty require it from you.) However in this class especially, much of the important information isn't in the textbook and it could show up on an exam. If I test you on what was said in class (and I am likely to) and you weren't there, that was your decision. If you decide to take me up on this, you better be good. Like showing your work with homework, if I know who you are I can better gauge your work. If you make yourself just a number, I will tend to see you that way.
- **Participation.** The best way to learn is to be involved. Conversely, being distracted is the worst. In particular, working on homework during class the day it is due is unacceptable. Get involved. I think this subject is really fascinating from a number of perspectives: scientific, historical, social, political, epistemological, etc. This stuff is fun.
- **Powers of 2 and logs.** Know them up to  $2^{16}$  (at least) and why this is important.
- **Your success!! If you are having problems, arrange a conference wth! (and sooner rather than later.)**

## Projects

By the end of Lecture 4, we will have discussed the common structures in protocols and developed a general model of a layer. The project paper should be about 10 pages single-spaced along with a presentation to the class of 5-10 minutes of the major points in your paper.

For a project, one take a protocol or group of protocols from the lower four layers or a relaying application protocol and apply this structure to it. Identify and document the mechanisms and policies in the protocol, what aspects are error and flow control and what aspects are relaying and multiplexing, does this protocol follow the structure outlined in class? If not, how does it differ, why does it differ, and should it? Does your example contradict the theory? Is the protocol wrong or is the theory wrong? If you choose a protocol that was discussed in class, then you must go well-beyond what was covered, e.g. actually defining the policies that the protocol uses. I will provide a list of the policies.

Possible protocols: 802.11, SCTP, Bluetooth, X.25, HDLC, Ethernet and its LLCs, Mail, Transaction Processing, ATM, ISDN, MPLS, etc.

Or a project of your interest. Possible topics might include:

A specific application with unique properties: p2p, process control in an electric grid, or a refinery or chemical plant, air traffic control, on-line trading, etc.

A specific aspect of networking: error detection/correction, flow control, security, multiplexing, re-transmission strategies, routing, congestion control, wireless protocol performance, distributed calculations, updating multiple copies, etc.

An area of networking relevant to your interests

Or a project of your choosing.