ECE 435 – Network Engineering
Lecture 1

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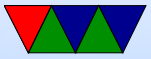
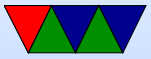
Introduction

- Distribute and go over syllabus
- Talk about the class.



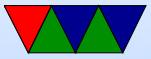
ECE435 – Homeworks

- Homeworks, 50%
- 11 total, lowest dropped
- Generally will be due on Thursday by beginning of class
- Will usually have at least a week to do them.
- Submission by e-mail, grades sent in response to that e-mail
- Will send out e-mail when posted on website



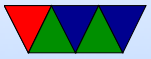
ECE435 – Exams

- Midterm, 10%
- Final, 15%



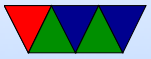
ECE435 – Project

- Project, 20%
- Involves using what we learn to do a networking-related project
- Can work in groups
- Open-ended, any language you want
- Presentation last week of class
- Writeup at the end
- More details as we get closer.



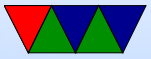
ECE435 – Other

- Class participation, 5%
- Late work penalty
  please turn in work, even if late, even if incomplete. homework grade adds up
- Class notes will be posted on the website.



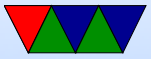
ECE435 – Homeworks

- Will initially involve some coding
- Lab: no dedicated lab. Might involve some sort of setup where you have to come in and try some things out.



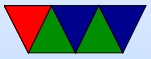
Hardware

- Will he helpful to have a device with network connection (Ethernet, wifi) that you can run tests on
- Raspberry Pi is great because if you mess things up you can just pop in a new SD card
- Laptop or desktop is fine too. It helps if it is running Linux. Although most TCP/IP stacks are similar for backwards compatibility reasons.



Textbook

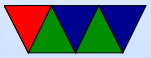
- (optional) Tanenbaum "Computer Networks"



Networking

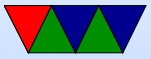
In this class we will cover

- Computer Networks
- Computer Security



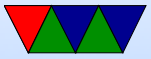
What is a Computer Network?

- A group of computers, connected to they can communicate
- Probably familiar with the Internet, which is a network of networks.



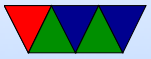
How can they be connected together?

- Wire (Ethernet, telephone, powerlines)
- Fiber Optic
- Wirelessly: radio, microwave, infrared, laser
- Sound?



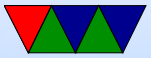
Why have networks?

- Resource sharing (printer, fileserver, etc.)
- Communication (e-mail, text messaging, video-conferencing, etc)
- Gaming
- Operating system/Security Updates



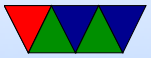
Why have network to your home?

- Accessing information (web-pages, etc)
- Entertainment (videos, gaming, web-pages, etc)
- Communication (e-mail, forums, video calls, phone calls)
- Shopping
- File sharing

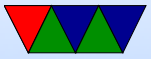


Network Problems

- Reliability
  - What makes a reliable network?
- Security
  - Is security a network-related problem? It makes local security issues exploitable world-wide...
- Expense
- Speed
  - Latency vs Bandwidth
- Addressing (how to find a machine)

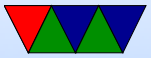


- Error correction
- Scalability
  - Trouble that appears as networks get bigger
- Standards
  - How do two computers understand each other? Who defines the rules?
- Privacy
  - Encryption? Trust? Authority? Tracking?
- Complexity
  - A lot of networking used to be easy and hands-on
  - Things are now fast at the expense of understandability



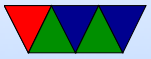
Some Network terms

- Client/Server
- Broadcast vs point-to-point
- Wide area network, local area network
- Bandwidth vs Latency.
  1Gbps might be fast, but what if 100ms latency?
- Connection oriented vs packet based (Switched phone vs VOIP)
- Topology (star, ring, cube, mesh, hypercube)



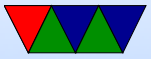
OSI Reference Model

ISO/OSI Open Systems Interconnection (1984)
ISO 7498
Many thought this would be the standard, but didn't end up that way
Everyone still talks about it anyway
Various layers each a new layer of abstraction.
Layers should be independent. Layering violations



1. Physical – **bits**: the raw bits. How 0 and 1 encoded, electrons or photons, etc.
   pins, volts, timing, frequency
   topology, how wires laid out
   bandwidth

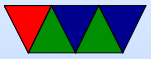
2. Data Link – **frames**: Transforms raw line to one that handles errors,
   breaks up data into frames, etc.
   Unique identity for each device on network
   Flow control, error handling



3. Network – **packets**: management of subnet. How packets routed from one network to another, addressing. (routing: what is routing?)

4. Transport – **end-to-end delivery**
   accepts a stream of bytes from above and make it suitable for the network layer.
   Gets back split up packets and turns it back into a total message.
   flow control, reliable delivery, error correction

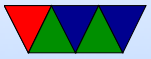
5. Session – allows different machines to have sessions



between them. session management, synchronization. Lets different apps share one connection to the network.

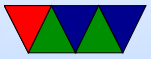
6. Presentation – syntax of data being transmitted. Char encoding, compression, encryption

7. Application – high level protocol, like webserver (http), ssh, etc.



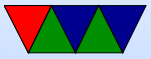
8th layer

- The user?
- Political? Financial? Government?



Summary

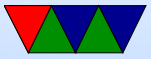
	OSI	TCP/IP
7	Application	Application
6	Presentation	
5	Session	
4	Transport	Transport
3	Network	Internet
2	Data Link	Host-to-network
1	Physical	Host-to-network



Layering

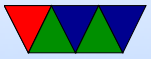
- Why is it good?
  Abstraction. Easier to do one layer and do it right. Should the webserver be aware if it is serving over copper vs fiber?

- Counterpoint: RFC 3439: "Layering considered harmful" (Dijkstra reference)



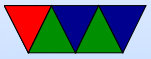
Results

- OSI (theoretical) never caught on for various reasons
- TCP/IP (practical) did, but has its own limitations which we'll discuss later



This year's Plan

- We'll start at the top and work our way down. Either way has issues



Coding

- Have you written a network program?
- How do you write a network program?
- We'll use C