

# ECE 435 – Network Engineering

## Lecture 1

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# Introduction

- Distribute and go over syllabus
- Note the class is only from 3:30 to 4:15 \*not\* 4:45
- Talk about the class.
  - Homeworks, 50%: 11 total, lowest dropped.  
Generally will be due on Wednesday 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, if you don't like that let me know.  
Will send out e-mail when posted on website.



- Midterm, 10%: week before fall break (due to travel)
- Final, 15%
- Class participation, 5%
- Project, 20%: Involves using what we learn to do a networking-related project, with a final writeup and demo the last week of classes. More details as we get closer.
- Late work penalty



- Class notes will be posted on the website.
- Will involve some C coding, also a lot of Linux configuration and possibly serial ports and network connections
- Lab: no dedicated lab. Might involve some sort of setup where you have to come in and try some things out.



# Raspberry Pi

- We will be using a Raspberry Pi.  
Model B+ or Model 2-B are probably the best, 3B probably also OK. It has to be a model with Ethernet.
- You will also need an SD card (4GB or bigger). Older ones take the big ones, newer the small ones. Usually not a problem as they tend to come with those adapters. You will want to install Linux (I tend to use Raspbian); getting a card pre-installed with Raspbian or “NOOBS” can save an hour or so of writing the SD card.



- For power you will need a USB-micro cable. You can power from any desktop or laptop (or a 1A or higher USB charger)



# Other Accessories

It can be fun to accessorize, but the stuff listed on the previous page is all you really need. Listed below are some \*optional\* extras you can get.

- A case can be useful, if only to avoid accidentally shorting out things. Many people get by just fine without one.
- A wall outlet adapter (a USB charger more or less)
- A dedicated GPIO connector to breadboard adapter
- HDMI cable and USB keyboard



# Other Hardware

- Having an Ethernet cable of your own might help





# Networking



# What is a Computer Network?

- A group of computers, connected to they can communicate



# How can they be connected together?

- Wire
- Fiber Optic
- Wirelessly: radio, microwave, infrared, laser
- Sound?



# Why have networks?

- Resource sharing (printer, fileserver, etc.)
- Communication (e-mail, text messaging, video-conferencing, etc)
- ???



# 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
- Security
- Expense
- Speed
- Addressing (how to find a machine)
- Error correction
- Scalability



# Network terms

- Client/Server
- Broadcast vs point-to-point
- Wide area network, local area network
- Bandwidth vs Latency. 100Mbps (100 mega-bits per second)
- 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

Doesn't always map well, but everyone talks about it

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





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
3. Network – **packets**: management of subnet. How packets routed from one to another, addressing. (routing: what is routing?)
4. Transport – accepts a stream of bytes from above and make it suitable for the network layer. 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.



	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

RFC 3439: “Layering considered harmful”



# Results

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

