

# ECE 471 – Embedded Systems

## Lecture 1

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# Introduction

- Distribute and go over syllabus
- Talk about the class.
  - Homeworks, 50%: 11 total, lowest dropped.  
Most will involve the Raspberry Pi.  
Generally will be due on Friday 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 e-mail when assignment posted on website.



- Midterms, two, 15% total  
Probably in October and mid-November
- Final, 10%
  
- Class participation, 5%
  
- Project, 20%: Involves using what you learned to do a small embedded project, with a final writeup and demo the last week of classes. More details as we get closer.
- No textbook.
- Late work penalty



- Class notes will be posted on the website.
- Will involve C coding, plus some minimal ARM assembly language and Linux knowledge. I will review everything you need to know.
- Might have some more C instruction this year based on exit-interview feedback. Believe it or not we actually listen.
- Labspace: no dedicated lab. In past students have used the electronics lab because HDMI and keyboards available, not sure situation with renovated labs. If it's an issue let me know.



# Raspberry Pi

- We will be using a Raspberry Pi.  
Model 3-B is currently probably the best, but any of the models (A, B, A+, B+, 2) should work with the homeworks. No compute node. Zero probably will work but a bigger pain to use (no ethernet, no GPIO header).
- You will also need an SD card (4GB or bigger). Older Pis take the wide ones, newer the narrow 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

- You will eventually need a breadboard. I know EE/CE students probably already have many already.
- I will loan out various devices/displays when necessary. I'll expect them back at the end of the year so try not to lose them.





# Embedded Systems



# What is an embedded system?

- Embedded.  
Inside of something.
- Fixed-purpose.  
Why? You can optimize.  
For cost, power, size, reliability, performance.
- Resource constrained.  
Small CPU, Memory, Disk, I/O, Bandwidth
- Often real-time constraints.



# What are some embedded systems?

- Cellphone (though lines blurring, general purpose)
- Vehicles (Cars/Airplanes)
- Appliances (TVs, Washers, Microwaves)
- Medical Equipment
- Industrial/Factory
- Space Probes
- Video Games?



# What Size CPU/Memory?

- Anything from 8-bit/tiny RAM to 32-bit 1GHz 1GB
- Performance has greatly improved over the years. ARM Cortex A9 in an iPad2 scores same on Linpack as an early Cray supercomputer

Type			Speed	RAM	Disk	GPU
Intel	Xeon	64-bit	3GHz	8GB	1TB	Nvidia
ARM	A53	64-bit(?)	1GHz	1GB	8GB	VC4
ARM	M0	32-bit	32MHz	16kB	128kB	none
MOS	6502	8-bit	1MHz	64kB	140kB	none

