ECE 471 – Embedded Systems
Lecture 1

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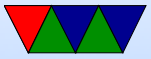
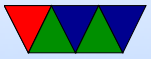
Introduction / Syllabus

- Go over syllabus (can be found on course website)
- In-person class attendance is not mandatory. Will stream and record videos. If attending asynch let me know. Don't feel obligated to provide video if zooming in. Probably most efficient if we use chat to ask questions.
- Lectures will be recorded and video posted to website.
- Class notes will be posted on the website.
- Due to room limitations splitting into two cohorts. Will re-evaluate Wednesday based on attendance.



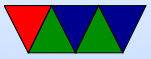
Syllabus continued

- Covid stuff. Short form on syllabus.
  - Stay distant.
  - Wear masks.
  - No food or drink.
  - If you feel sick at all, please attend remotely.



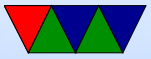
Syllabus – grading

- Homeworks, 50%: 11 total, lowest dropped.
  - Most will involve the Raspberry Pi.
  - Generally will be due on Wednesday by beginning of class. Will 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



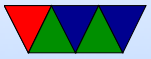
Will be take-home of some sort

- Final, 10%, taken remotely
- Class participation, 5%
  Part of this is returning borrowed items at end.
- 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. Presentations via Zoom



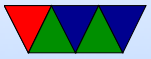
Syllabus – Work

- No textbook.
- Late work penalty. I will consider late work, but best to turn in what you have at time.
- 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.



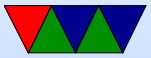
Syllabus – Academic Honesty

- This has been a problem in the past!
- Do not copy code from other students, either current or from previous years.
- Asking help from the professor/TA is fine
- Asking for general help, or discussing with classmates is fine
- Even having someone look over your code to help find a problem is fine
- Just don't copy someone else's code and submit it as



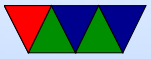
your own

- Also don't copy code off the internet (again, looking for advice online is fine, but copying code directly is not)



Raspberry Pi

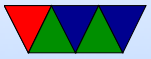
- We will be using a Raspberry Pi.
- See note on course website about what you need
- Brief summary: Model 3B+ is currently probably the best, but any of the models (A, B, A+, B+, 2B, 3B) should work with the homeworks. No compute node. Zero probably will work but a bigger pain to use (no Ethernet, no GPIO header).
- You will also need an SD card (8GB or bigger). Older



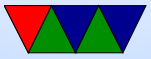
Pis take the wide ones, newer the narrow ones. Usually not a problem as they tend to come with those adapters. You will want to install Linux (I tend to use Raspbian); getting a card pre-installed with Raspbian or "NOOBS" can save an hour or so of writing the SD card.

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

- The recently released Pi-4 is usable for this class, but it has a lot of new features which make it a bit harder to



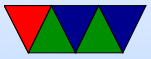
use (it used micro-HDMI for output, it needs a USB-C power supply)



Other Accessories

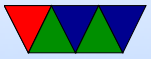
It can be fun to accessorize, but the stuff on the previous page is all you need. Below are some *optional* extras.

- 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
- USB serial
- Ethernet cable (or wireless)

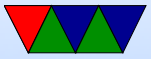


Other Hardware

- 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.
- I'll try to hand this out soon as who knows if/when things will get shut down again.

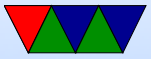


Embedded Systems



What is an embedded system?

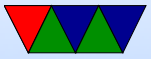
- Embedded.
  Inside of something.
- Fixed-purpose.
  Why? You can optimize.
  For cost, power, size, reliability, performance.
- Resource constrained.
  Small CPU, Memory, Disk, I/O, Bandwidth
- Often real-time constraints.



What are some embedded systems?

Seemingly everything has a computer in it these days. IoT.

- 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	4GHz	16GB	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