Reminders:
- Labs start today/tomorrow! Please install the Arduino IDE ahead of time and bring supplies/micro USB cable if you have them
- No late prelabs
Homeworks

- Due before class Wednesday and Friday
- First one is out at the end of class
- Smaller, theoretical assignments
  - Typically a short reading and 1-3 questions
- Graded on **good-effort completion**
  - A preview of material taught in lecture
  - You’re not expected to know it perfectly
  - If you get stuck, write down why you’re stuck and move on
Community guidelines

- Do not assume what people do/do not know
- Treat everyone with respect
  - Trust intent, acknowledge impact
- Give space to ask/answer questions
- Active listening
- Teamwork over competition
Review

- Circuits are loops through which electricity flows (have a power source and some conductors)
- We learned computations for voltage, current, and power
Interpreting device data sheets

- Often, we assume:
  - Wires are perfect conductors
  - Constant resistance
  - Constant forward voltage
  - Discrete (on/off) or at least linear behavior
- In reality: interference; variations with supply voltage, temperature, etc

Yellow LED data sheet
What is the actual minimum resistance?

\[ V = IR \]

\[ 1.2V = (7mA) \cdot R \]

\[ R \geq \frac{1.2V}{7mA} \]
So are we stuck deciphering datasheets all day?

No: make reasonable assumptions to get a tolerance in safe values
Digital devices

Leds are digital **output** devices

Things like push buttons are digital **input** devices

(*When connected correctly*) are driven by or produce a high/low signal
Circuit principle: must be closed for electricity to flow
Your book talks about:

- **Accelerometers** (measure acceleration of displaced mass)
- **Anemometers** (air flow for velocity)
- **GPS** (satellite for position)
- **Gyroscopes** (gimbals and modern)
- **Microphones**
- **Engine controllers, thermometers, cameras, chemical sensors, etc**
Other input components in your kits

- Thermistor/Photoresistor - resistance changes based on temperature/light
- Potentiometer - divides voltage* based on rotation of the dial
- Tilt sensor - Metal bearing completes circuit
Output components

Your book talks about:

- LEDs
- Motors (DC)

Your kits have:

- LCD screen (controlled digitally)
- Servo motor (controlled by lengths of high/low pulses)
- Piezo speaker (electricity displaces film to make sound)
How do you control a device that has higher power/voltage/current requirements than your Arduino can provide?
Transistors

Basically an electric switch

Voltage applied to Gate connects Drain and Source

Come in different types (beyond the scope of this course)
Be careful when using transistors!

Problems with this circuit:

- Issues with **FET in kit**:
  - Gate voltage
  - Current
- No isolation between Arduino and higher-voltage circuit
Optocouplers

- Control one circuit using another, but they are completely electrically separate!
A better circuit

Still need to double-check datasheets!