

# PCB Fabrication @ WSU

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# Who am I?

- Why am I making slides?
  - Today will likely be the worst day for listening / slides
- Why do these slides look so professional??
  - Hint: it's not chatgpt
- Why is Billy glaring at me???
  - It's because of love

## I found Wright State's Powerpoint template!!!

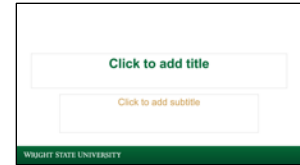
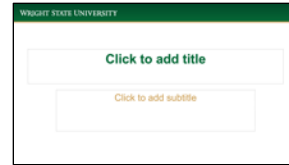
### Prepare for (up to) 7 Cover Designs



photo  
icon  
to  
add  
photo



### And 2 Inside Slide Designs



<--- These cover designs have the option  
of adding a photo, but not in .gif :(

# Where to be?

- Russ 152c (here) for big group meetings
- Russ 346, 347 for design and review
- Russ 348 for fabrication
- Check [github.com/wrightedu/intel](https://github.com/wrightedu/intel) for future days if lost

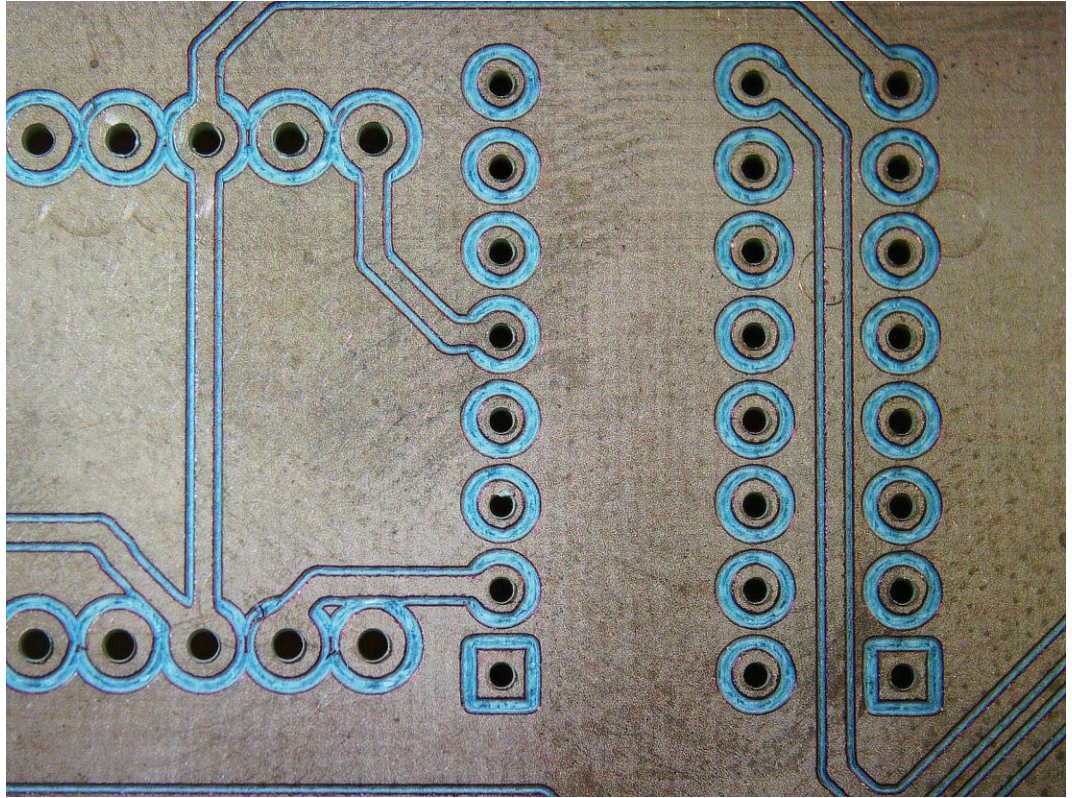
# Welcome!

- The plan ->

	T	W	Th
Syllabus Link & Resources	Introduce Project Ideas <i>* what are project</i> Bitty Board Hard As Maltflake Pad Prototype / Breadboard	Arduino Programming <i>list of topics (I/O, vars, etc.)</i> Control 7-seg inputs? Functions & Arrays	KiCAD PCB layout Manufacturing oriented design Design Standards <u>Fiducials</u>
new Laptop	Circuit Schematics of symbols (API) 7-seg - diagram 7-segment Datasheet Wire up 7-seg HW - find another datasheet	KiCAD schematics of footprints? HW (optional): - create for their idea/project	Fab outputs Design Review Levant next 3 wks

## The actual plan

- \*minus all the errors
- \*\* plus a solder resist mask
- \*\*\* plus components
- \*\*\*\* and programming (for the arduino)



# How do we get there?

- Simple circuits
- Breadboard a circuit
- Program an Arduino (C++)
- Make a circuit schematic
- Make a PCB layout
- Fabricate a PCB

# Today's goals

- Morning
  - Resources
  - Arduino
  - KiCad
  - Arduino Kit
  - Laptops!!!!
- After Lunch
  - Electronic Circuits
  - PCB Fabrication
  - WSU resources
  - Breadboarding 101

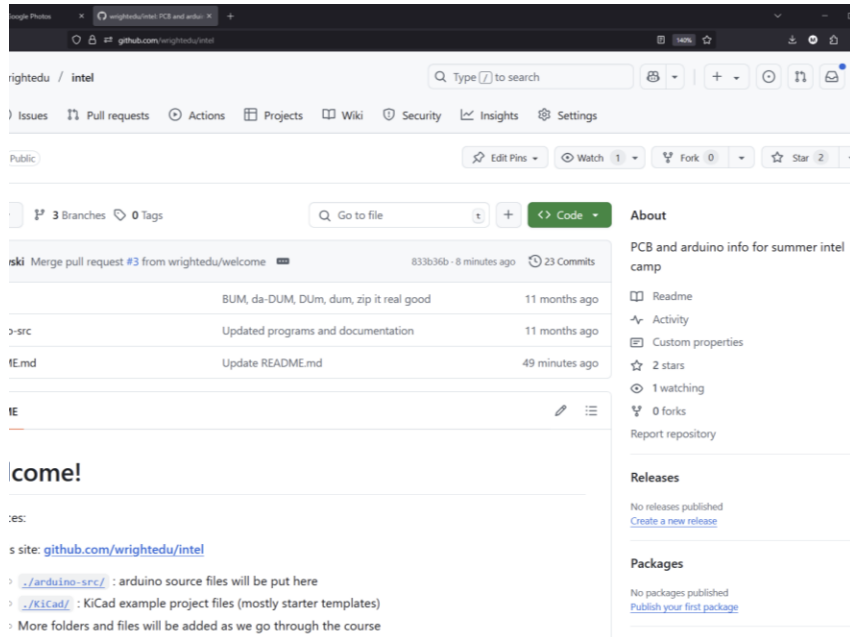




**This is a photo example.**



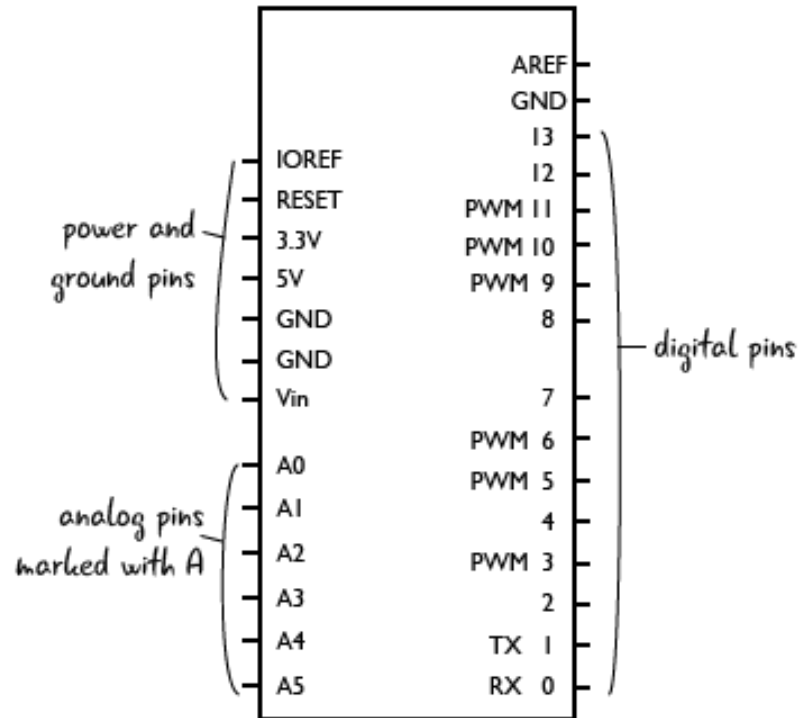
- Resources: **Github.com/wrightedu/intel**



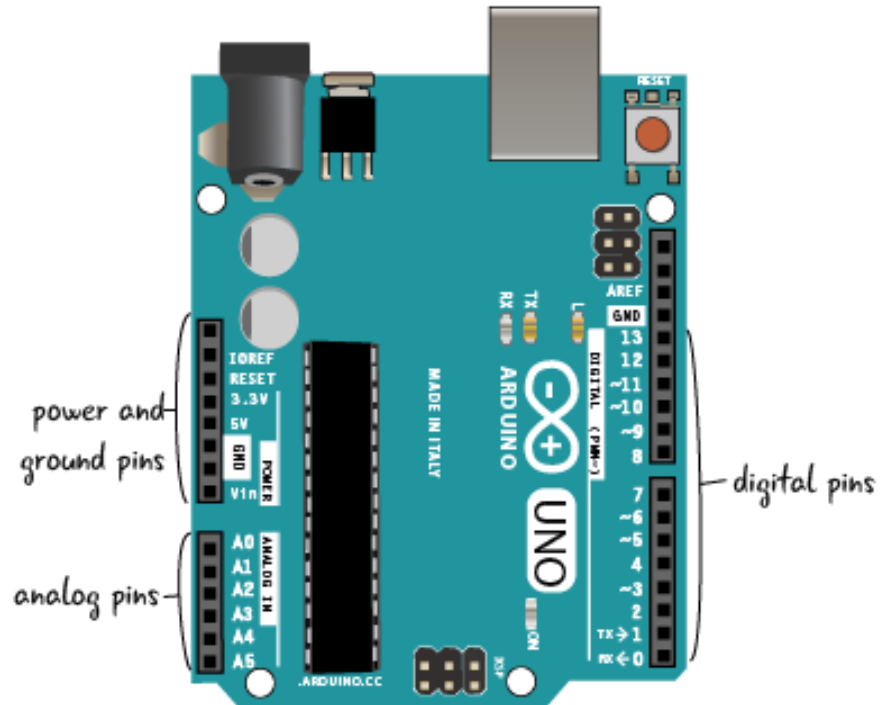
- A laptop (needed tomorrow)!
- Your Arduino kit (needed today!)
- Github.com/wrightedu/intel

# What is an Arduino?

Arduino Uno schematic



Arduino Uno with pins labelled



# The Arduino IDE



- IDE == Integrated Development Environment
- Write code
- Test code
- Push code to your Arduino

The screenshot shows the Arduino IDE 2.3.6 interface. The top menu bar includes File, Edit, Sketch, Tools, and Help. Below the menu is a toolbar with icons for checking, running, and selecting a board. A dropdown menu for 'Select Board' is visible. The main editor area displays the 'Blink.ino' sketch with the following code:

```

1 // the setup function runs once when you press reset or power the board
2 void setup() {
3   // initialize digital pin LED_BUILTIN as an output.
4   pinMode(LED_BUILTIN, OUTPUT);
5 }
6
7 // the loop function runs over and over again forever
8 void loop() {
9   digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
10  delay(1000); // wait for a second
11  digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage LOW
12  delay(1000); // wait for a second
13 }
14

```

Below the editor is the 'Output' window, which shows the following text:

```

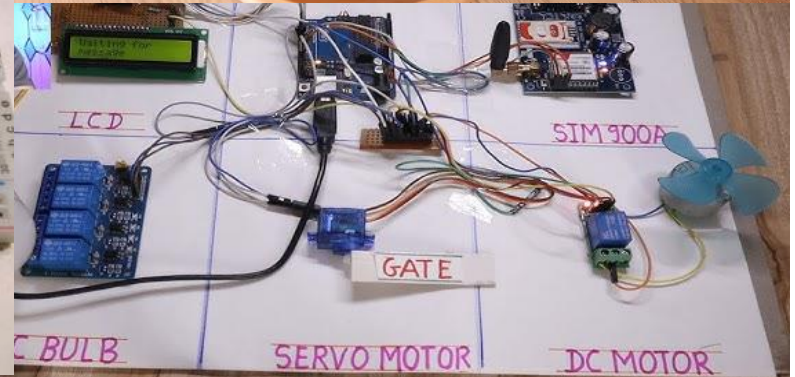
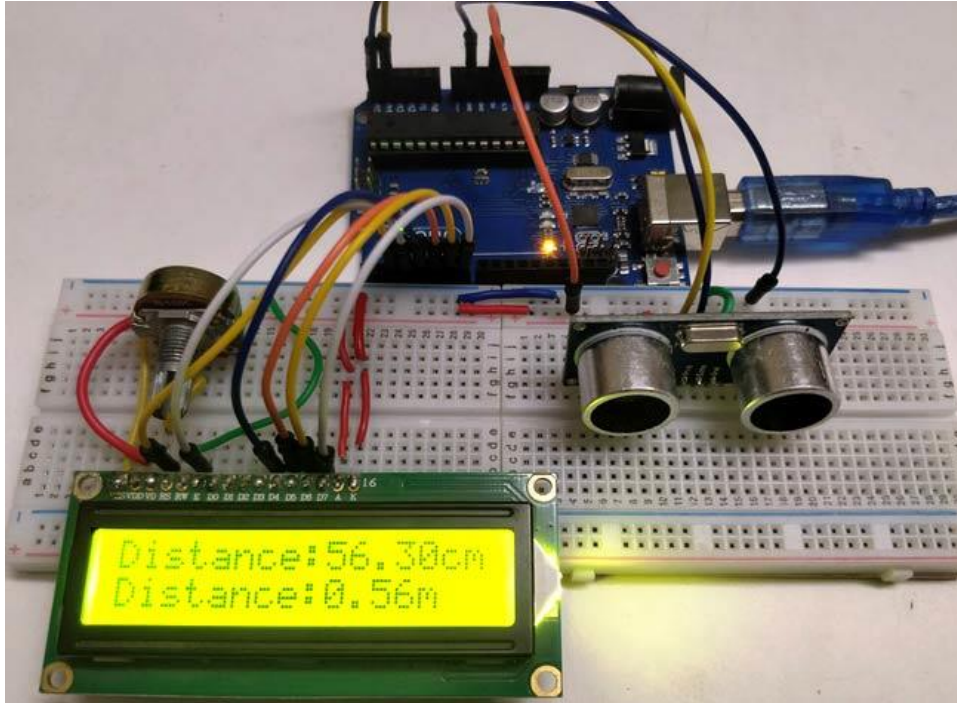
Installing LiquidCrystal@1.0.7
Installed LiquidCrystal@1.0.7
Downloading Stepper@1.1.3
Stepper@1.1.3
Installing Stepper@1.1.3
Installed Stepper@1.1.3
Downloading SD@1.3.0
SD@1.3.0
Installing SD@1.3.0
Installed SD@1.3.0
Downloading Servo@1.2.2
Servo@1.2.2
Installing Servo@1.2.2
Installed Servo@1.2.2

```

The status bar at the bottom right indicates 'Ln 1, Col 1' and 'No board selected'.



# Example projects

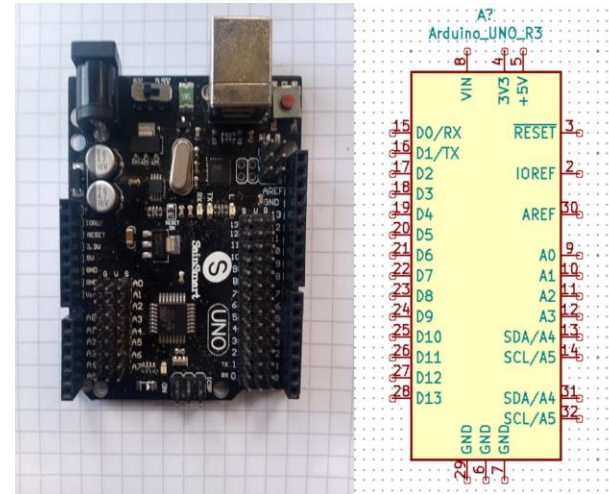


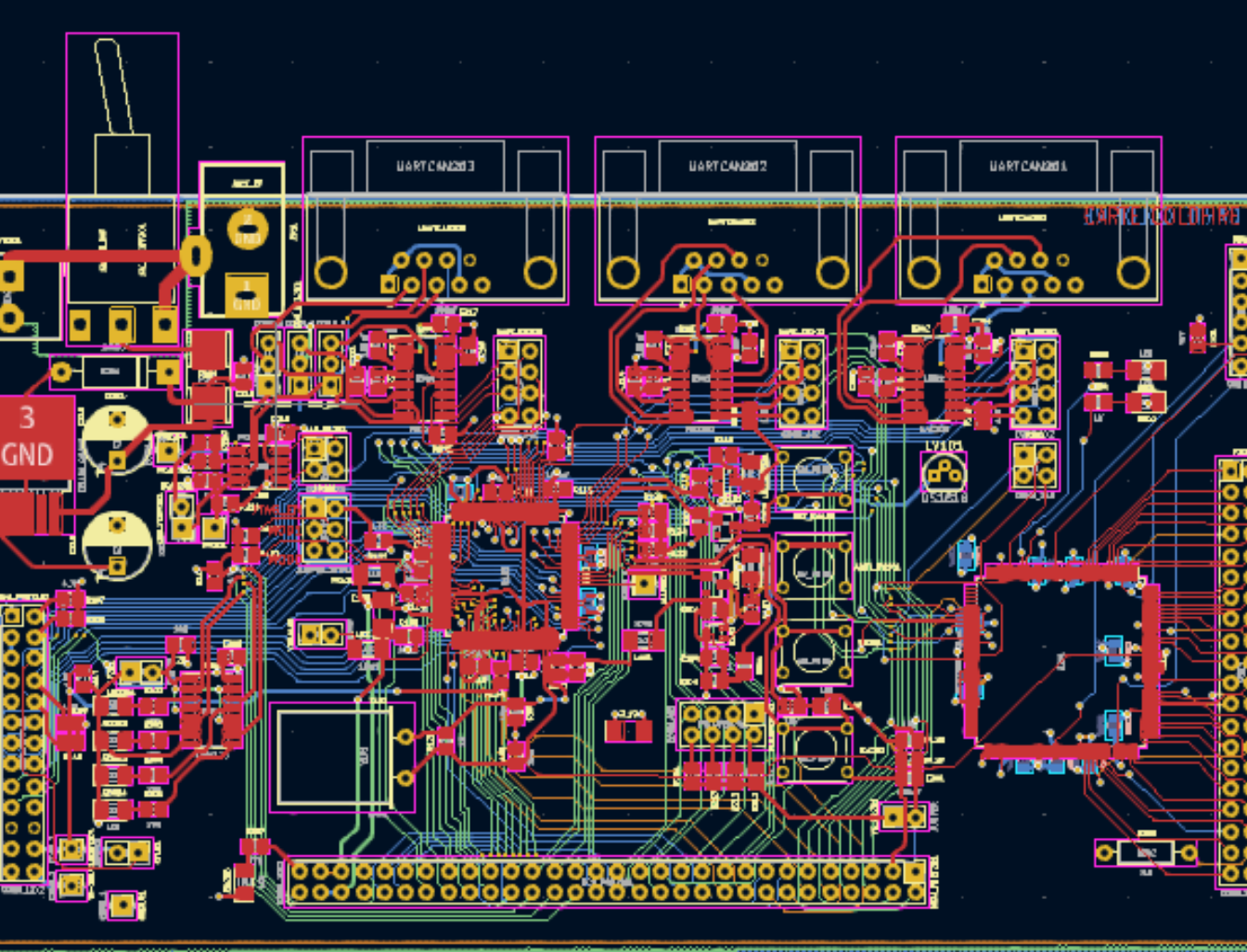
# Arduino questions?

## KiCad



- Software tool for creating circuit schematics and PCB layouts
- Really cool
- Very powerful
- Pain in the ass to learn





This is a  
photo  
example.

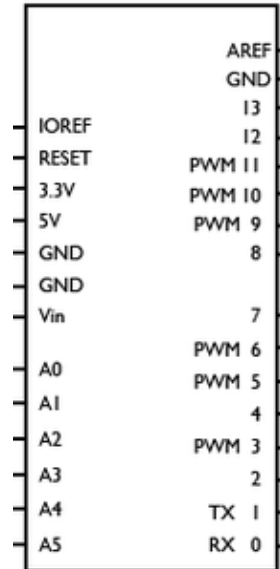


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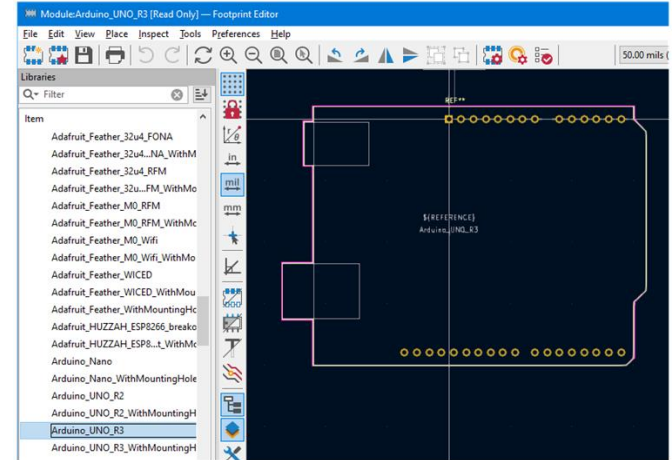
# My first schematic

Arduino Uno schematic

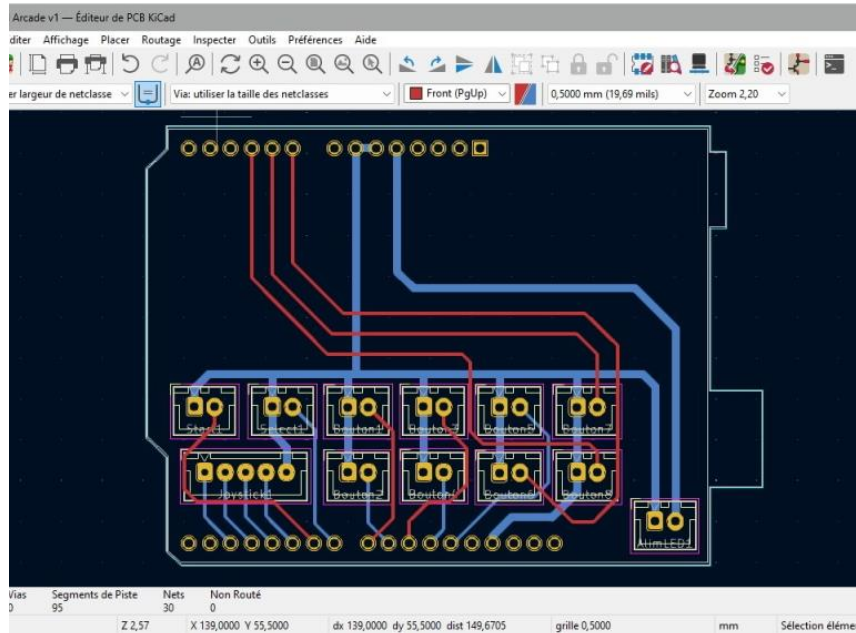


# KiCad is more than just schematics

- It has "Footprints" for most common components
- 2D / 3D understanding of the physical connections for a given component



## PCB design



- Assigning a footprint to each component on our schematic lets us make a PCB!

# KiCad questions?

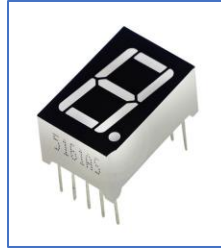
# Arduino Kit contents (of interest)



LEDs



RGB LED



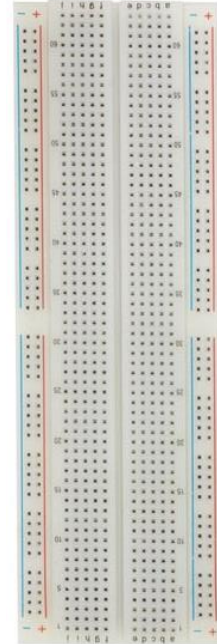
7 segment display



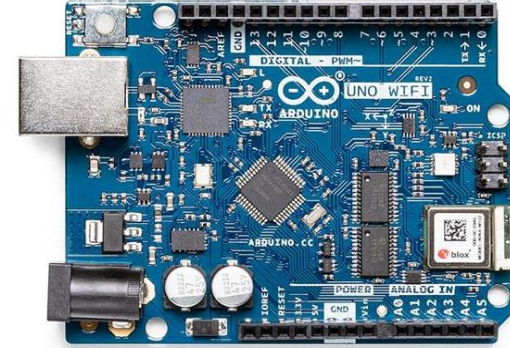
Keypad / membrane switch



Distance sensor



breadboard



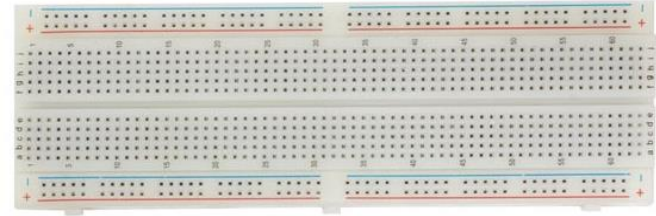
Arduino



Various resistors

# How do we get there?

- Simple circuits
- Breadboard a circuit
- Program an Arduino (C++)
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- Fabricate a PCB







**This is a  
photo  
example.**



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# The plan (continued)

- Week 1: learn and design
- Week 2: finish design and fabricate
  - Only ~12 students can be fabricating at the same time
  - Split into teams of 4 students
    - Next week, the first 3 teams done with their design will fabricate
    - Fabrication takes ~3 days



# Safety

- Safety glasses or approved eyewear must be worn near milling machines and chemicals while in use
- No open-toed shoes in 348 Russ (while fabricating)
- No cell phone usage in 348 Russ while processes are underway (chemical or mechanical)
- More safety talks to come later

## Week 3 & 4

- Additive Manufacturing with Dr. Mian
- Clean Room with Dr. Dan ?
- Groups of ~12 students will be moving around to different rooms, we will try to keep things clear but when in doubt find one of us



**I lied, it can  
totally be a .gif**

**It just breaks  
when I .pdf this :p**



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# After lunch

- Bring your Arduino kits
- Bring your laptop (if convenient)



## Break for Lunch

No you do not have to go to the Rancho.

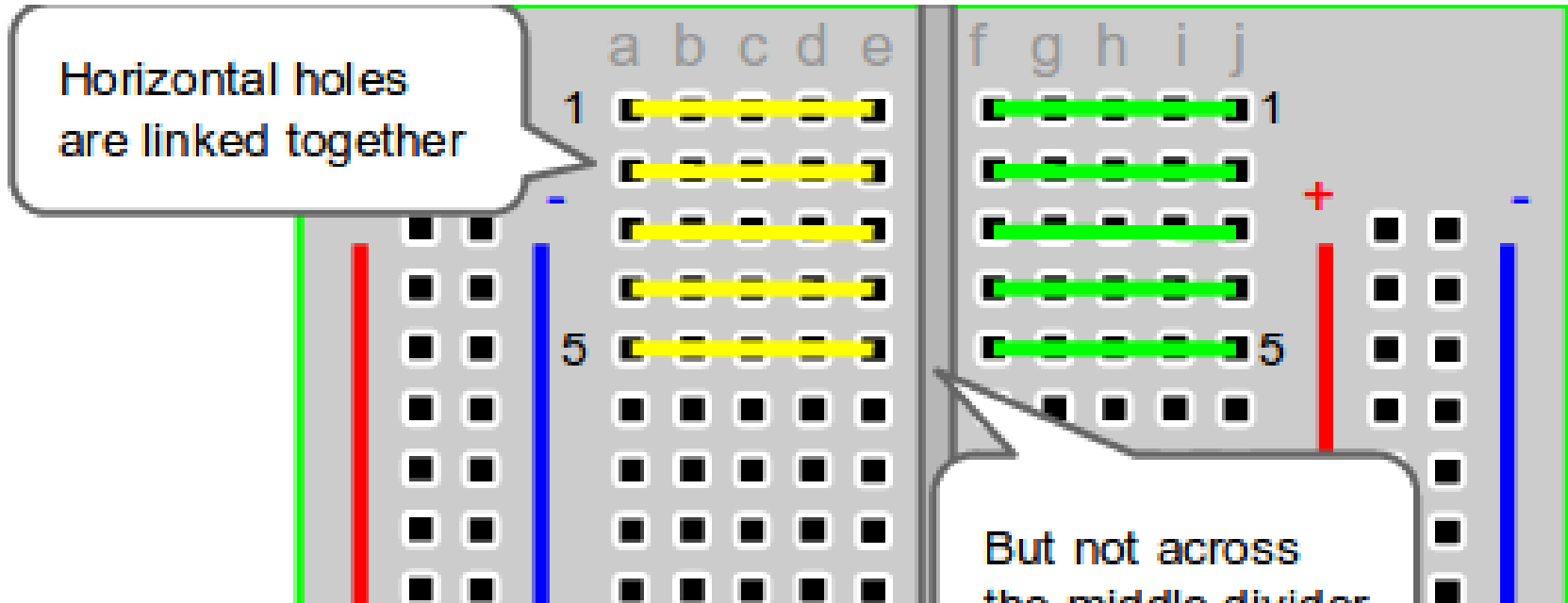
Please be back by ???



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# WSU resources images

# Breadboarding 101



# Fabrication outputs

- Fiducials
- Plated Through Holes (PTH)
- Non-Plated Through Holes(NPTH)
- Front Cu (FCU)
- Back Cu(BCU)
- Solder Mask
- Edge Cuts / Board Outline



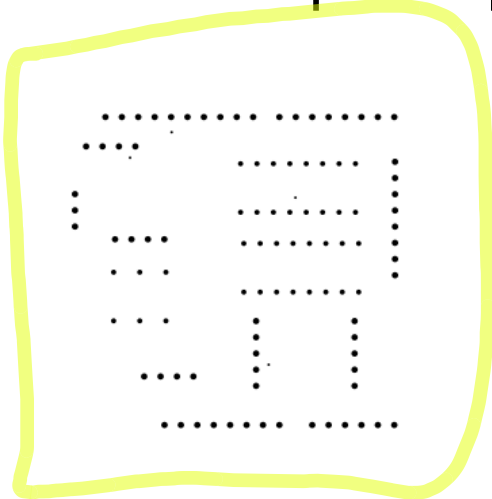
# Fiducials

- Alignment holes for everything else
- Frequently not a separate output file



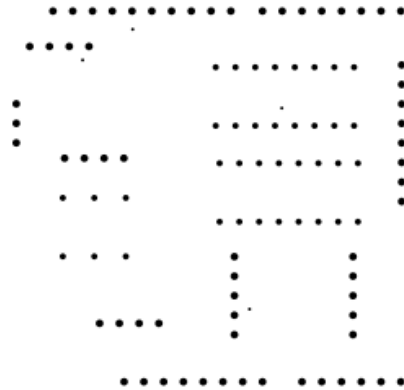
# Plated Through Holes (PTH)

- Drill bits make holes
- Electro plater plates holes



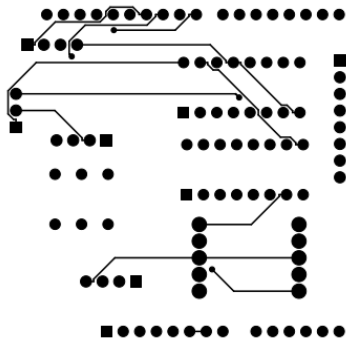
# Non plated through holes

- Look just the same... just not plated

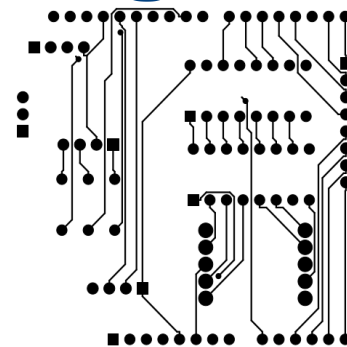


# Front and Back Copper

- Require fiducials to align
- Looks similar, same process on different sides of board

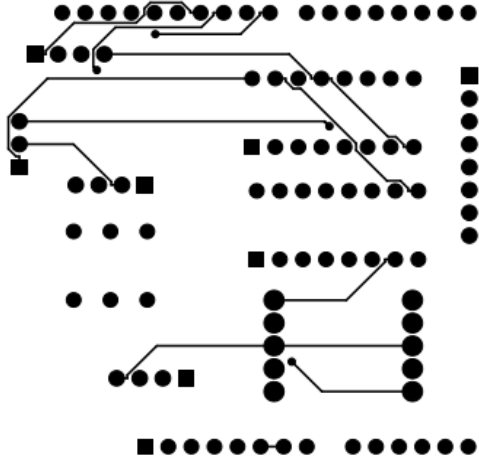


Front



Back

## F-Cu

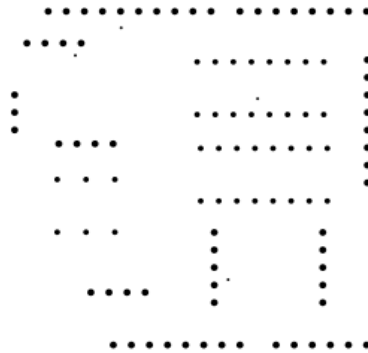


- Either mill this with Universal Cutter (depth matters!) OR Laser
- This is not the final tool path, just what needs isolating

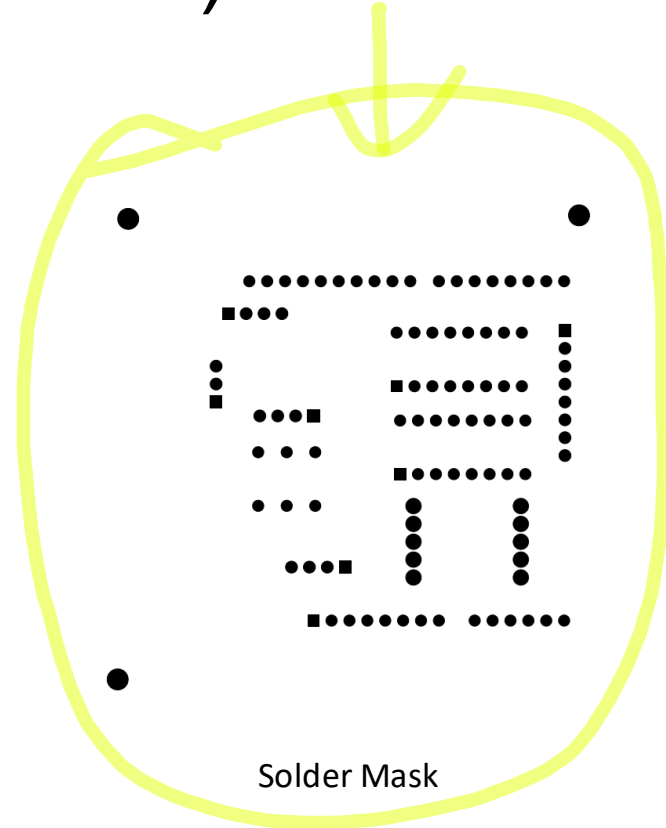


# Solder Resist Mask (Solder Mask)

- Paint the entire board
- Laser off the black parts



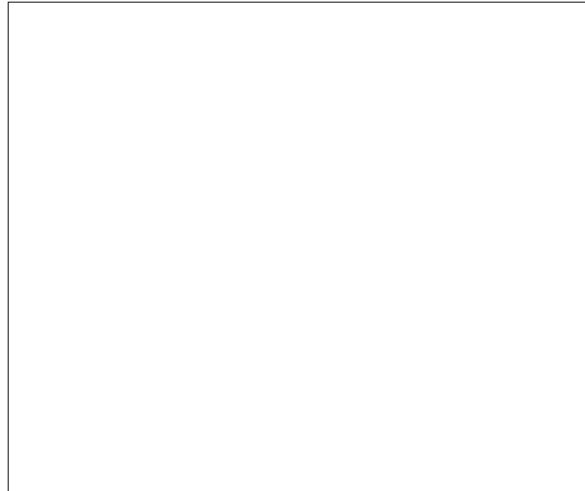
PTH



Solder Mask

# Edge Cuts

- Board outline, again most of these are not the "tool path"



# Tool Paths

- Specialty software (usually made by the machine manufacturer) generates "tool paths" from all previous files