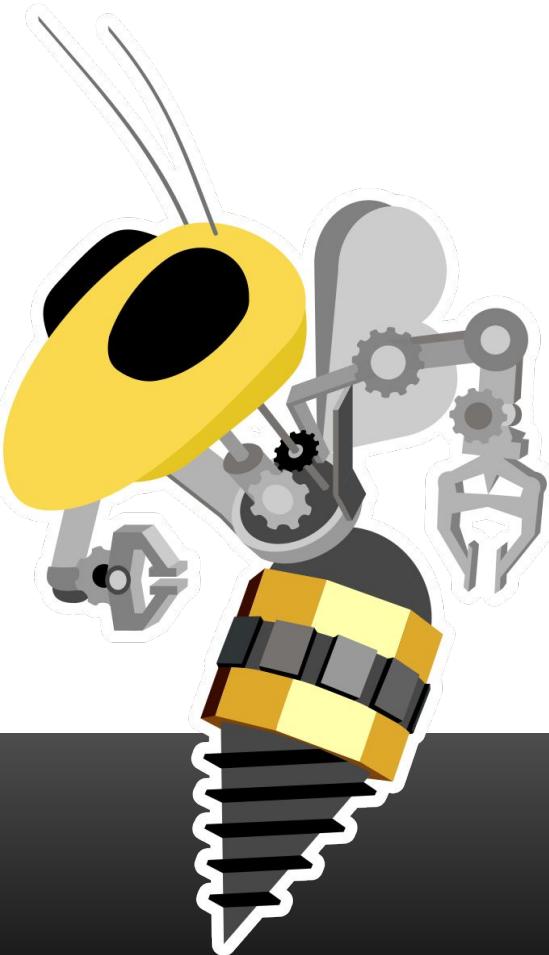


Welcome!

Electrical Training
Week 3

ROBOJACKETS
COMPETITIVE ROBOTICS AT GEORGIA TECH

www.robojackets.org

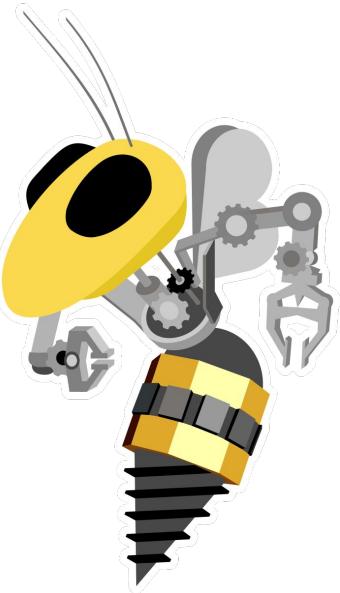


Last Week!

- Introduction to PCBs
- Introduction to KiCAD
- Parts and Libraries in KiCAD
- Configuring KiCAD Setup
- Making a Part in KiCAD

This Week!

- Communication Systems
- KiCAD Schematics

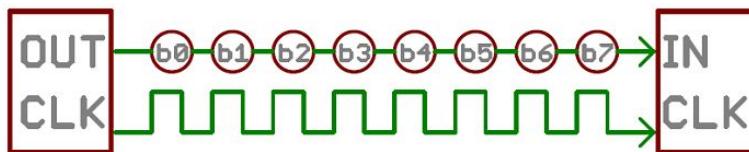


Communication Systems

How many are there again...?

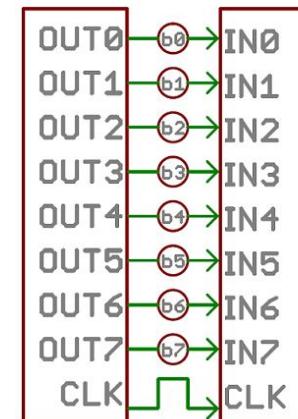
Serial vs Parallel Communication

Serial



- Stream data one bit at a time
- Example: USB, SPI

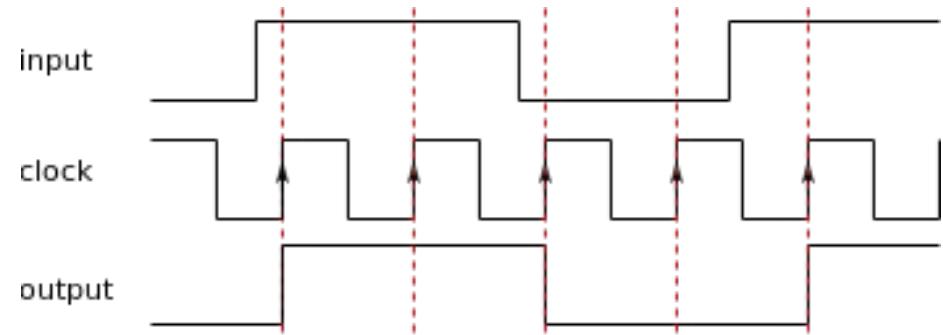
Parallel



- Many bits of data sent at the same time through different wires.
- Example: PCI and DIMM (on computer motherboards)

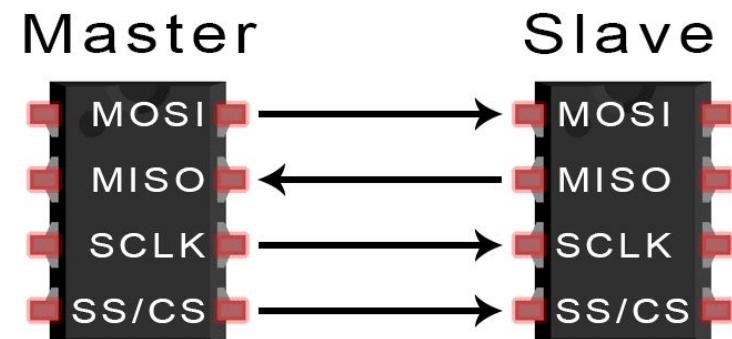
Clock Signals

- Square waves of known frequency (baud rate)
- Edge used to synchronize data reading across communicating devices



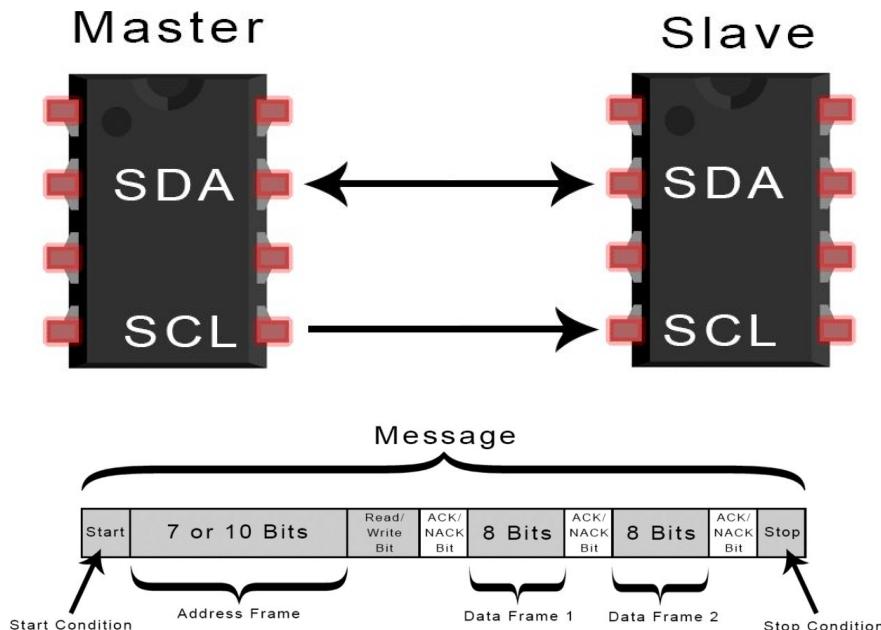
SPI (Serial Peripheral Interface)

- Continuous bidirectional transfer
- All devices share 3 Lines
 - Unique Slave Select line per device
- Master controls CLK



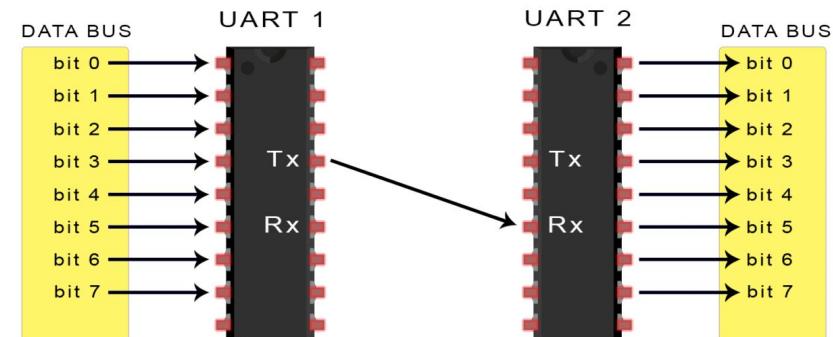
I2C (Inter-Integrated Circuit)

- Synchronous
- Uses only two wires :
 - SCL: Clock signal
 - SDA: Data signal
- Sends data in 'frames'
- Any device can claim master by controlling SCL



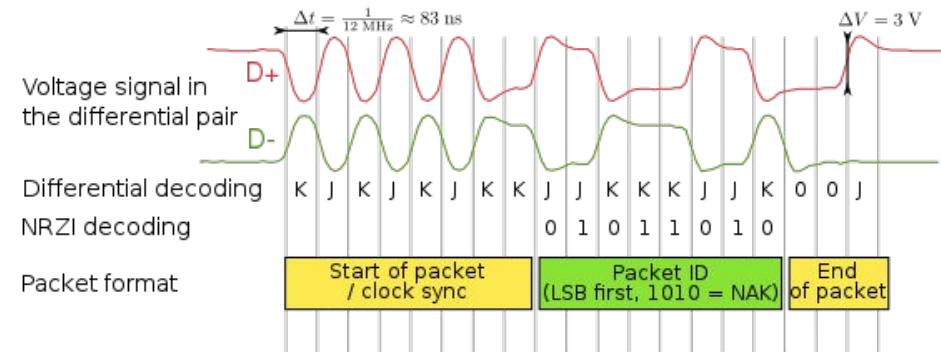
UART (Universal Asynchronous Receiver/Transmitter)

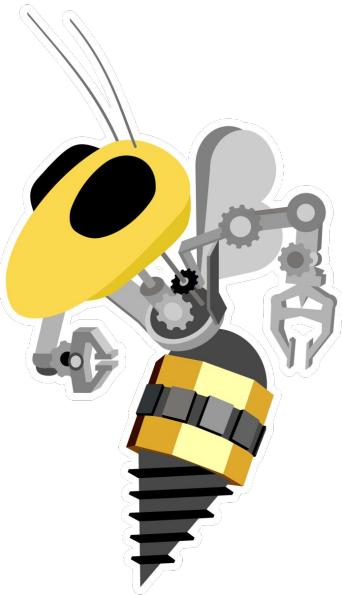
- Asynchronous (no clock needed)
- Uses 2 wires
- Need same baud rate



USB (Universal Serial Bus)

- Differential Pair signal
- Defines rate in “clock sync” phase
- Useful for computer-device communication

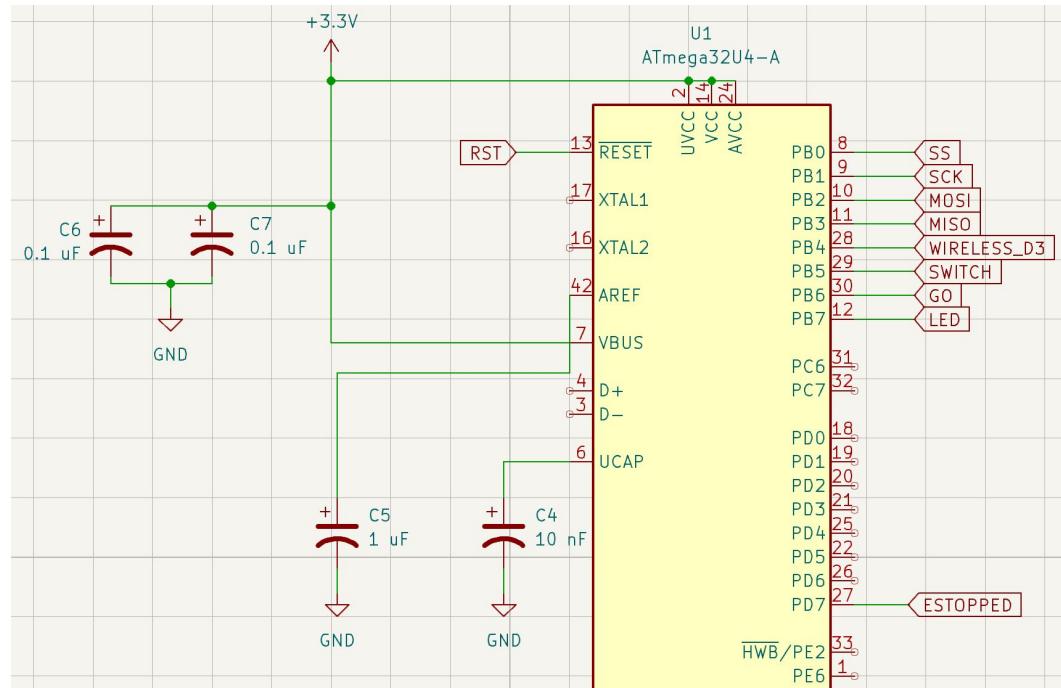




KiCAD Cont.

ROBOJACKETS
COMPETITIVE ROBOTICS AT GEORGIA TECH

Goals by End of Today (Schematics)

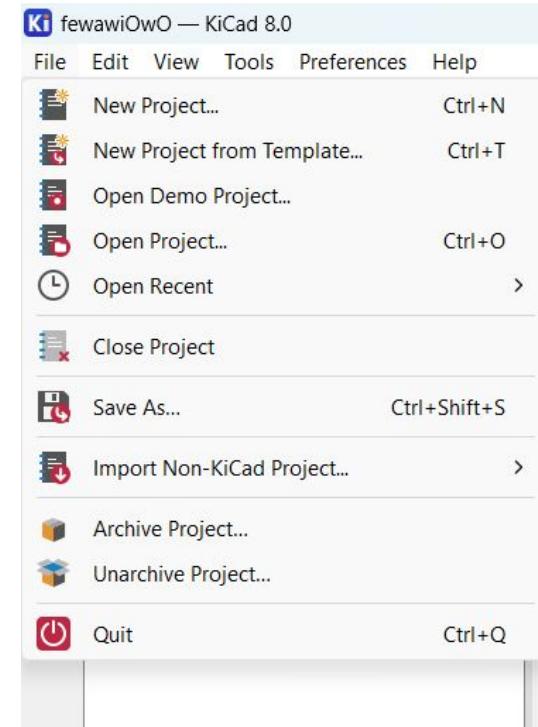




Some Useful Features to Know

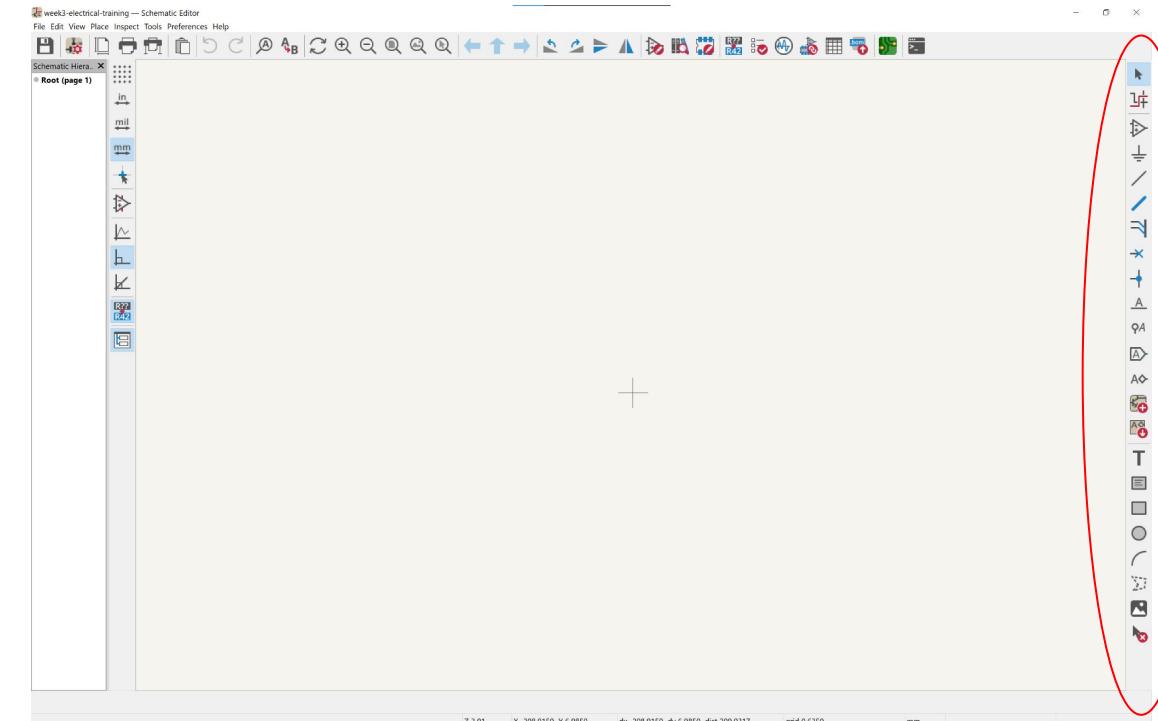
Create a new project!

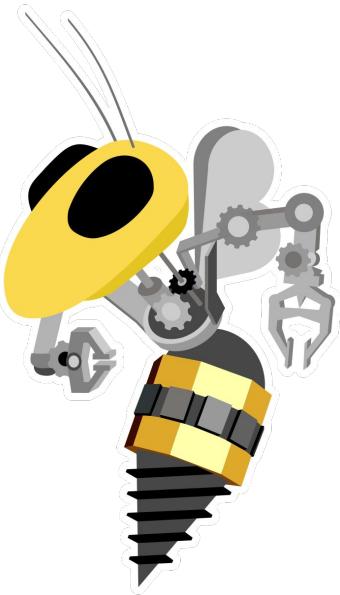
- Click file top left and hit new project
- Name your project and save it to a good location
 - I have mine in Documents for some reason
 - If you have multiple projects, do not save the new project inside of an existing one



SideBar Tools

Most actions for drawing in the schematic are in the bar on the right (ex. add symbol, draw wire)



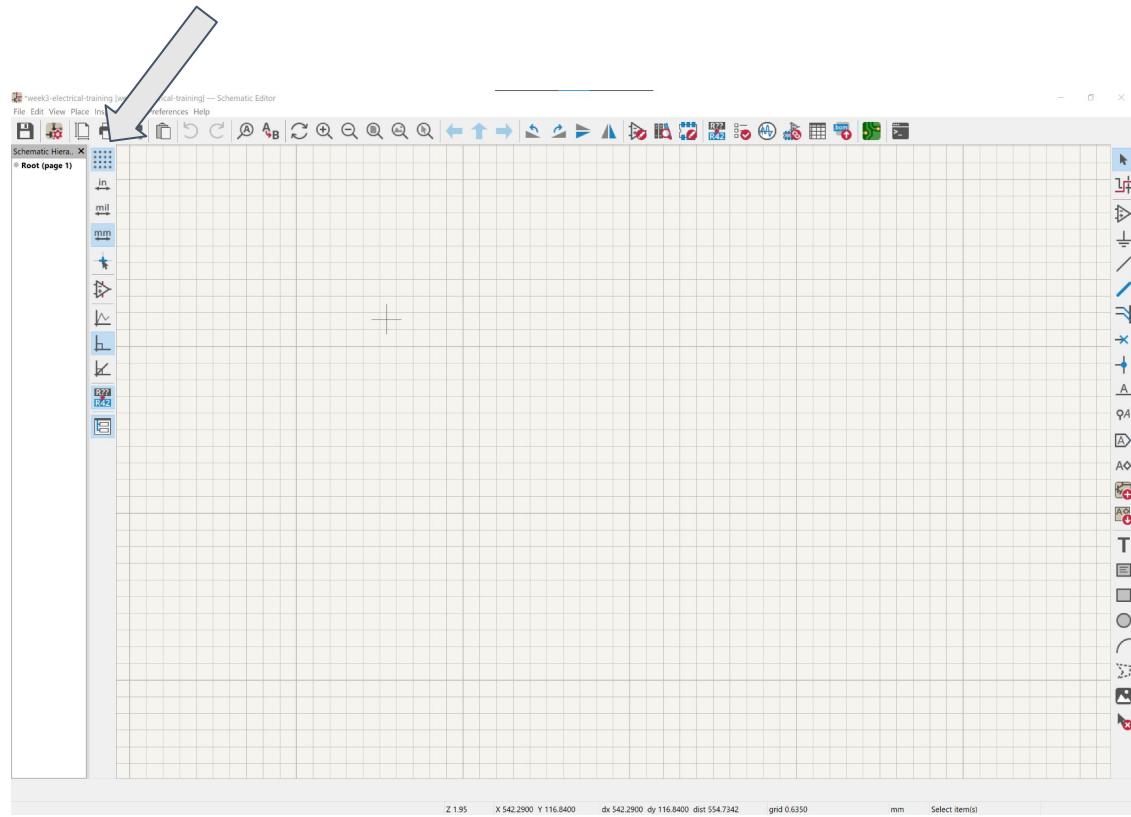


How to Build your Own Schematic

Step 1: Grid Lines

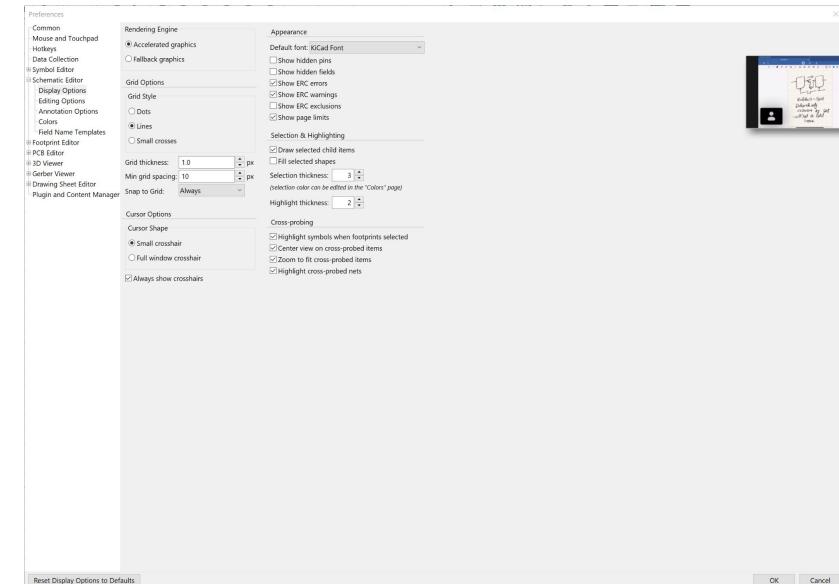
*Your screen
should look
like this.*

Make sure this is selected (blue)



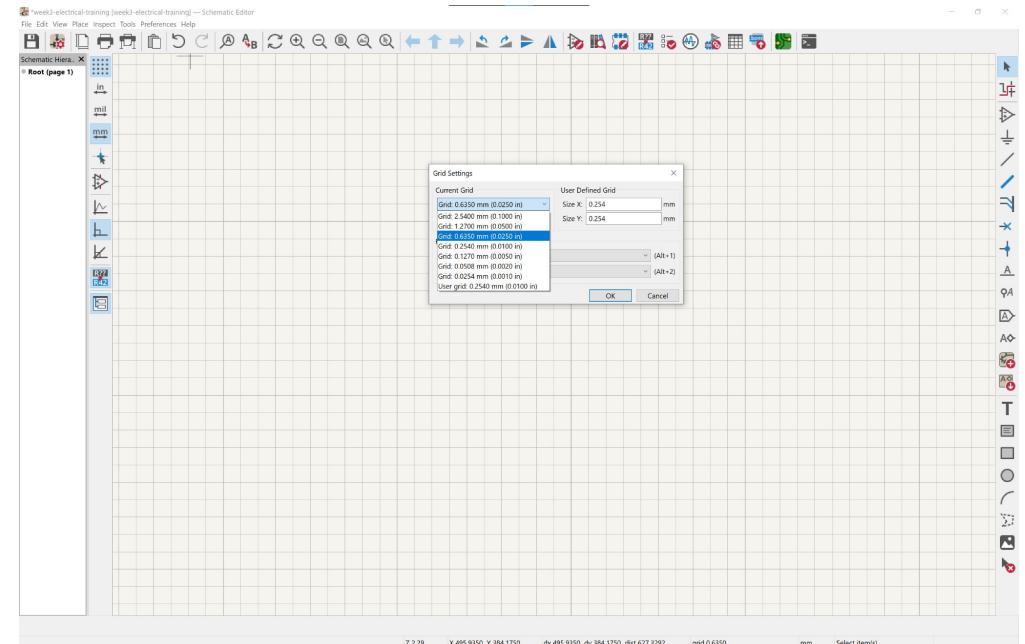
Step 1: Grid Lines

- If nothing shows up, you may need to change your grid style to lines since dots is the default
- Go to Preferences > Preferences > Schematic Editor > Display Options
 - Change Grid Style to Lines
- The previously blank page should now have grids



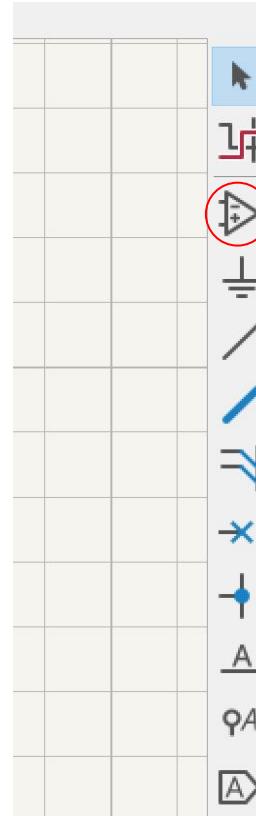
Step 1: Grid Lines

- You can change the size of your grid in View > Grid Properties
- There are some predefined grid sizes, but you can also define your own
 - Make sure to select User grid to use your custom grid size



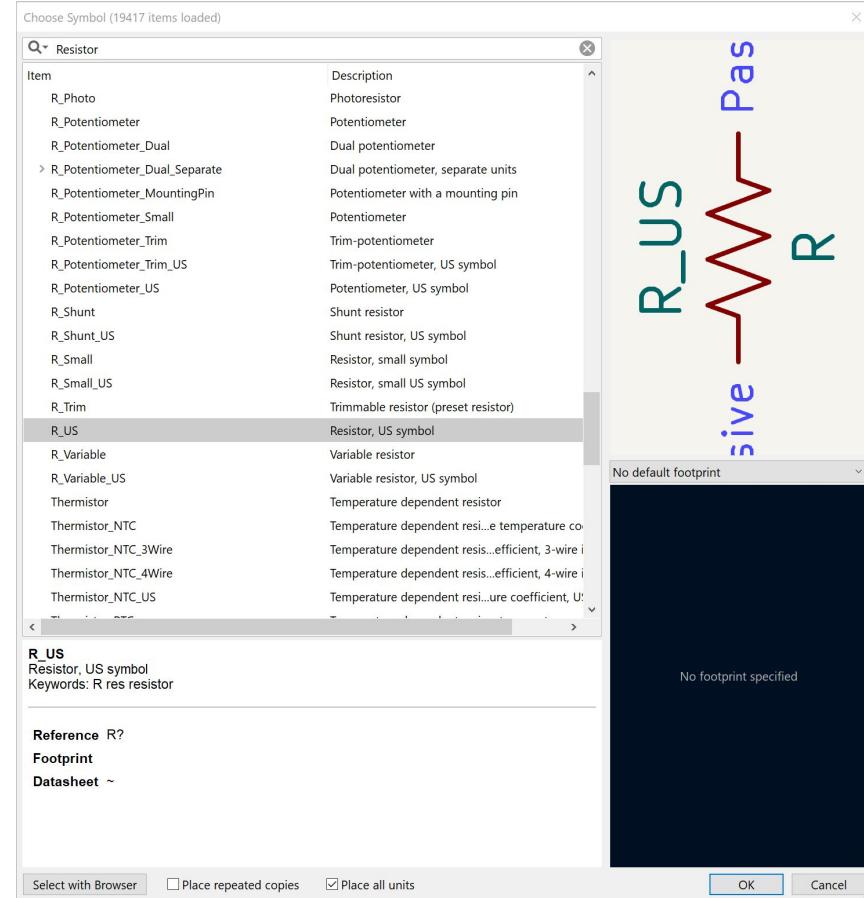
Step 2: Adding Symbols

*Select the 'Add a
Symbol' icon or
press 'A'*



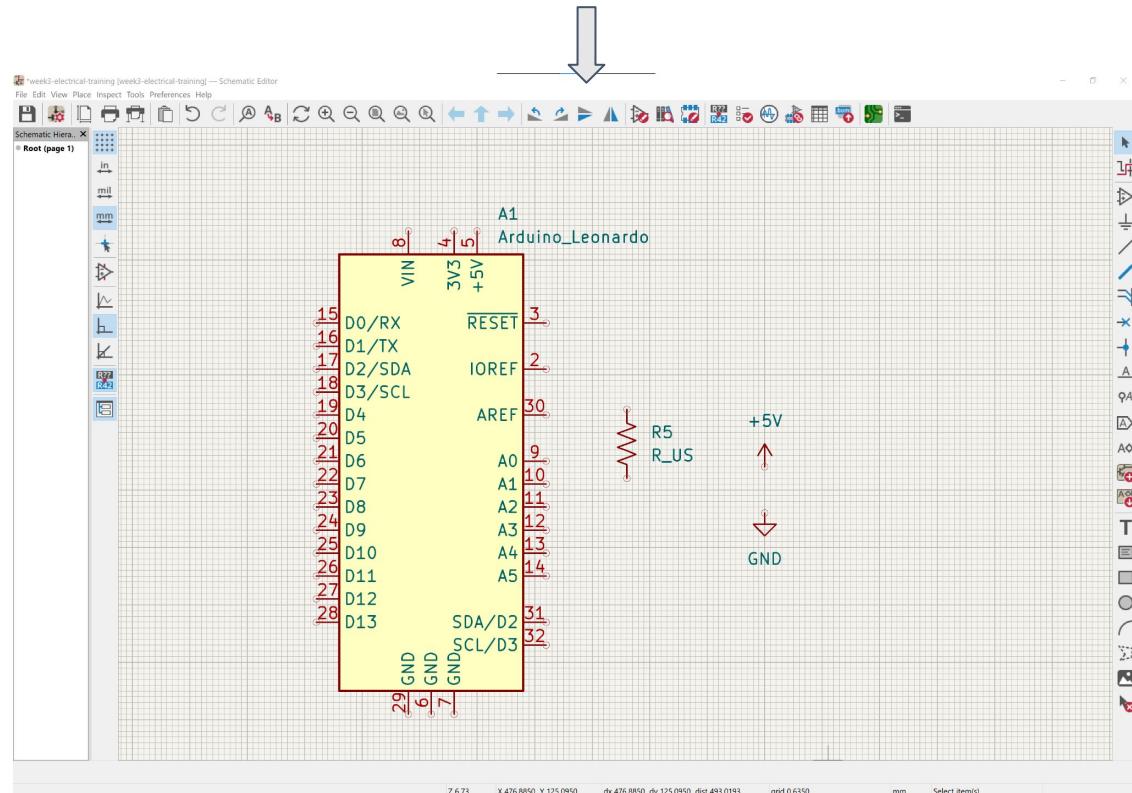
Searching for Parts

*Use keywords
to find what
you're looking
for (ex.
resistor, relay)*



Step 3: Rearranging Parts

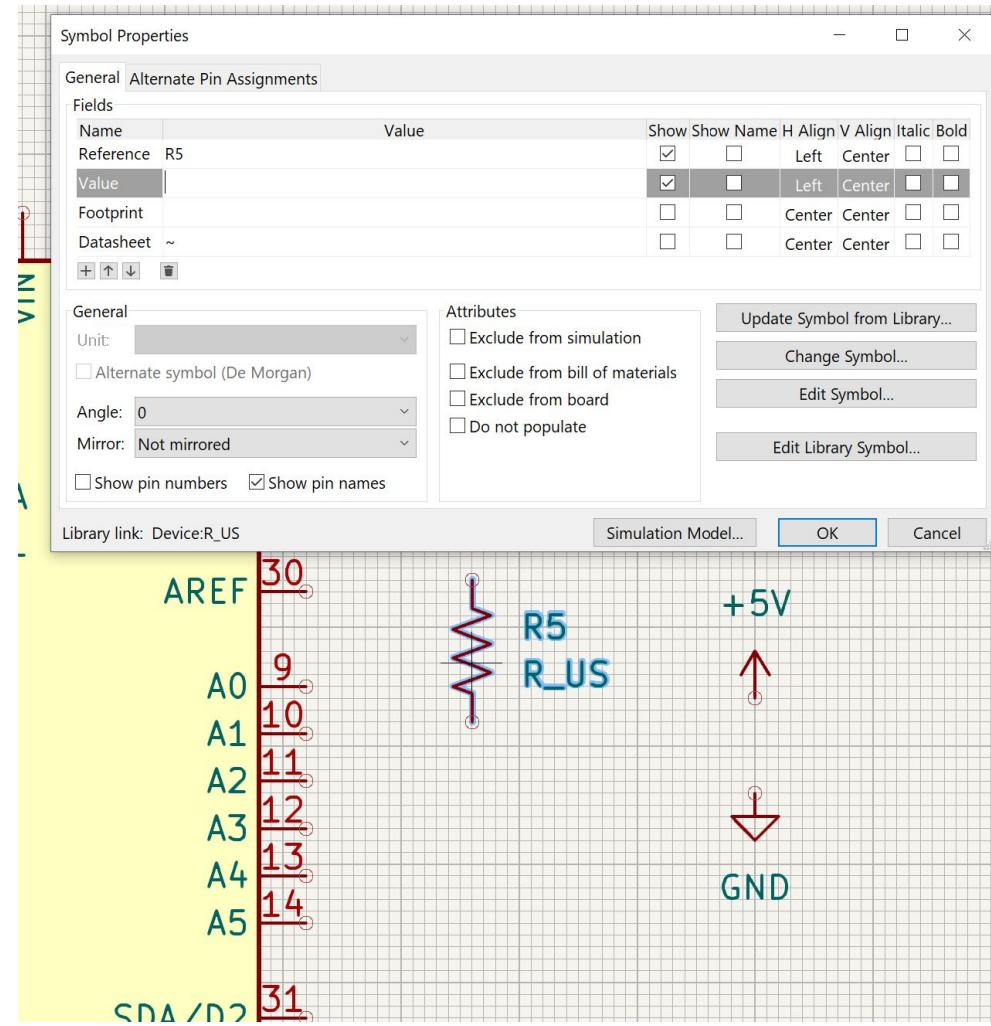
Click to rotate or flip



Step 3: Rearranging Parts

- After you've found most or all of your parts, we may need to rearrange their positions or orientation
- You can move your parts around by clicking on a part and dragging it to where you want to place it
- You can rotate your parts by clicking "Rotate" in the top bar or clicking on a part and pressing 'R' (CCW)

Step 4: Setting Value of Parts

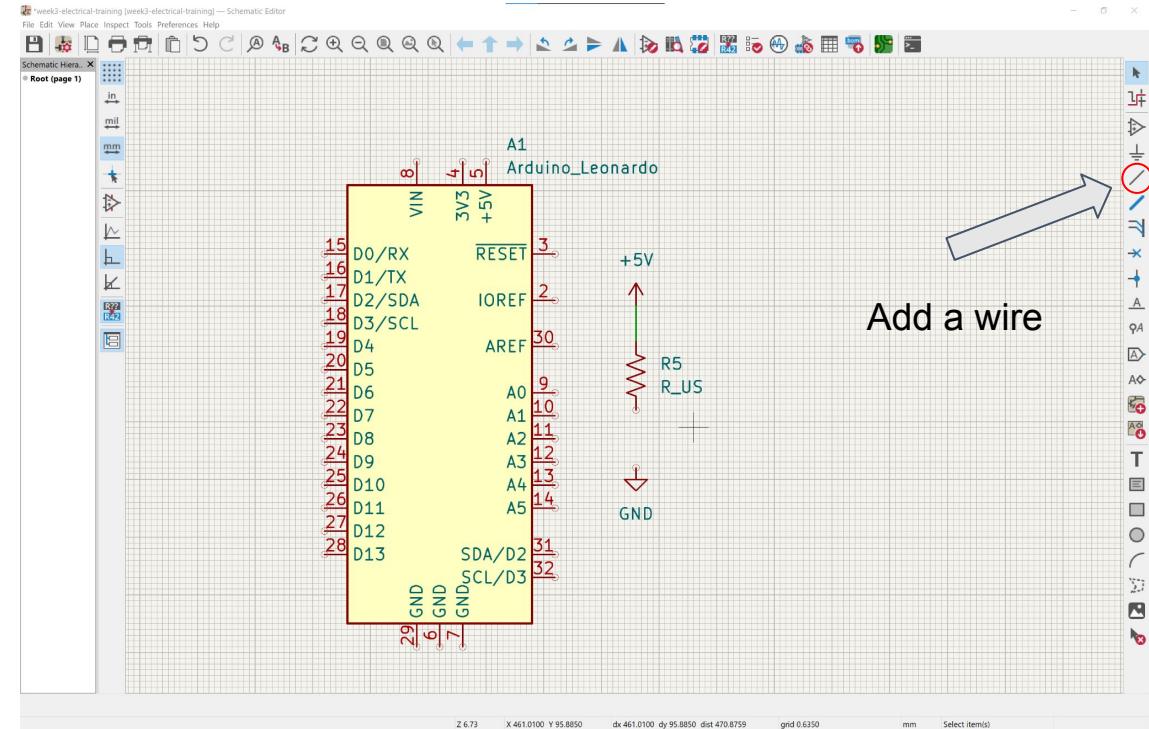


Step 4: Setting Value of Parts

- Right click on a part and select ‘Properties’ to change a part’s value or left click on a part and press ‘E’ to open the Properties menu
- You can enter any text into the ‘Value’ field, but RJ convention is to just write a number (if possible, abbreviate like 10K) for resistors and include the units for capacitors and inductors

Step 5: Wiring

*There is blank
space here so I
will put somethin
g here*

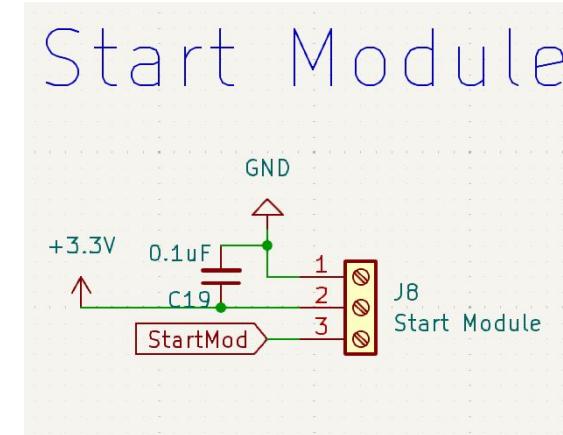
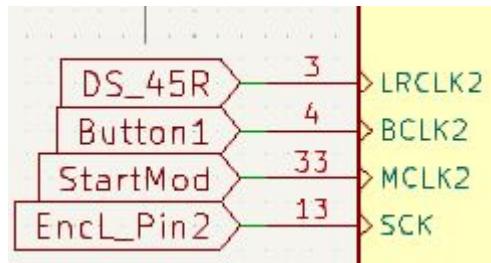


Step 5: Adding & Deleting Wires

- To connect the parts, we need to add wires between them
- Click on ‘Add a wire’ in the right bar and click on the points you want to connect
 - If you want to stop drawing a wire, you can right click and select ‘Finish wire’ to keep what you’ve drawn so far
- You can also click on any unconnected pins of parts to start drawing a wire from that point

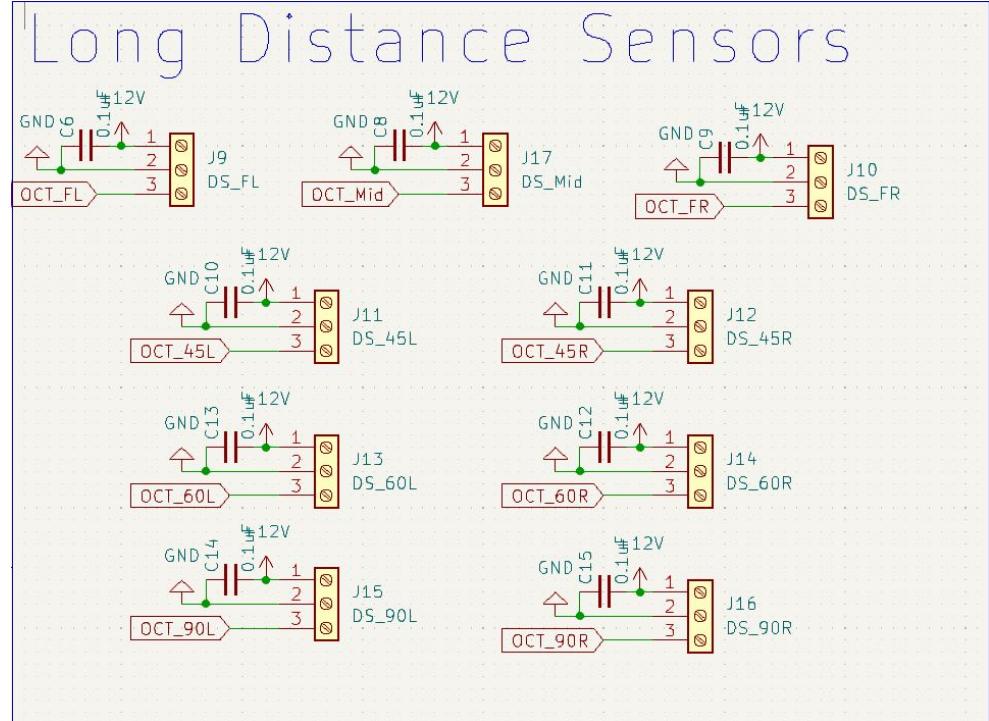
Step 5 (continued)

- For readability, do not have cross screen wires
- Use global labels instead!
- Same global label = same wire connection



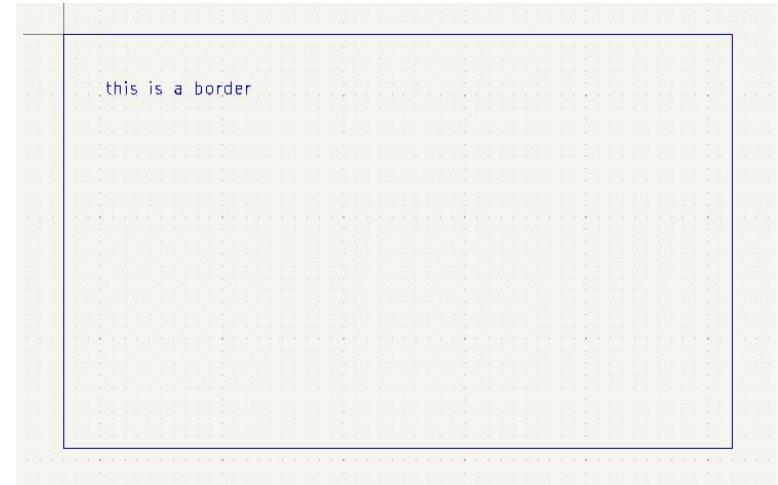
Step 6: Organization

*Make it look
nice so people
don't die when
reading it*



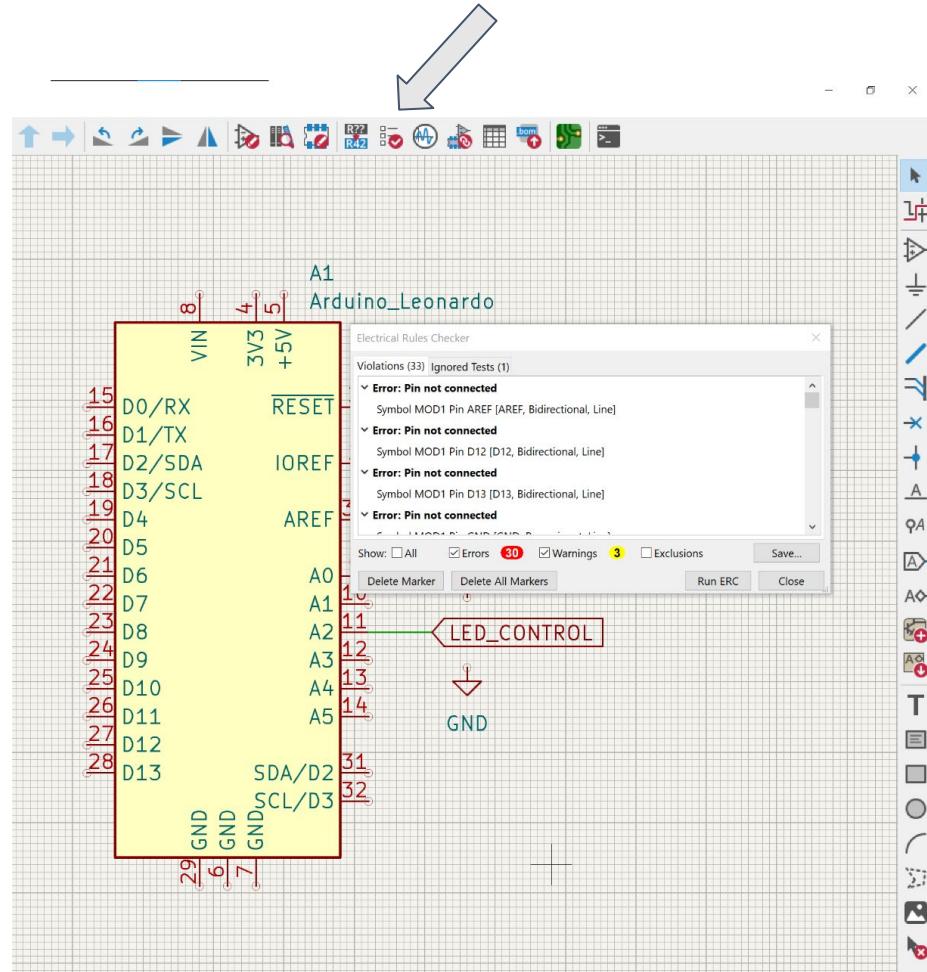
Step 6: Organization

- Move same parts into the same area
- Add borders (add rectangle on the right panel)
- Add titles (add title on the panel on the right, shortcut: T)
 - Recommended font: 200 mils (does not matter)
- Make it look nice!
- Rename some of your common parts to specifics (e.g. Screw Terminal -> Front line sensor)



Step 7: Electrical Rules Check (ERC)

*Check if there
are errors or
warnings.*



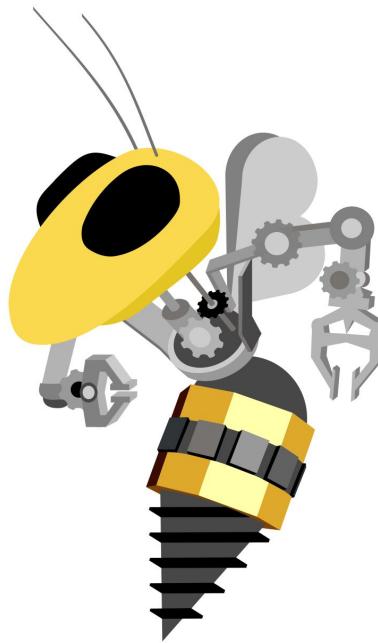
Step 7: Electrical Rules Check (ERC)

- ERC is to ensure our schematic is good and all the connections are made
- Click on “Perform electrical rules check” in the top bar
 - You have to click on Run ERC and it will tell you how many warnings and errors you have
 - It will add arrows in your schematic pointing to all of the locations with issues to help you diagnose where they are

Live Demonstration

- I will now embarrass myself





Lab!

Creating a Schematic in KiCAD

For next time...

We will be working on PCB Design! Bring the following:

- Laptop/Computer
- Mouse (highly recommended)
- A Coke for Kyle

Location:

- Electrical: Skiles 169
- Firmware: Van Leer C457

Feedback

