Building the badge

How you can make small, cheap and custom hardware for function or fashion.

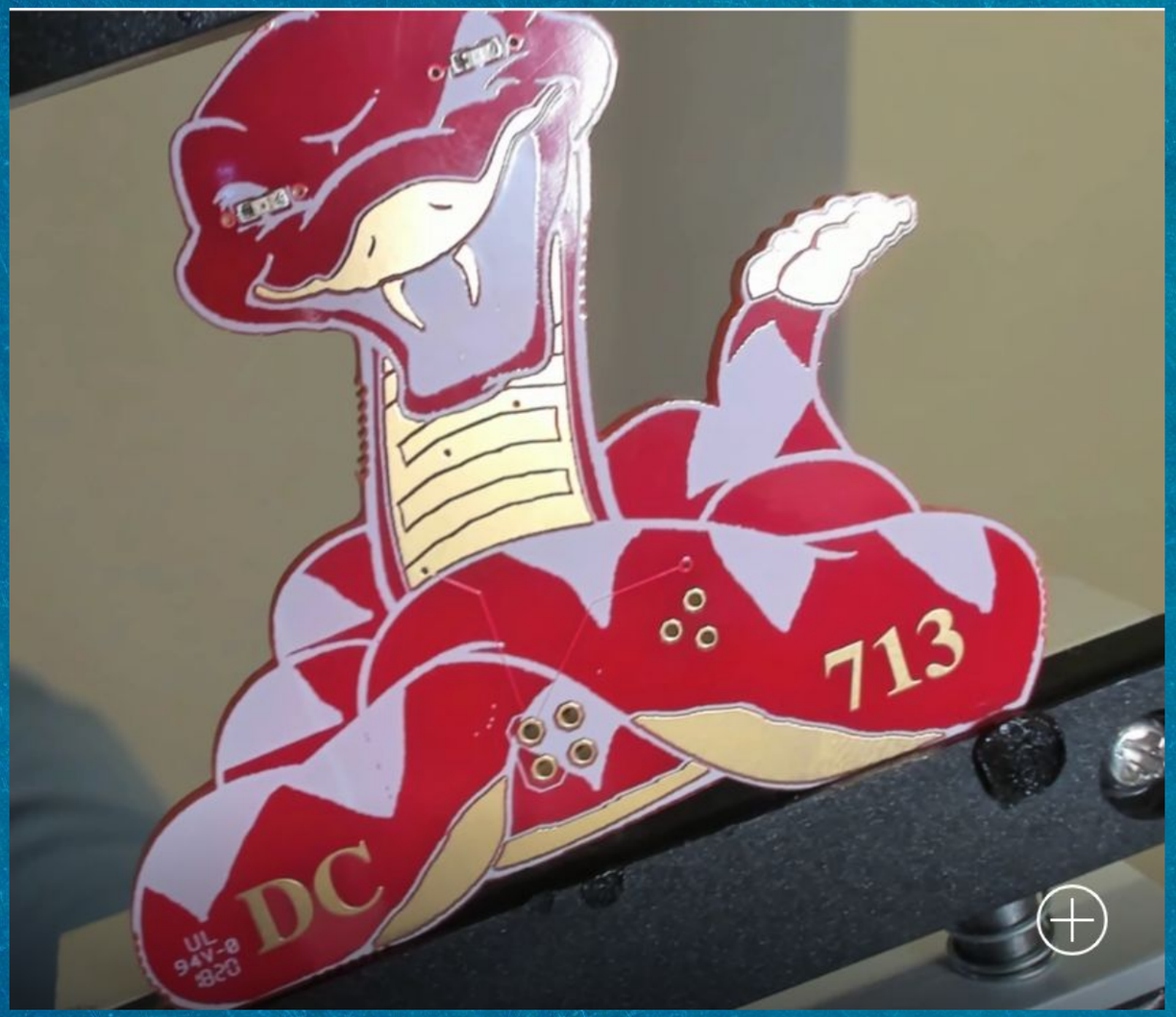
James Dietle
@jamesdietle
linkedin/in/jamesdietle

Agenda

- Why would you make a circuit board that you can wear?
- Where to start (Constraints are good)
- Bring out the GIMP (or Adobe)
- Firing up Kicad
- Send it to the printers!
- Planning out your costs

Who am I?

#Snekbadge, #Cornbadge



Why would you make a circuit board?

Be a part of History

http://grandideastudio.com/wp-content/uploads/history_of_defcon_electronic_badges_slides.pdf

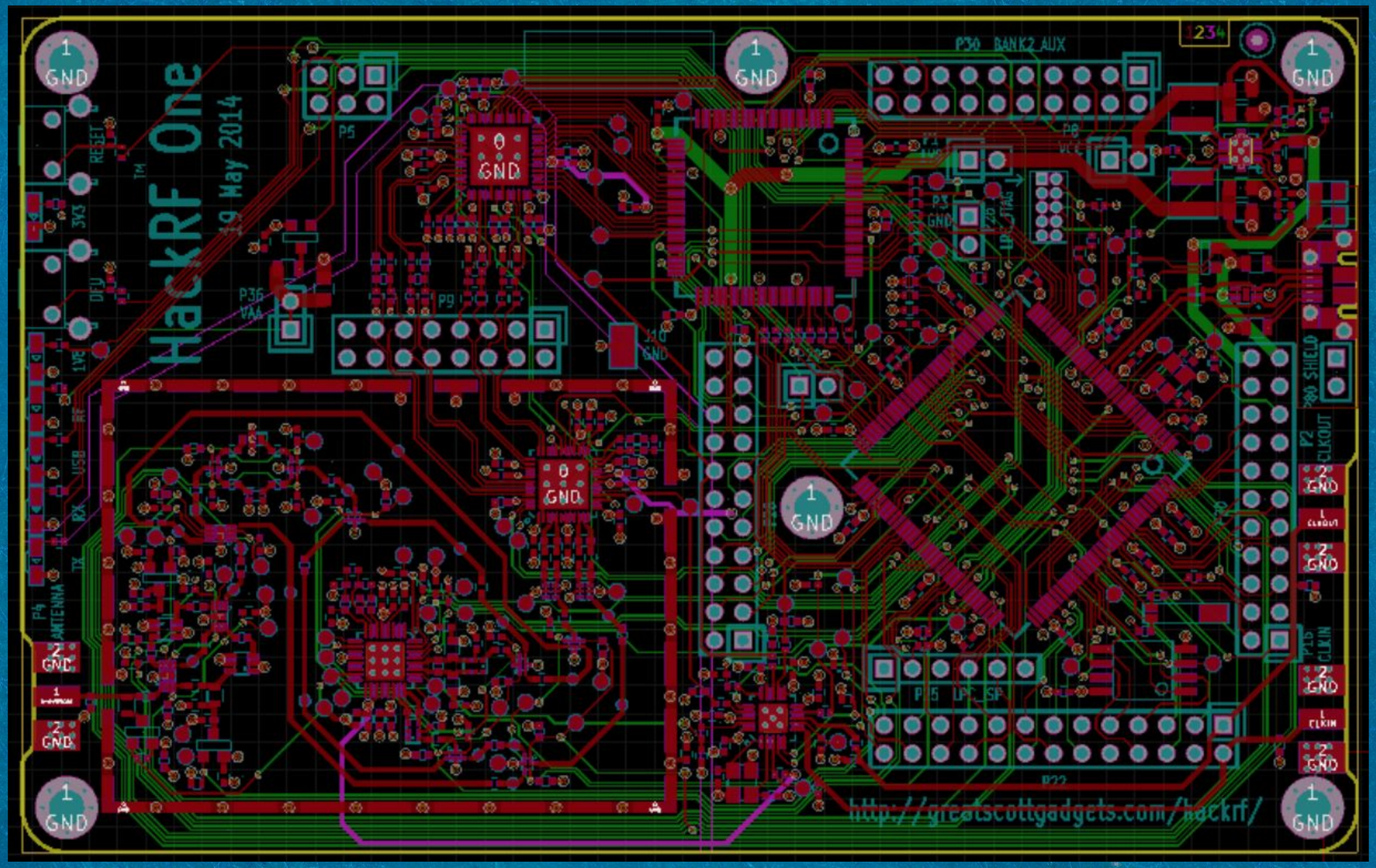
Why would you make a circuit board?

The explosion

https://twitter.com/see_ess

Why would you make a circuit board?

Daunting



Why would you make a circuit board?

Back to the Fundamentals

- Foothold for EE Knowledge
- Anyone can understand simple circuits
- Allows working into more difficult problems and solutions

Why would you make a circuit board?

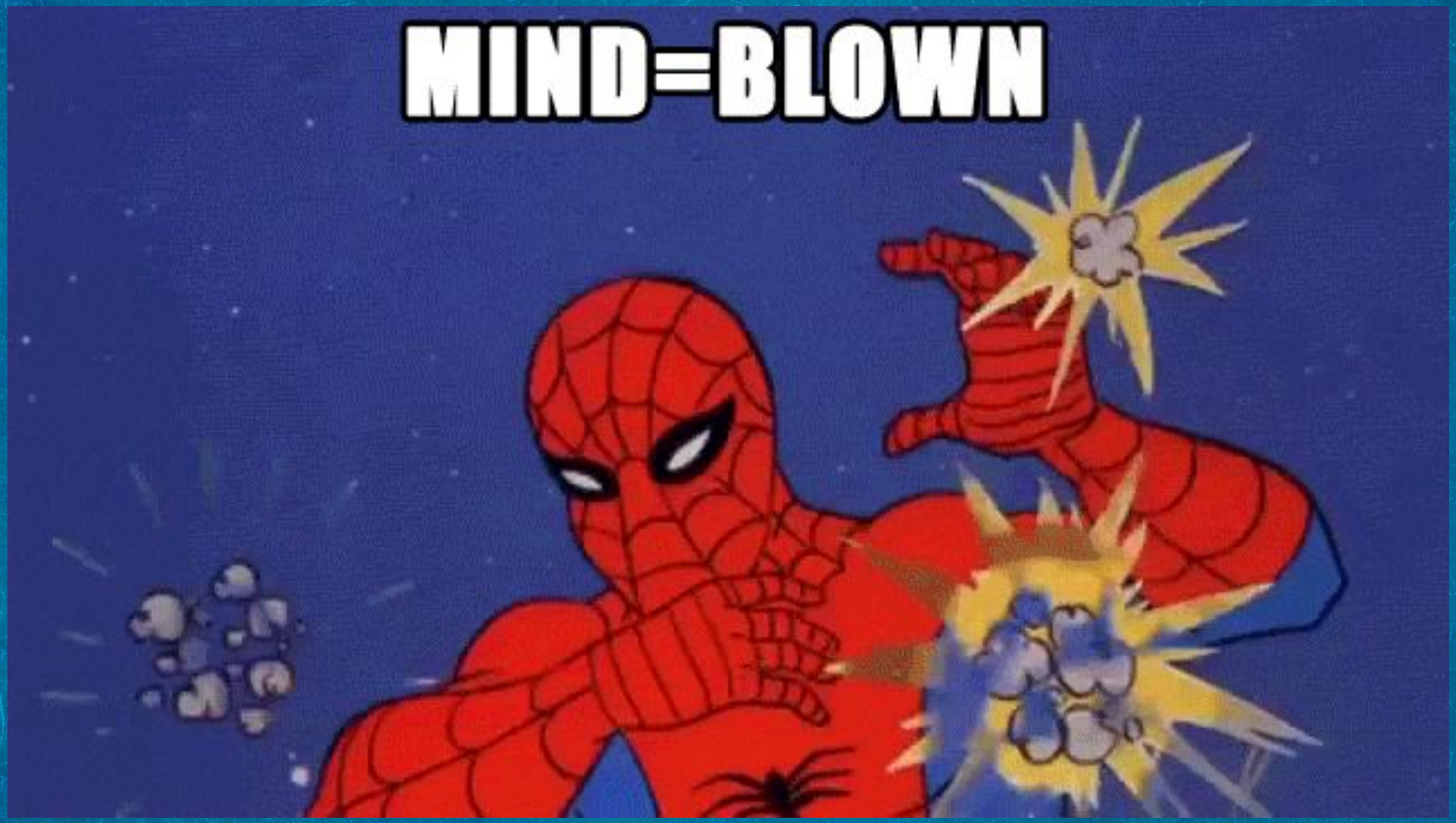
SAOs

- Super easy
- Constraints encourage creativity
- Forced deadlines! (Get it by DEFCON!)

V 1

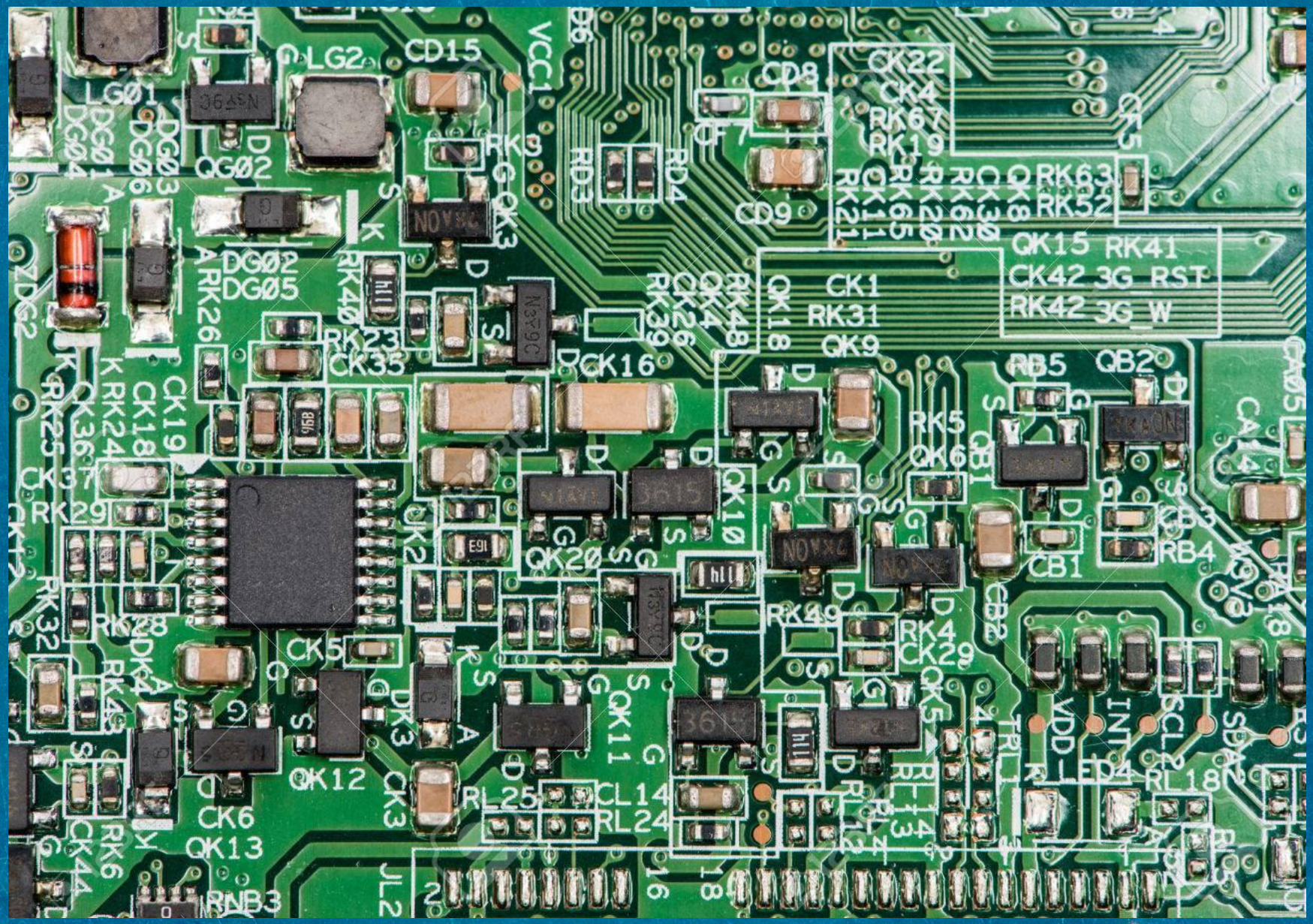
V 1.69

Too many topics to cover... im going to miss something



Where to start

What is a PCB made of

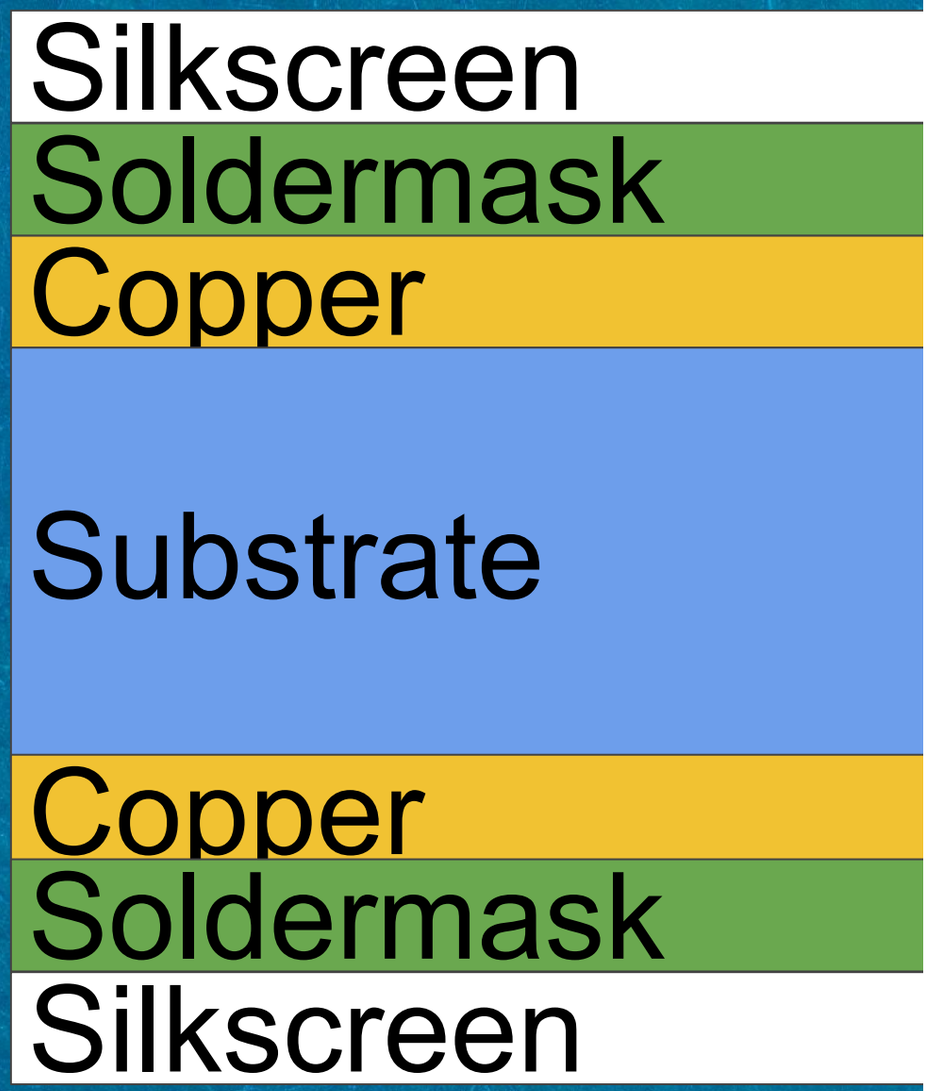


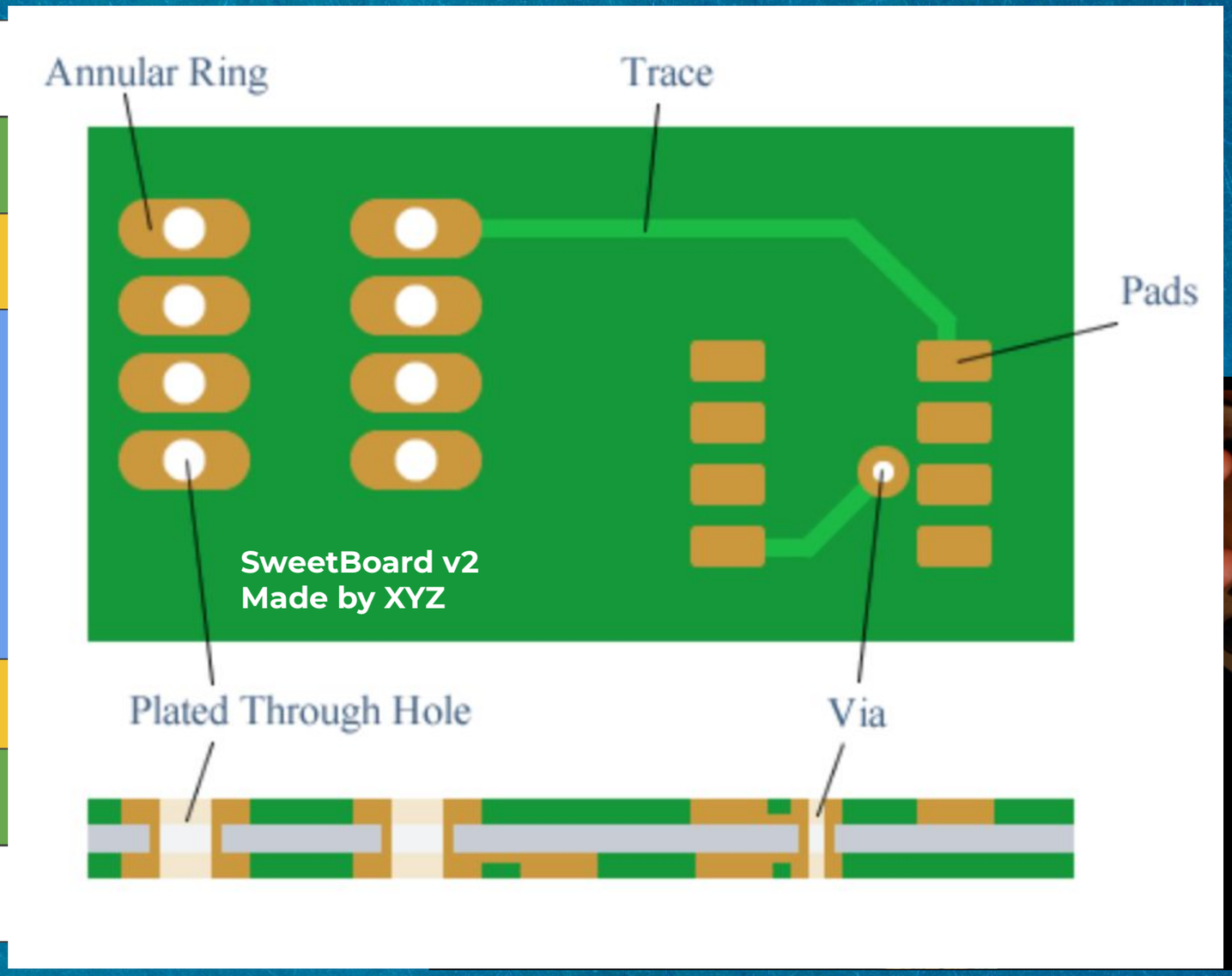
Basic PCB layout

Both Sides

Silkscreen
Soldermask
Copper
Substrate
Copper
Soldermask
Silkscreen

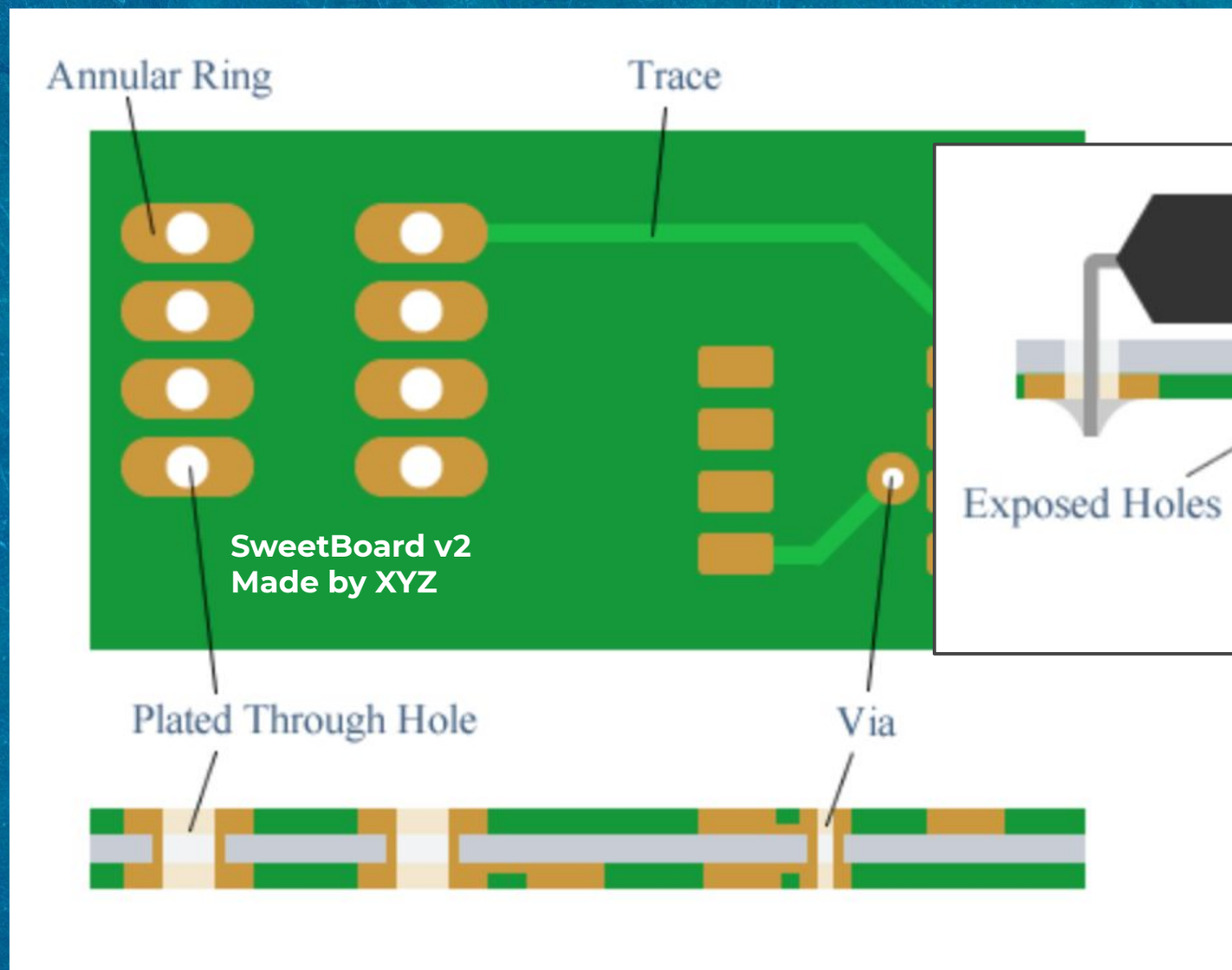
Compared to board

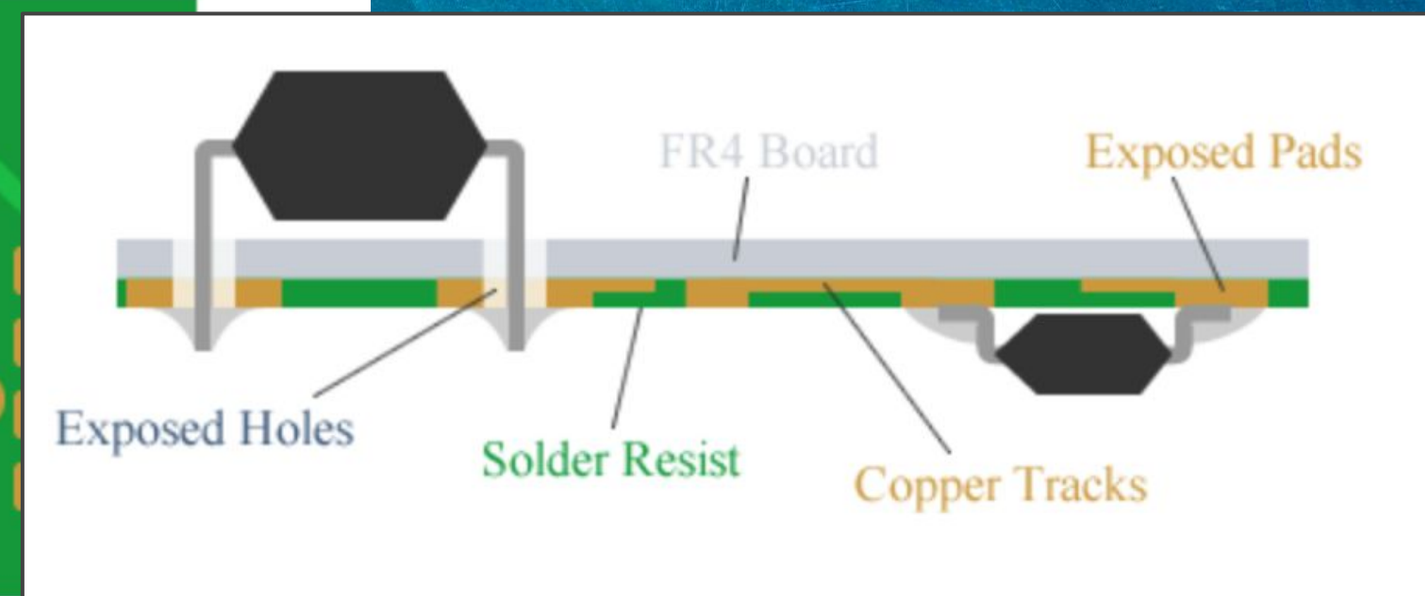




Where to start

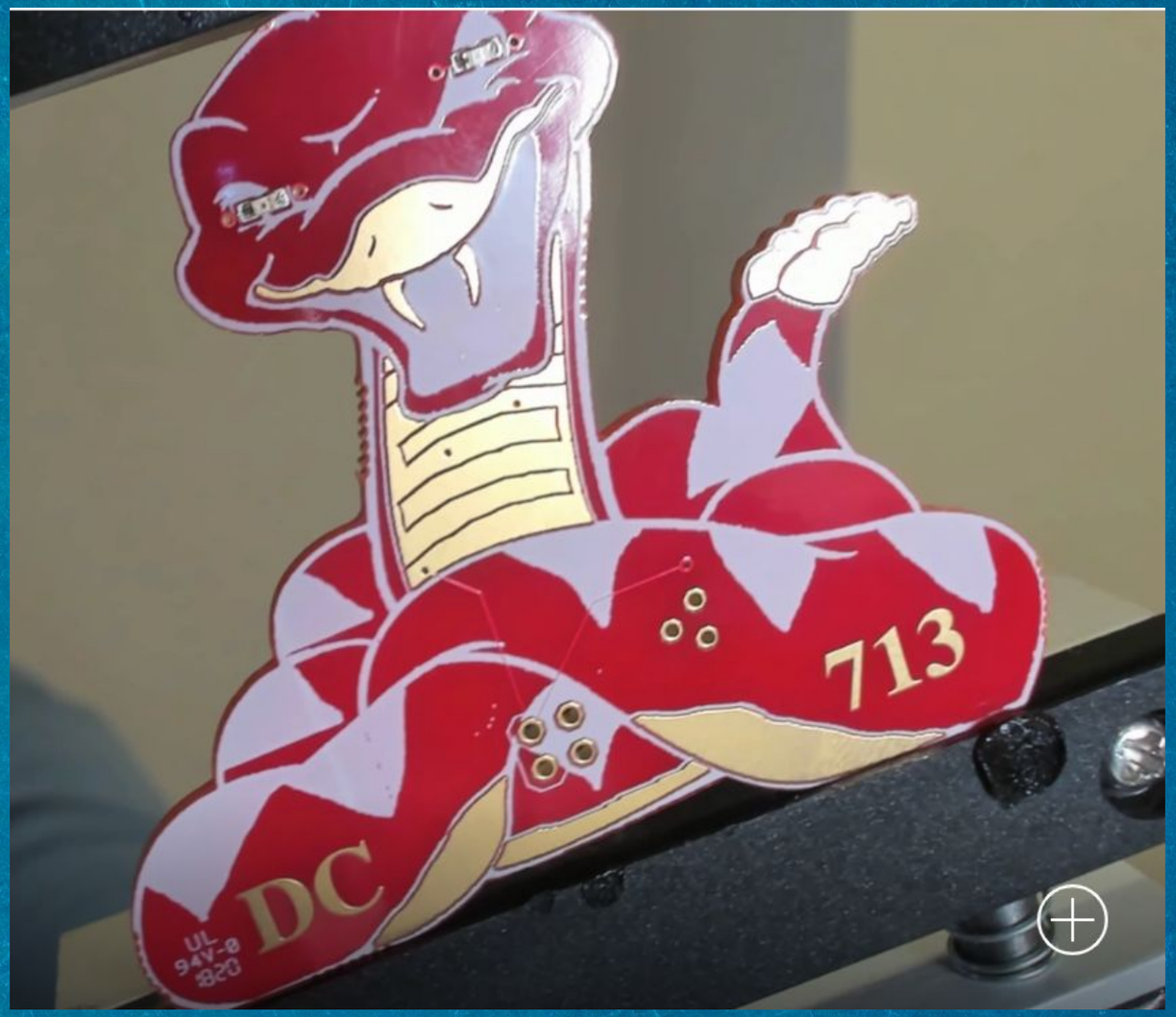
Cross-Section





Color Palette

Silkscreen
Soldermask
Copper
Substrate



Color Palette

Silkscreen
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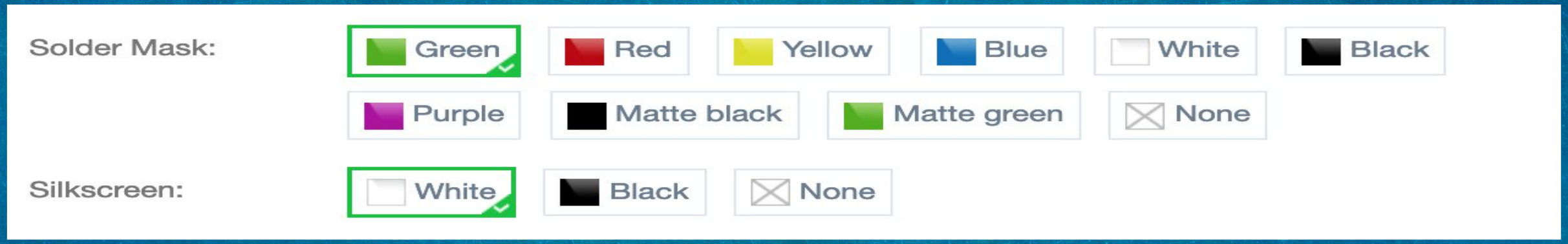
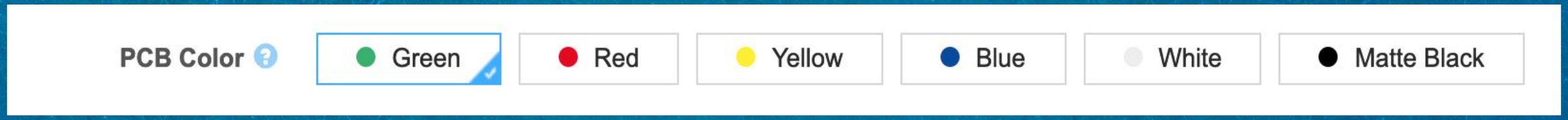
Substrate

Colors for PCB

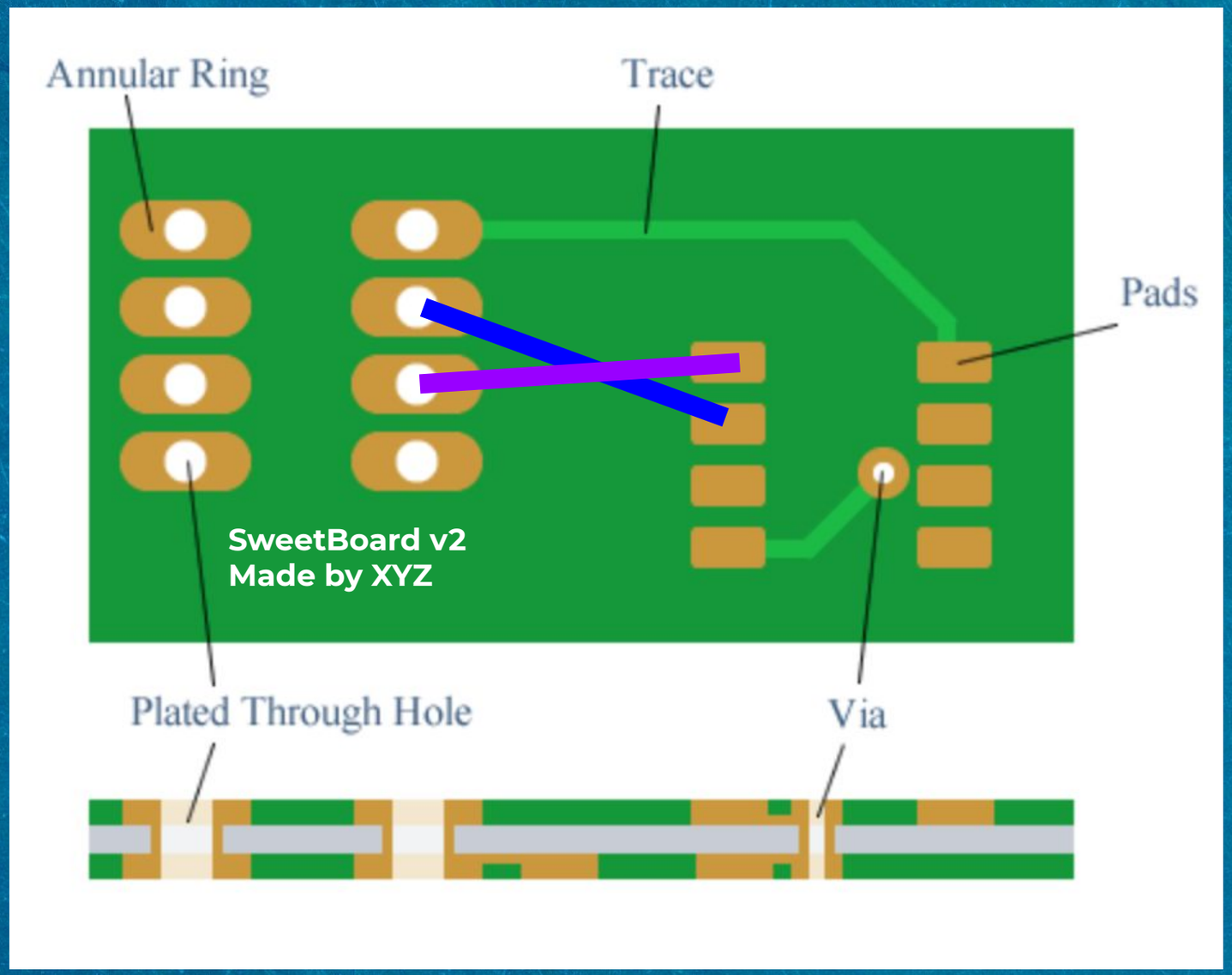
- PCBWay



- JLCPCB

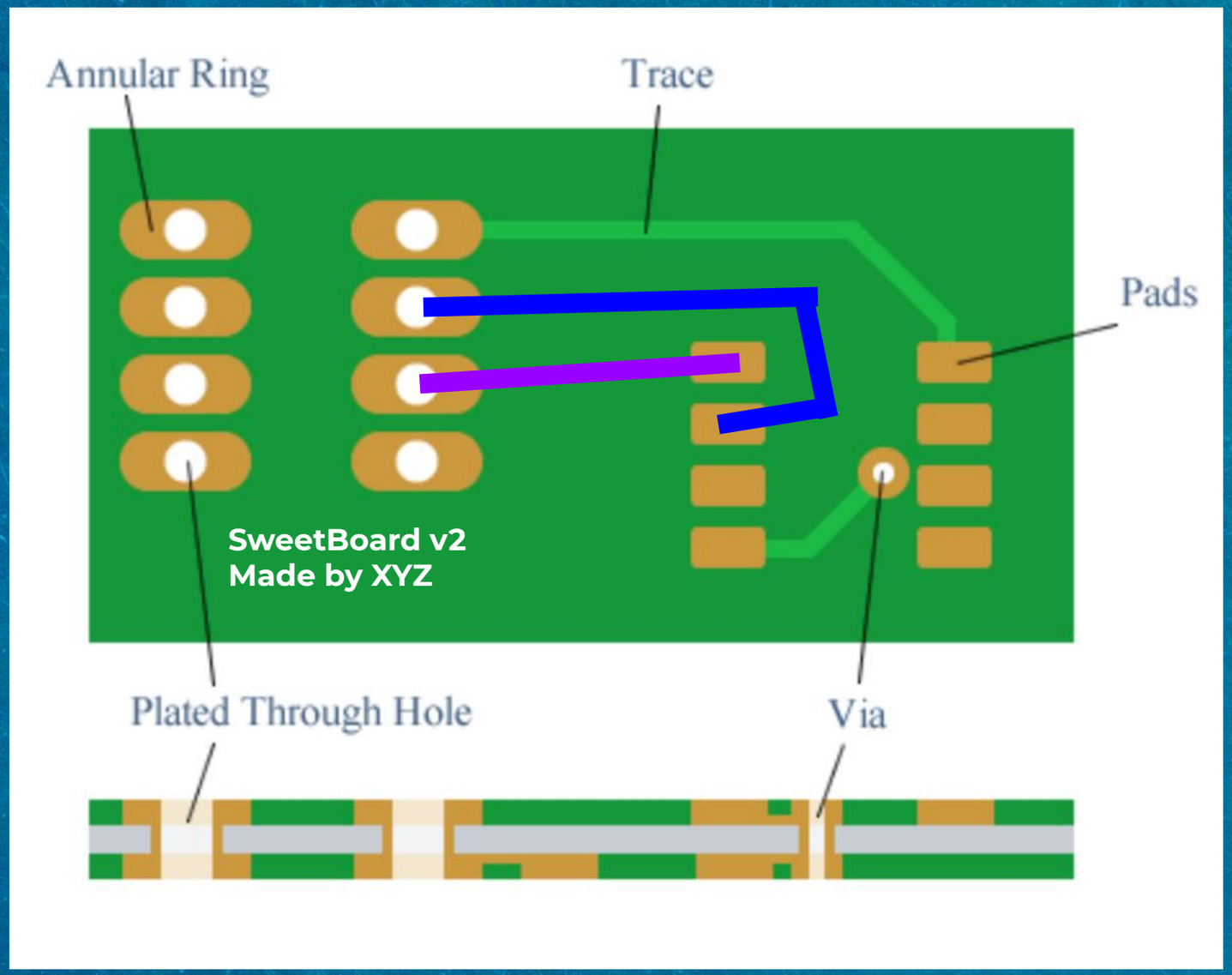


What you can't do



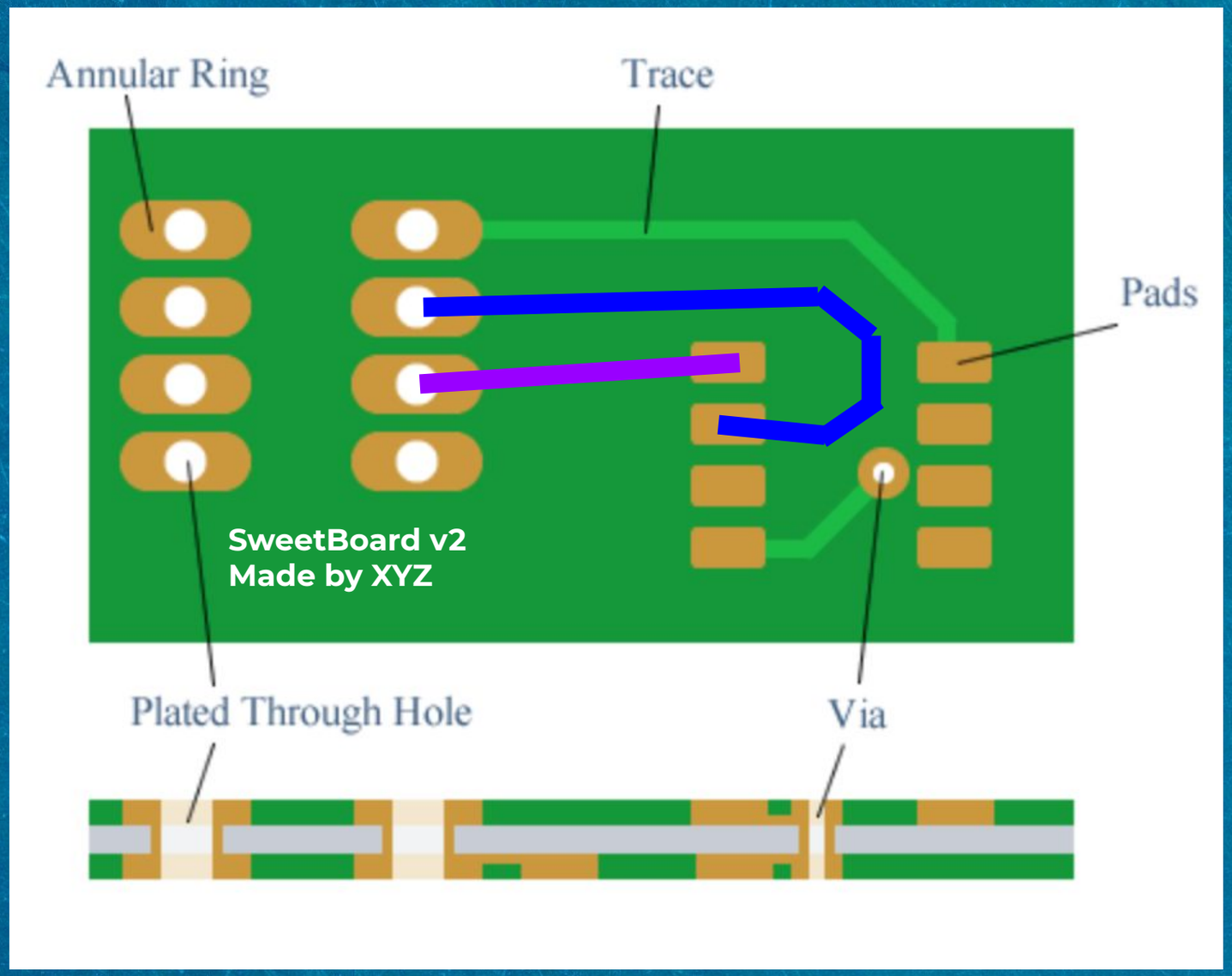
- No Cross Traces

What you can't do



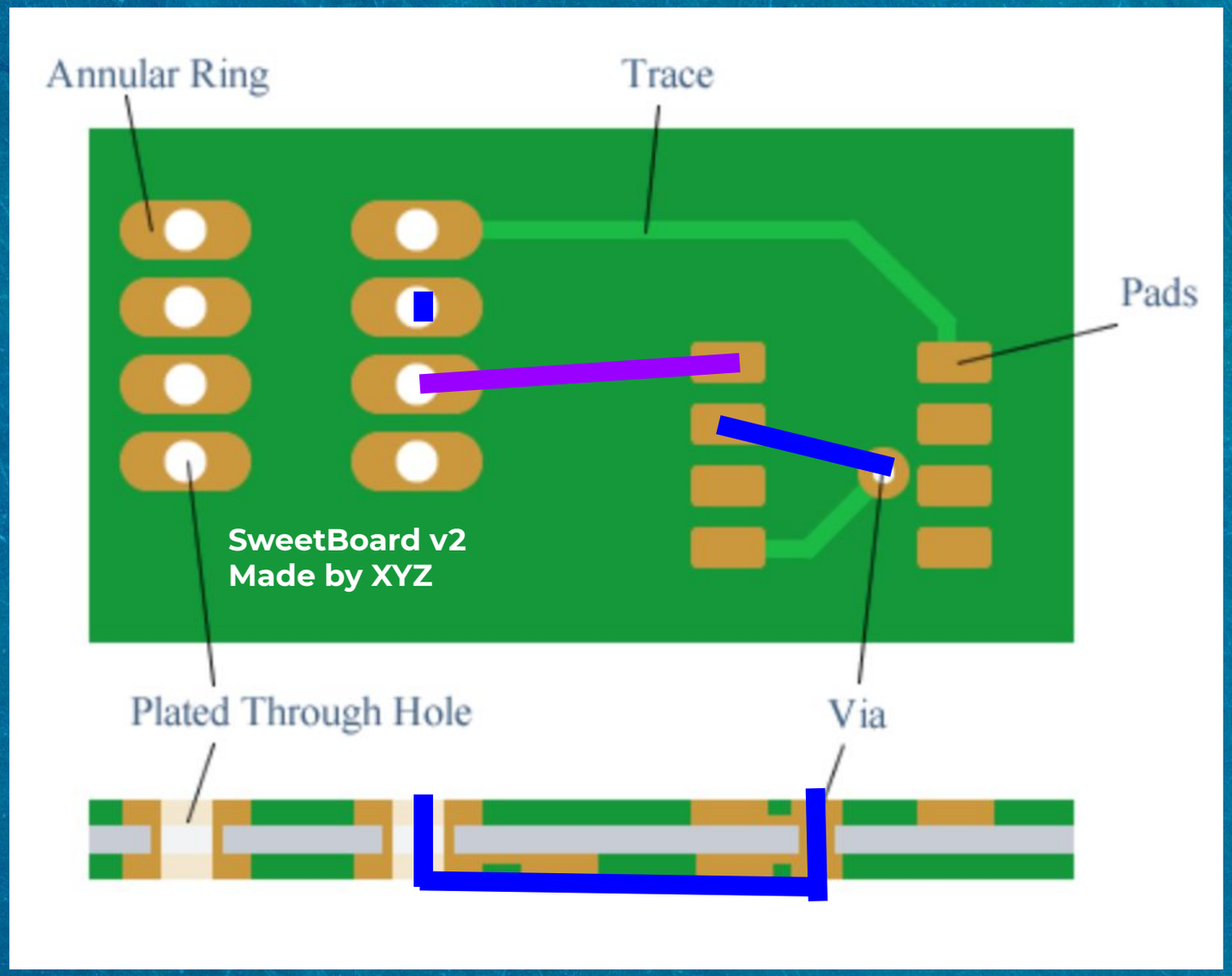
- No Cross Traces
- No Right Angles

What you can't do



- No Cross Traces
- No Right Angles
- Don't get too close

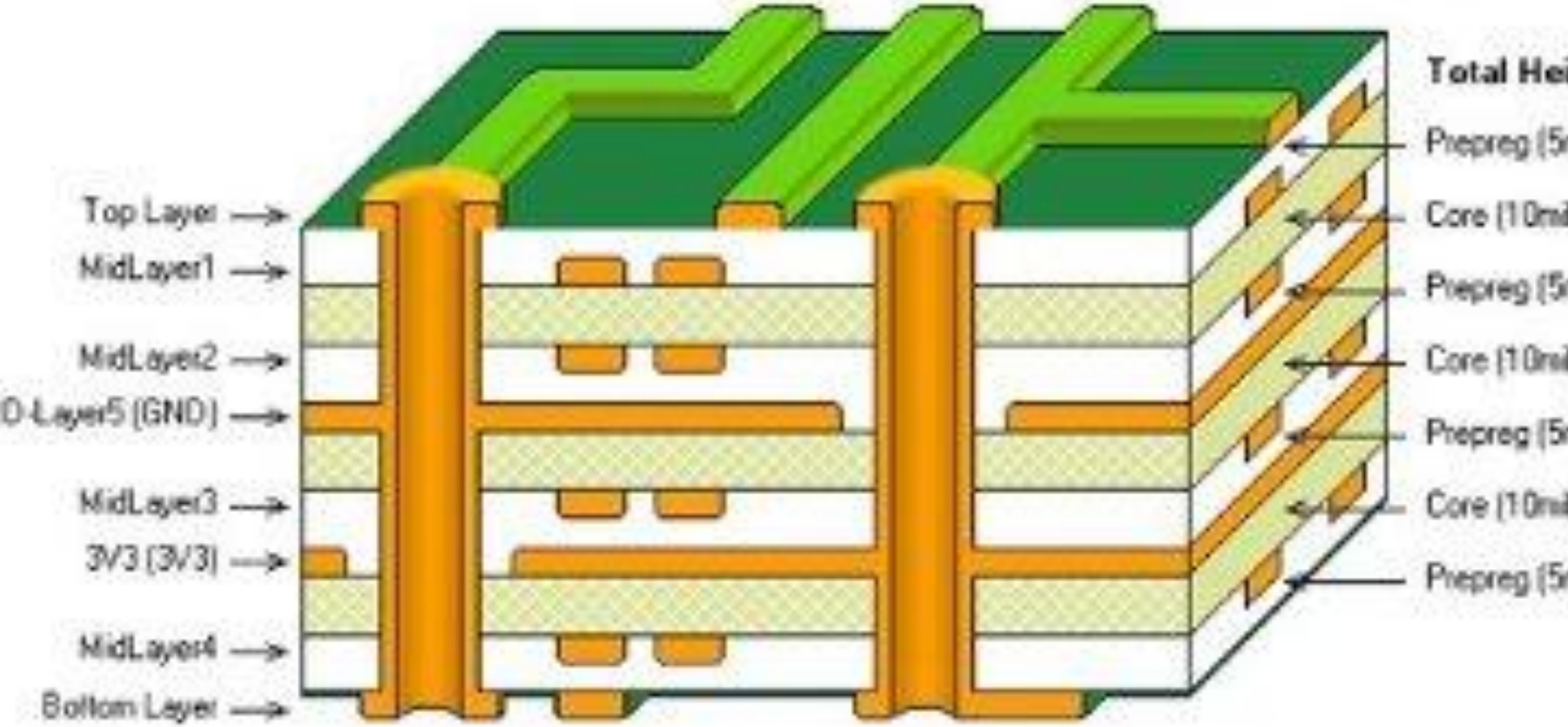
Use 3-D space!



- Go to the other side

Where to start

Where to start



Bring out the GIMP

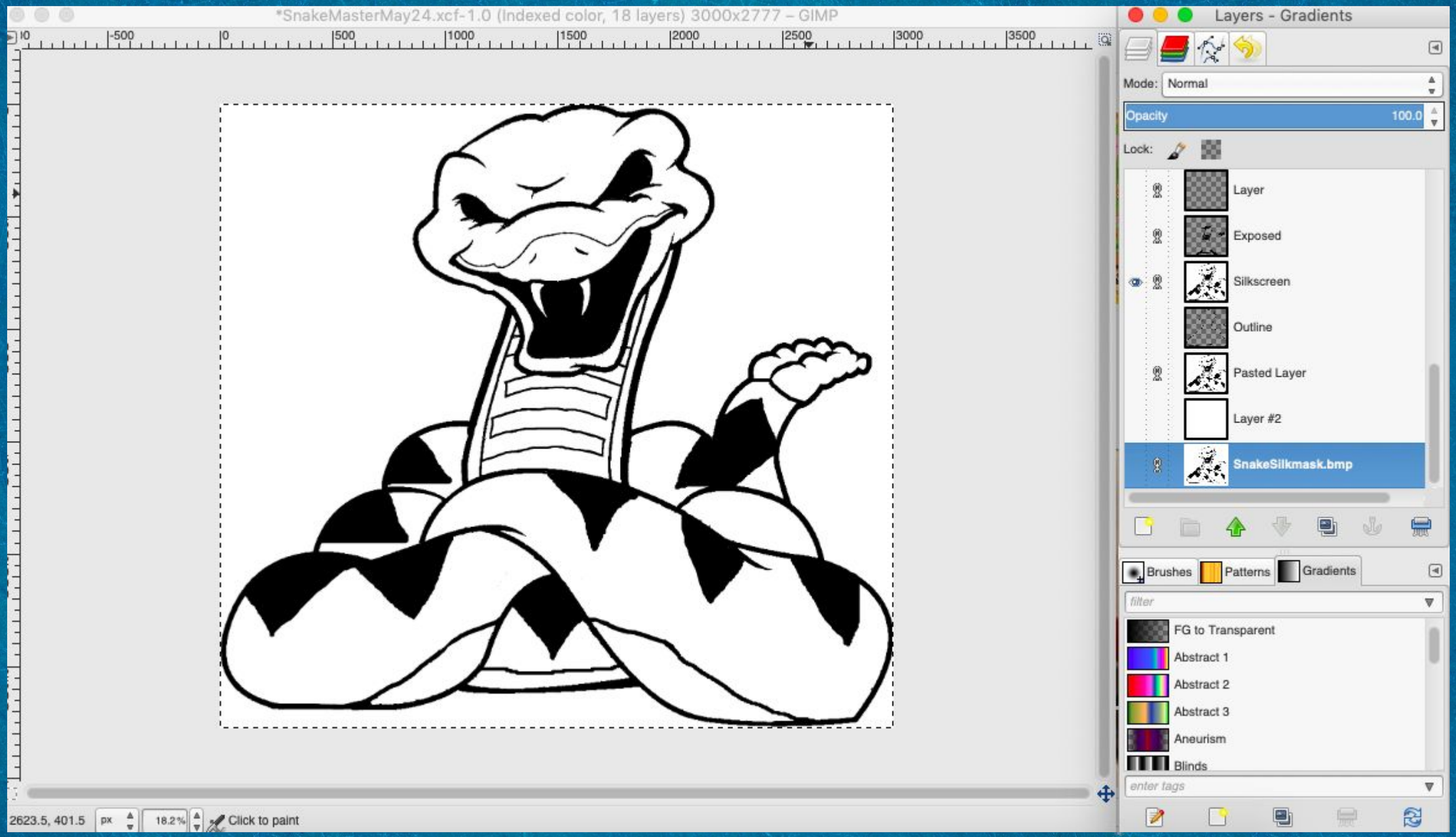
Artwork

Free

$$$

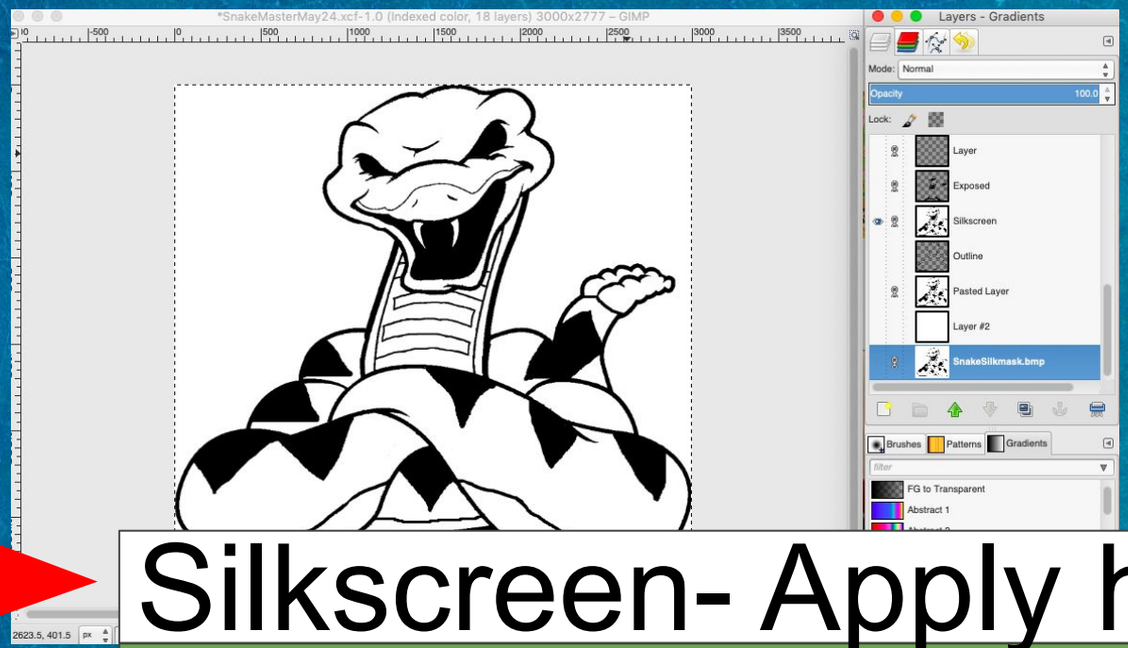
Bring out the GIMP

Use Layers for artwork



Bring out the GIMP

Front Silkscreen



Silkscreen- Apply here

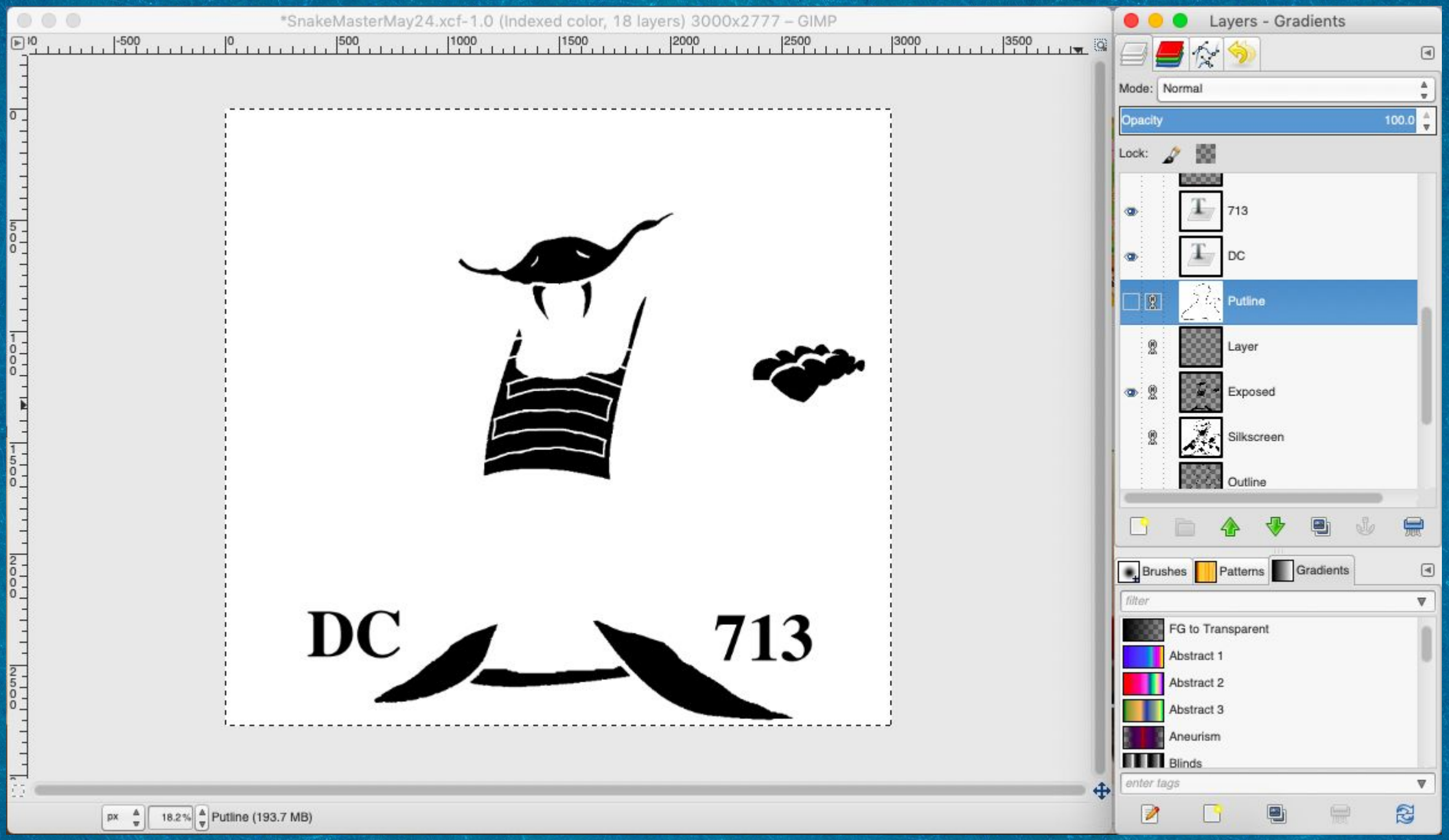
Soldermask- Default is there

Copper- N/A

Substrate-N/A

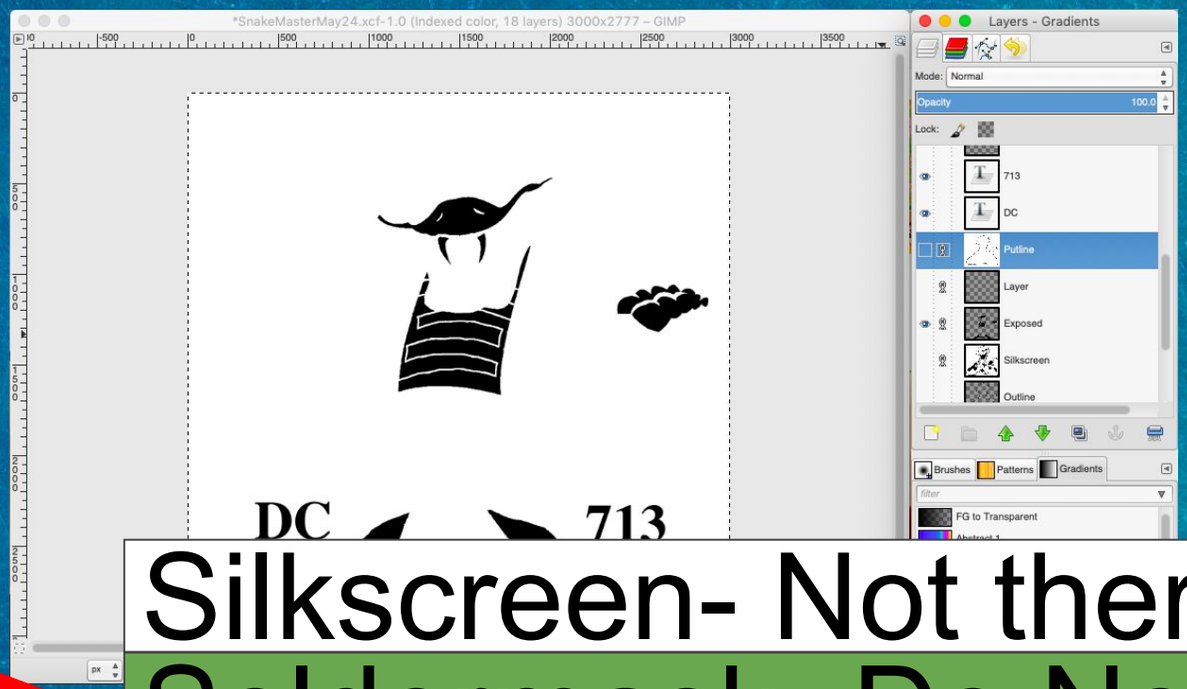
Bring out the GIMP

Front Soldermask



Bring out the GIMP

Front Soldermask



Silkscreen- Not there

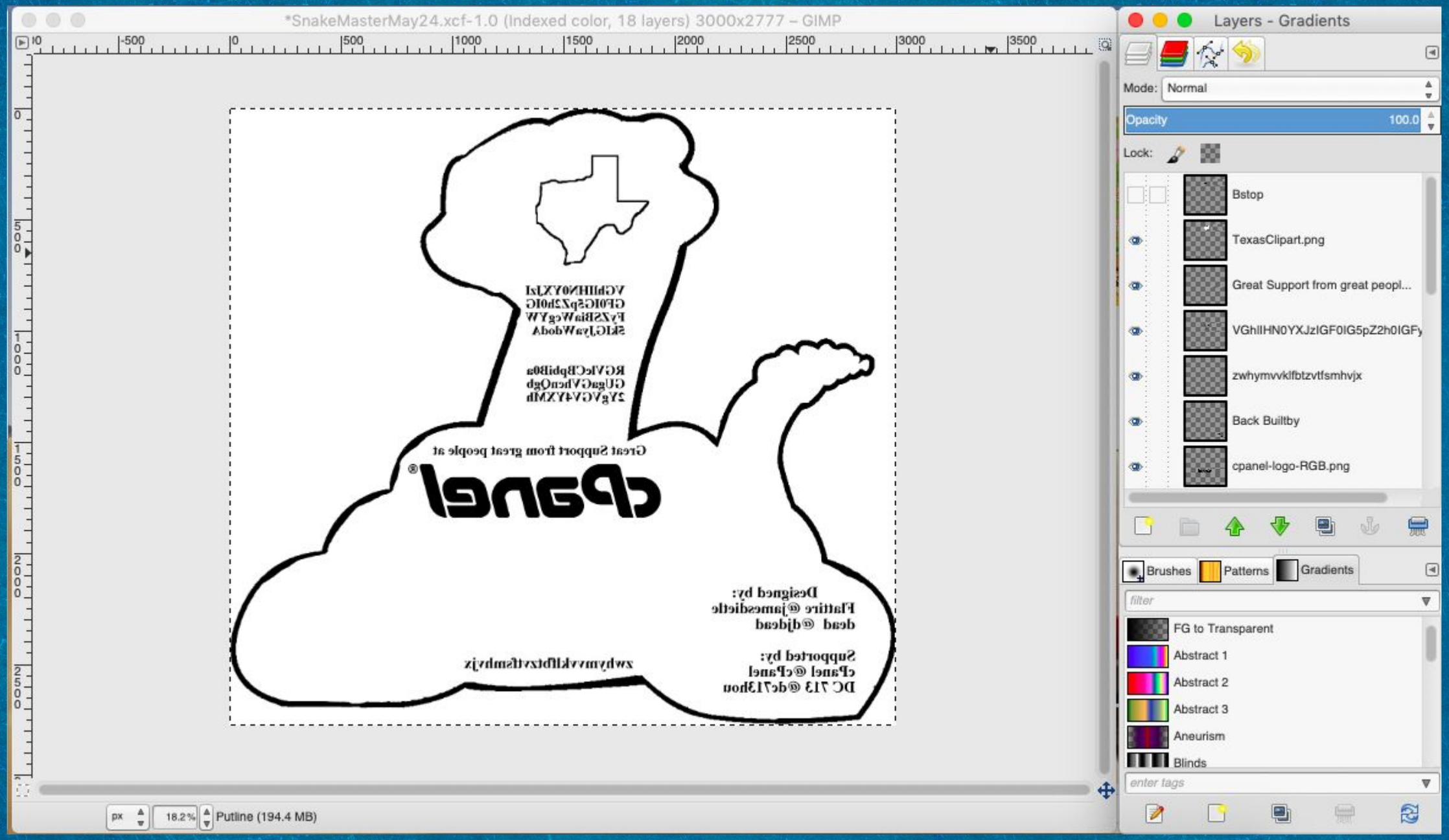
Soldermask- Do Not apply here

Copper- Need to have copper behind

Substrate

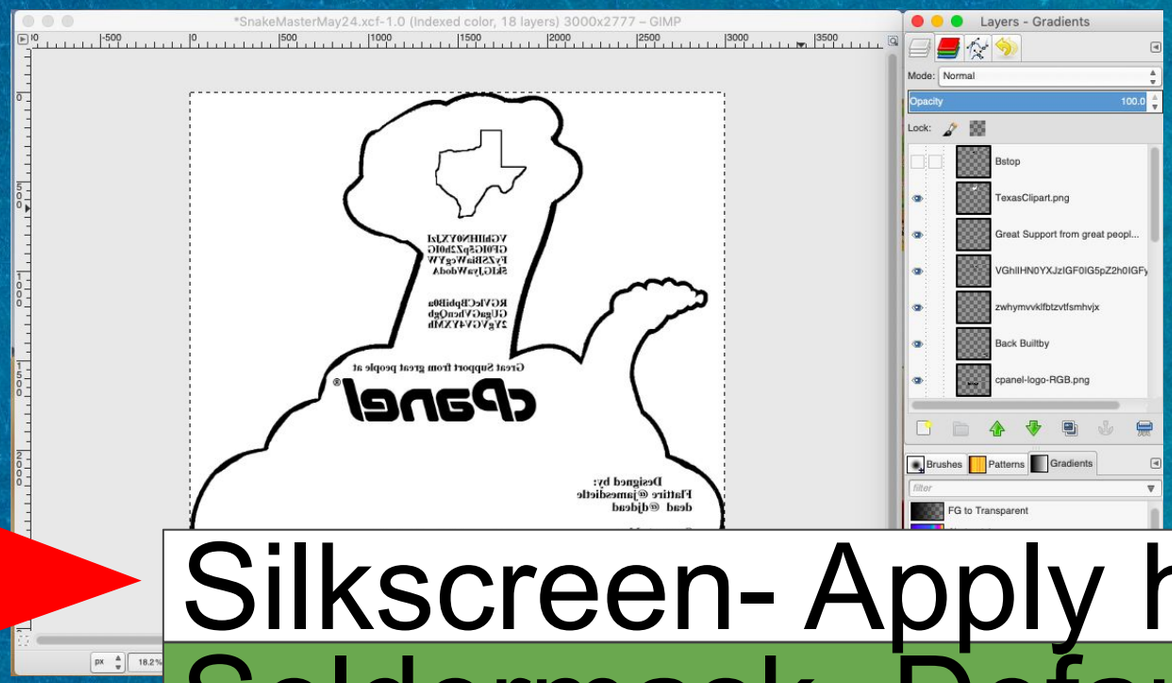
Bring out the GIMP

Back Silkscreen



Bring out the GIMP

Back Silkscreen



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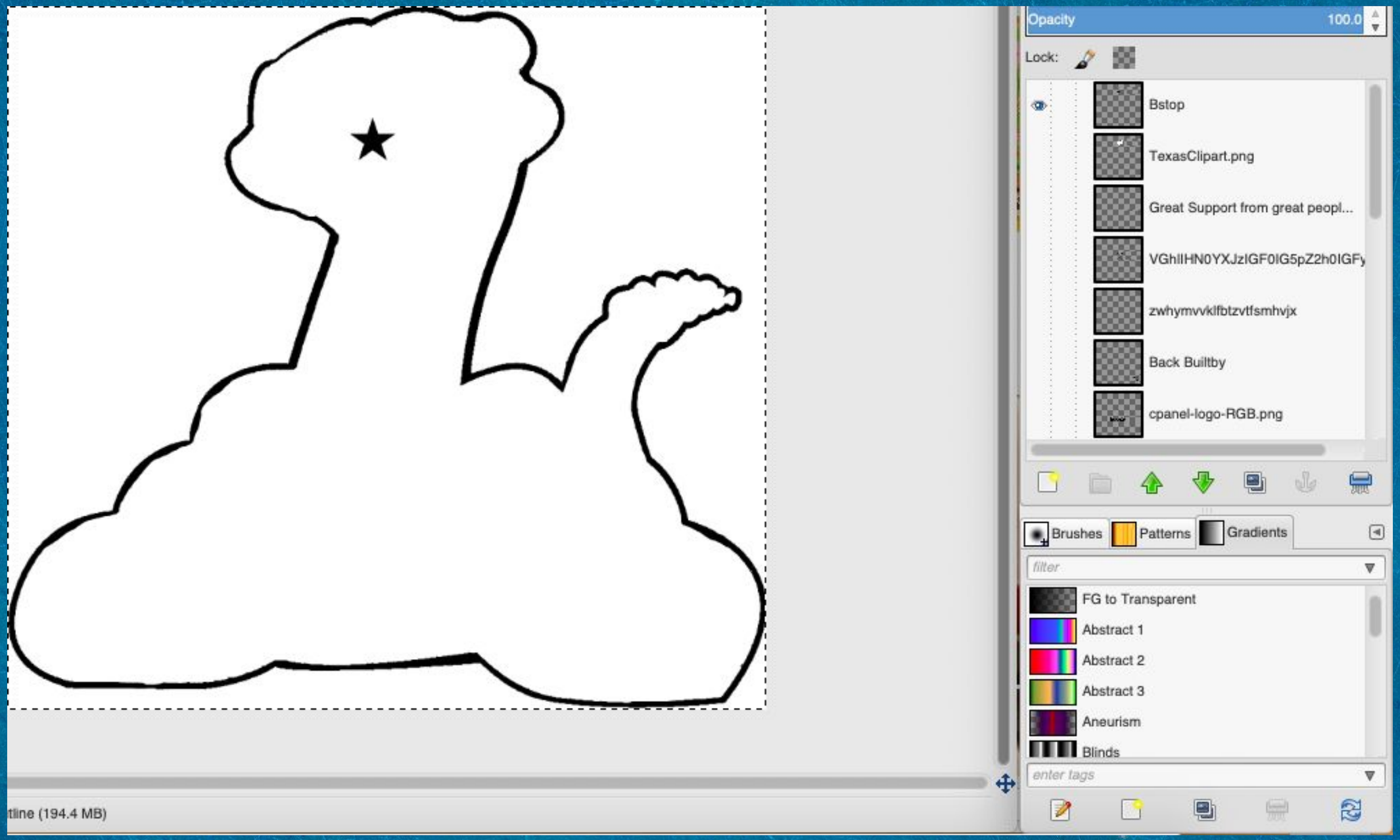
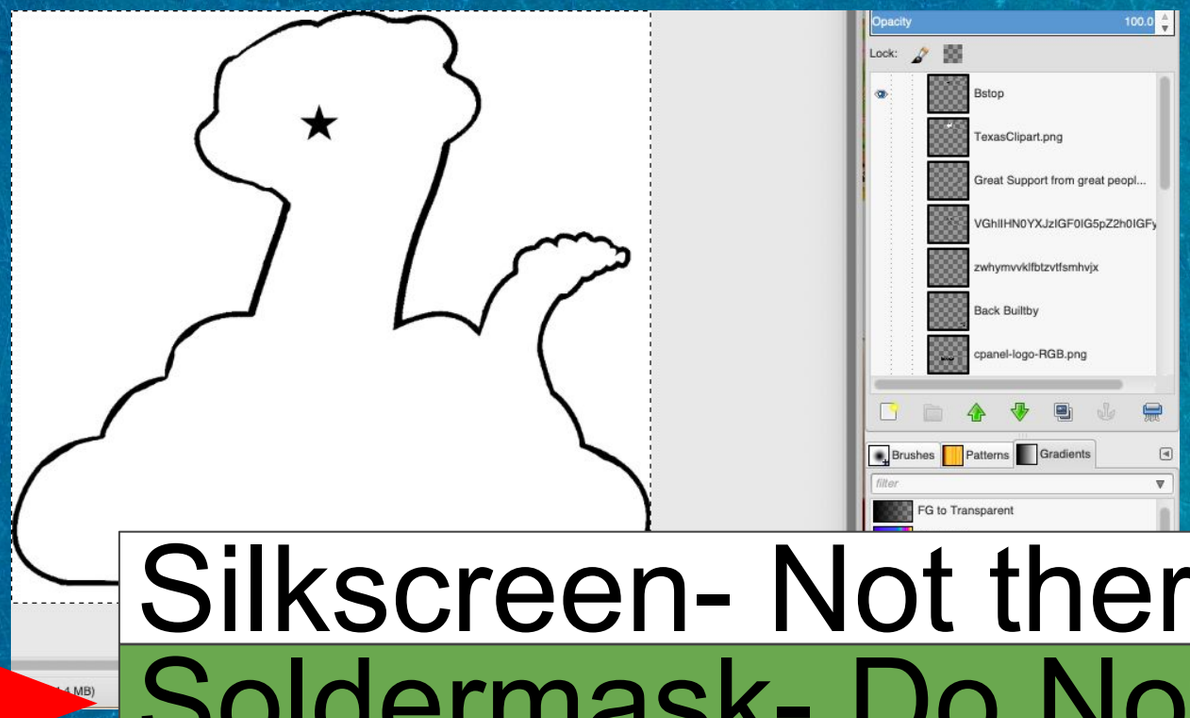
Bring out the GIMP

Back Soldermask



Bring out the GIMP

Back Soldermask



Silkscreen- Not there

Soldermask- Do Not apply here

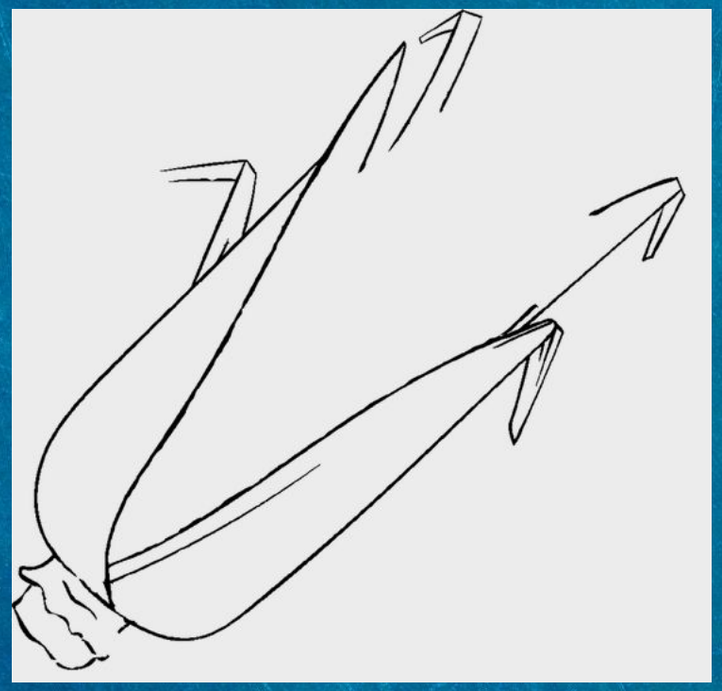
Copper- Need to have copper behind

Substrate

Bring out the GIMP

Art Considerations

- Standard size for wearables
- Sharp corners and machining
- Structural integrity
- Getting caught on things



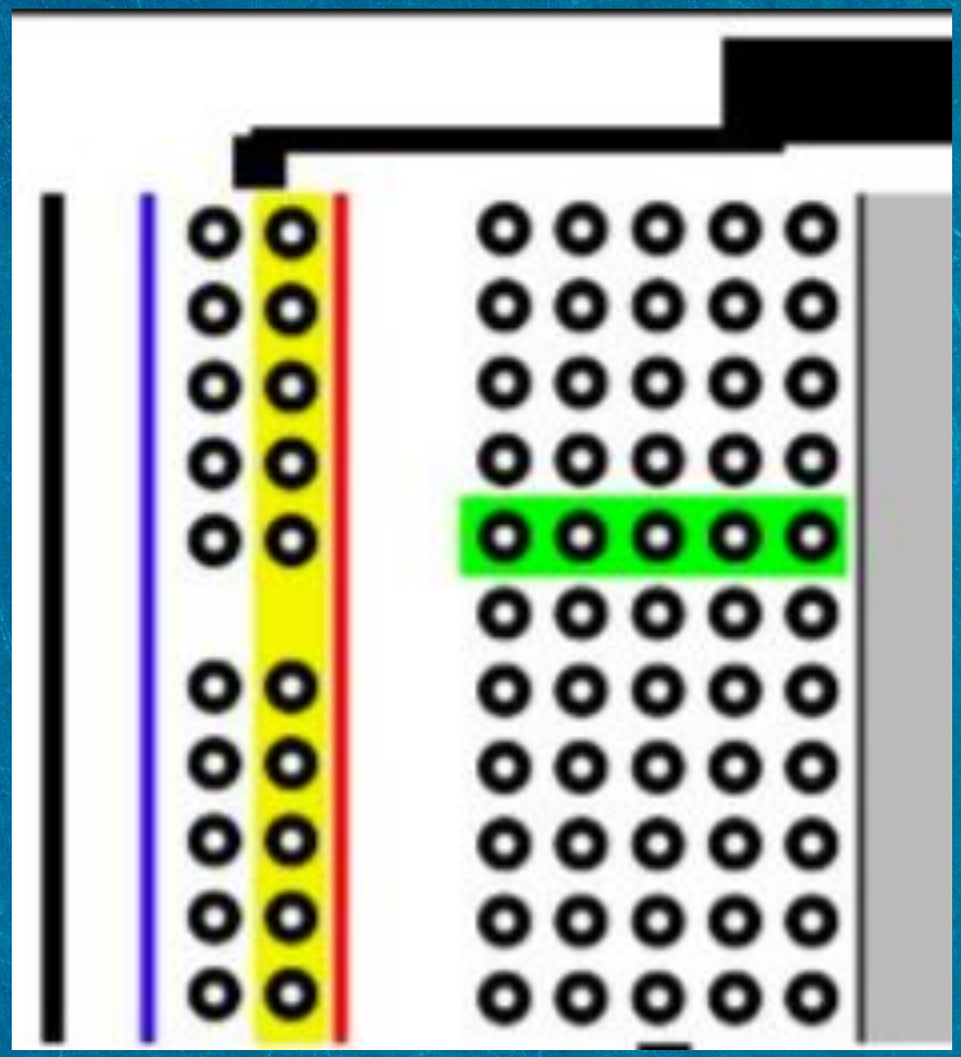
Firing up Kicad

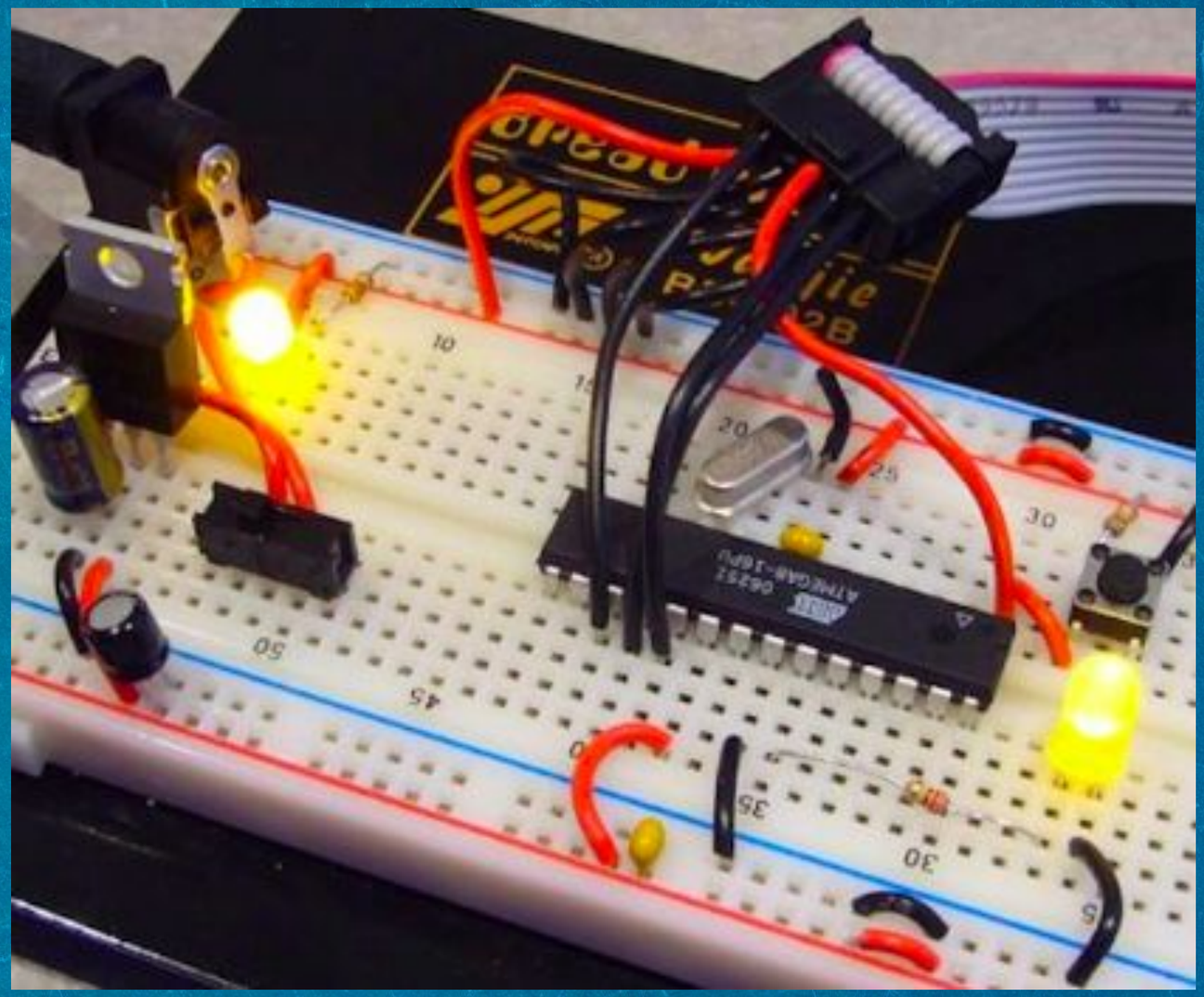
Kicad vs. Eagle vs. EasyEda

- Both are very similar
- Price
  - Kicad Free
  - Eagle Two- 1 free and 1 paid versions
- Design
  - Kicad move group and shortcuts
  - Faster learn curve
- More #badgelife seem to use Kicad

Firing up Kicad

Breadboard: You tested this right?





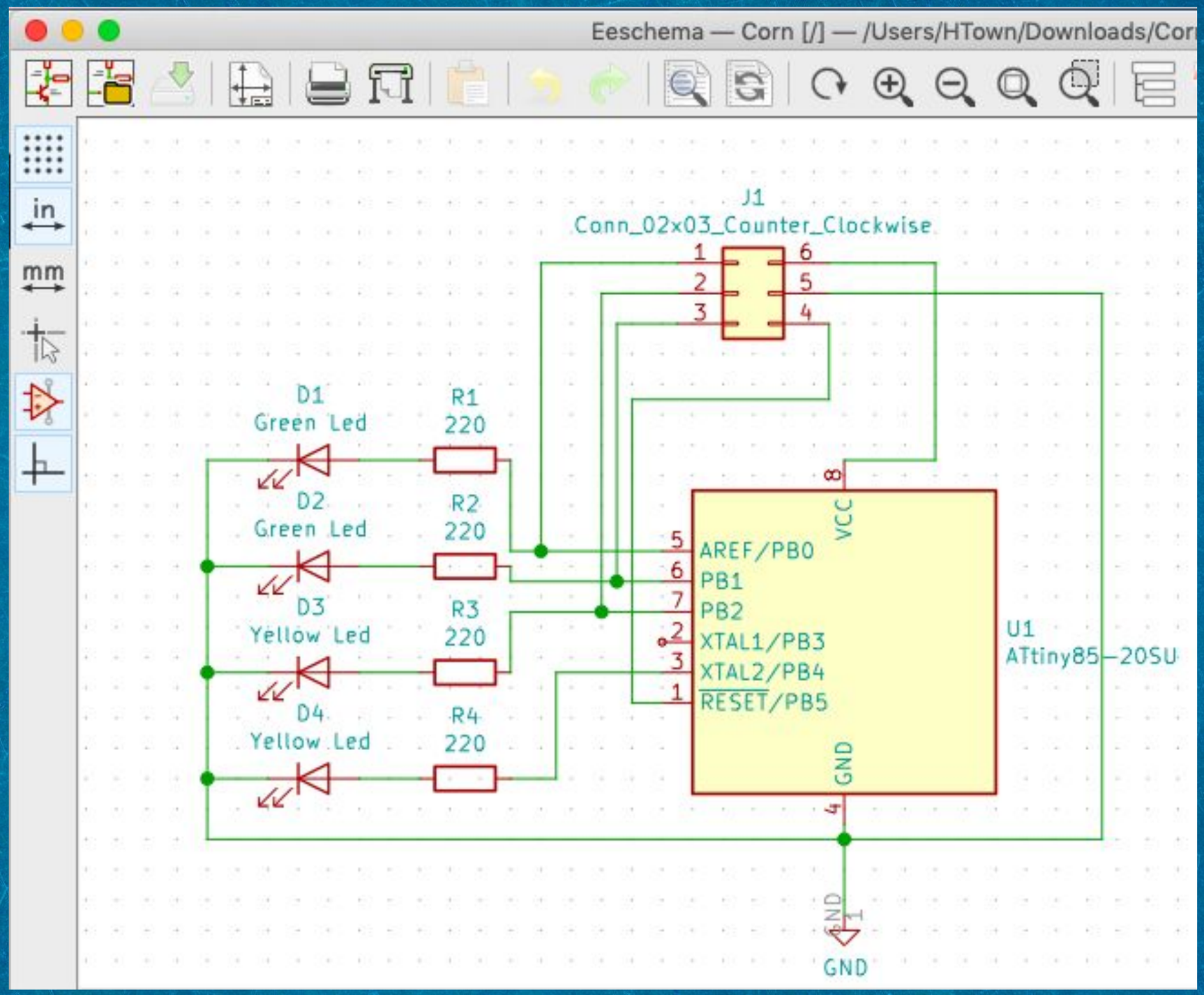
Firing up Kicad

My components!?

- Data sheets
- Find a similar project

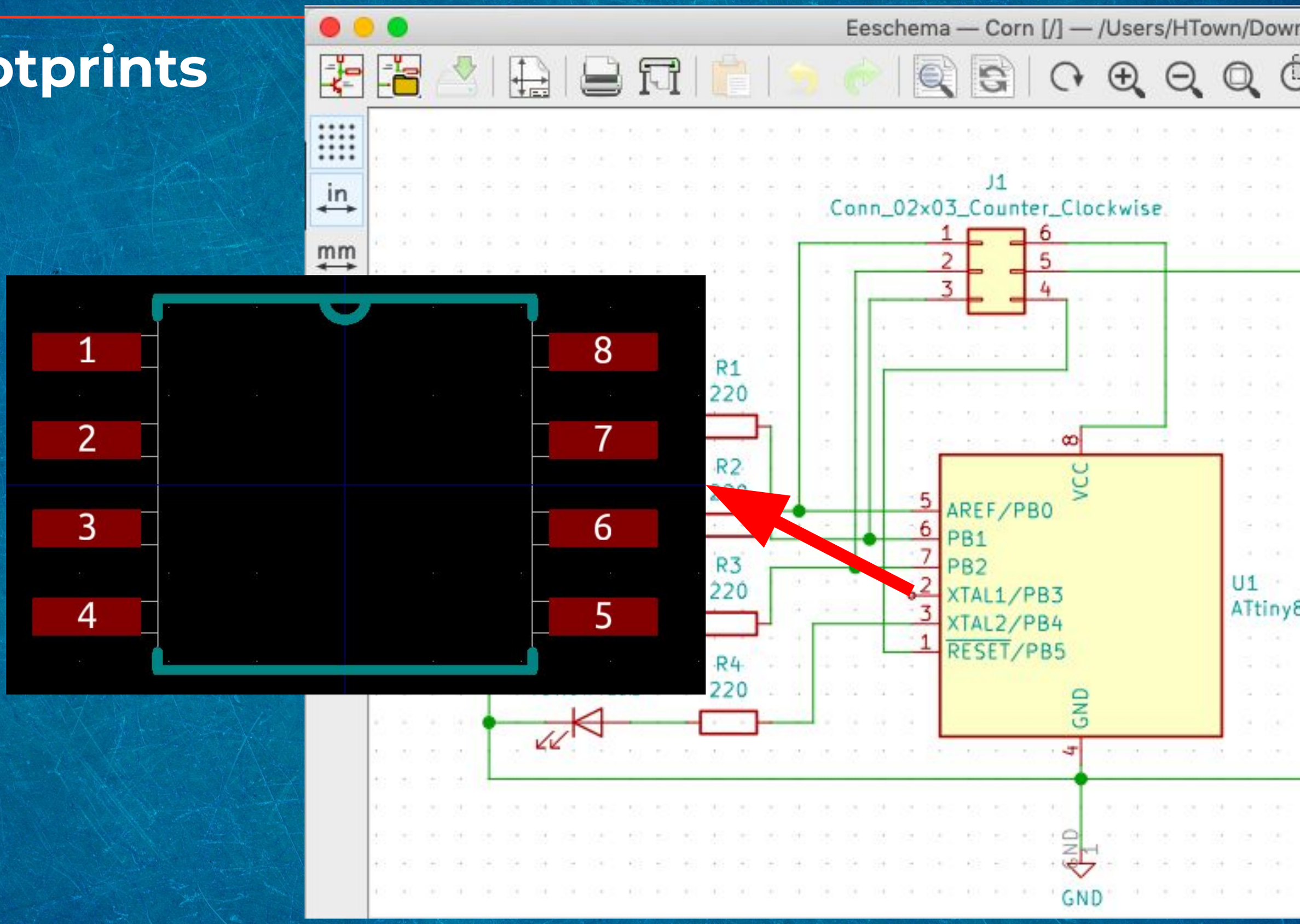
Firing up Kicad

Schematic



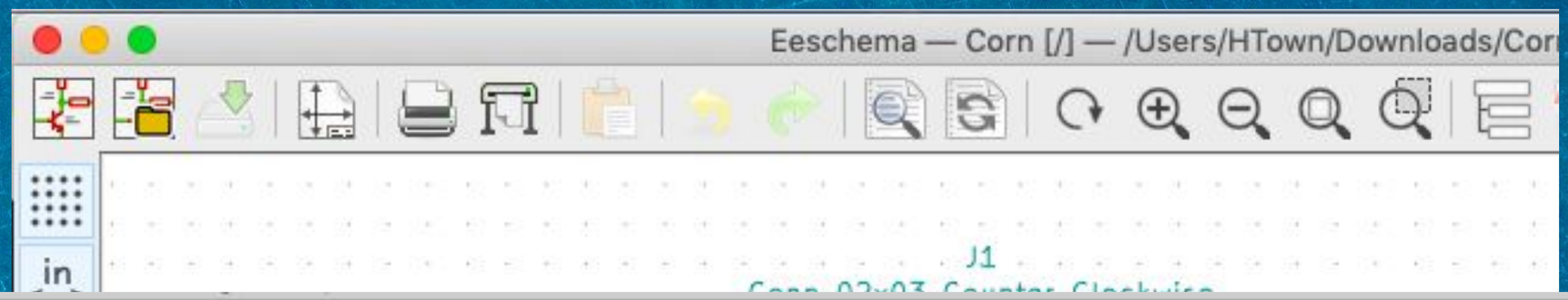
Firing up Kicad

Footprints



Firing up Kicad

Schematic



Filter footprint list by pin count

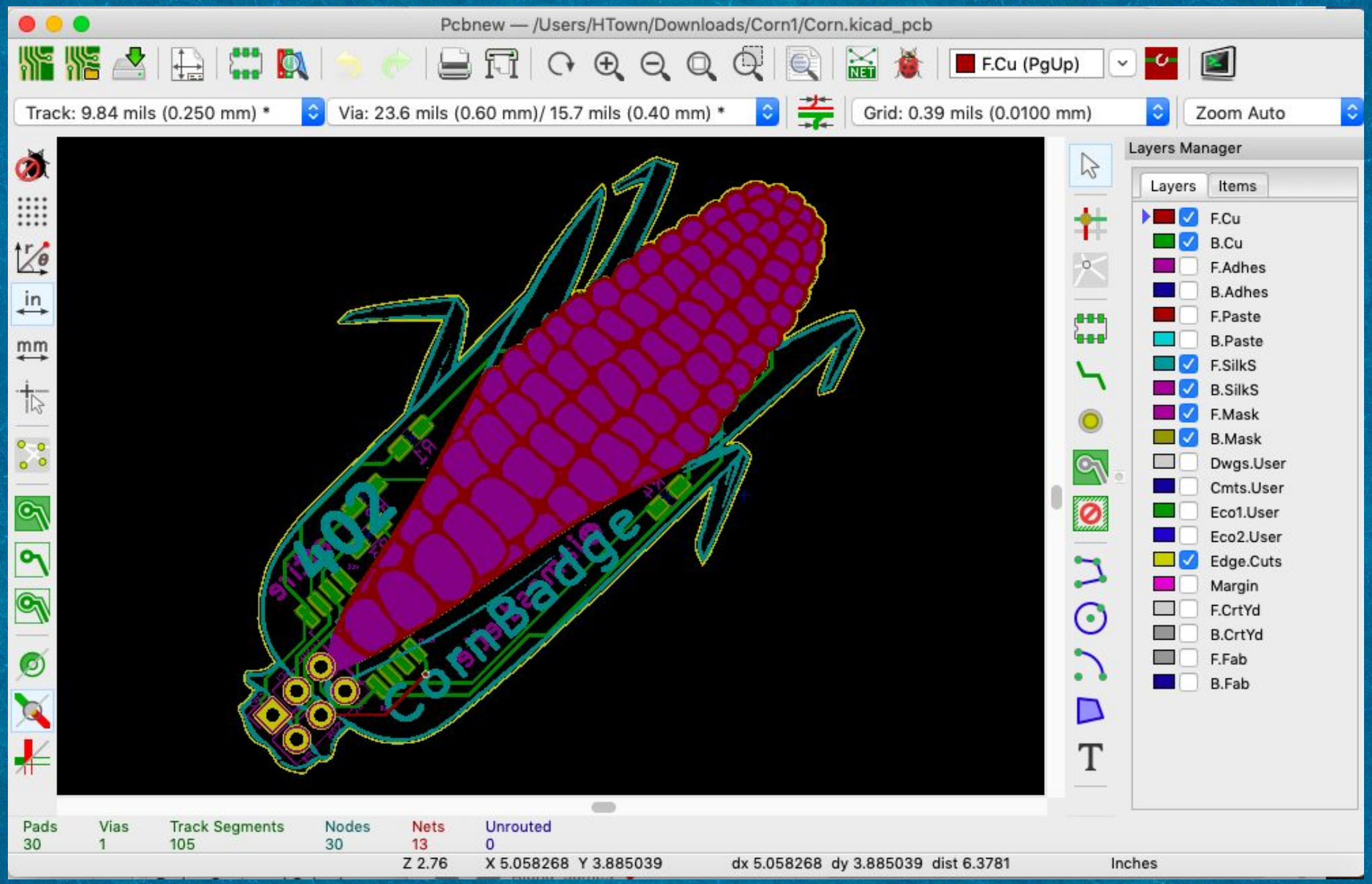
1	D1 -	Green Led	LEDs:LED_1206_HandSoldering
2	D2 -	Green Led	LEDs:LED_1206_HandSoldering
3	D3 -	Yellow Led	LEDs:LED_1206_HandSoldering
4	D4 -	Yellow Led	LEDs:LED_1206_HandSoldering
5	J1 -	Conn_02x03_Counter_Clockwise	Pin_Headers:Pin_Header_Straight_2x03_Pitch2.54mm
6	R1 -	220	Resistors_SMD:R_0603_HandSoldering
7	R2 -	220	Resistors_SMD:R_0603_HandSoldering
8	R3 -	220	Resistors_SMD:R_0603_HandSoldering
9	R4 -	220	Resistors_SMD:R_0603_HandSoldering
10	U1 -	ATtiny85-20SU	ATTINY85-20SU:SOIC127P798X216-8N

4102 IR-DirectFETs:DirectFET_MP
4103 IR-DirectFETs:DirectFET_MT
4104 IR-DirectFETs:DirectFET_MX
4105 IR-DirectFETs:DirectFET_MZ
4106 IR-DirectFETs:DirectFET_S1
4107 IR-DirectFETs:DirectFET_S2
4108 IR-DirectFETs:DirectFET_SH
4109 IR-DirectFETs:DirectFET_SJ
4110 IR-DirectFETs:DirectFET_SQ
4111 IR-DirectFETs:DirectFET_ST
4112 LEDs:LED-L1T2_LUMILEDS
4113 LEDs:LED_1W_3W_R8
4114 LEDs:LED_0402
4115 LEDs:LED_0603
4116 LEDs:LED_0603_HandSoldering
4117 LEDs:LED_0606
4118 LEDs:LED_0805
4119 LEDs:LED_0805_HandSoldering
4120 LEDs:LED_1206
4121 LEDs:LED_1206_HandSoldering
4122 LEDs:LED_BL-FL7680RGB

Apply, Save Schematic & Continue | Cancel | OK

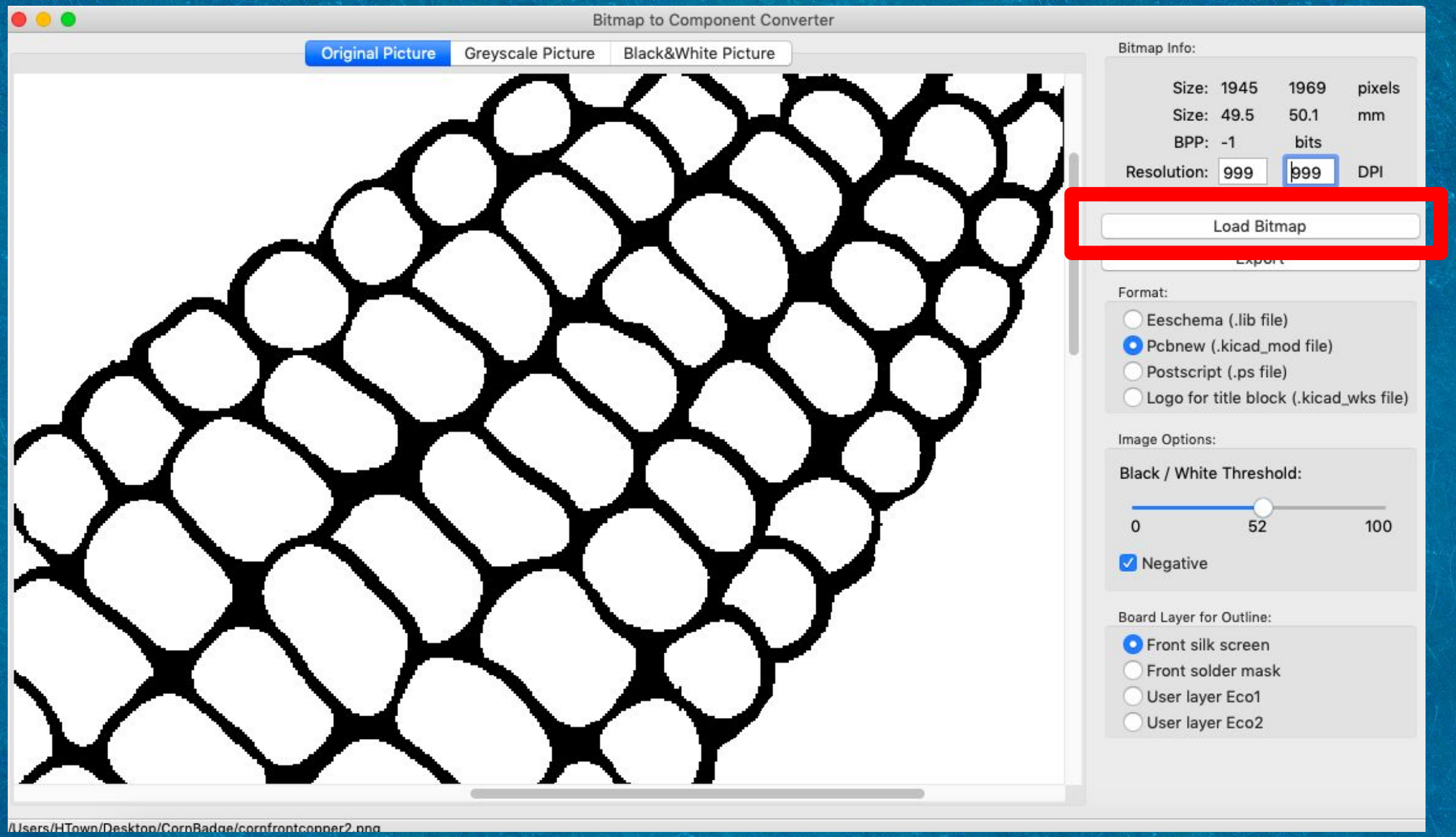
Firing up Kicad

We will now make this



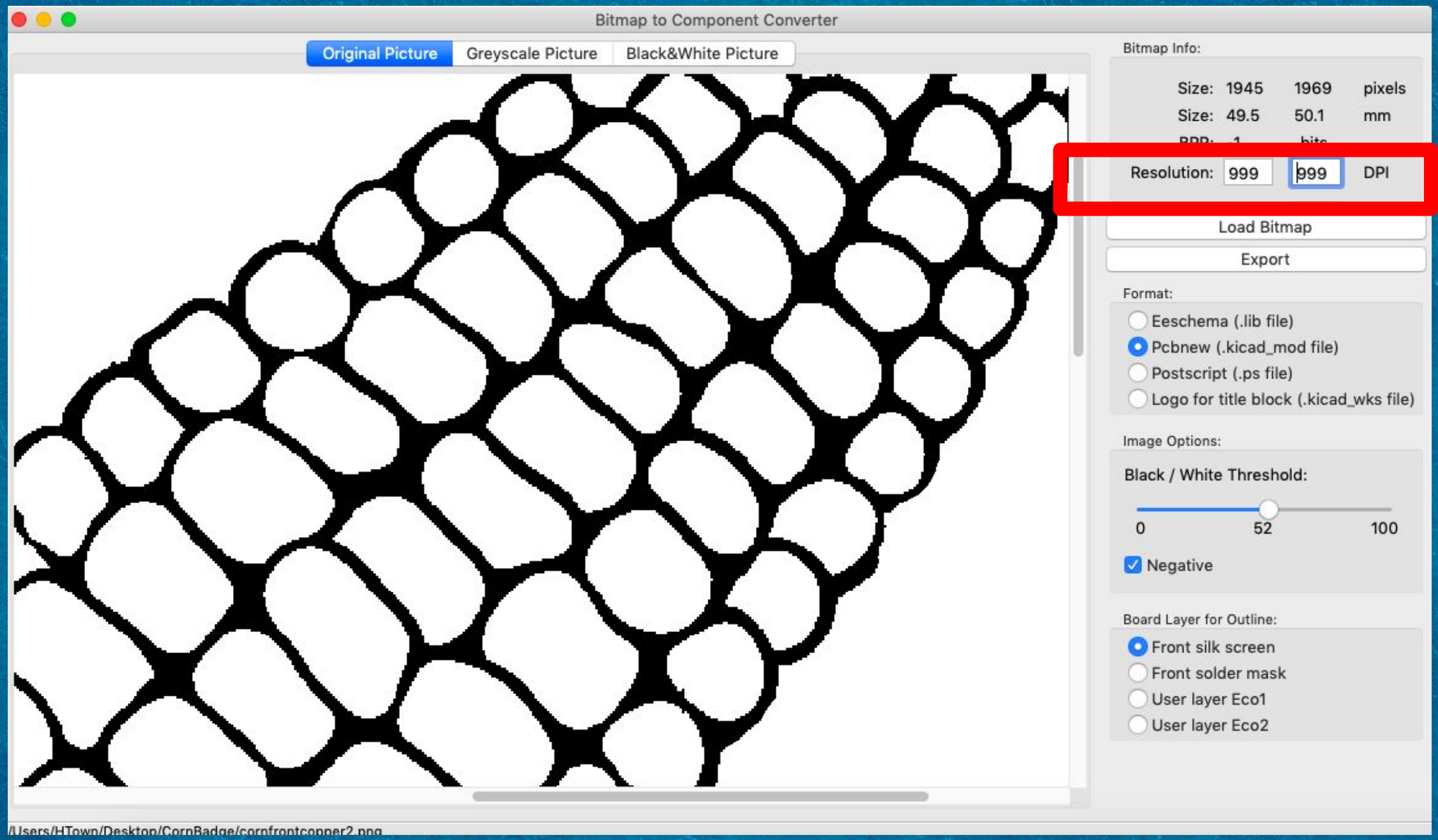
Firing up Kicad

Adding in your art as layers



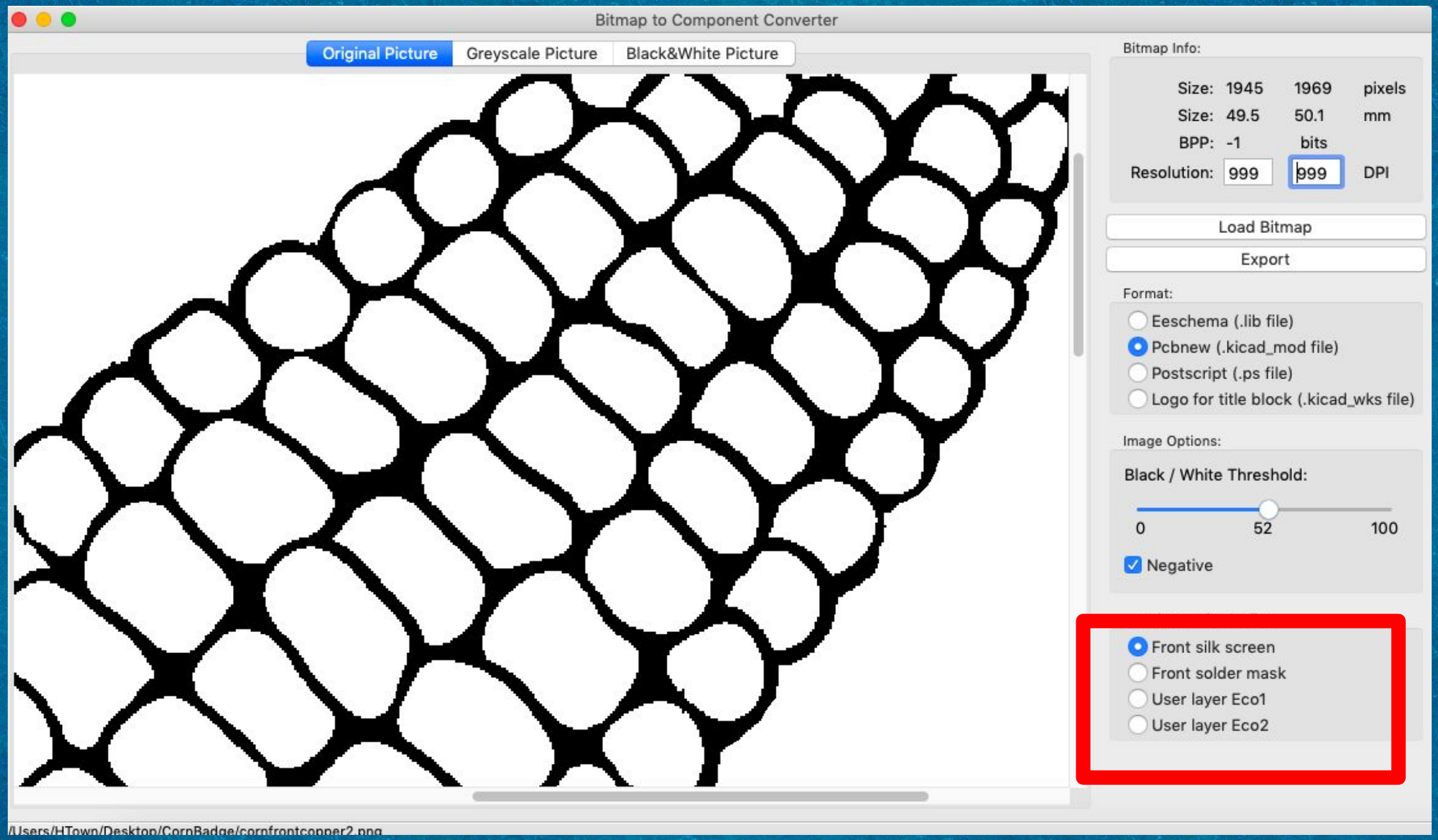
Firing up Kicad

Adding in your art as layers



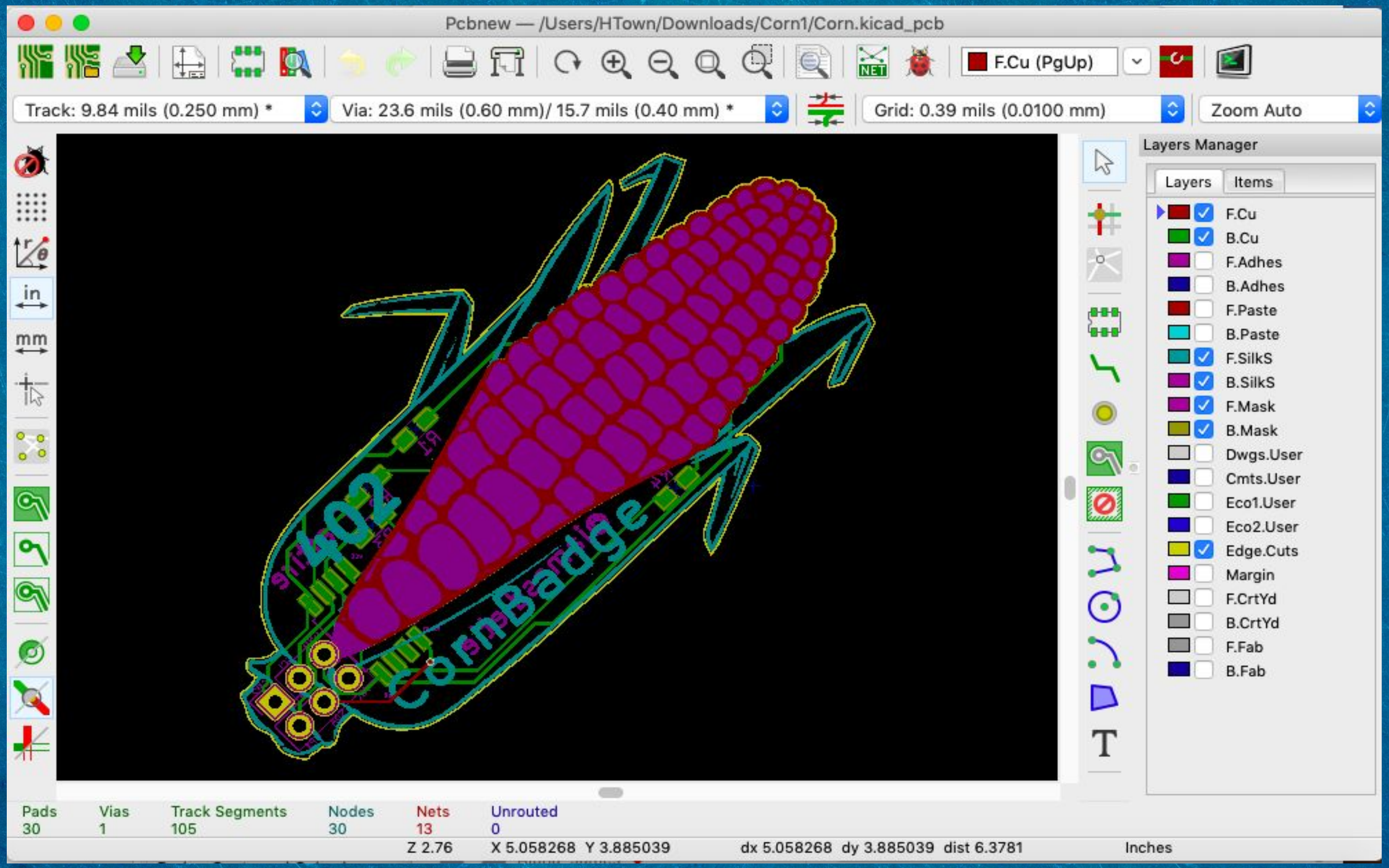
Firing up Kicad

Adding in your art as layers



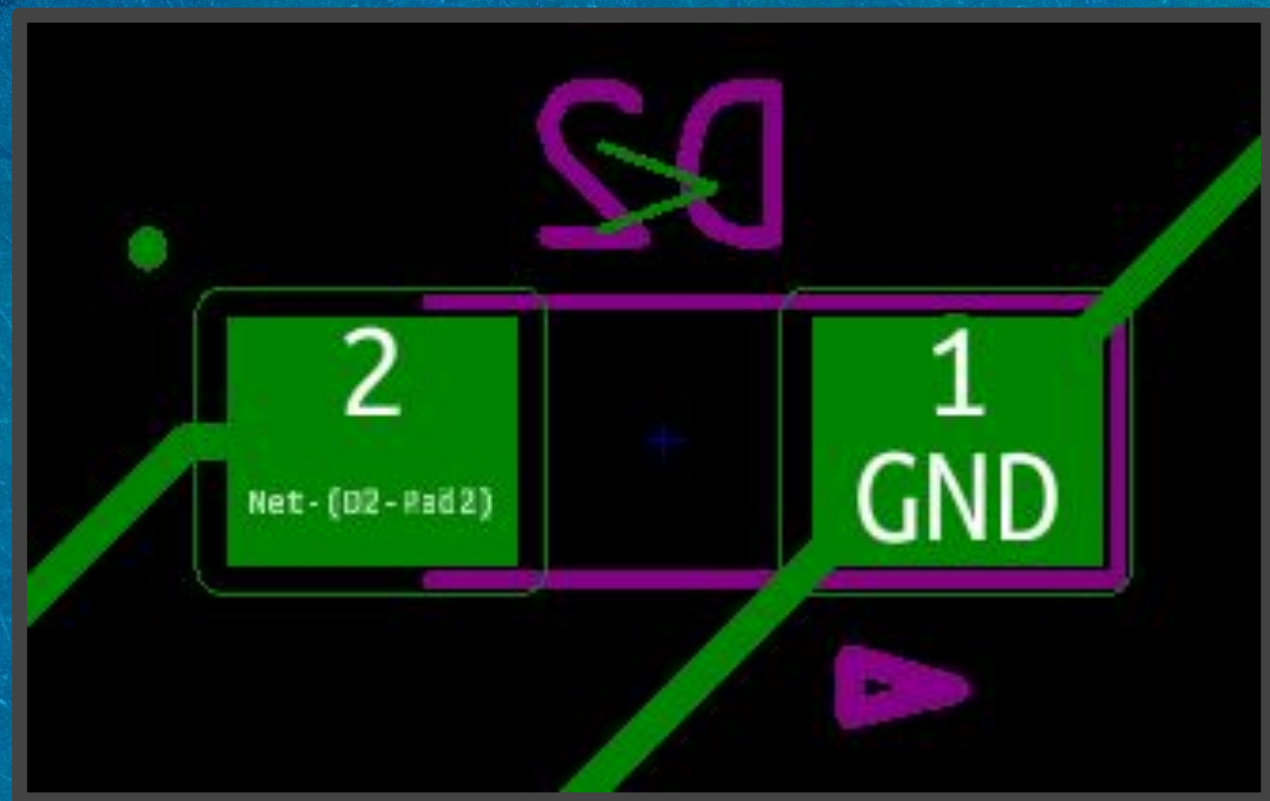
Firing up Kicad

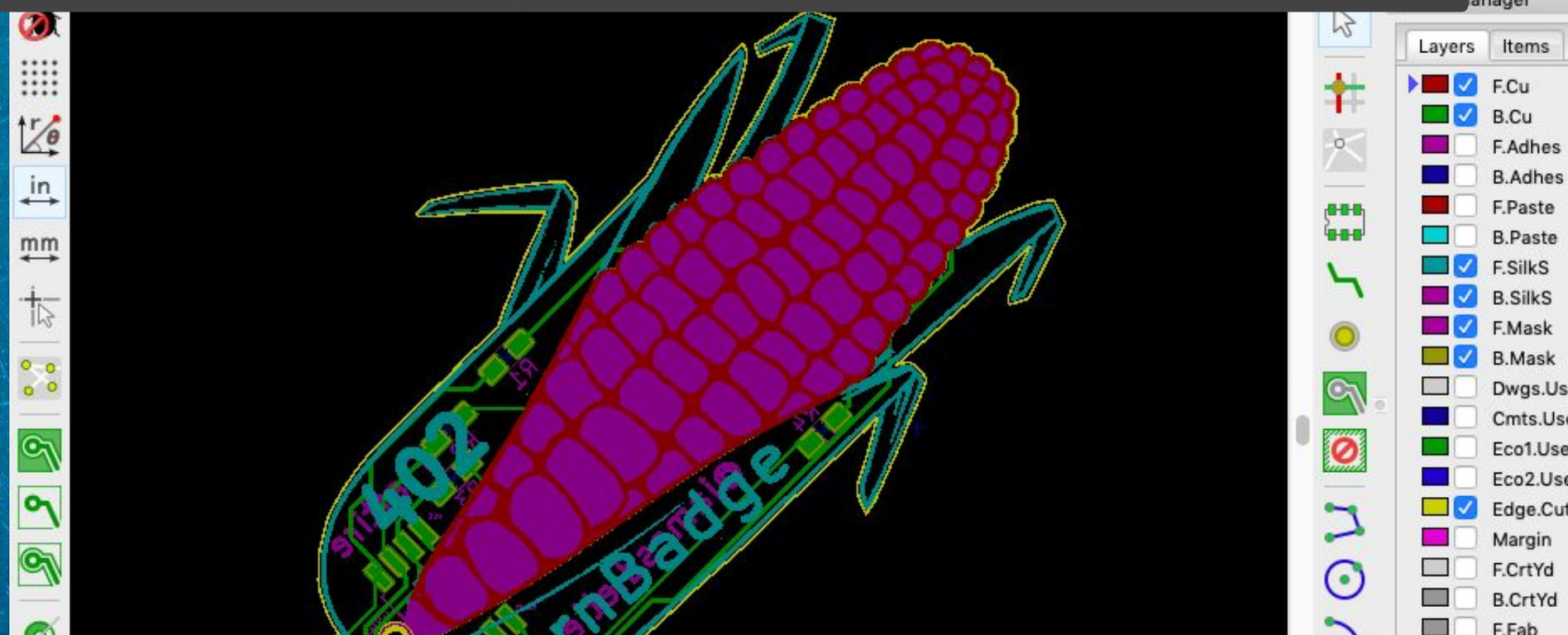
What are all these layers?



Firing up Kicad

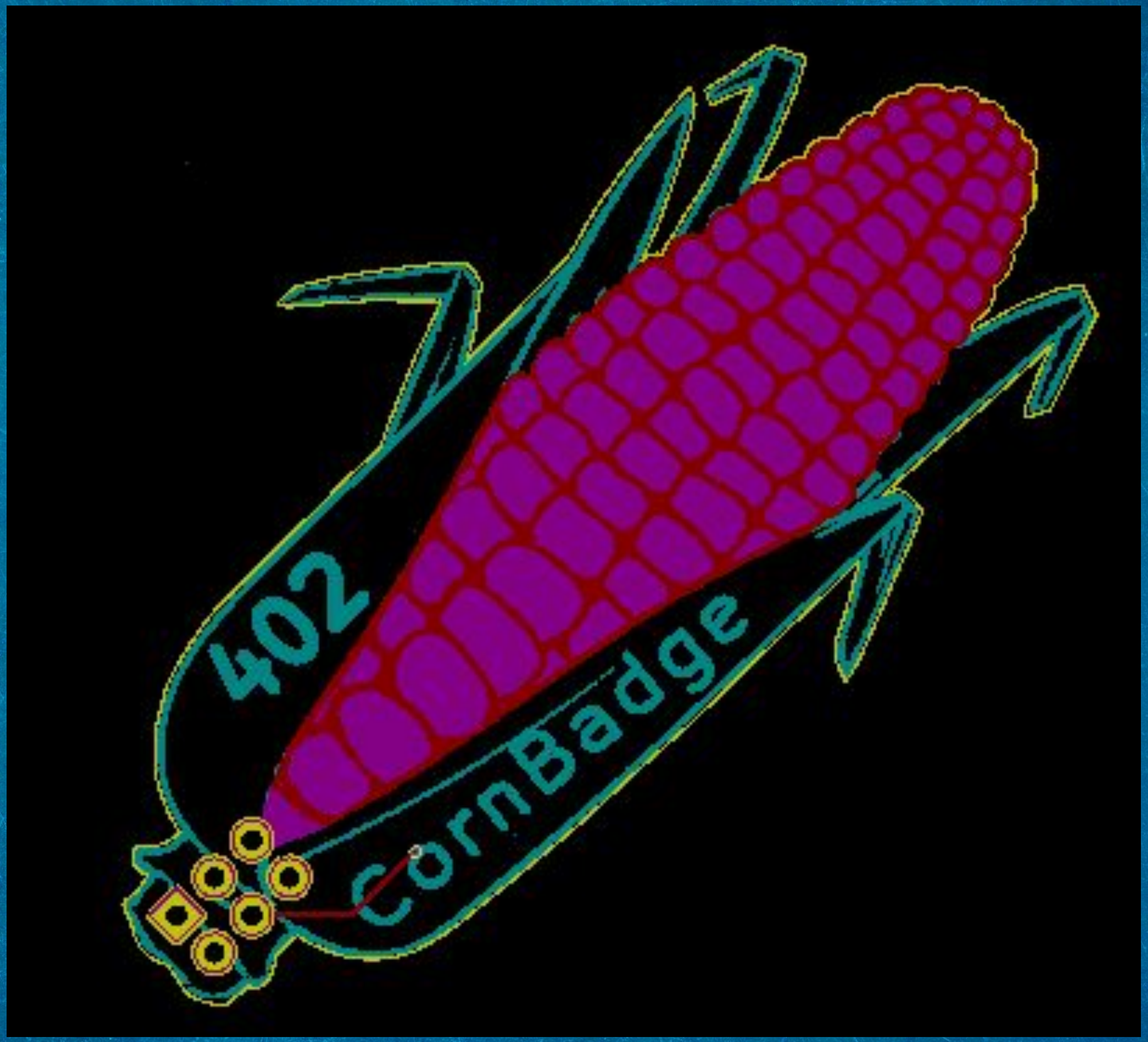
Components





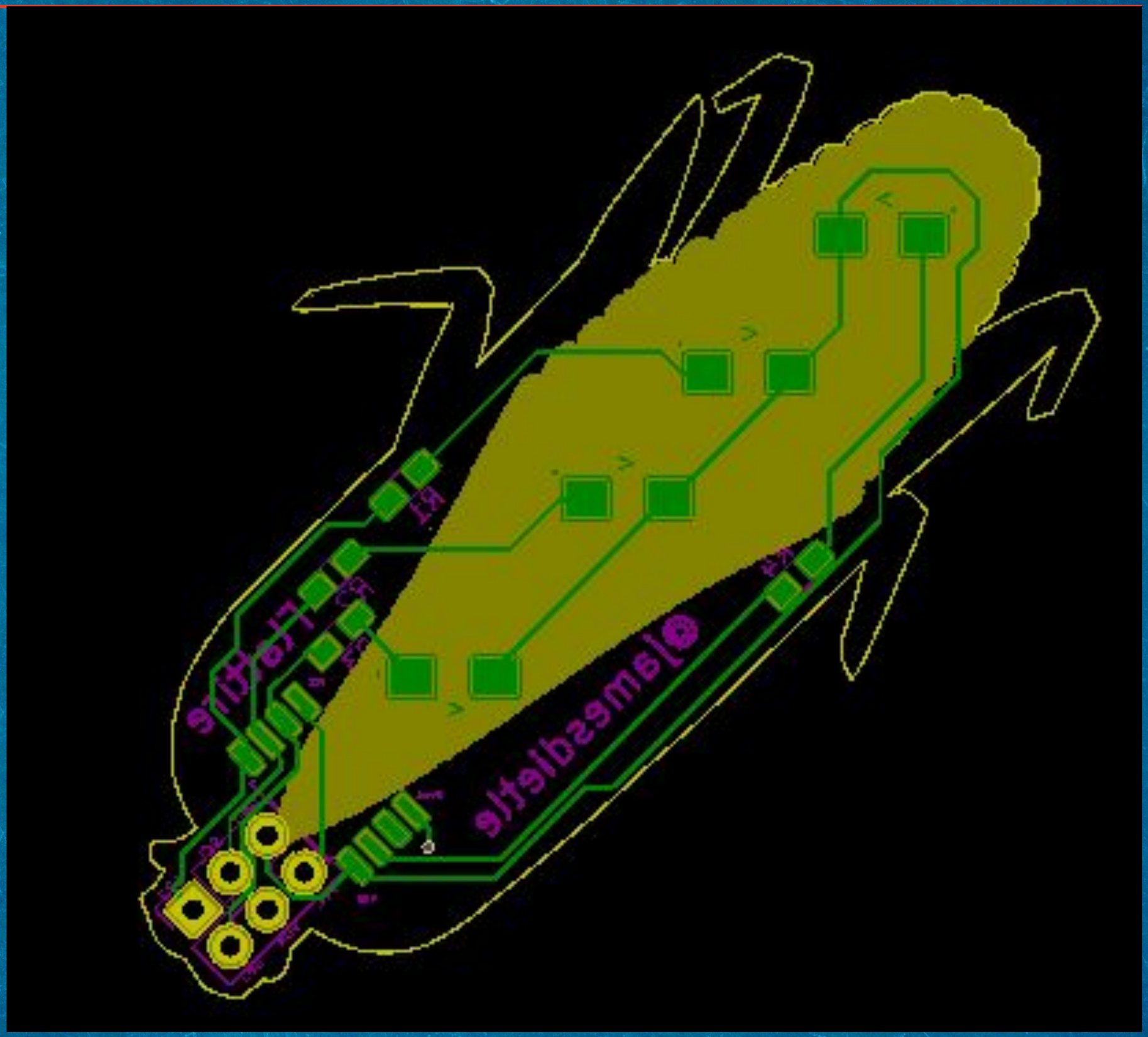
Firing up Kicad

Front Side



Firing up Kicad

Back Side



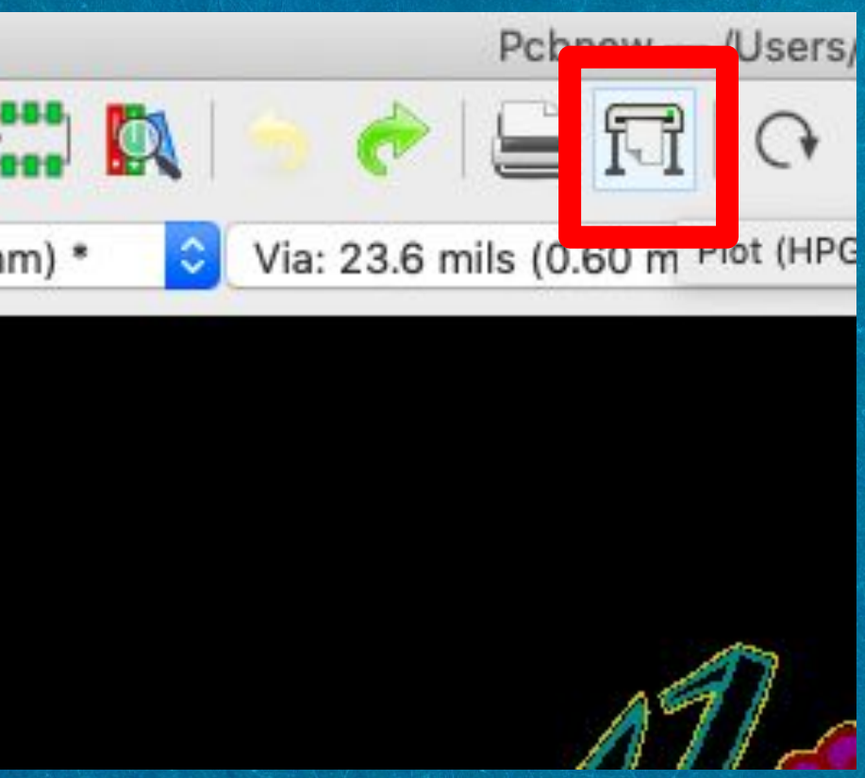
Firing up Kicad

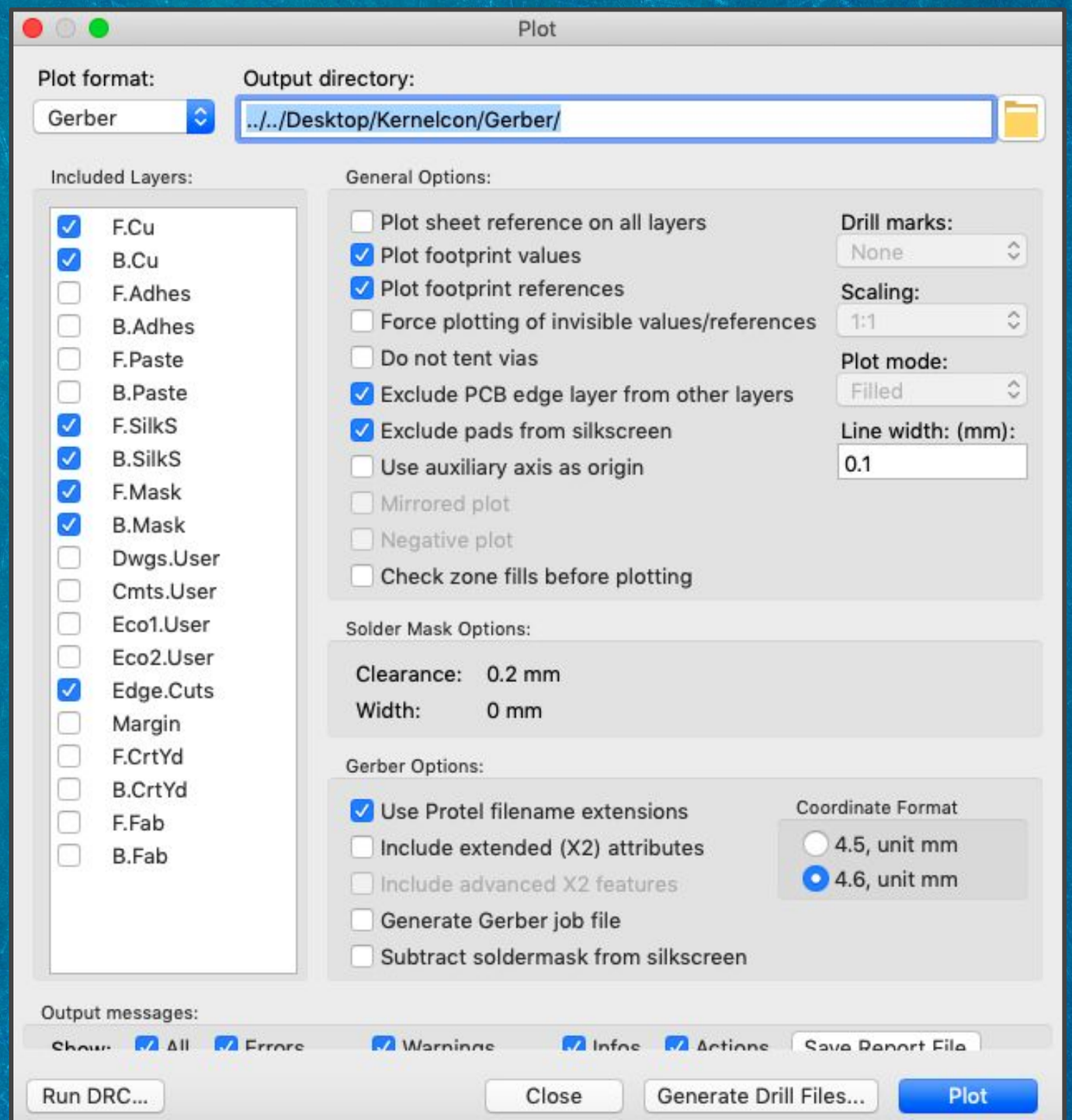
3-D print

Firing up Kicad

Creating the Gerber file

Used to tell machines how to print circuit board.





Send it to the printers!

Different Options

Macrofab

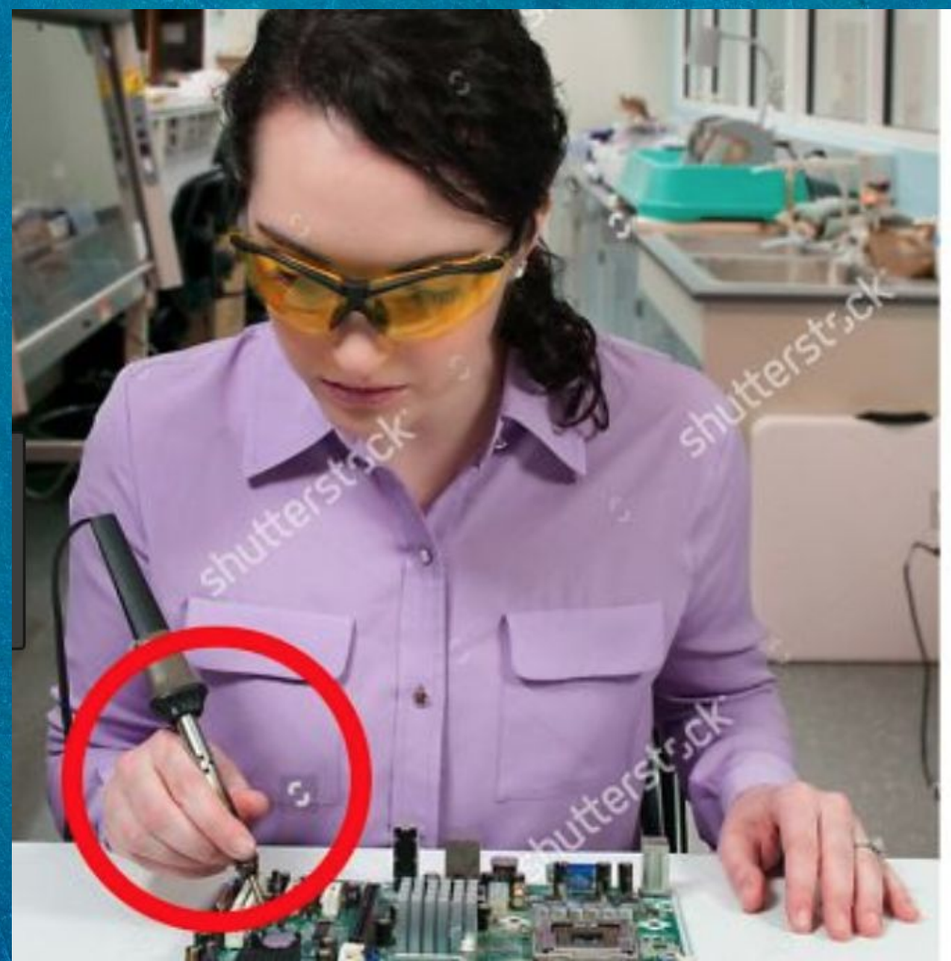
OshPark

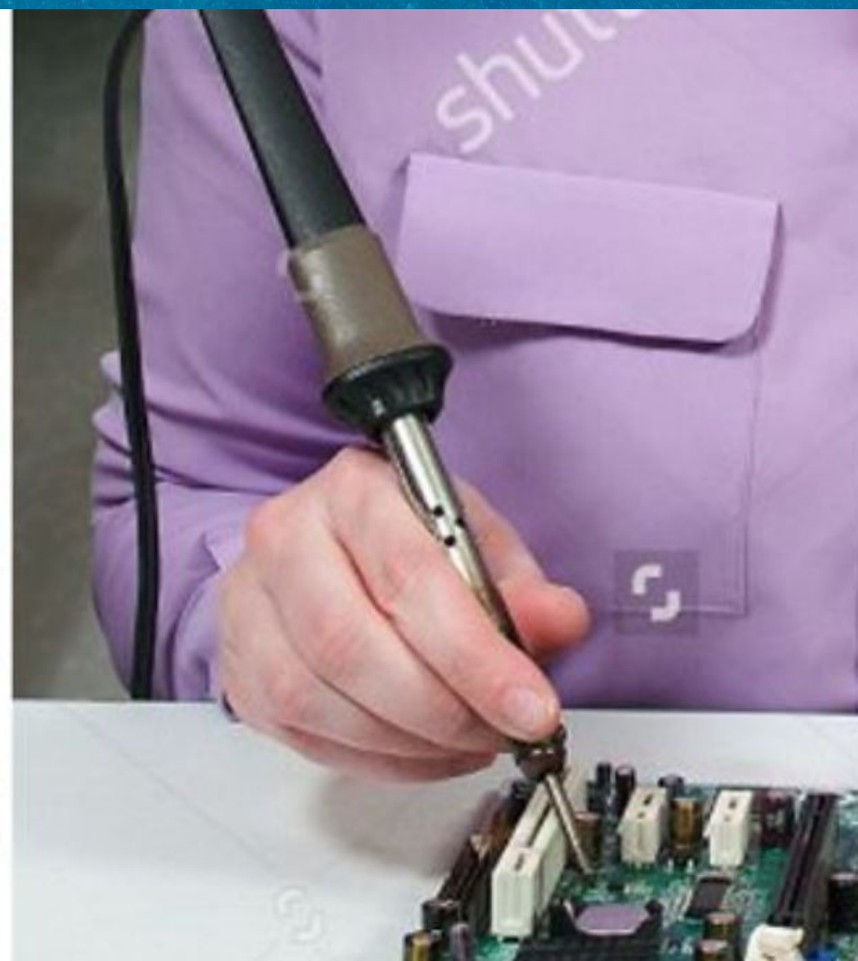
PCBWay

Send it to the printers!

Pick and Place

- It’s a kit!
- I’ll do it myself!
- I’ll get an oven
- Built and ready to go!





Send it to the printers!

Working Overseas

- Language gap
- Takes longer
- Cheaper!

Local Work

- Can be faster
- Clear communication
- More expensive

Send it to the printers!

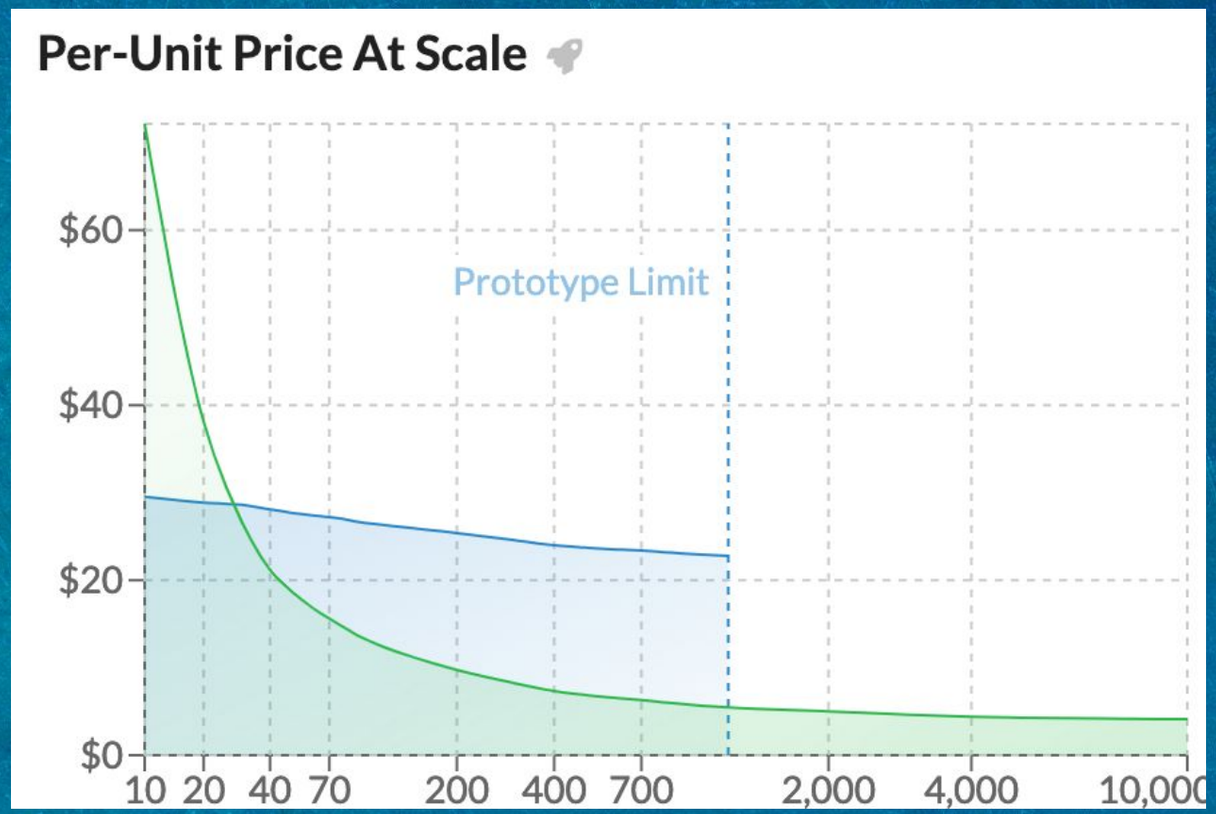
Markings

Costs and Funding Strategies

Costs and Funding Strategies

Bulk Buying

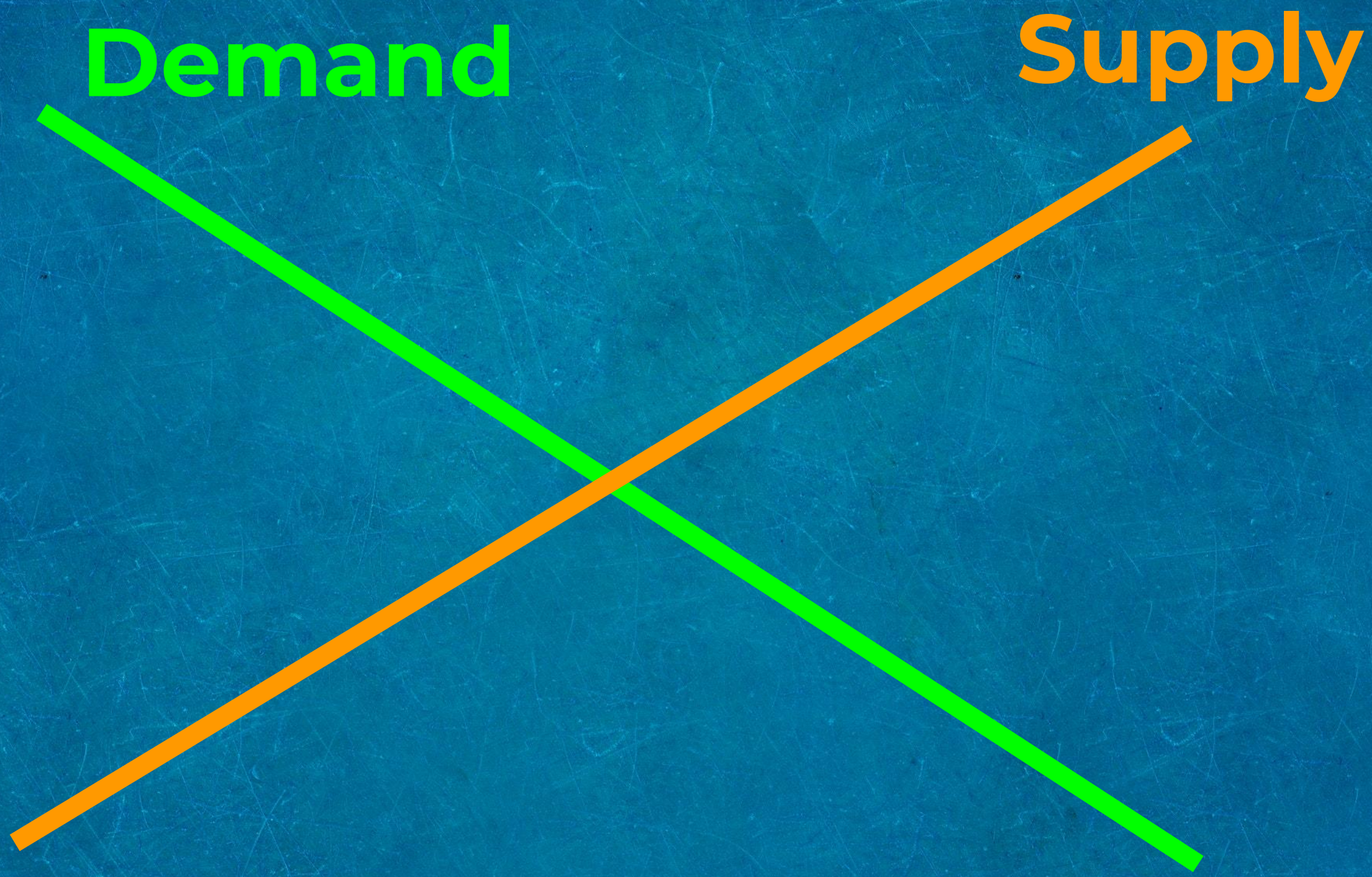
- Decrease ind. pricing
- Must sell more units



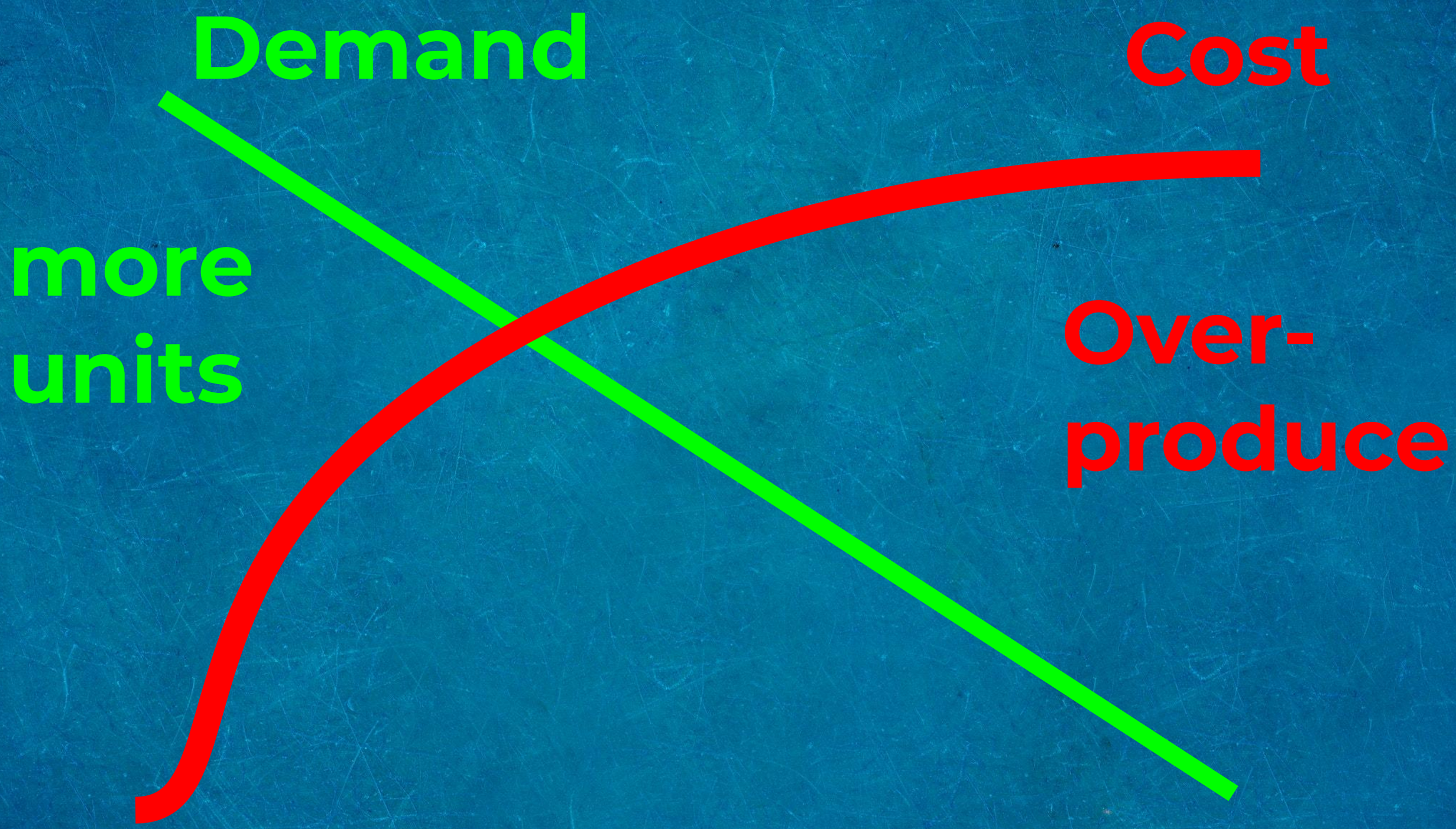
Pricing (USD)

Qty.	Unit Price	Ext. Price
1	$1.23	$1.23
10	$1.21	$12.10
25	$1.13	$28.25
100	$1.03	$103.00

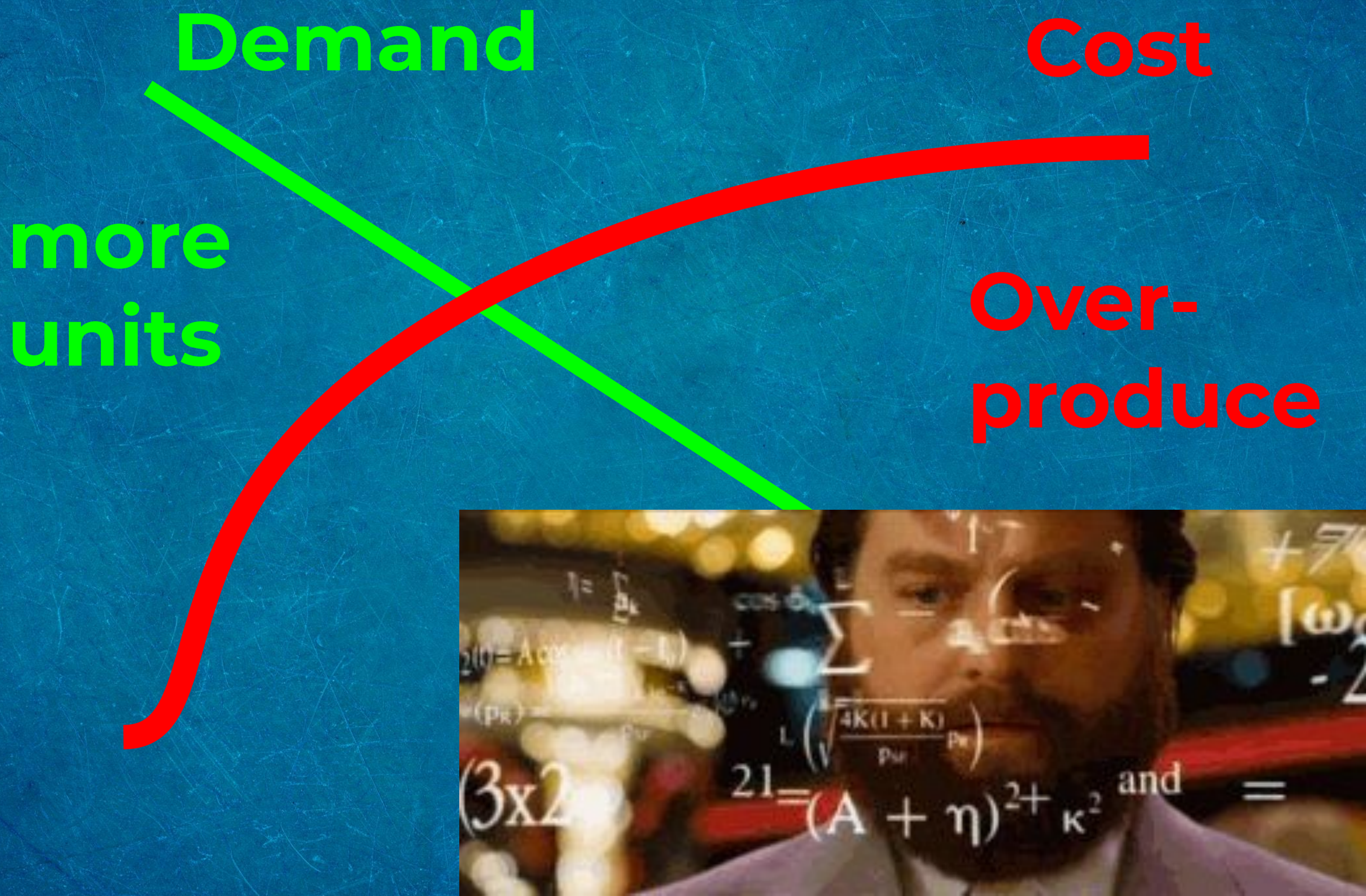
Costs and Funding Strategies



Costs and Funding Strategies



Costs and Funding Strategies



Costs and Funding Strategies

Fundraising

Tindie

- Pay upfront
- 5% fee
- 1 month holding

Kickstarter

- 6% fee
- Know how many to order
- Timeframe

Costs and Funding Strategies

Fundraising

Tindie
- Pay upfront
- 5% fee
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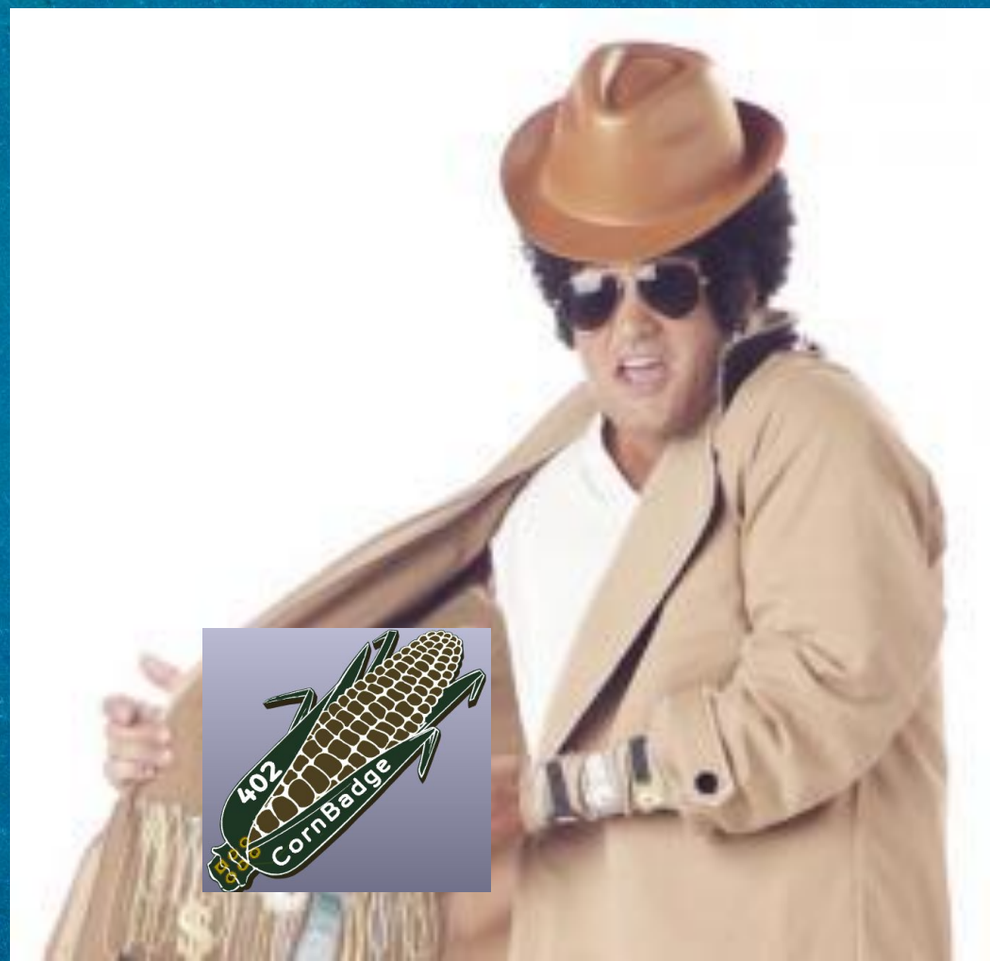
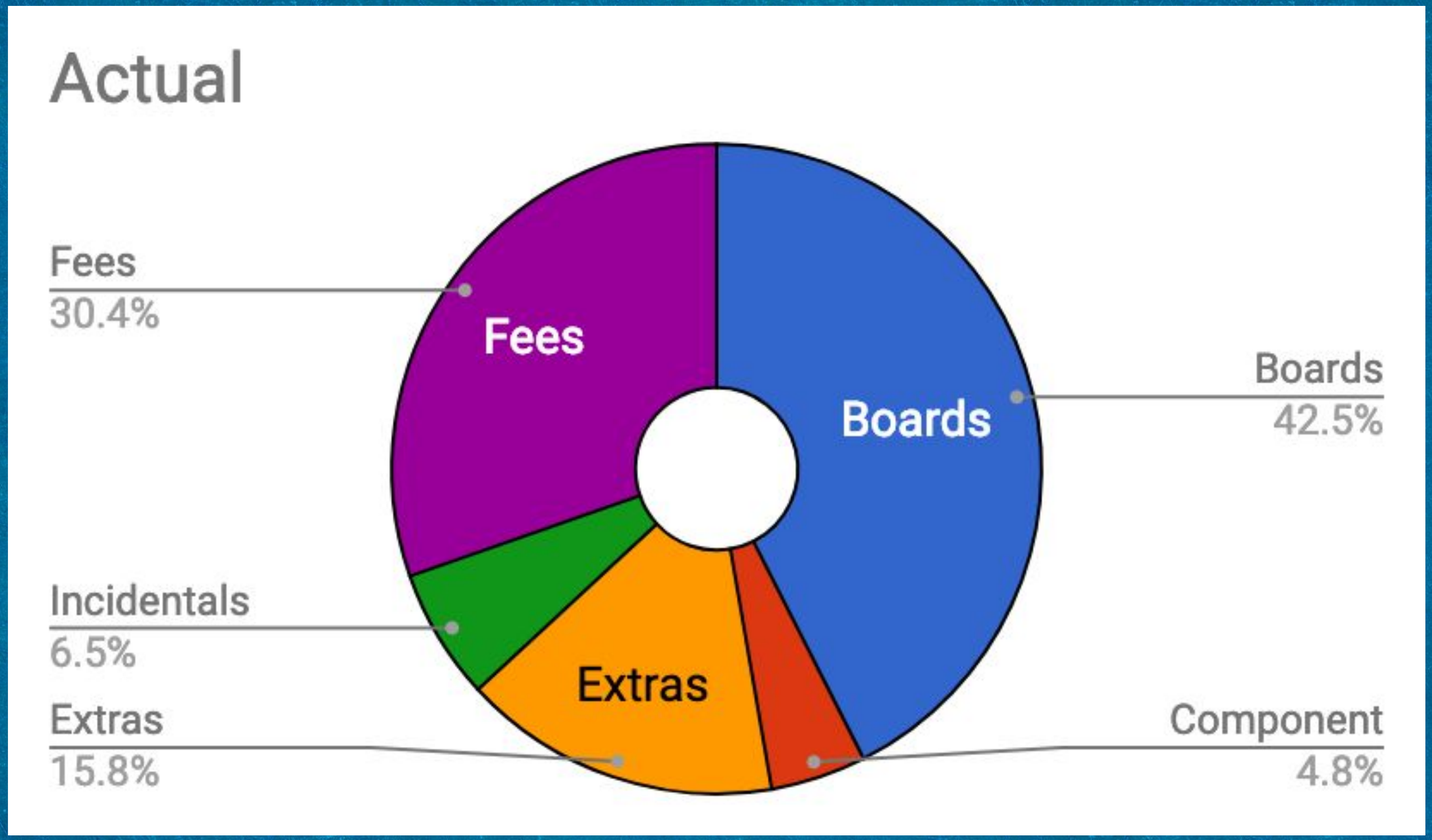
Kickstarter
- 6% fee
- Know how many to order
- Timeframe

Yourself
- No fees
- Handle money
- It is a job



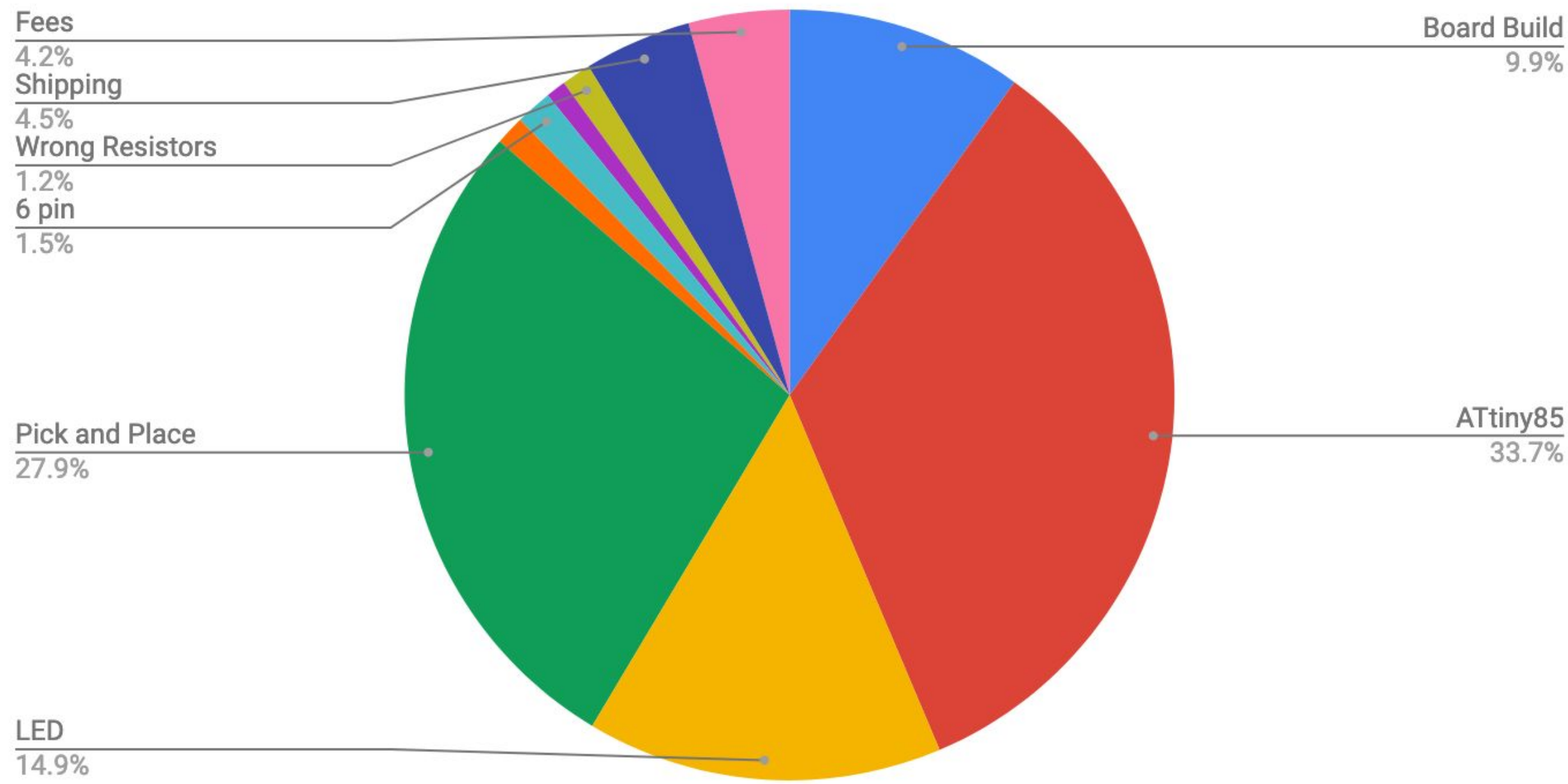
Costs and Funding Strategies

DC713 Snek Badge Costs



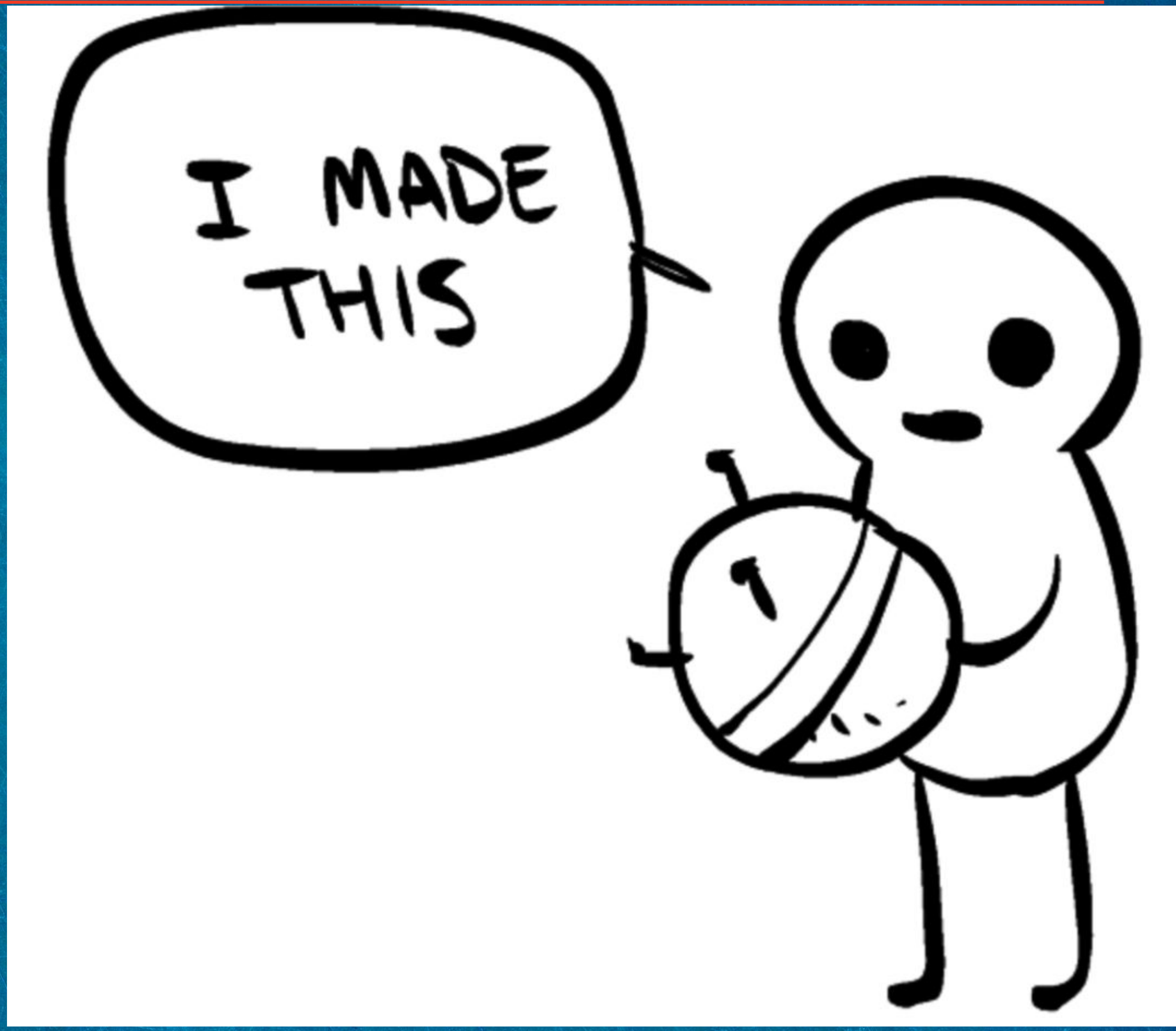
Costs and Funding Strategies

Corn Badge Costs



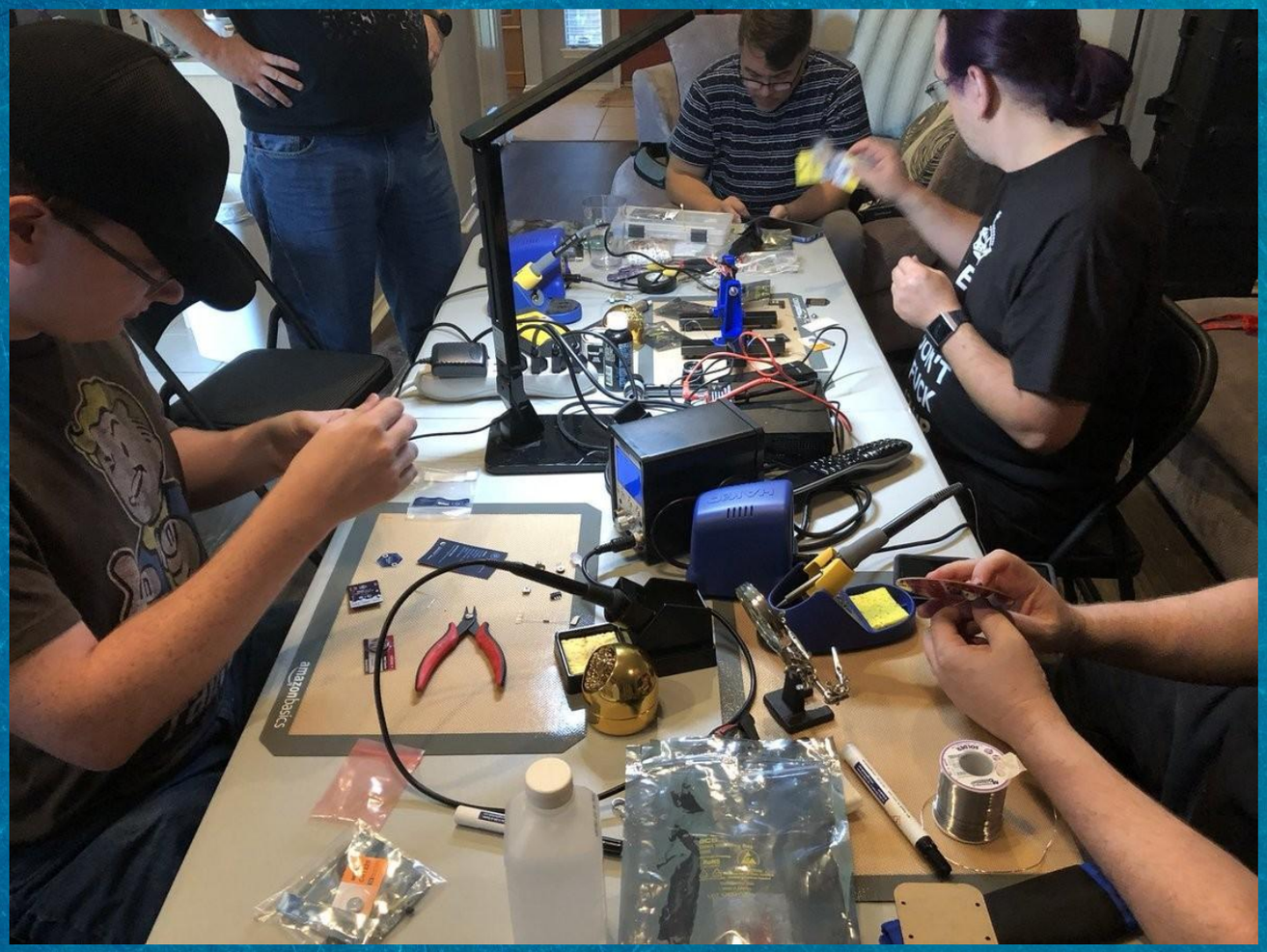
Should I still do this?

Yes!



Should I still do this?

DC 713 & Family



Questions?

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