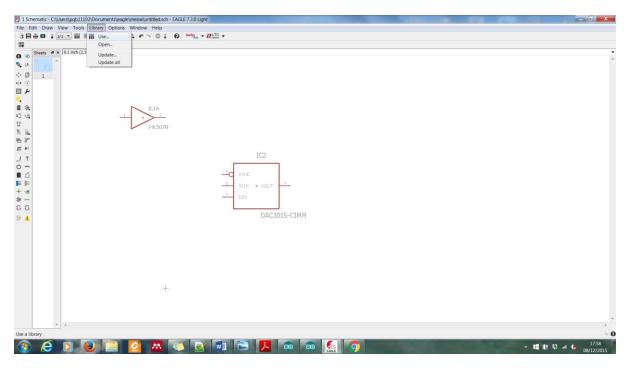
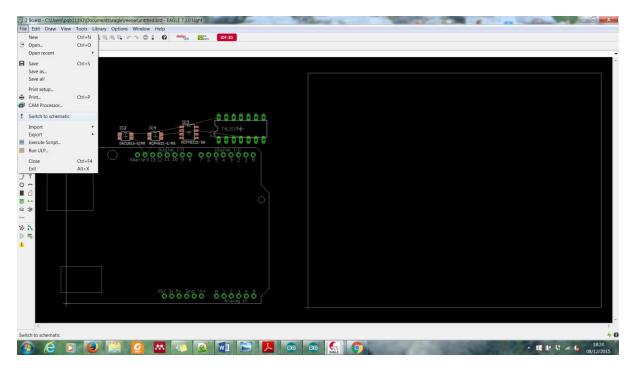
Making the schematic + board in Eagle

Following this tutorial on how to make a shield for Arduino in Eagle - <u>http://www.open-</u><u>electronics.org/how-to-make-an-arduino-shield-with-eagle-cad-tutorial/</u>

- 1. Open eagle
- 2. New schematic
- 3. Add library that includes Microchip DAC that I bought. (<u>http://www.diymodules.org/eagle-show-library?type=usr&id=1012211260</u>). A lot of googling and figuring out the user of the word 'footprint' helps for the search.
- 4. Libraries in eagle. Download Library for arudino https://github.com/adafruit/Adafruit-Eagle-Library



Adding in librarys to use shown above.



Switching between board and schematic view.

"If you want the connection points shown in the schematic, then ADD a Hole component (with an assigned PAD). See holes.lbr for examples. The Package can consist of just a Round PAD with a typical Drill size 0.033" and Diameter 0.063" for AWG 22 wire"

[http://www.element14.com/community/thread/19357/l/how-to-add-connection-points-for-soldered-wires?displayFullThread=true]

lame	Description	•		
MOUNT-HOLE2.8	2,8			
MOUNT-HOLE3.0	3,0			
MOUNT-HOLE3.2	3,2			>NAME
MOUNT-HOLE3.3	3,3			
MOUNT-HOLE3.6	3,6			
MOUNT-HOLE4.1	4,1			
MOUNT-HOLE4.3	4,3		>VALUE	
MOUNT-HOLE4.5	4,5			
MOUNT-HOLE5.0	5,0			. 2mm .
MOUNT-HOLE5.5	5,5			2mm 1 0.1in
trafo	Transformers		THROUGH-HOLE PAD	
PT04,5-1	TRANSFORMER		Package: 2,54/0,8	
PT04,5-2	TRANSFORMER		-	
wirepad	Single Pads		THROUGH-HOLE PAD	
1,6/0,8	THROUGH-HOLE PAD			
1,6/0,9	THROUGH-HOLE PAD			
2,15/1,0	THROUGH-HOLE PAD			
2,54/0,8	THROUGH-HOLE PAD			
2,54/0,9	THROUGH-HOLE PAD			
2,54/1,0	THROUGH-HOLE PAD			
2,54/1,1	THROUGH-HOLE PAD			
3,17/1,1	THROUGH-HOLE PAD		Attribute Value	
3,17/1,3	THROUGH-HOLE PAD			
3,81/1,1	THROUGH-HOLE PAD			
3,81/1,3	THROUGH-HOLE PAD			
3,81/1,4	THROUGH-HOLE PAD	=		
✓ Pads ✓ Smds ✓ Description		Preview		
arch Description		Preview		
ributes 🖸		•		
House my				

Pads for the wires to buttons & pot

Surface mounted resistors

ame	Description		
01_FAB_Hello			
RESISTOR			>NAME
RESISTOR1206	1206 Neil Gershenfeld's library	C¢1	
 DI_ng RESISTOR 	Nell Gershenleid S library		
 01_SparkFun RESISTOR 	SparkFun Electronics' preferred foot Resistor	p G\$1 	>VALUE
			2mm 1 0.1in
		Package: 1206	
		RESISTOR	
		chip	
		Attribute Value	
		Attribute Value	
✓ Pads ✓ Smds ✓ Description	V Prev		
arch S resistor1206	V Prev	▼	
ibutes 😰		•	

To replicate or copy parts of the schematic like the button circuit use the following:This can be done with the help of the commands GROUP, CUT, and PASTE.

Connecting to 5V.

select label option.



Label the end of the wire you want to connect to 5V.



Then Rename it 5V (shown below)

B1-5V —B1-5V	Name New name:
	OK Cancel

A pop up window will come up asking if you want to connect this to 5V. Say yes.

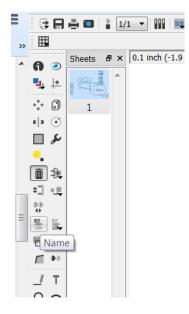
1	B1-5V	
r	Warning	-57
	Connect B1-5V and 5V?	
	Yes No	

Done.

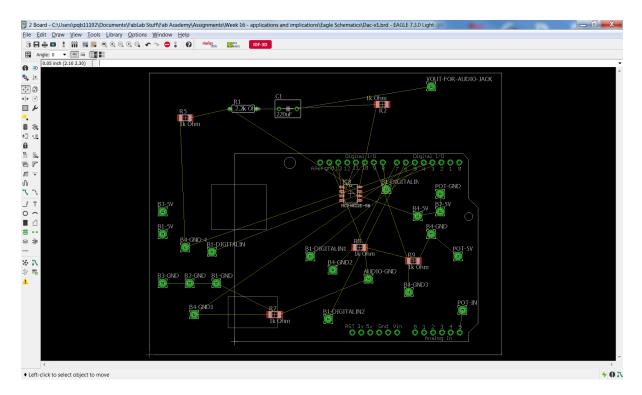
Add GND

ADD ADD		X
Name	Description	
	Description	
O1_FAB_Hello GND	SUPPLY SYMBOL	
▲ 01_ng	Neil Gershenfeld's library	
GND	Nell deisilemeid s library	
▲ 01_SparkFun	SparkFun Electronics' preferred foot p	
GND	SUPPLY SYMBOL	
JOYSTICK-PSP1000	This is a footprint for the PSP-1000 Jo	
▲ supply1	Supply Symbols	>VALUE
GND	SUPPLY SYMBOL	
▲ supply2	Supply Symbols	
GND	SUPPLY SYMBOL	SUPPLY SYMBOL
		Attribute Value
		Attribute value
Pads Smds Description	V Preview	
Search 😰 gnd	•	
Attributes 💌	▼	
		OK Cancel

Re-naming

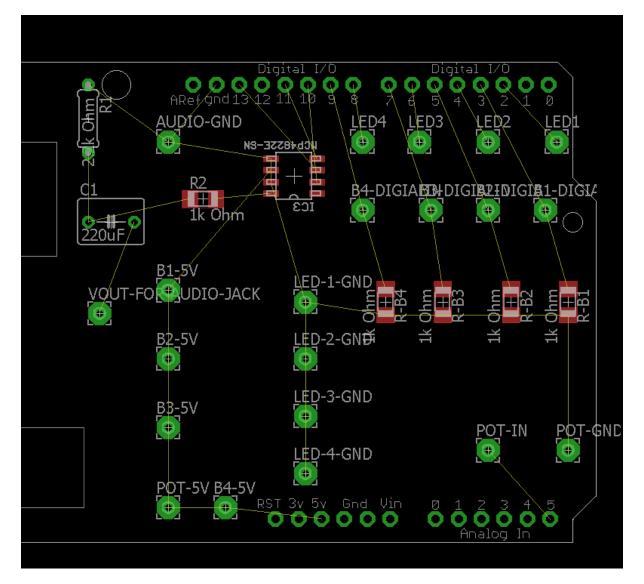


Stopped at this point 10:03 9th Dec 2015. Some pieces not joined up and others I'm not sure why they are joined up.



When you get to this stage. Type in 'rats' this tries to sort out the mess of where and create airlines between the components based on the layout of the board you have at that moment in time. Every time you move a component you almost need to use the rats command again to reset the connections.

Before Auto routing



Try and lay out all the pieces so all the 5V are near each other and GND are near each other etc. .

Next thing to do is autorouting



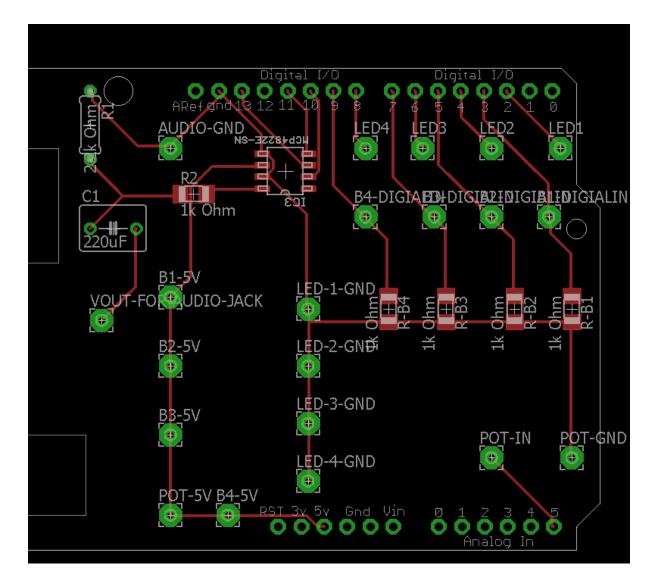
Set the following settings shown below. We don't want anything on the bottom so enter N/A. Then press continue. Then press start.

Autorouter Main Setu	p 📃 📉
Preferred Directions	The Autorouter is routing the board with different sets of parameters depending on the Effort setting, if Routing Grid or Preferred Directions are set to Auto. Multiple-core
1 Top Auto 🔻	processors are supported.
16 Bottom N/A 🔻	Auto grid selection Variant with TopRouter Maximum number of running threads
	Load Save as
	Continue Select Cancel

It'll generate a number of options. So select the one you're most happy with and select evaluate.

toutii 1 co	-	Optimize12	: 100.0%	6 Vias: 0	(TopRc	
2 co	mpleted	Optimize4:	100.0%	Vias: 0		
3 co	mpleted	Optimize4:	100.0%	Vias: 0		Ξ
4 co	mpleted	Optimize4:	100.0%	Vias: 0		-
5 co	mpleted	Optimize4:	100.0%	Vias: 0		
6 co	mpleted	Optimize4:	100.0%	Vias: 0		
7 со	mpleted	Optimize4:	100.0%	Vias: 0		
8 co	mpleted	Optimize4:	100.0%	Vias: 0		Ŧ
•		111			•	

You can see here below that there are no traces trying to run over each other which is great. If there were I would have used a 0 Ohm resistor to jump over a trace.



Next you'll need to check both the 'electric rules check' (erc) and 'design rules check' (drc).

Erc shows a mixture of errors and warnings.

Board and schematic are consistent Frrors (6) No SUPPLY for POWER pin U\$1 3V No SUPPLY for POWER pin U\$1 5V No SUPPLY for POWER pin U\$1 GND1 No SUPPLY for POWER pin U\$1 GND2 No SUPPLY for POWER pin U\$1 VIN No SUPPLY for implicit POWER pin IC3P VCC Varnings (26) Missing junction in net N\$11 Missing junction in net N\$5 Missing junction in net N\$5 Missing junction in net N\$6 Missing junction in net N\$9 Part AUDIO-GND has no value Part B1-5V has no value Part B2-5V has no value Part B2-5V has no value Part B3-5V has no value Part B3-DIGIALIN has no value Part B3-DIGIALIN has no value Part B4-DIGIALIN has no value			
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 No SUPPLY for POWER pin U\$1 5V No SUPPLY for POWER pin U\$1 GND1 No SUPPLY for POWER pin U\$1 GND2 No SUPPLY for POWER pin U\$1 VIN No SUPPLY for implicit POWER pin IC3P VCC Warnings (26) Missing junction in net N\$11 Missing junction in net N\$13 Missing junction in net N\$5 Missing junction in net N\$6 Missing junction in net N\$9 Part AUDIO-GND has no value Part B1-5V has no value Part B2-DIGIALIN has no value Part B3-5V has no value Part B4-5V has no value 	1 1 1 1 1 1 1 1 1 1 1 1 1 1		
 No SUPPLY for POWER pin U\$1 GND1 No SUPPLY for POWER pin U\$1 GND2 No SUPPLY for POWER pin U\$1 VIN No SUPPLY for implicit POWER pin IC3P VCC Warnings (26) Missing junction in net N\$11 Missing junction in net N\$13 Missing junction in net N\$5 Missing junction in net N\$5 Missing junction in net N\$9 Part AUDIO-GND has no value Part B1-5V has no value Part B2-5V has no value Part B2-DIGIALIN has no value Part B3-5V has no value Part B3-DIGIALIN has no value Part B4-5V has no value Part B4-DIGIALIN has no value Part B4-DIGIALIN has no value 	1 1 1 1 1 1 1 1 1 1 1 1 1 1		
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 No SUPPLY for POWER pin U\$1 VIN No SUPPLY for implicit POWER pin IC3P VCC Warnings (26) Missing junction in net N\$11 Missing junction in net N\$13 Missing junction in net N\$5 Missing junction in net N\$6 Missing junction in net N\$9 Part AUDIO-GND has no value Part B1-5V has no value Part B1-DIGIALIN has no value Part B2-5V has no value Part B3-5V has no value Part B4-5V has no value Part B4-5V has no value 	1 1 1 1 1 1 1 1 1 1 1 1 1 1		
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 Missing junction in net N\$6 Missing junction in net N\$9 Part AUDIO-GND has no value Part B1-5V has no value Part B1-DIGIALIN has no value Part B2-5V has no value Part B2-DIGIALIN has no value Part B3-5V has no value Part B3-DIGIALIN has no value Part B3-DIGIALIN has no value Part B4-DIGIALIN has no value Part B4-DIGIALIN has no value 	1 1 1 1 1 1 1 1 1 1 1 1 1		
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 Part B2-DIGIALIN has no value Part B3-5V has no value Part B3-DIGIALIN has no value Part B4-5V has no value Part B4-DIGIALIN has no value 	1 1 1 1		
 Part B3-5V has no value Part B3-DIGIALIN has no value Part B4-5V has no value Part B4-DIGIALIN has no value 	1 1 1		
 Part B3-DIGIALIN has no value Part B4-5V has no value Part B4-DIGIALIN has no value 	1		
Part B4-5V has no value Part B4-DIGIALIN has no value	1		
A Part B4-DIGIALIN has no value	-		
	1		
🔥 Part LED-1-GND has no value			
	1		
🛕 Part LED-2-GND has no value	1		
🛕 Part LED-3-GND has no value	1		
🛕 Part LED-4-GND has no value	1		
🔔 Part LED1 has no value	1		
🚹 Part LED2 has no value 1			
🛕 Part LED3 has no value	1 –		
🔔 Part LED4 has no value	1		
🔔 Part POT-5V has no value	1		
A Part POT-GND has no value	1		
Centered	Clear all		

2	Board	d - C:\Use	rs\pqb1	.1192\D	ocume
File	Edit	Draw	View	Tools	Libra
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: :	~	Redo		Ctr	l+γ
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		Descript	ion		

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IVIIGIIL WAI			Setting arter	III SU IIIIIIIIII III	I LIE LIALES	

🖻 Design Rules (default)		ĸ	1						
File Layers Clearance	Distance Sizes	Restring	Shapes	Supply	Masks	Misc			
Minimum Width 10mil									
Minimum Drill 24mil									
	Min. Micro Via 9.99mm								
Min. Blind Via Ratio 0.5									
Minimum Sizes of objects in signal	Minimum Sizes of objects in signal layers and of drill holes.								
Minimum Width and Minimum Dri	Minimum Width and Minimum Drill may be overwritten by larger values in the <i>Net classes</i> for specific signals.								
Min. Micro Via applies to <i>blind</i> vias that are exactly one layer deep. Typical values are in the range 50100 micron. The value has to be smaller than Minimum Drill; otherwise (e.g. with the default value of 9.99mm) there are no micro vias defined.									
Min. Blind Via Ratio defines the minimum drill diameter d a blind via must have if it goes through a layer of thickness t . Board manufacturers usually give this "aspect ratio" in the form 1:0.5, where 0.5 would be the value that has to be entered here.									
					OK	Cancel Apply			

rs\pqb11192\Documents\FabLab S

Vie	w Tools	Library	Options					
▦	Grid							
•	Layer settings							
+	Mark							
٢	Show							
ล	Info							
0	Redraw		F2					
	Zoom to fi	t i	Alt+F2					
÷,	Zoom in		F3					
$\Theta_{\mathbf{a}}$	Zoom out		F4					
0	Zoom sele	ct						

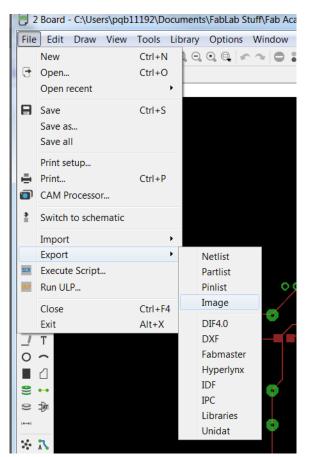
We'll be using 2 different tool bits for milling out the PCB. One for creating the traces and another tool bit for drilling the through holes and holes for the pads. So we'll have to export 2 different pngs. The first with only the traces, pads and Vias. A second png with only the 'Holes' and 'Drills'.

ayers:				
Nr	Name			
1	Тор			
16	Bottom			
17	Pads			
18	Vias			
19	Unrouted			
20 🔳	Dimension			
21	tPlace			
22	bPlace			
23	tOrigins			
24	bOrigins			=
25	tNames			
26	bNames			
27	tValues			
28				
29 💋				
30				
31 💋				
32				
33 🗾				
34				
35 🜌				
37	tTest			
38	bTest			
39				
40				
41	tRestrict			
42				
43				
44				
45	Holes			
46	Milling			
47				-
		New	Change	Del
			All	None
		ОК	Cancel	Apply

Then we need to export 2 images for milling the (1) the traces and (2) the holes. Select from the File> Export> Image>

Shown below with the settings shown on the right. 500 dpi and monochrome as a png. These settings are from the following

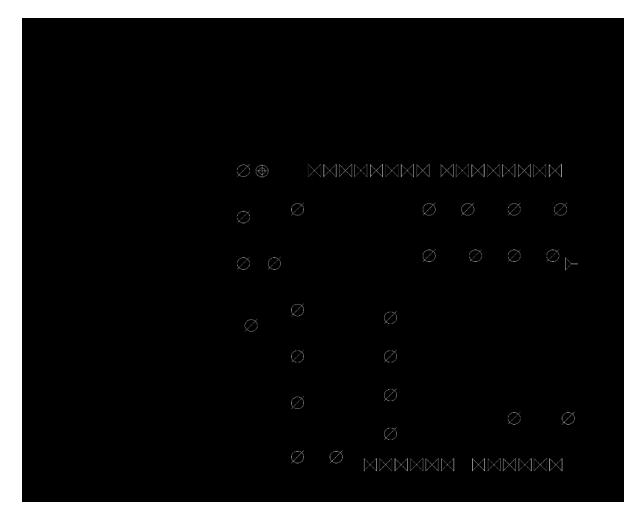
Tutorial from week 6 'Electronics Design'



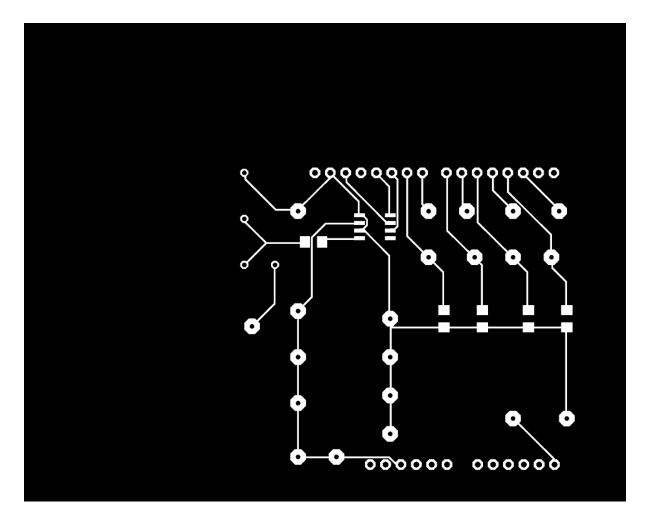
Export Image						
File	natics/DAC-Traces.png	Browse				
	Clipboard	Monochrome				
Resolution	500	dpi				
Image Size	1969 x 1575	pixel				
Area	Full					
	ОК	Cancel				

Our end images are shown below:

Or you can download from here

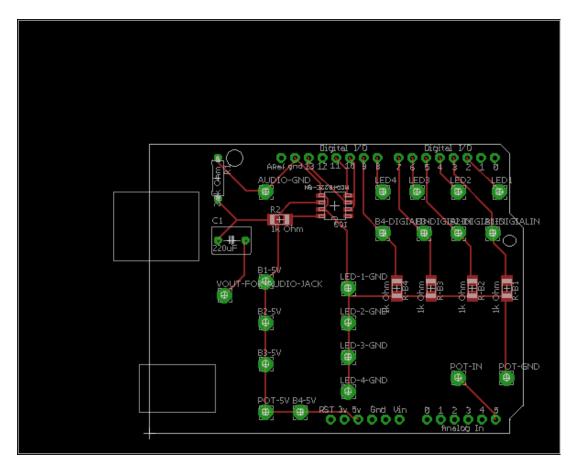


images/DAC-drill.png



DAC-Traces.png

I've also exported an image will all layers showing so I can use this as a guide for stuffing the board so I can reference where the components should be located.



DAC.png

The next step is to crop the image to be the size of the board you want. I did this in illustrator.

So now I have my images to mill out the circuit the next step is to mill it out on the milling machine.