CNC Workshop (Basic)

Nottingham Hackspace

What does it do?

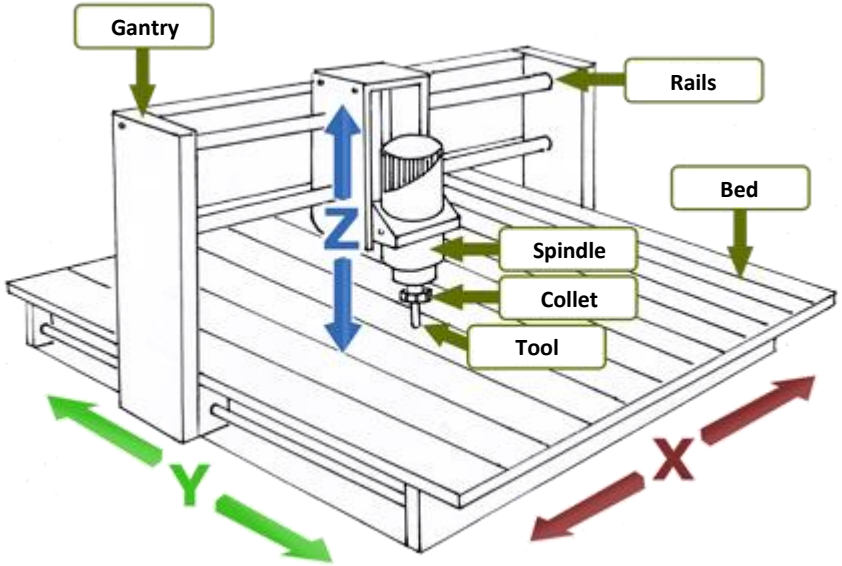
- The CNC machine is used for cutting things!
- On our small CNC mill we can cut:
  - Wood and Plastics
  - Metals with Extreme Caution

How does it work?

- The machine can move in 3 Directions
- Up – Down, Left – Right, Forwards – Backwards

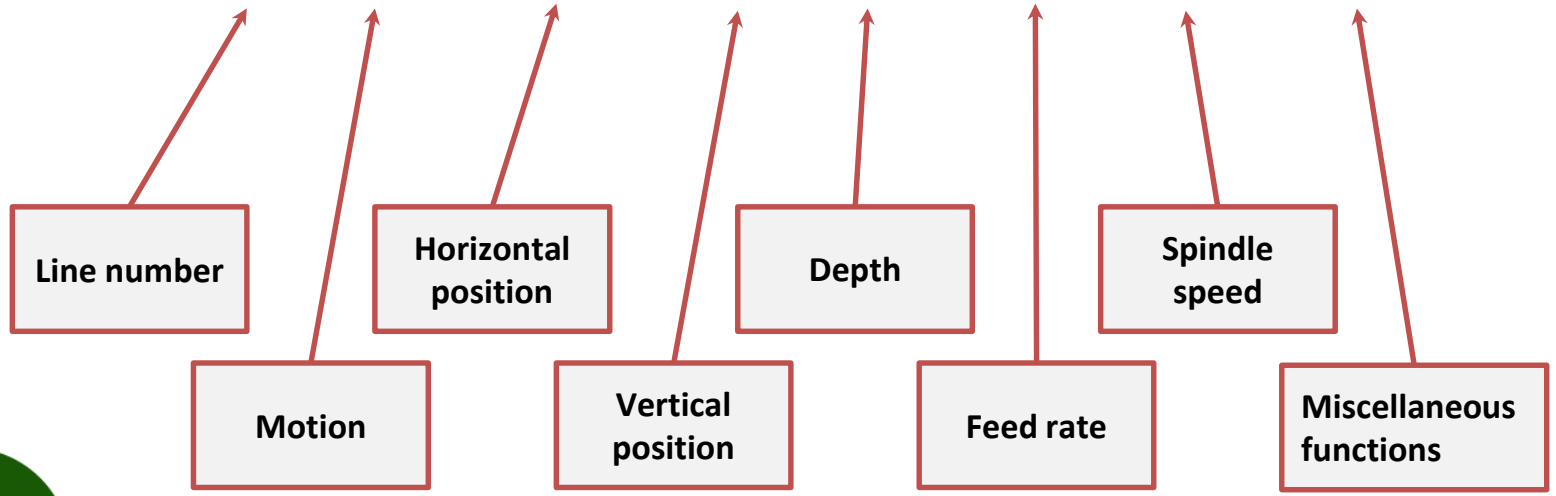
- Numbers are used to control these motions

The CNC Machine



G-Code

N## G## X## Y## Z## F## S## M##

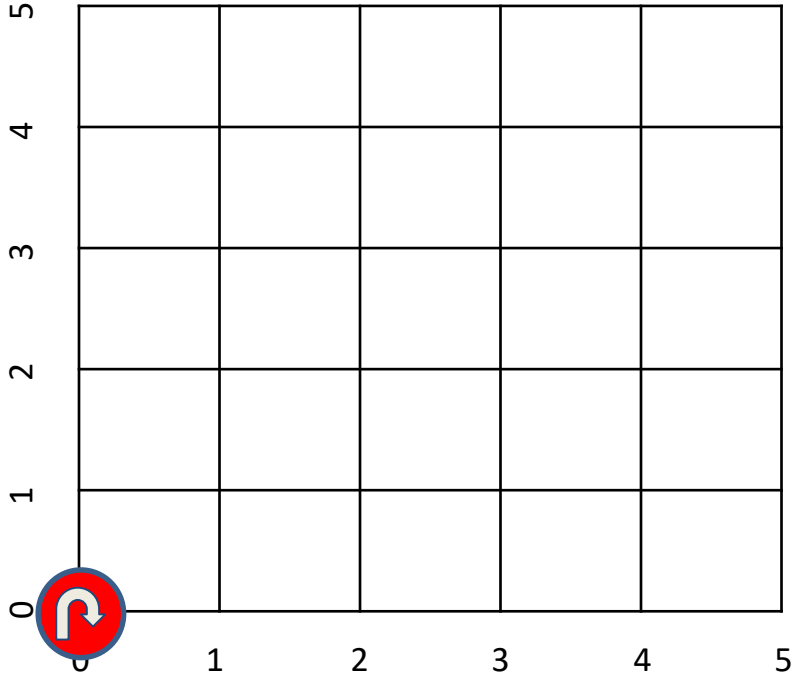


Important G-Codes

N0100	Line Number
G00	Move Quickly (Rapid)
G01	Move Slowly (Accurate Cut)
M03 S17000	Start Spindle with Speed 17000 RPM
M30	End Program

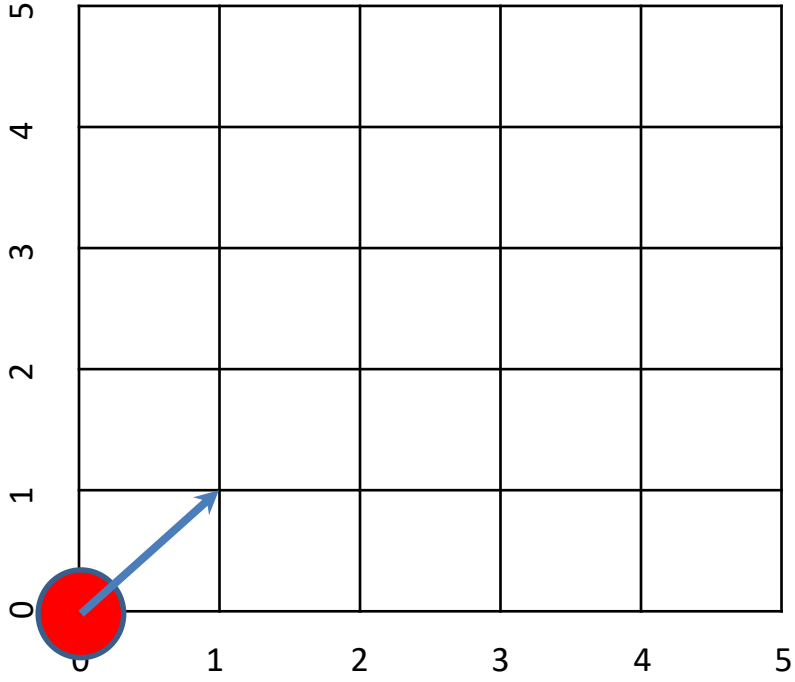
G-Code Example

- N0100 M03 S17000
- N0200 G01 X1 Y1
- N0300 G01 X4 Y1
- N0400 G01 X4 Y4
- N0500 G00 X1 Y1
- N0600 M30



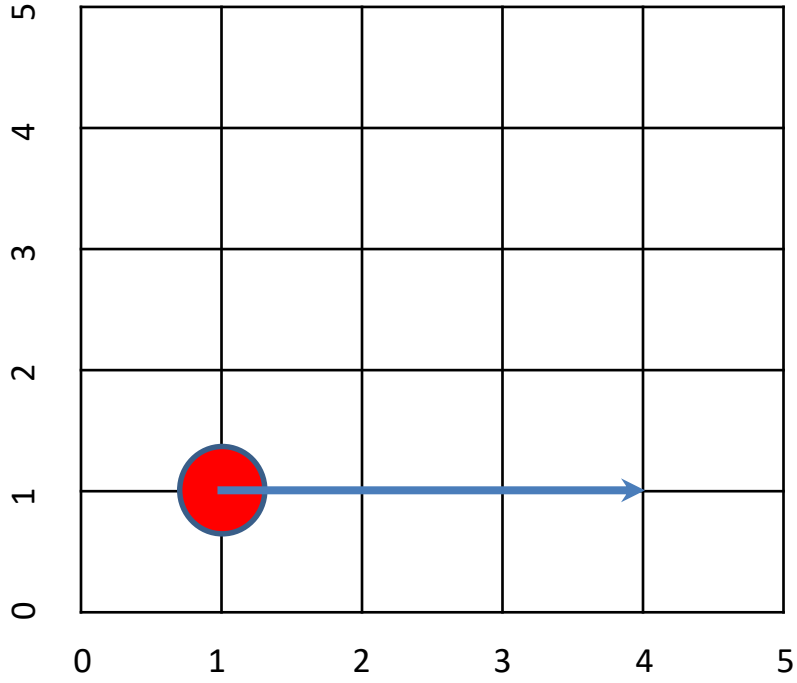
G-Code Example

- N0100 M03 S17000
- N0200 G01 X1 Y1
- N0300 G01 X4 Y1
- N0400 G01 X4 Y4
- N0500 G00 X1 Y1
- N0600 M30



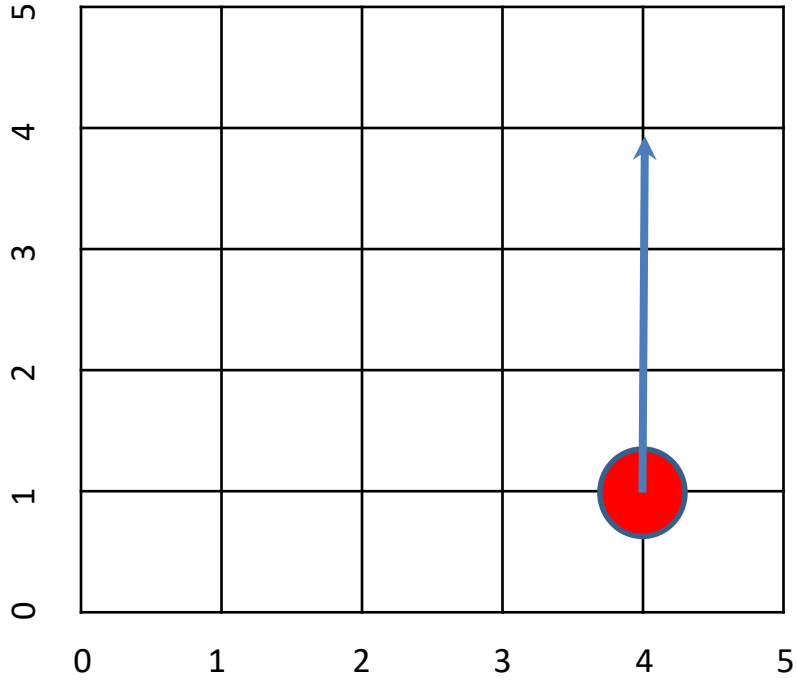
G-Code Example

- N0100 M03 S17000
- N0200 G01 X1 Y1
- N0300 G01 X4 Y1
- N0400 G01 X4 Y4
- N0500 G00 X1 Y1
- N0600 M30



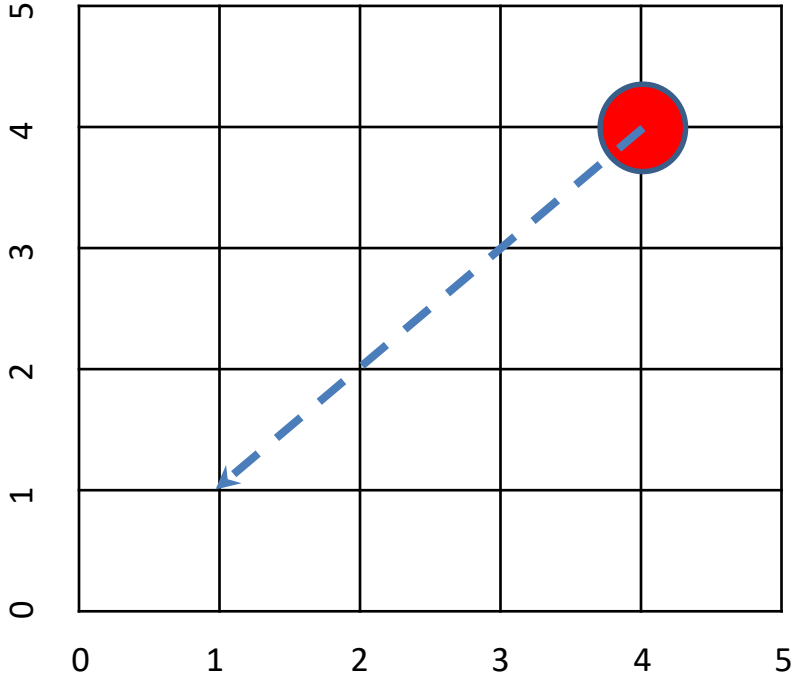
G-Code Example

- N0100 M03 S17000
- N0200 G01 X1 Y1
- N0300 G01 X4 Y1
- N0400 G01 X4 Y4
- N0500 G00 X1 Y1
- N0600 M30



G-Code Example

- N0100 M03 S17000
- N0200 G01 X1 Y1
- N0300 G01 X4 Y1
- N0400 G01 X4 Y4
- N0500 G00 X1 Y1
- N0600 M30



G-Code Example

- N0100 M03 S17000
- N0200 G01 X1 Y1
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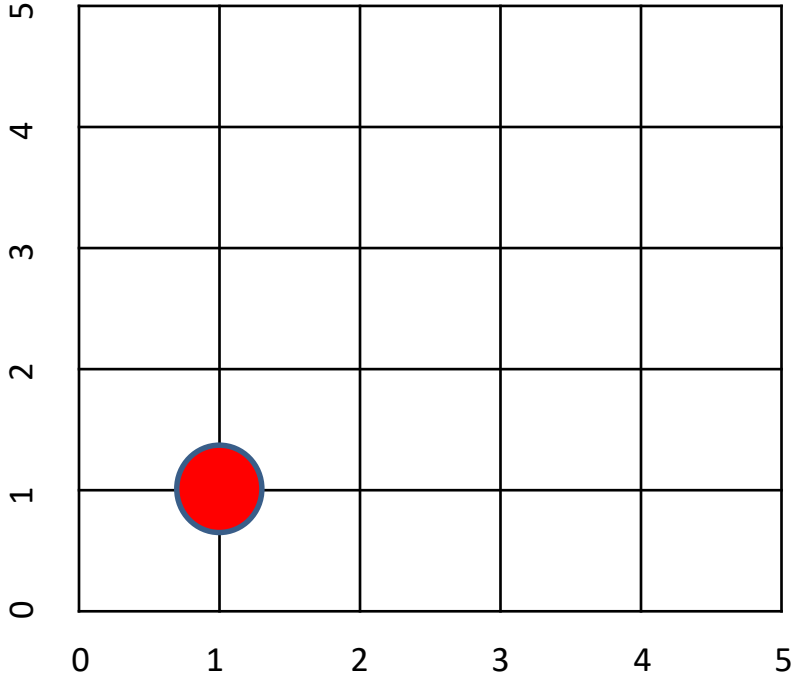
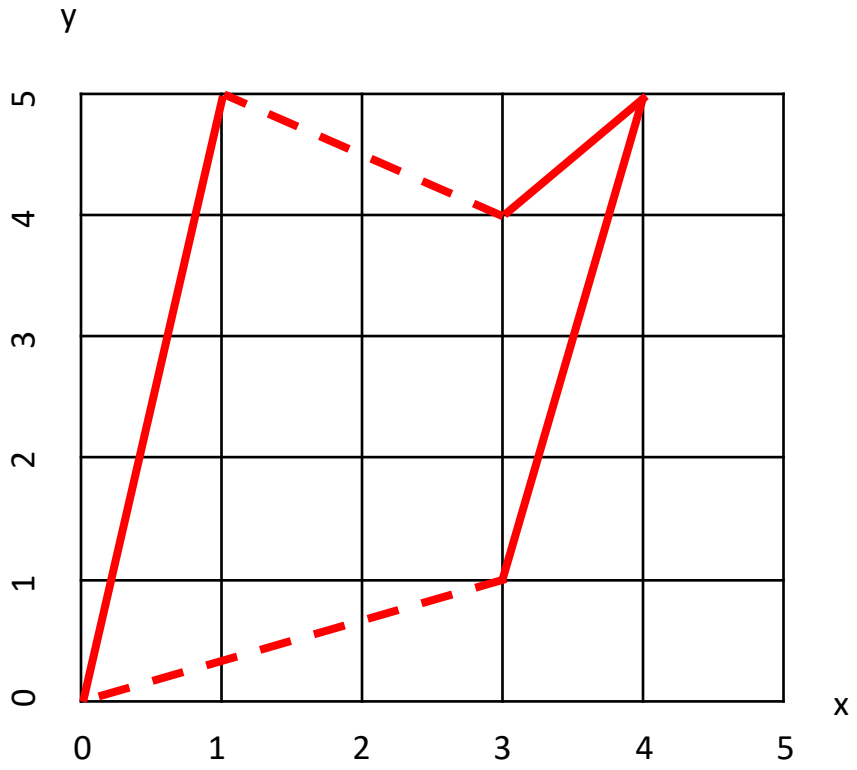


Activity 1 – Writing G-Code

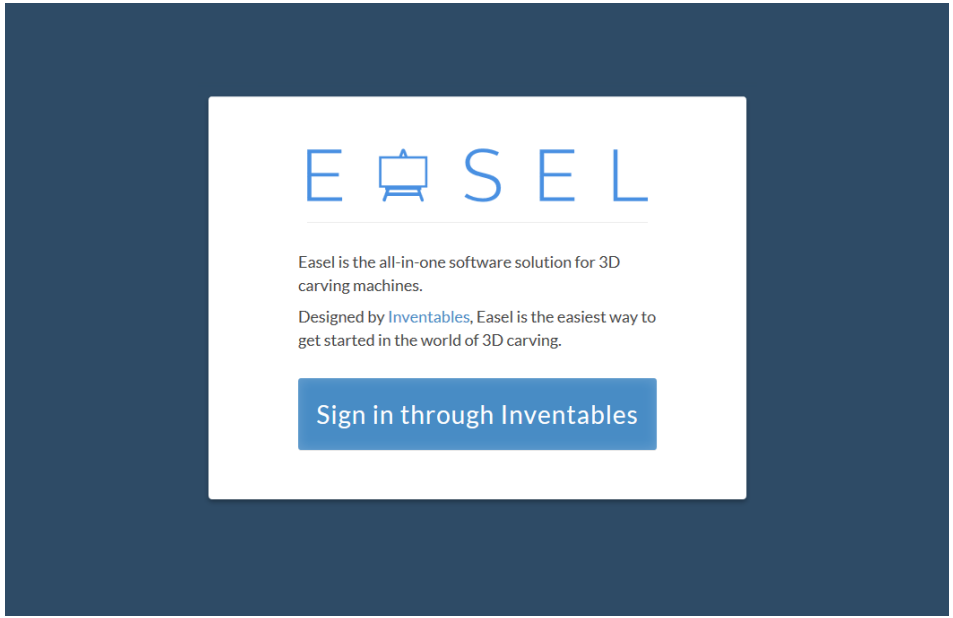
- Write G-Code to produce the shapes shown on the worksheet.



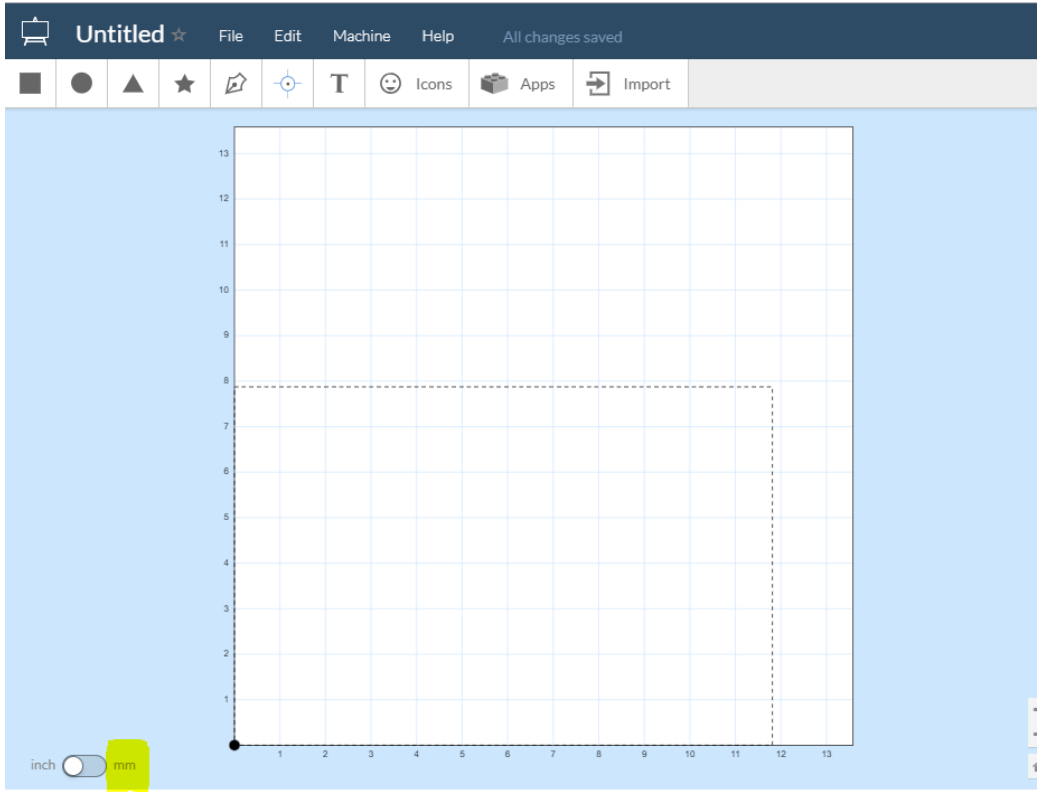
NOTE: Remember to turn the spindle on & end the program!

Activity 2 - Generating G-Code

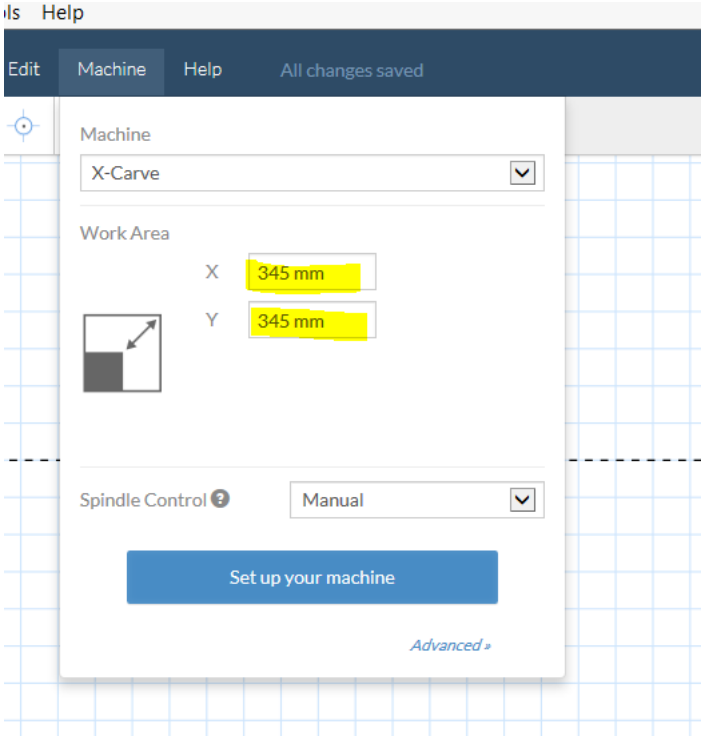
- Go to: http://easel.inventables.com
- Make an Account



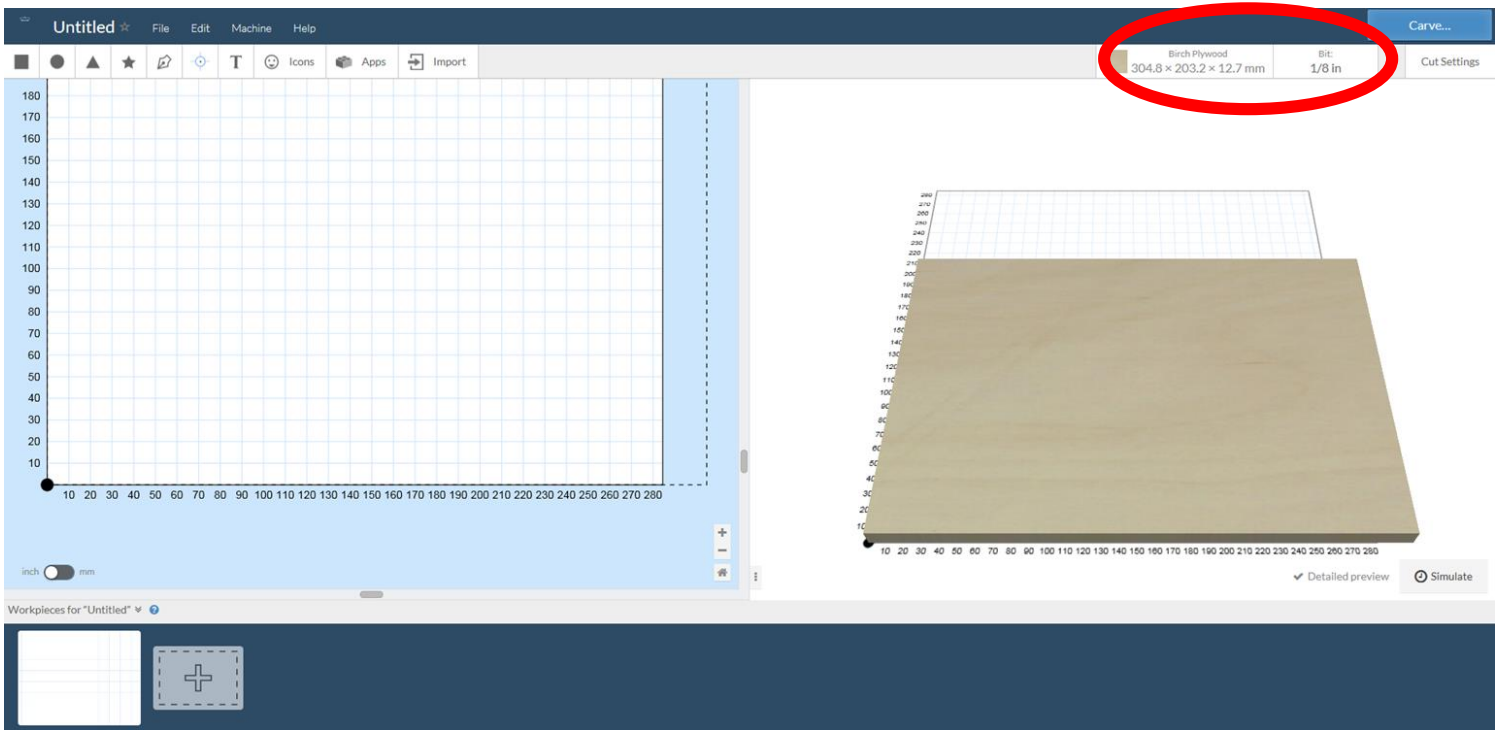
Select Units



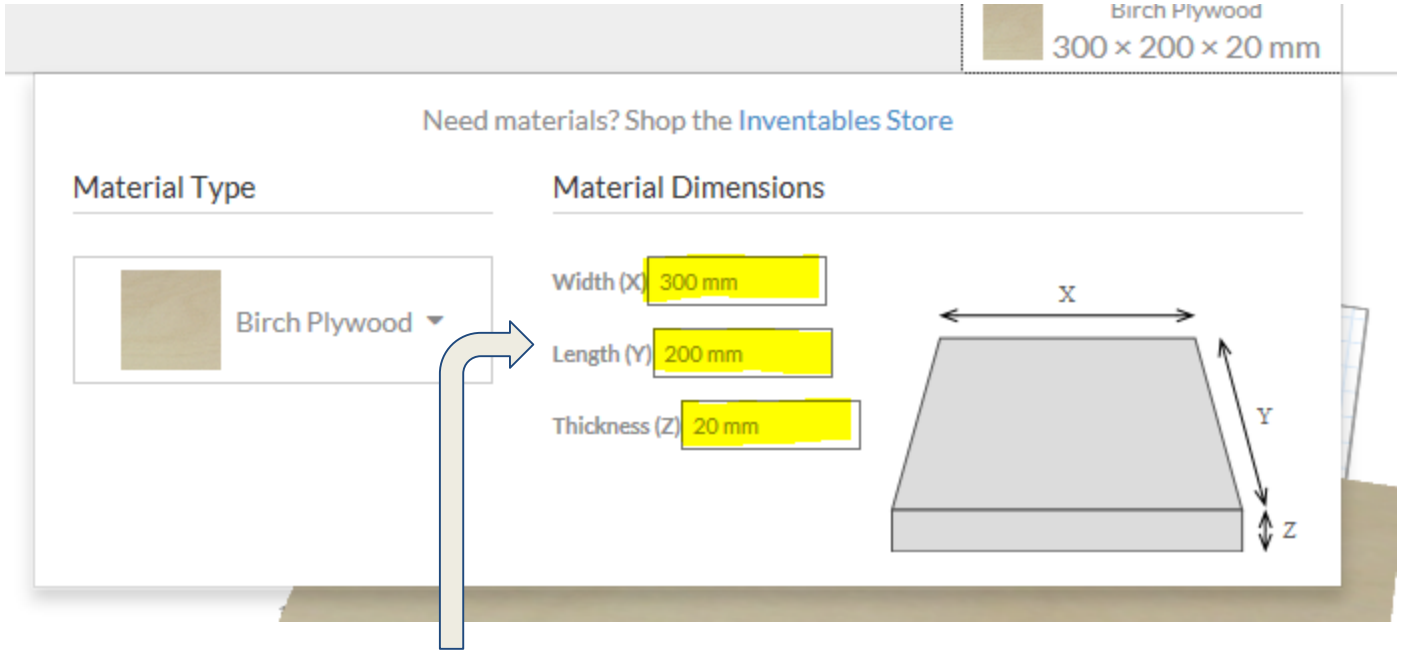
Setup Machine



Setup your Material

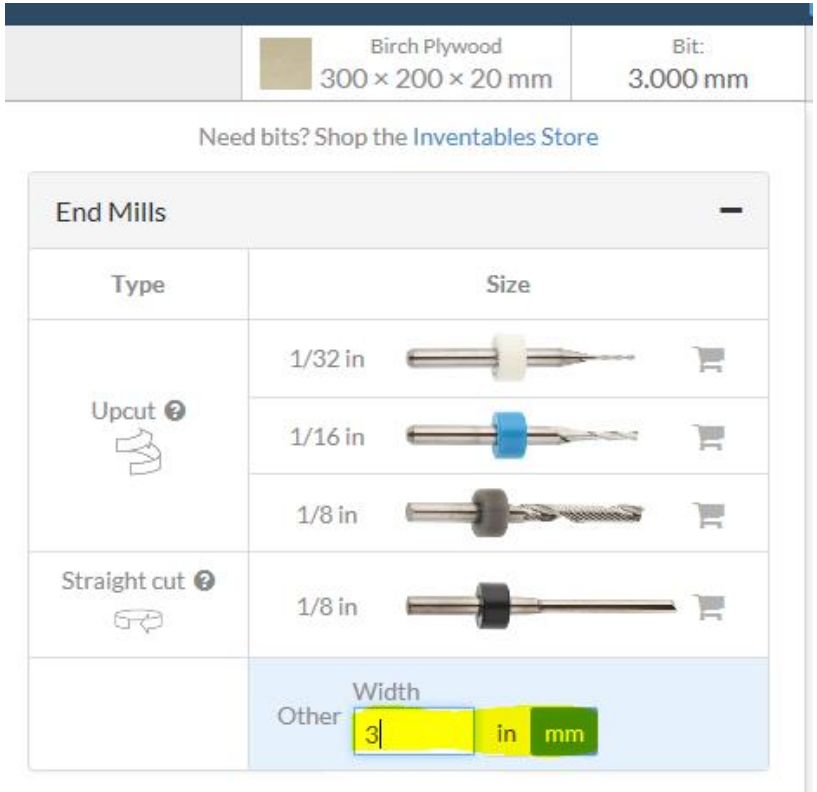


Setup your Material



Measure your chopping board now!

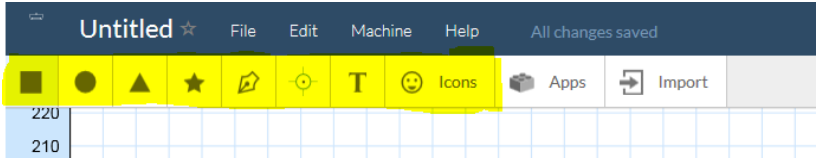
Setup your cutting tool

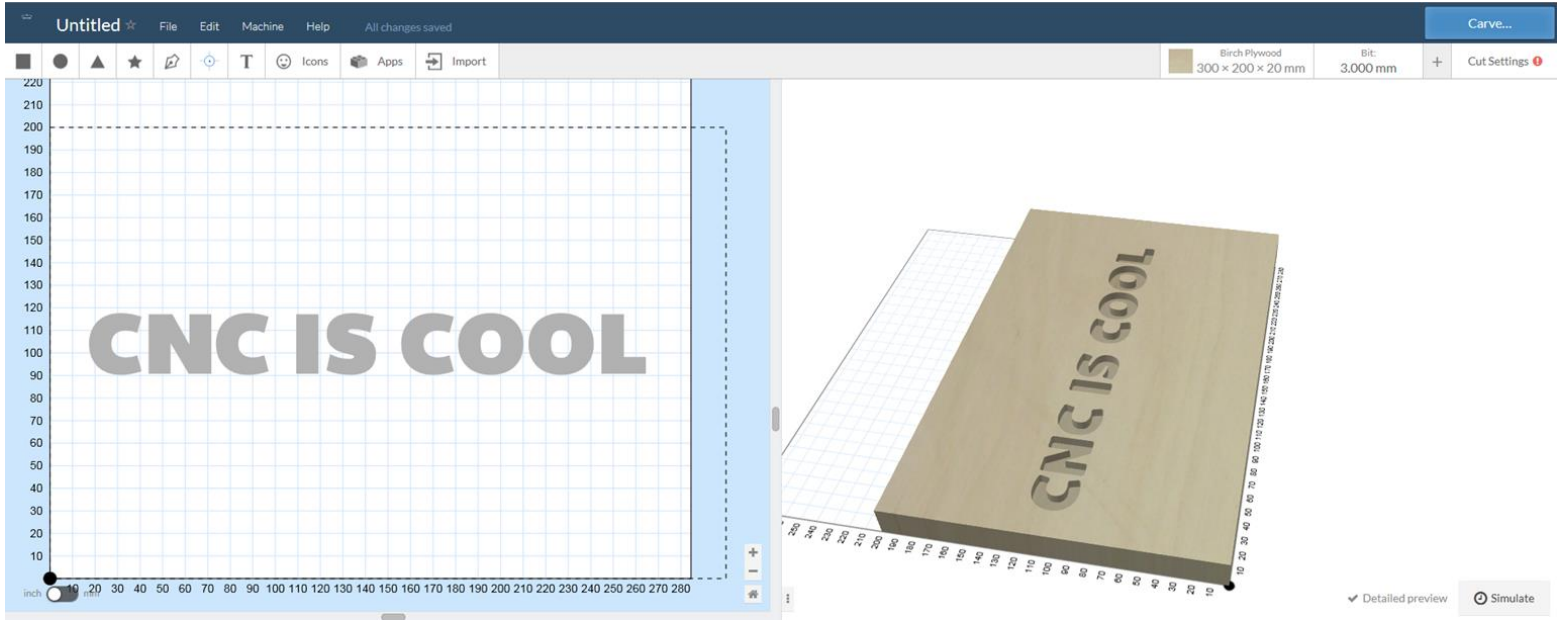


Measure your tool now!

Draw your path

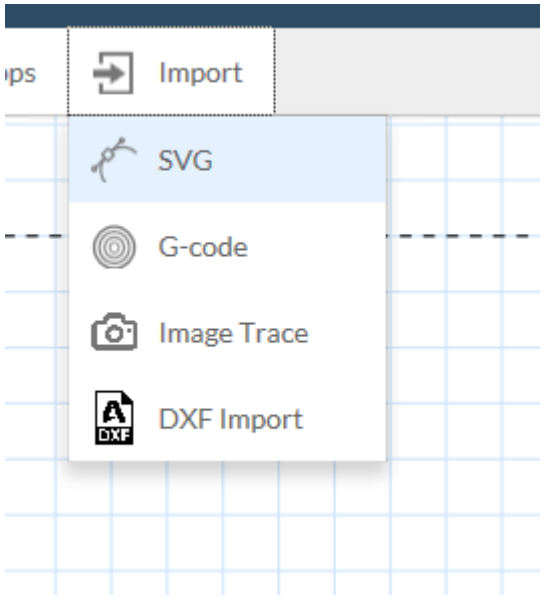
Use these tools



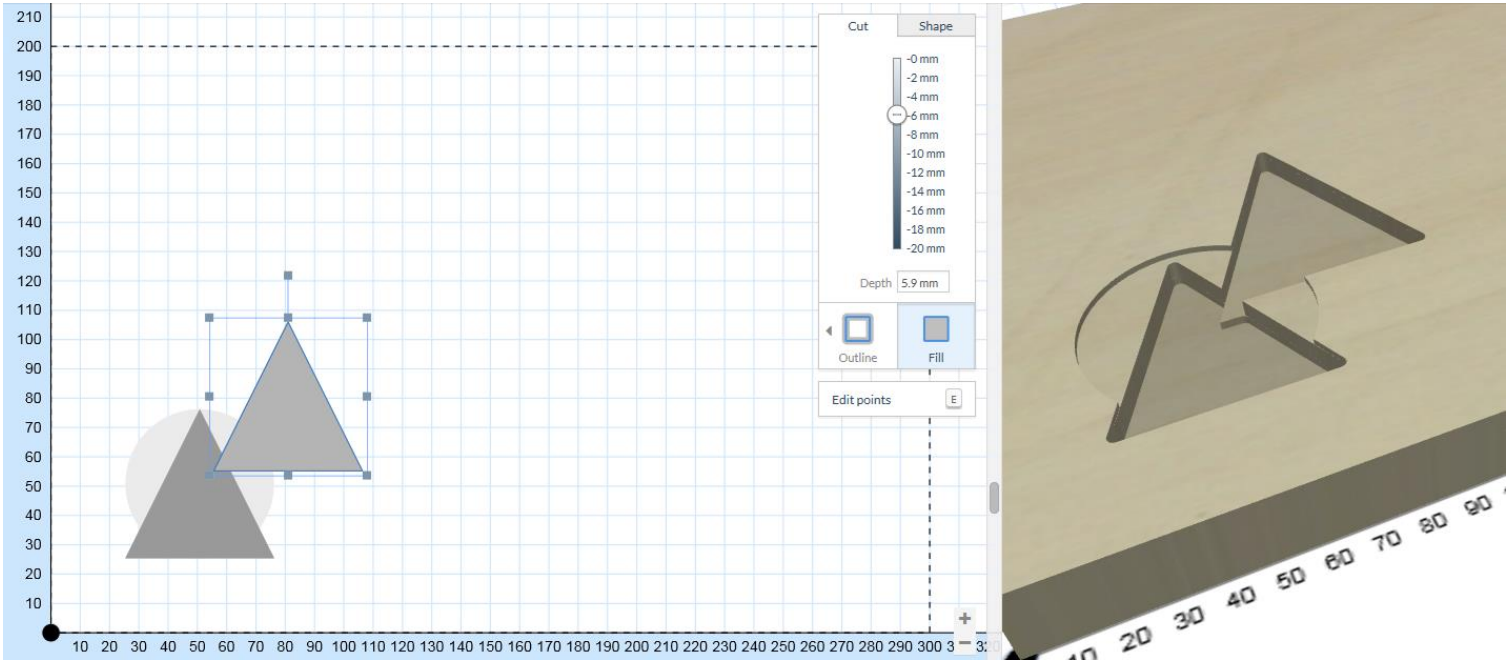


Trace Image and Import DXF or SVG

- Shapes/ drawings can be imported in the same way as for the Laser Cutter using the “Import” Menu

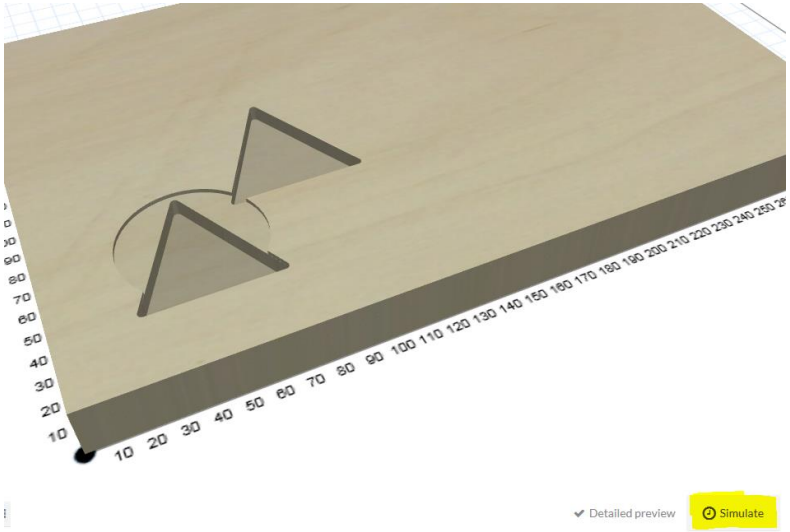


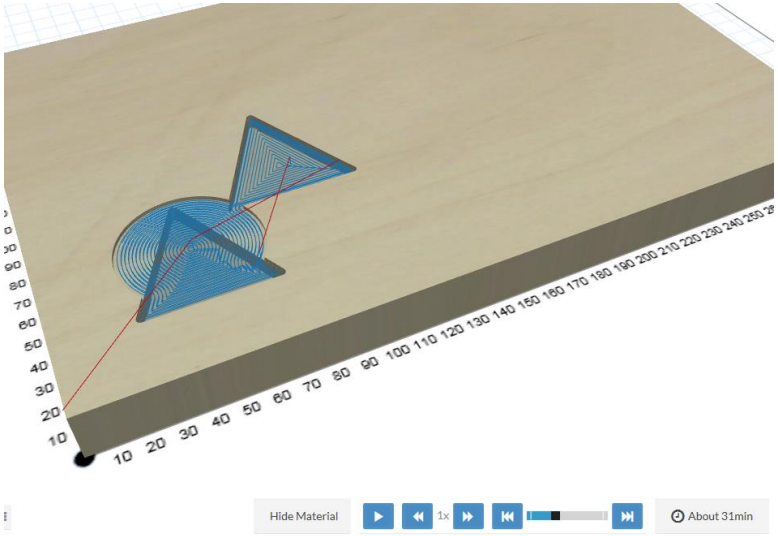
Set the Depth of Cut



NOTE: It's important to remember how long the flutes on your tool are!

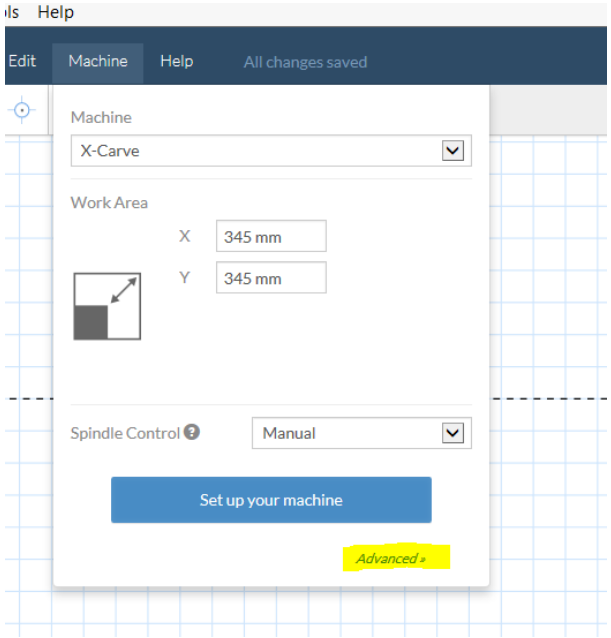
Simulate

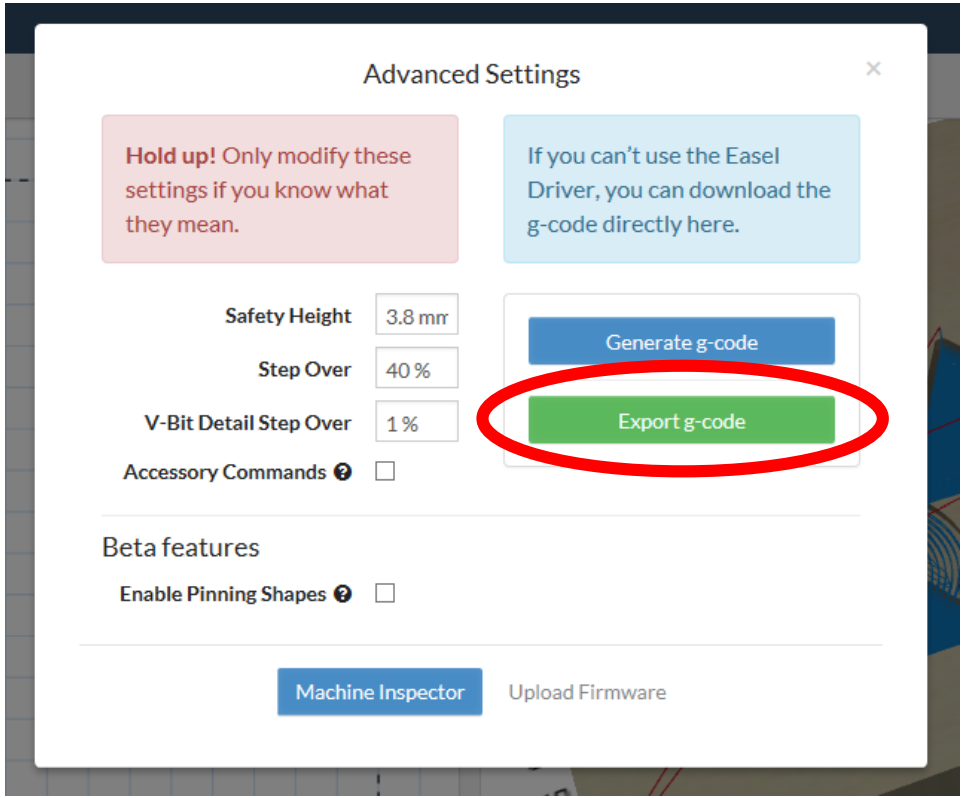




NOTE: For this workshop, make sure the estimated time is around 15 mins.

Export G-Code





Raw G-Code

```
G21G90G1 Z3.810 F228.6G0 X51.560 Y49.930G1 Z-0.700 F228.6G1 X51.776 Y50.455 F762.0G1 X51.816 Y50.881 F762.0G1
X51.640 Y51.410 F762.0G1 X51.275 Y51.707 F762.0G1 X50.773 Y51.835 F762.0G1 X50.412 Y51.749 F762.0G1 X50.072 Y51.519
F762.0G1 X49.858 Y51.202 F762.0G1 X49.781 Y50.919 F762.0G1 X49.827 Y50.468 F762.0G1 X50.188 Y49.728 F762.0G1 X51.447
Y49.726 F762.0G1 X51.560 Y49.930 F762.0G1 X52.645 Y49.412 F762.0G1 X52.953 Y50.163 F762.0G1 X53.035 Y51.020 F762.0G1
X52.667 Y52.121 F762.0G1 X51.847 Y52.787 F762.0G1 X51.029 Y53.035 F762.0G1 X50.632 Y53.035 F762.0G1 X49.921 Y52.864
F762.0G1 X49.209 Y52.384 F762.0G1 X48.752 Y51.706 F762.0G1 X48.565 Y51.018 F762.0G1 X48.655 Y50.134 F762.0G1 X49.437
Y48.530 F762.0G1 X52.156 Y48.525 F762.0G1 X52.645 Y49.412 F762.0G1 X53.729 Y48.895 F762.0G1 X54.106 Y49.810 F762.0G1
X54.235 Y50.445 F762.0G1 X54.235 Y51.139 F762.0G1 X54.118 Y51.722 F762.0G1 X53.684 Y52.810 F762.0G1 X52.977 Y53.480
F762.0G1 X52.411 Y53.853 F762.0G1 X51.812 Y54.100 F762.0G1 X51.150 Y54.235 F762.0G1 X50.490 Y54.235 F762.0G1 X49.490
Y53.994 F762.0G1 X48.869 Y53.661 F762.0G1 X48.358 Y53.239 F762.0G1 X47.942 Y52.735 F762.0G1 X47.630 Y52.153 F762.0G1
X47.365 Y51.177 F762.0G1 X47.365 Y50.452 F762.0G1 X47.502 Y49.784 F762.0G1 X47.873 Y48.887 F762.0G1 X48.724 Y47.330
F762.0G1 X52.864 Y47.324 F762.0G1 X53.729 Y48.895 F762.0G1 X54.814 Y48.377 F762.0G1 X55.259 Y49.458 F762.0G1 X55.435
Y50.323 F762.0G1 X55.435 Y51.257 F762.0G1 X55.273 Y52.066 F762.0G1 X54.701 Y53.500 F762.0G1 X53.725 Y54.423 F762.0G1
X52.975 Y54.919 F762.0G1 X52.162 Y55.253 F762.0G1 X51.272 Y55.435 F762.0G1 X50.348 Y55.435 F762.0G1 X49.059 Y55.125
F762.0G1 X48.196 Y54.661 F762.0G1 X47.507 Y54.093 F762.0G1 X46.940 Y53.405 F762.0G1 X46.508 Y52.601 F762.0G1 X46.165
Y51.336 F762.0G1 X46.165 Y50.329 F762.0G1 X46.348 Y49.433 F762.0G1 X46.790 Y48.366 F762.0G1 X48.012 Y46.132 F762.0G1
X53.573 Y46.123 F762.0G1 X54.814 Y48.377 F762.0G1 X55.898 Y47.859 F762.0G1 X56.411 Y49.106 F762.0G1 X56.635 Y50.202
F762.0G1 X56.635 Y51.376 F762.0G1 X56.428 Y52.410 F762.0G1 X55.718 Y54.190 F762.0G1 X54.474 Y55.366 F762.0G1 X53.541
Y55.984 F762.0G1 X52.512 Y56.407 F762.0G1 X51.394 Y56.635 F762.0G1 X50.206 Y56.635 F762.0G1 X48.627 Y56.255 F762.0G1
X47.524 Y55.662 F762.0G1 X46.655 Y54.945 F762.0G1 X45.938 Y54.076 F762.0G1 X45.386 Y53.050 F762.0G1 X44.965 Y51.494
F762.0G1 X44.965 Y50.207 F762.0G1 X45.195 Y49.083 F762.0G1 X45.707 Y47.845 F762.0G1 X47.300 Y44.933 F762.0G1 X54.281
Y44.922 F762.0G1 X55.898 Y47.859 F762.0G1 X56.983 Y47.341 F762.0G1 X57.565 Y48.754 F762.0G1 X57.834 Y50.081 F762.0G1
X57.834 Y51.494 F762.0G1 X57.583 Y52.754 F762.0G1 X56.735 Y54.881 F762.0G1 X55.224 Y56.310 F762.0G1 X54.107 Y57.049
F762.0G1 X52.863 Y57.560 F762.0G1 X51.515 Y57.834 F762.0G1 X50.085 Y57.834 F762.0G1 X48.682 Y57.549 F762.0G1 X48.137
Y57.355 F762.0G1 X46.854 Y56.665 F762.0G1 X45.802 Y55.798 F762.0G1 X44.935 Y54.746 F762.0G1 X44.273 Y53.515 F762.0G1
X43.838 Y52.074 F762.0G1 X43.766 Y51.582 F762.0G1 X43.766 Y50.085 F762.0G1 X44.041 Y48.733 F762.0G1 X44.624 Y47.324
F762.0G1 X46.588 Y43.735 F762.0G1 X54.990 Y43.721 F762.0G1 X56.983 Y47.341 F762.0G1 X58.067 Y46.823 F762.0G1 X58.718
Y48.404 F762.0G1 X59.034 Y49.961 F762.0G1 X59.034 Y51.613 F762.0G1 X58.738 Y53.098 F762.0G1 X57.752 Y55.571 F762.0G1
X55.970 Y57.255 F762.0G1 X54.673 Y58.114 F762.0G1 X53.213 Y58.713 F762.0G1 X51.637 Y59.034 F762.0G1 X49.963 Y59.034
F762.0G1 X48.358 Y58.708 F762.0G1 X47.647 Y58.45[illegible]762.0G1 X46.18[illegible]7.667 F762.0G1 X44.949 Y56.651 F762.0G1 X43.933
Y55.417 F762.0G1 X43.160 Y53.979 F762.0G1 X42[illegible].338 F762.0[illegible]566 Y51.670 F762.0G1 X42.566 Y49.963 F762.0G1
X42.888 Y48.382 F762.0G1 X43.542 Y46.803 F762.[illegible]75 Y42[illegible].0G1 X55.698 Y42.519 F762.0G1 X58.067 Y46.823
```

```
G21
G90
G1 Z3.810 F228.6
G0 X148.069 Y144.652
G1 Z-0.700 F228.6
G1 X149.457 Y145.255 F762.0
G1 X147.108 Y145.311 F762.0
G1 X144.635 Y145.252 F762.0
G1 X142.305 Y145.080 F762.0
G1 X145.774 Y143.432 F762.0
G1 X148.069 Y144.652 F762.0
G1 X145.855 Y142.116 F762.0
G1 X148.633 Y143.593 F762.0
G1 X151.178 Y144.690 F762.0
G1 X153.754 Y145.573 F762.0
G1 X154.944 Y145.900 F762.0
G1 X152.165 Y146.264 F762.0
G1 X149.638 Y146.452 F762.0
G1 X147.108 Y146.512 F762.0
G1 X144.579 Y146.452 F762.0
G1 X142.051 Y146.264 F762.0
G1 X139.699 Y145.974 F762.0
G1 X137.321 Y145.562 F762.0
G1 X138.154 Y145.336 F76[illegible].0
G1 X141.439 Y144.156 F[illegible]62.0
```

NOTE: Use a good text editor like Notepad++ to get a nicely formatted list

Modifying the G-Code

- To turn on the spindle add:
- To end the program add:
- Change the file extension from “.nc” to **“.ngc”**
- Save your file to a memory stick

```
%
M03 S17000
```

```
M30
%
```

Activity 3 - Using the Machine!

- Time to go use the machine
- Remember there are some instructions on the wiki for this step here: https://wiki.nottinghack.org.uk/wiki/Superbox_CNC_Router