



3D Design and 3D Printing – Session A

TechResort Innovators Sessions #2107A

Skills involved:	3D Design using Microsoft 3D Builder	✓
	Using a 3D Printer	✓
	Creativity and Imagination!	✓
Suitable for ages:	10+	

In these sessions we're going to investigate 3D printing. In order to make the most of 3D printing we'd like to be able to design the objects we make ourselves: this is much more useful and rewarding than just downloading stuff off of the internet.

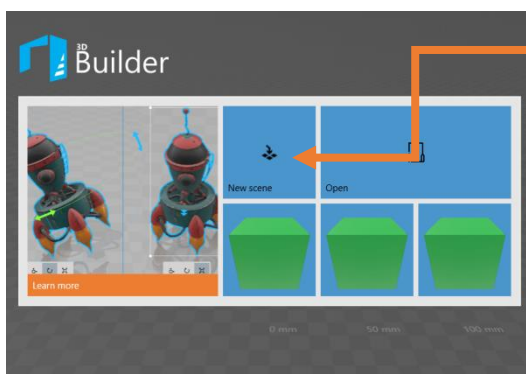
Firstly we're going to find out how to use Microsoft's 3D builder software which comes free with Windows 10. This is a very easy to use entry level tool for creating 3D designs. We'll design a name badge for ourselves and, with some help from the TechResort Elves, this will be made on one of our 3D printers.

In subsequent sessions we'll explore the software further and see what else we can design and build!

Beginning your first 3D design

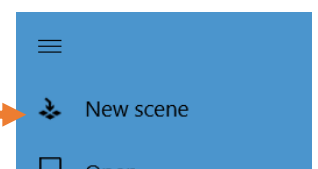
Start 3D Builder from the icon on the desktop or in the start menu.

Depending upon which version of Windows you have installed you might see a screen like this:



In which case click on the 'New Scene' button here.

Or you may have to open a new scene by clicking on the symbol at the top left of the window and clicking 'New Scene'.



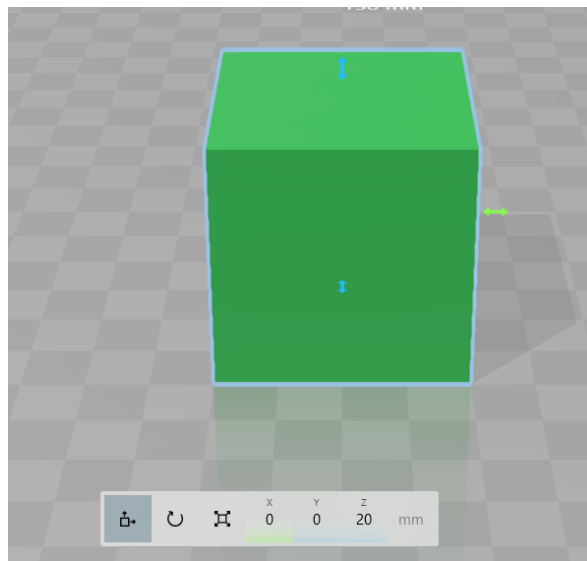
This is one of those times it's better to use a mouse rather than a trackpad.

This sort of 3D design package allows you to build models by combining simple shapes (these are often known as 'primitives').

We're going to make a 3D name badge as our first project. This will start life as a flat rectangular plate, to create this, click on 'Insert' and then 'Cube'.




This creates a cube which is 40mm high, 40mm wide and 40mm long in your Scene:



Changing how you view your design

The first thing to do is to practice moving around your object to get different views of it. Hover the cursor over your scene then press and hold the left mouse button. Now, moving the cursor will rotate the view around your object so you can see it from different directions. Doing the same with the right mouse button held down will move the view up, down, left or right. Scrolling the mouse wheel or using two fingers on the track pad should enable you to zoom in and out.

Going back when you make a mistake

Now there's one more, very important thing to remember. If you make a change you're not happy with, towards the top right of the window, you'll see this button . Clicking on this will 'Undo' the last change you made so that you can go back to where you were before you made it and have another go. Holding the Ctrl key and pressing 'z' will also undo your last change.

Moving and modifying objects

Our object has a blue line around it. This means it has been 'Selected' and we can move and modify it. The symbols in the blue box below our object define how we can change it.

Try clicking on each of them in turn:



This is the 'Move' tool. When it is selected, clicking and dragging one of the 3 arrows surrounding our object allows us to move it around the scene. Try this and note how the number in the blue box that originally says '20 mm' changes. If you wish to move your object by a precise amount you can click on that number and type the value in using the keyboard.

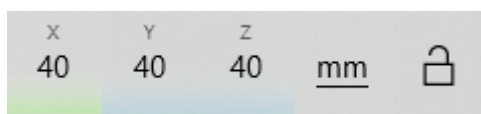


This is the 'Rotate' tool. When it is selected we still see three arrows, but this time they are connected by circles drawn round our object. We can rotate our object by clicking and dragging them or, again, by typing the relevant angle when we click on the number in the blue box.

- Rotate the cube by exactly 90 degrees in one direction. Does it still look the same? Why is that?
 - Now rotate the cube by exactly 45 degrees. What does it look like?



This is the 'Scale' tool. It's really useful because it allows us to change the size and shape of our object. When we click on this, we can change the size of our cube which has a width (x), length (y) and height (z):



Note that the menu includes a padlock. By clicking on that, we can change it so it looks like this:



Which we say is 'Locked'.

Or like this:



Which we say is 'Unlocked'.

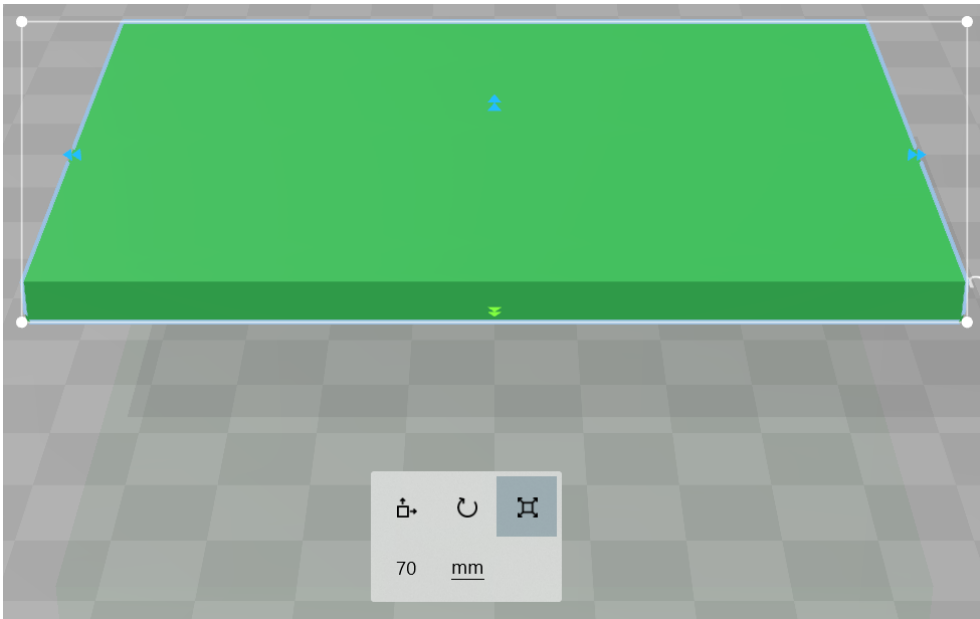
- Try changing the numbers x, y and z with the padlock in both the 'Locked' and 'Unlocked' states. What happens?

When the padlock is 'Locked' what we have done is fix what is called the 'aspect ratio'. This means that when we change one size using the number, all the others change the same way. When the padlock is 'Unlocked' we can change all the dimensions of our object, i.e. its height, width and length, on their own.

We can also change the size of the object when we drag on the arrows around it. The padlock works in the same way when we do this.

Making our first changes


We want to change our cube so it's a flat rectangular plate which can form the basis of our badge so, making sure our aspect ratio is 'Unlocked', change its height to 5mm, width to 100mm and length to 70mm (hint: you can do this by clicking the arrow and dragging the mouse to change the size – or by clicking the arrow and typing in the number you want in the box at the bottom left or the tools). It should now look like this:



By clicking on each of the double arrows in turn, you can check that the dimensions are correct. The image above shows that our length is 70mm.


It's important to ensure our object is flat on the floor of our scene, especially if we are going to 3D print it: we may have moved it as part of our edits. To do this, make sure our object is selected (has a blue outline) and click on 'Object' then 'Settle' in the main menu:



Then click on  **Settle** to accept. This will place your object flat on the floor.


We want to make a badge with rounded edges. There are a few steps we need to do that, but following them will help you understand the editing process better.

Duplicating and selecting objects

With your plate selected, click on  Duplicate in the 'Object' menu. This creates a second plate, identical in size to the first but in a slightly different position.




Now that we have two objects, it's time to explore the selection menu on the right. It looks like this.

You should explore this  menu so you understand how to select and deselect different objects as this is important for performing further actions. You can select either, both or neither of your two plates.

The 'Items' menu tells you what you have selected:

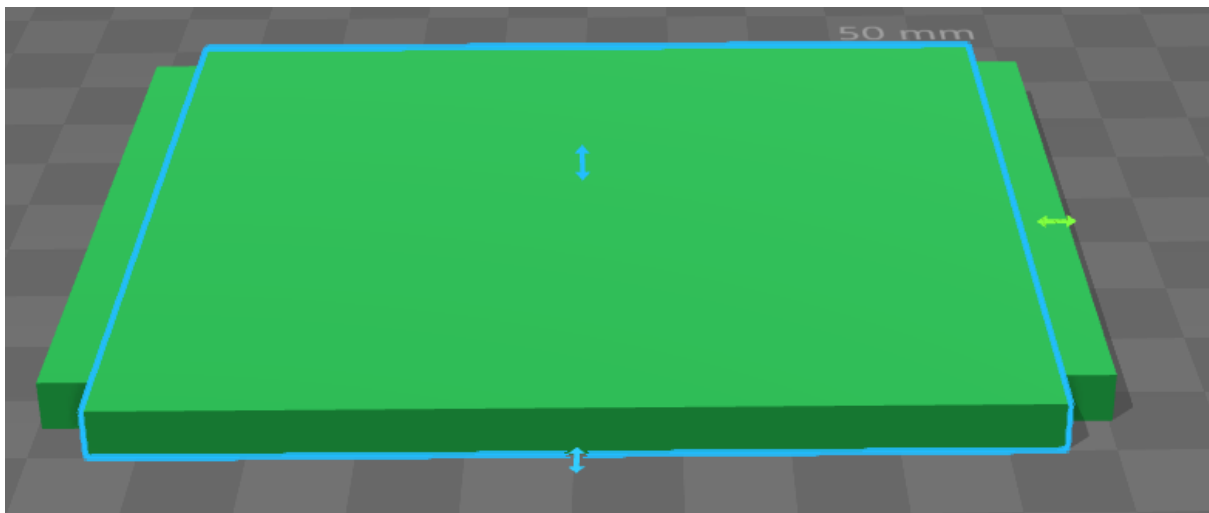
You have selected one  of the plates.

You have selected both  of the plates.

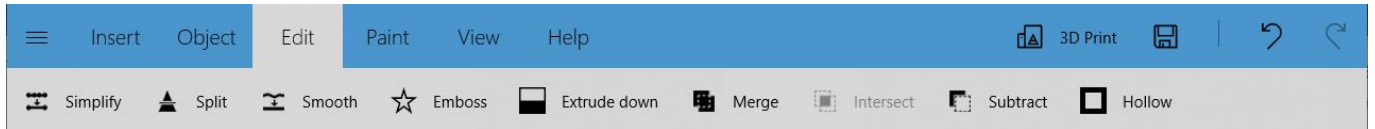
You have not selected  either of the plates.

Combining objects

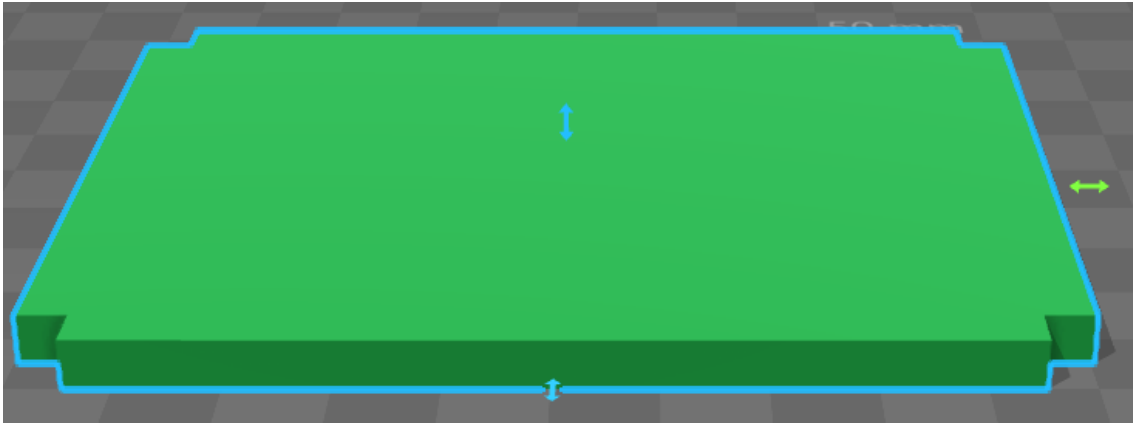
Select just one of your plates. Use the 'Scale' tool to change its width to 90mm and its length to 80mm. Then use the 'Move' tool so that both plates have their centres in the same position. This should be easy to do as the object you are moving should automatically move, or 'snap' to the correct position when it is close to it. Alternatively you could move both plates by typing in the same positions using the keyboard. Your scene should look like this:



Let's combine our two plates into a single object. Select them both and then, from the 'Edit' menu, click on the 'Merge' item.



Now your object will look like this:



Move object types

It's time to create the rounded corners for your badge. From the 'Insert' menu, select the 'Cylinder'. A cylinder will appear but its default size is 40mm high and 40mm wide.

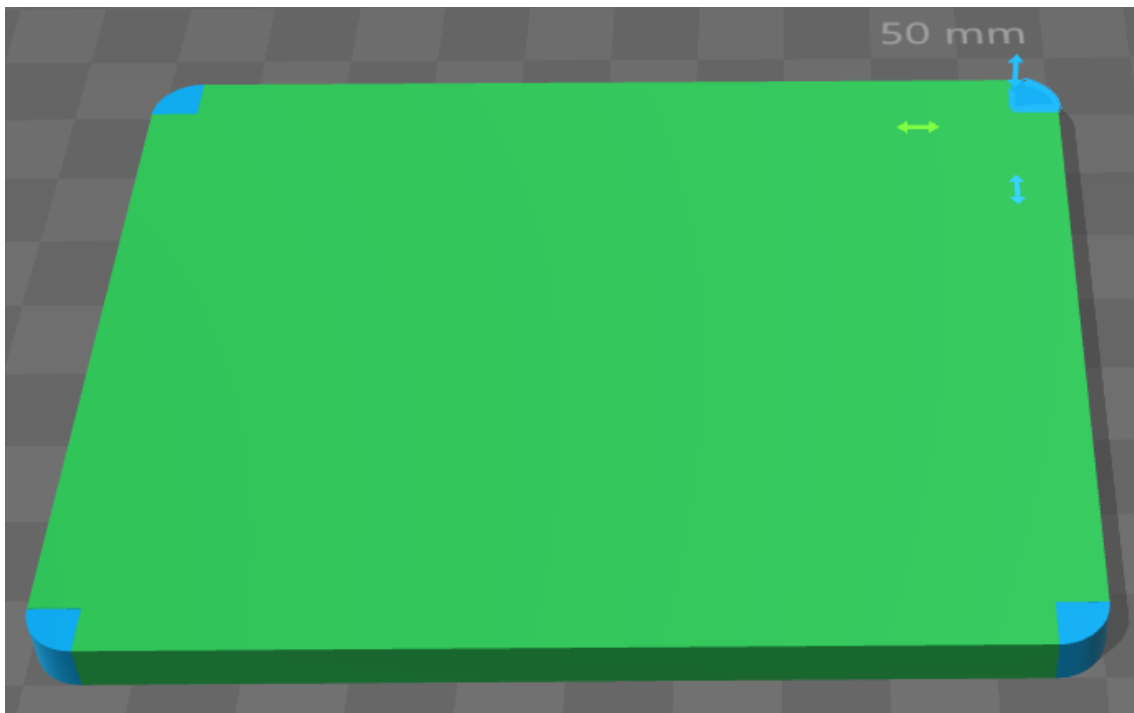
Use 'Scale' with the aspect ratio 'Locked' and change its width to 10mm. Then 'Unlock' the aspect ratio and change its height to 5mm. Use the 'Move' tool to move it so that it 'snaps' to the corner of our odd shaped plate like this:



Remember that you might have to use the 'Object' -> 'Settle' command to position your cylinder on the floor of the scene.

Creating your badge plate

Now use the 'Object' -> 'Duplicate' tool to create three more identical cylinders and then move each of them to a corner of your plate:

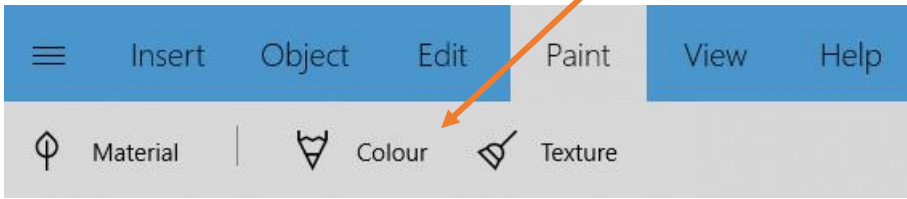



Now select ALL of your Objects: your merged plates and your four cylinders. You can now use the 'Merge' tool to merge them into a single object:



You'll probably want to make your object all one colour. For this we'll use the paint menu.

Make sure the object is selected and click on 'Colour' in the sub-menu at the top of the screen



Click 'Selected' and choose your colour, then click on the object to paint it that colour, then click on  to confirm.

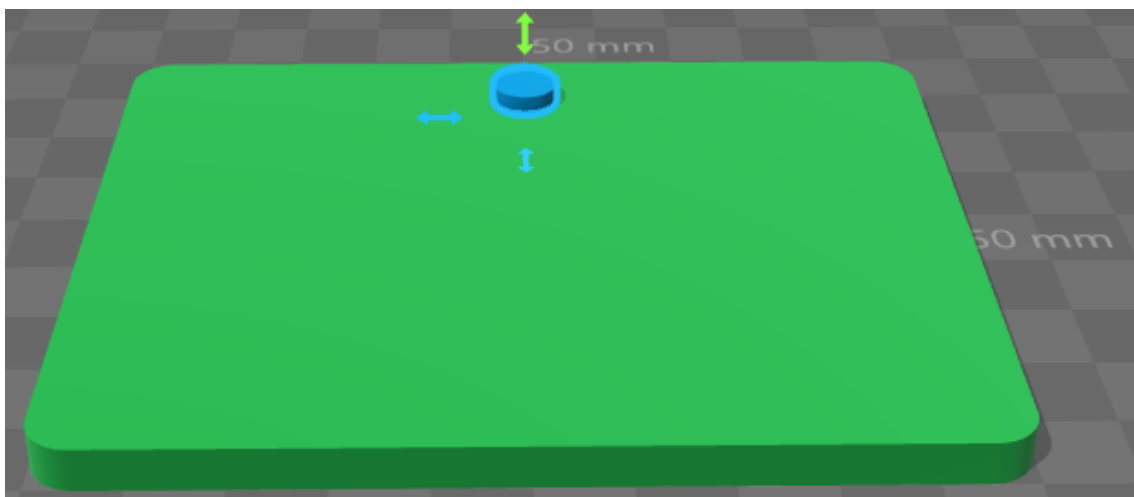
If your menu doesn't look like this, it's probably because you're using an older version of the software in which case you should just be able to select the object, and then select the colour you'd like it to be.

Note: The colour you make it now doesn't define the colour it will be printed when we use the 3D printer.

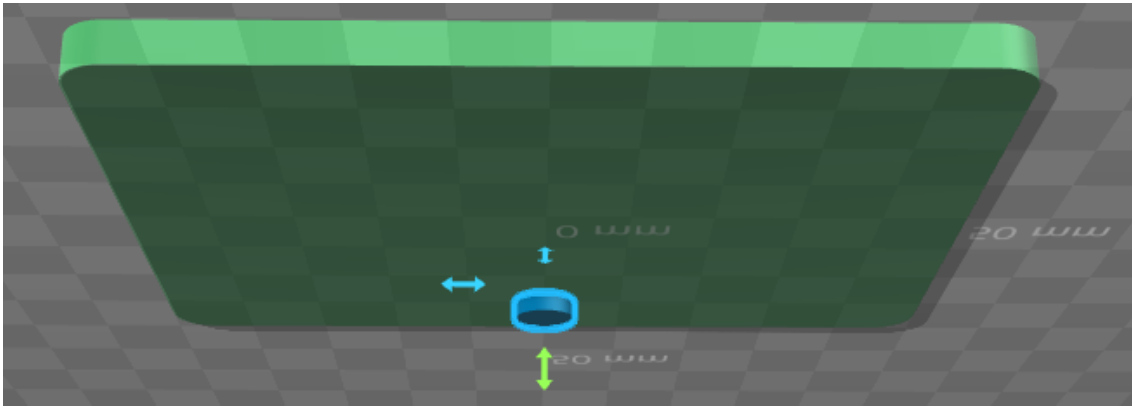
Subtracting objects

Let's put a hole in our badge so we can attach a chain or a clip. For this we're going to use a 'Subtract' command. Insert a cylinder with a height of 10mm and a width of 8mm. Then position it on your plate so it protrudes both above and below the plate. Remember you can rotate the view to look at both the top and bottom of your plate.

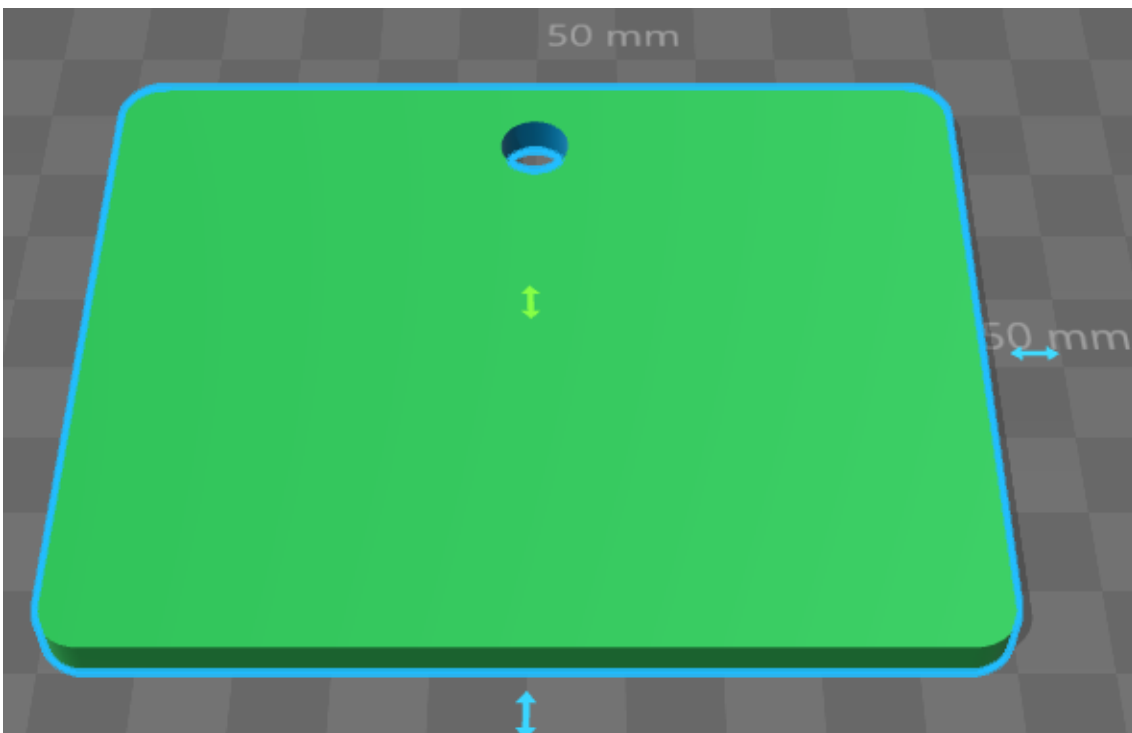
Top:



Bottom:



Now with ONLY the cylinder selected, click on 'Edit' -> 'Subtract'. This subtracts the cylinder from everything else so what you are left with is only the part of the plate where there was no cylinder. This has made a hole in your plate:

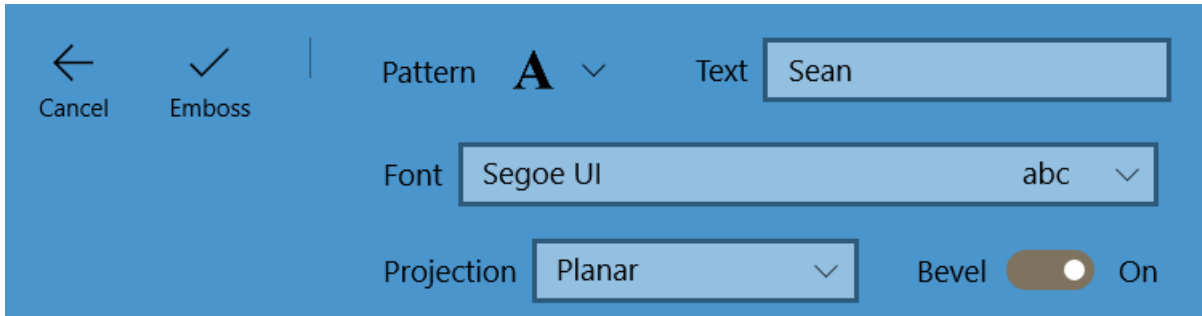


Congratulations! You've now created your first object that can be 3D printed.

Embossing

Now we can personalise your badge so everyone knows who designed and made it. This is soooo easy!

Select your object (you should only have one) then click on 'Edit' -> 'Emboss'. This should bring up a menu like this for adding text:



If you don't see the text options like this, click on the 'down' arrow next to 'Pattern' and select the first item in the menu: 'A Text'. You can also change the Font – really bold fonts work best.

Type the text you want to put on your badge in the Text Box in the above menu.



Now you can use the scale menu to change the size and position of your text in the same way as with your other objects.

Note that as we will be printing these badges scaled to 60%, it is necessary to emboss the badge so that it is raised up from the base of the badge by quite a bit – otherwise, your name might not print correctly. Adjust the arrows on the emboss screen in order to do this (or set height to 100%).



When you're happy with the size and position of your message, click on the 'Emboss' button (as seen on the left) to add it to your badge which should now look something like this:




Finishing your badge

Now you can use the Emboss tool again to add more symbols (click on the down arrow next to 'Pattern'), and extra text if you wish to your badge.

If you're feeling confident, you can even use the 'Insert' menu to add extra cubes, cylinders or other objects to the badge. If you do so, always remember to 'Merge' them with the badge so you have a single object. Here's one we made earlier:



Saving your work

Now we should save our badge. Click on the  symbol again and choose 'Save As' and use a suitable name for your badge. You should save your design twice: once in *.3mf format, this is the file we'll edit in the future if we want to change our design, and once in *.obj format, this is the file we'll use to send to our 3D printer when we want to make it.

Next, we'll explore how we actually make your design using one of our 3D printers! Show your finished design to one of our Elves; they'll inspect it and let you know if you need to change anything before we make it.