Construct a simple wing using blender
(suitable for snappyHexMesh)

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In this tutorial flow over a simple wing shape (Not a particularly accurate one) will be illustrated.

Note that for blender keys on the keyboard are referred with the following notation
     X - the x key on the keyboard,
     A - the a key,
     SPACE - space bar,
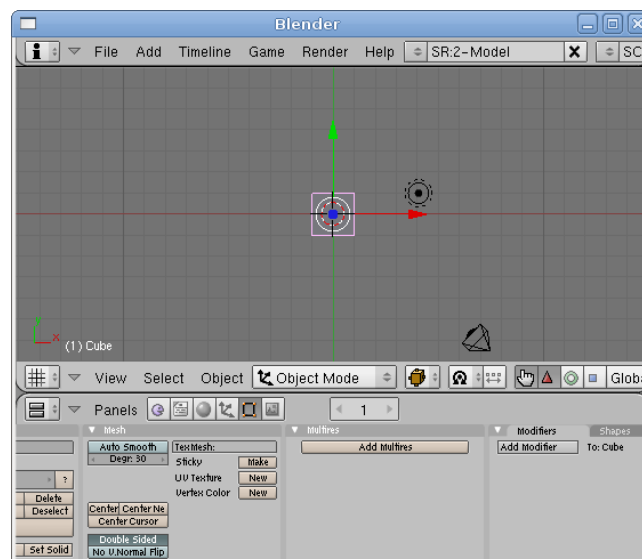Mouse buttons are
     LMB – left mouse button
     RMB – right mouse button

This is consistent with the online blender tutorials (highly recommended - http://en.wikibooks.org/wiki/Blender_3D:_Noob_to_Pro)

Part 1 – Blender.

Start blender. (Either from a shell, or through the panel menus)

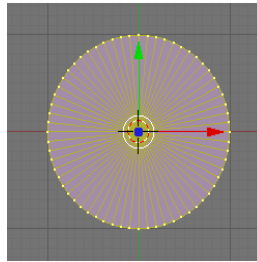You will have a window that looks something like this:

Note that the default scene, starts with a camera (bottom right), a lamp (middle right) and a cube (centre – in pink). As we're not interested in any of these we can delete them. Select all (press **A** twice) and then delete them with **X**.

You now should have an empty screen. Next we want to add our aerofoil. To add an object press **SPACE**, then select *add->cylinder*.
     Note: blender adds all objects aligned with the current plane, so before this step you should
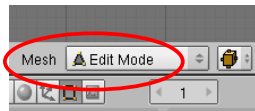
select *view->top* from the menu. This will give the correct orientation of our aerofoil.

Select the number of vertices (eg. 64, 32 is probably not enough) and press OK. You will now have a cylinder in the centre of your window, like so.
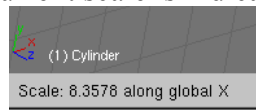

all the vertices of our cylinder are shown, and are selected.

> Note: blender has a number of modes, the two we will use in this tutorial are *object mode* and *edit mode* . In *object mode* we can manipulate objects, while in *edit mode*, we can manipulate the vertices making up the object. Press **TAB** to switch between *object mode* and *edit mode*. The current mode is indicated in the bottom toolbox.
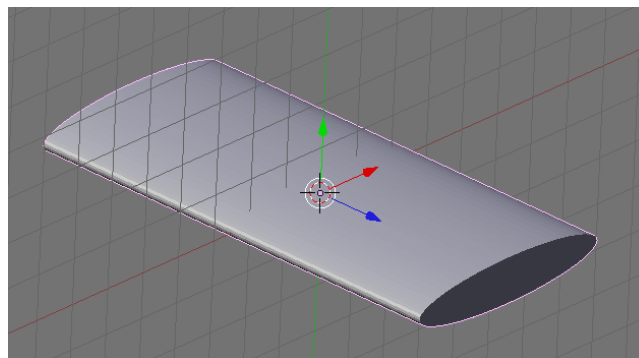

We would like to now shape our aerofoil. To do this we want to be in *object mode* (though it is also possible in *edit mode*). Change to object mode, and select the cylinder with the right mouse button (**RMB**).

Now we want to scale it into something approaching an aerofoil shape, press **S** (scale). If you move the mouse you'll see that the object scales as you do it. We would like a bit better control. Press **X**, and you will see that the object now scales along the x-direction only, also if you type a number it will scale by this amount. If you enter the wrong value, you can press **BACKSPACE**, or if you change your mind completely you can press **ESC** (this generally cancels any operation). Pressing **ENTER** completes the operation The current scale is indicated in the corner of the 3D-view.

We will scale our aerofoil in 3-directions separately. 2.5 times in the x-direction (**S X 2.5 ENTER**), 0.5 times in the y-direction (**S Y 0.5 ENTER**), and 5 times in the z-direction (**S Z 5 ENTER**), your aerofoil should now look like this.

Next we want to add a flap, in addition to the aerofoil. The current aerofoil is a good shape, so we will copy it, then move it and scale it.

Select the aerofoil (**RMB** – it should be pink) and duplicate it **SHIFT-D** , by default it will now move with your mouse so you can reposition it, we don't want to do that so press **ESC** to cancel the move (the duplicate operation still completes).

Now we want to move it. Press **G** (grab) – the aerofoil will now move with your mouse. As with scaling we can move it more accurately one axis at a time and by a fixed amount.
Press **X** to move it along the x-axis and then type 3.5 and **ENTER** to move our flap 3.5 units behind. (don't worry about the overlap yet)

Next we want to scale it so that its smaller than our aerofoil. We only want to scale it in the x and y directions, so we can do it along each axis separately. Alternatively we can scale it in one operation like so,
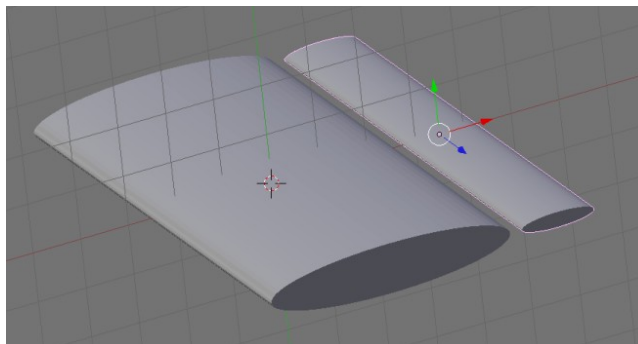press **S** (scale)
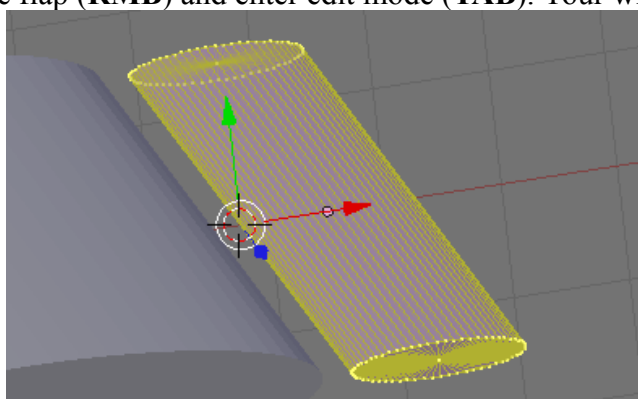press **SHIFT-Z** (ie don't scale along the z-axis)
press 0.3 (we want it to be 0.3 times the size of the aerofoil)
press **ENTER** (complete the operation)

your objects should now look like this

Next we want to rotate our flap. We want to rotate it around the leading edge, so we will need to do it in *edit mode*. Select the flap (**RMB**) and enter edit mode (**TAB**). Your window will look like this
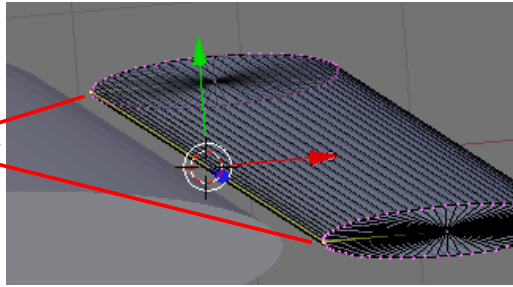

Now we want to change our rotation point to the leading edge.

Firstly unselect all the vertices (ie. press **A**). Select the two vertices at the leading edge (hold down **SHIFT** while selecting the second).
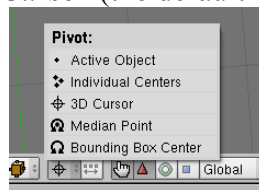You will probably need to zoom in to do this.

Select these two vertices with the **RMB** while holding down **SHIFT**

Now we need to change the centre of rotation. Press **SHIFT-S** and choose *Cursor to Selection*. This will move the *3D Cursor* to the centre of the leading edge.

> Note: the *3D Cursor* is the red and white circle in the 3d-window. It is used to mark the place where new objects are inserted, as well as (occasionally) the reference point for rotations and scaling.

Change the pivot point using to the *3D Cursor* (the default is *Median Point*)

Now we can rotate the flap (you can also do this in *object mode*).
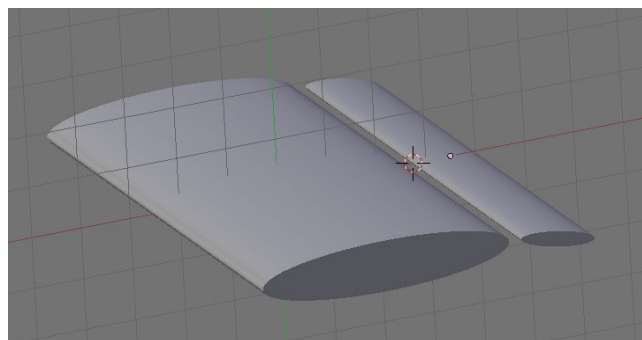In *edit mode* press **A** twice so that all the vertices in the flap are selected.
Next press **R** (rotate)
press **Z** (rotate along the z-axis)
type 10 (we want to rotate it 10 degrees)
press **ENTER** (to apply the rotation)

have now got an aerofoil, and a rotated flap. It should look like the following (in object mode)

Finally, we want to scale our wing to a smaller size. In *object mode*, select both the aerofoil and the flap by pressing **B** and drawing a box through both wings (it doesn't need to go around them).
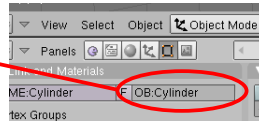Press **SHIFT-C** to reset the *3d cursor* to the origin. Next press **S** (scale), 0.1 and **ENTER** to scale the wing and aerofoil to 10% of their original size.

Finally, we want to export it (This is using the script from the OpenFOAM message board http://openfoam.cfd-online.com/forum/messages/1/8516.html)

First we will give our objects names.
Select just the large aerofoil, then change the name (the *OB:* field) in the *Links and Materials* panel at the bottom by clicking in the *OB:* field.

Change the name here to "wing"

In the same way change the name of the flap to "flap".

Export the objects using *File->Export->Named ASCII STL file (.stl)... .*

You now have an ASCII STL file with multiple objects suitable for using in snappyHexMesh.