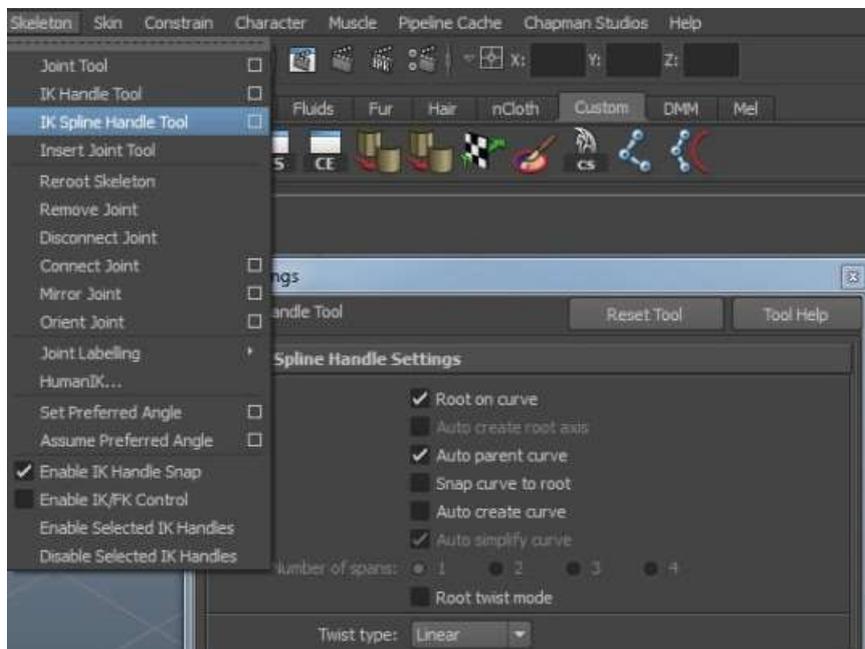
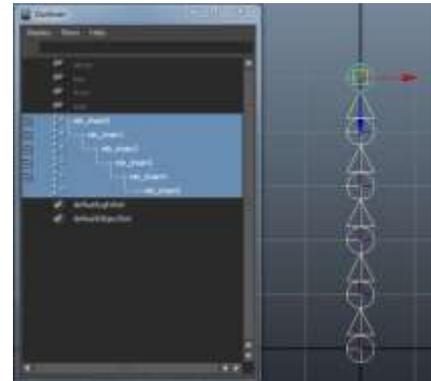


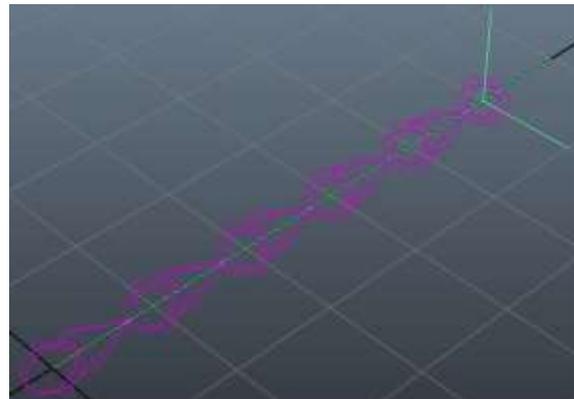
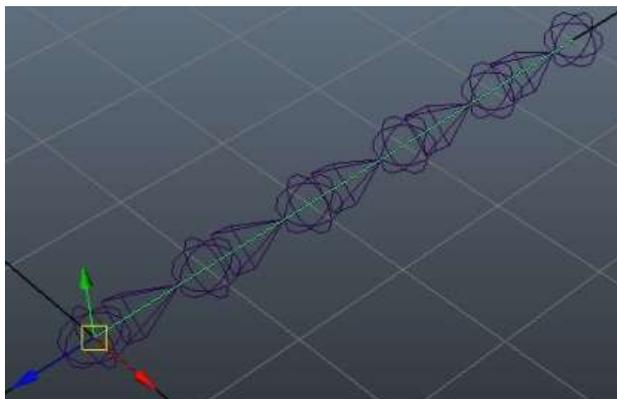
## IK Spline with Squash / Stretch

We are going to build a joint chain controlled by a different type of IK system than before. Previously we set the location of the base joint and built a control curve for just the tip. With a spline IK system we will also have control of the overall curve of the joint chain.

In the top view, start by creating your joints. I have held the 'X' key down to snap the joints to the grid. Rename the joints to 'mb\_chain' or similar. Now using the *cv curve tool* and holding 'v' to snap to each joint, create a *CV Curve*.



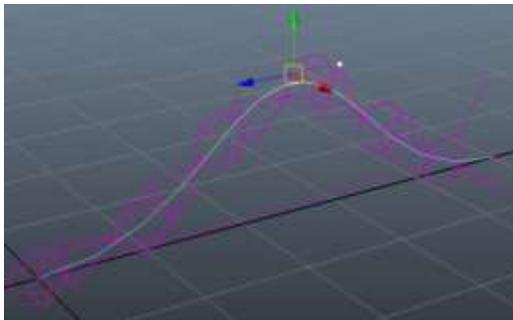
In the IK Spline Handle Tool settings, ensure that *Auto create curve* is deselected and with the tool still selected select and ctrl select in the outliner (or *shift-select* in the viewport) the first and last joints in the chain followed by the curve we just built.



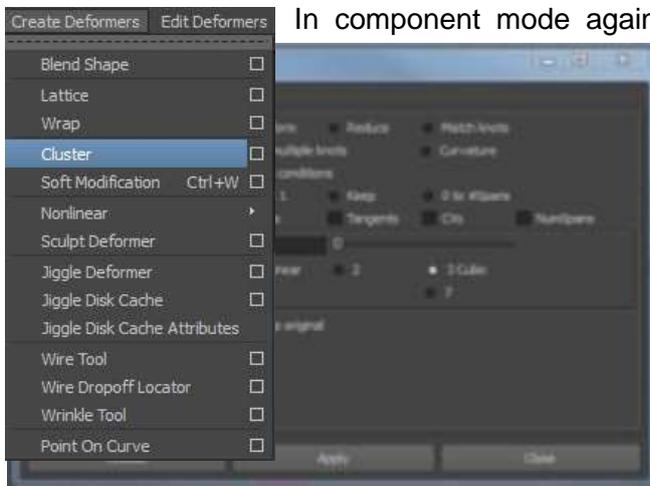
An *IK Handle* should be created (and be selected) and an effector should be created under the second to last joint.



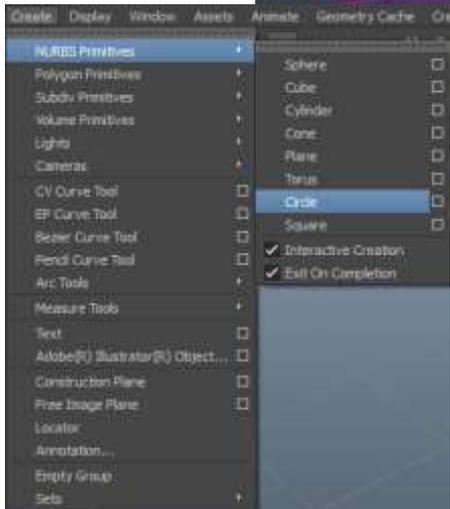
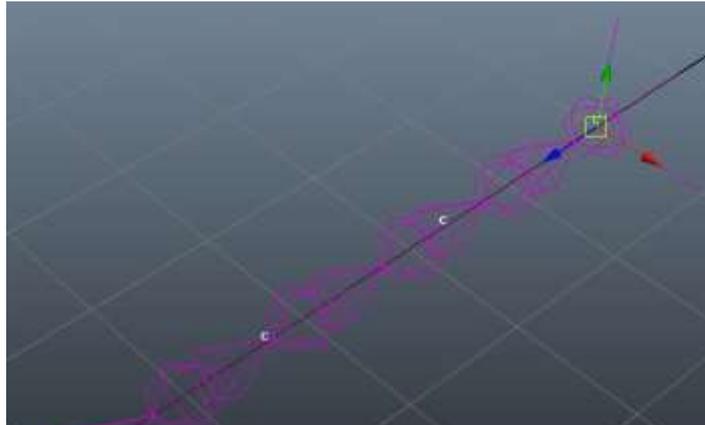
If we select the curve and go into component mode (*F8*) we can see that we have six control vertices defining the shape of our spline (you could also take this opportunity to move the vertices and see how the joint chain is affected by the shape of the curve). We want to reduce this number to four.



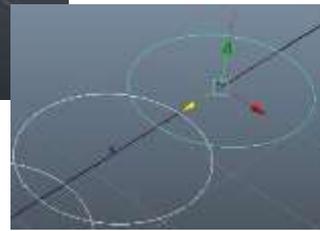
Select the curve and switching to the *Surfaces* menu set click the *Edit Curves > rebuild curve*  The number of resulting vertices will be the number of spans plus the degree of the curve, which in this case is three. So for four control points, we need the number of spans to be four minus three which is one. Rebuild the curve.



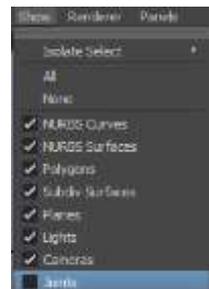
In component mode again, select the first vertex and click *Create Deformers > Cluster*  Ensure that 'relative' is selected and click apply to build a cluster to control the vertex. You will need to make sure you are in the *Animation* menu set. Repeat this process to create a cluster on each of our curve control vertices. Rename the clusters to 'cl\_chain' or similar.



Create a circle (*Create > NURBS Primitives > Circle*) on each of the cluster points. You

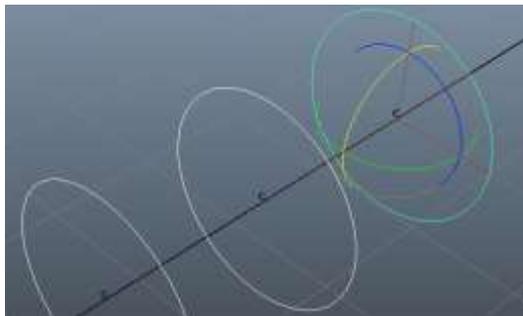


can use 'V' to snap, and you may find it easier if you temporarily hide the joints visibility in the viewport Show menu.



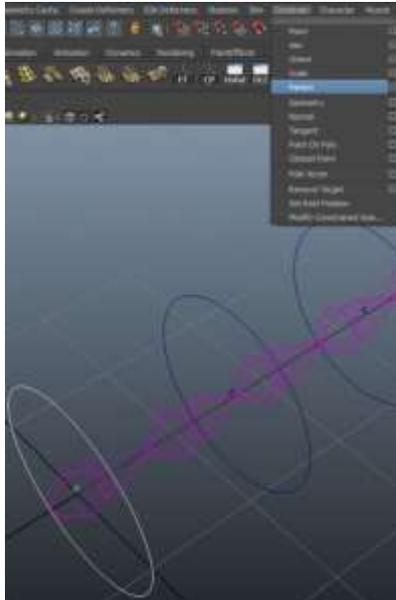
Rotate the control curves by 90° in the X axis and then delete history (*Edit >*

*Delete by Type > History*) and freeze transformations (*Modify > Freeze Transformations*). We

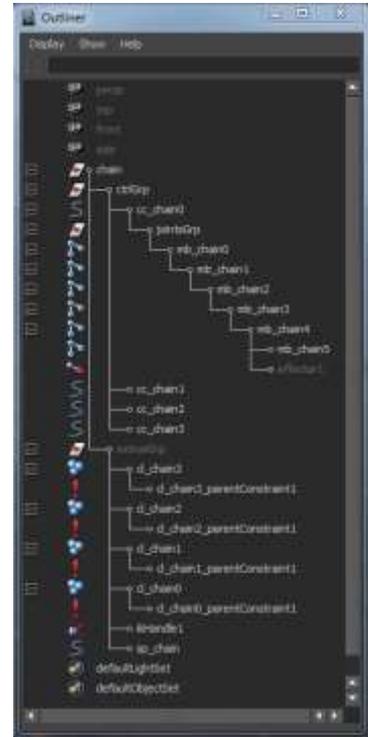


can bring our joint visibility back now, and rename our controls to *cc\_chain* or similar too.

Select the first control curve followed by the first cluster and create a parent constraint (*Constrain > Parent*) this will drive the cluster from the control curve. Repeat this procedure on the other three curves and clusters. Remember that we can repeat the previous Maya action by pressing 'g'.



Now we have a completed Spline IK joint chain. Clean up the scene by organising your *Hypershade* as seen below. Essentially we want to separate the control objects from the rig objects so that it is neat and we can hide the stuff that we don't need to see. When we bind an object (such as a tail, or the spine of a character) we will also hide the *jointsGrp*.



Although we can use this rig as it is, what we really want is the ability to squash and stretch the chain in between the first and last control. To do this we are going to use some MEL commands using the Command Line in the bottom left of our Maya window. First we need to create a node to tell us the length of our curve. Type in "*arclen -ch 1 sp\_chain*" (where *sp\_chain* is the name of your curve) and press enter.

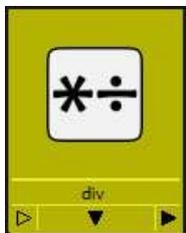


We should get the message “// Result: curveInfo1”. We need to remember the name of our node because it is not visible in the outliner or viewport. Type in “*select curveInfo1*” and press enter to select our node.

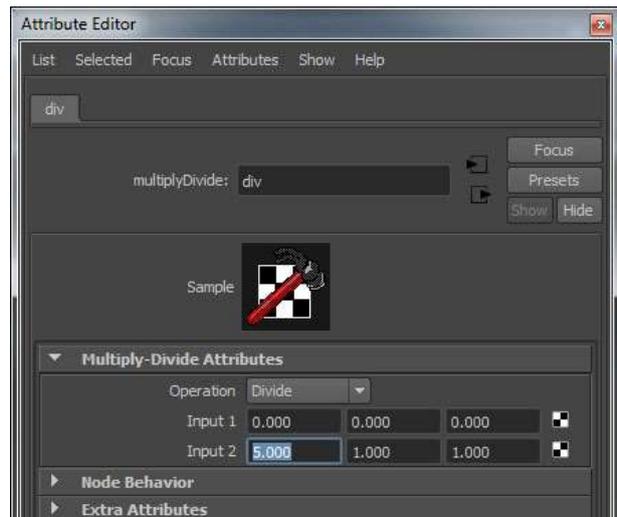
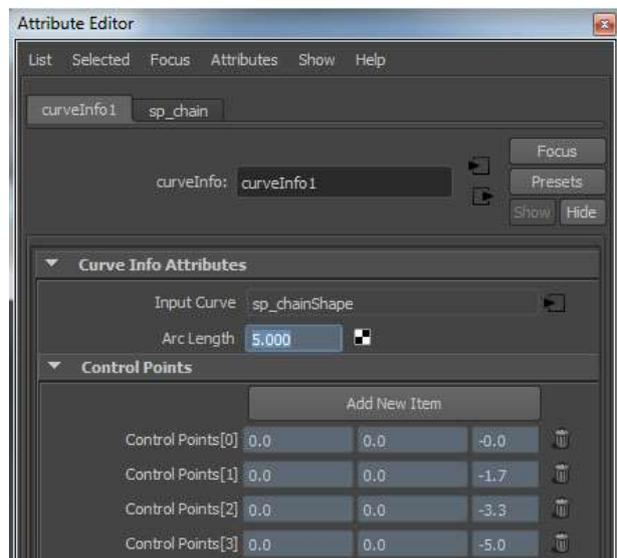
Open the Hypershade window up and click on *Graph > Add Selected to Graph*. The curve info node will appear in the work area. In the left hand menu, create a new Multiply Divide node (*Maya > Utilities > Multiply Divide*) and rename it ‘*div*’.



We want to use the multiply divide node to calculate the difference between the curve length at rest and the curve length as it is. To get the value at rest (which it is at the moment)



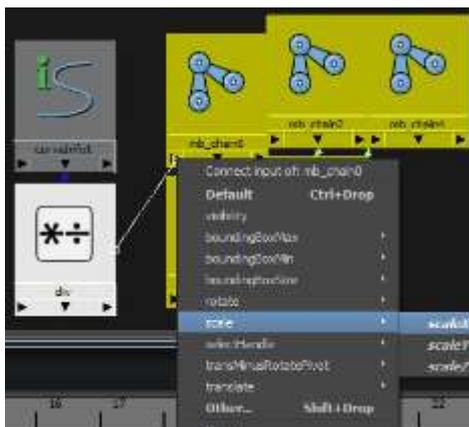
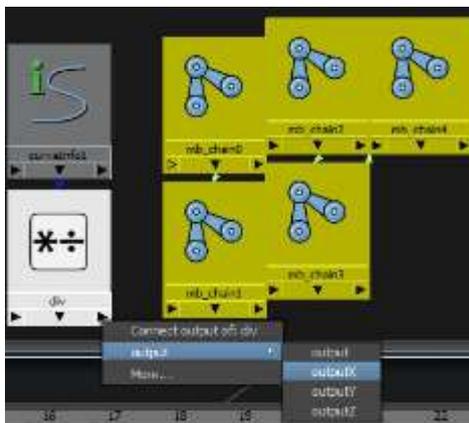
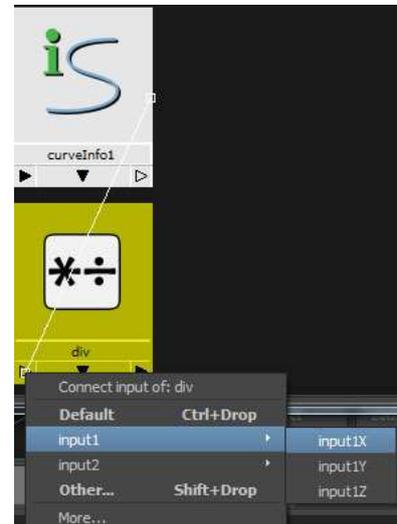
select the curveInfo1 node from the Hypershade and copy the value (in my case this is five). Select the multiply divide node and paste this value into *the Input 2 X* field. Also make sure that the operation is set to ‘*Divide*’.





Right click and hold on the output of the curveInfo1 Node and select 'arcLength' and then left click and hold on the inputs of the div node and select 'input1 > input1X'. The div node will now be able to give us the value of how much our join chain is squashed or stretched by.

Select all the joints in our chain apart from the last one and *add selected to graph* as we did before. Now like we connected the curveInfo and div nodes, we want to connect *the div > output > outputX* to the *mb\_chain0 > scale > scaleX* and then connect the div outputX value to each of the other joint's scaleX attributes.



Now when we move our control curves to change the shape of our joint chain, the joints will automatically stretch to the correct length.

