

NURBS, or Non-Uniform Rational B-Splines, like Bezier curves, are Parametric. Instead of drawing every point, you simply define control vertices and weights creating a smooth curve. NURBS curves are a foundation of modeling and an extremely important aspect of both hard surface and organic modeling. In this tutorial, you will learn how to create and adjust a NURBS curve. We will have you create simple shapes (the same shapes that were in the Bezier tutorial) by creating an initial NURBS Curve, and then modifying it for the rest of the shapes.





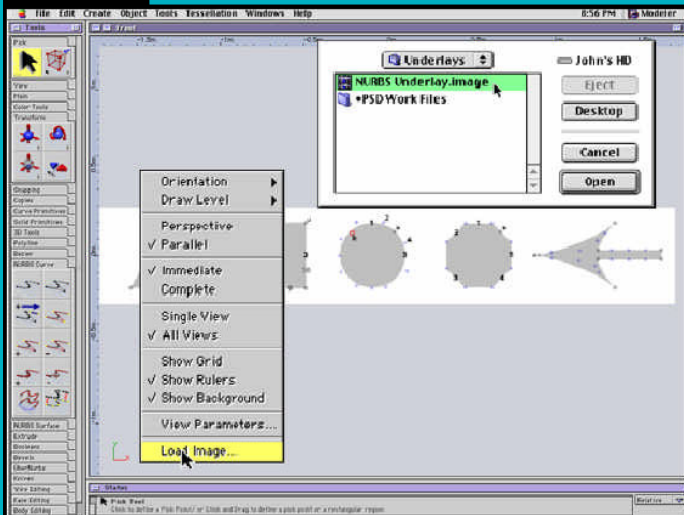
[DBL+CLK] the Universe Toolkit Modeler application program to launch the EI Modeler.

Note: Macintosh keyboard commands are indicated in **red**.
PC keyboard commands are indicated in **blue**.



3

Preparing the Workspace

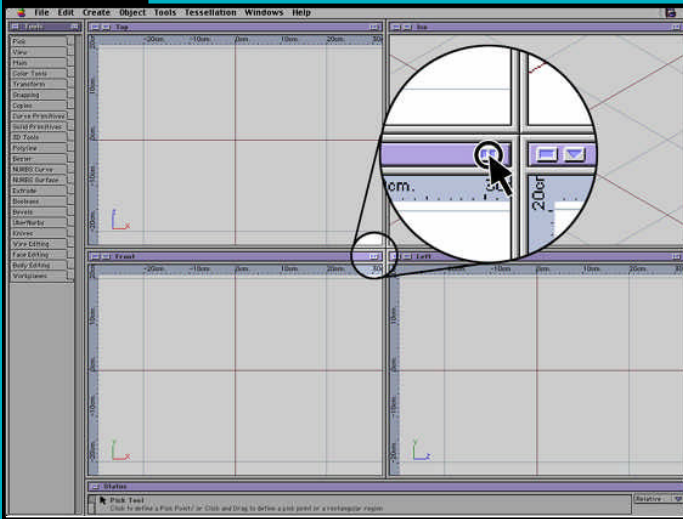


First, we'll load in our underlay. You can load underlays into any or all the views to guide your work. While underlays may seem tedious, they save hours of work in the Modeler. You will use them often. Once the underlay is in position, lock it. The Modeler treats underlays as objects so we need to make sure that we do not accidentally select it later.



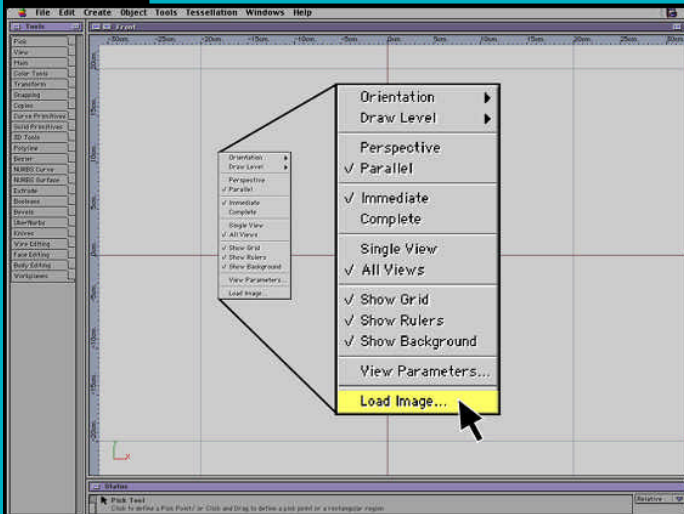
Overview





Since all of this tutorial will take place in the Front View window only, **[CLK]** on the button in the upper right of the title bar.

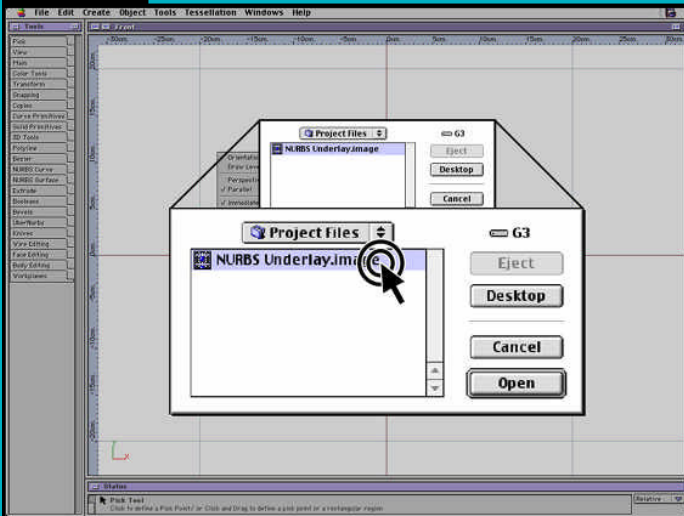




[**CTRL/R+CLK**] in the Front View window.

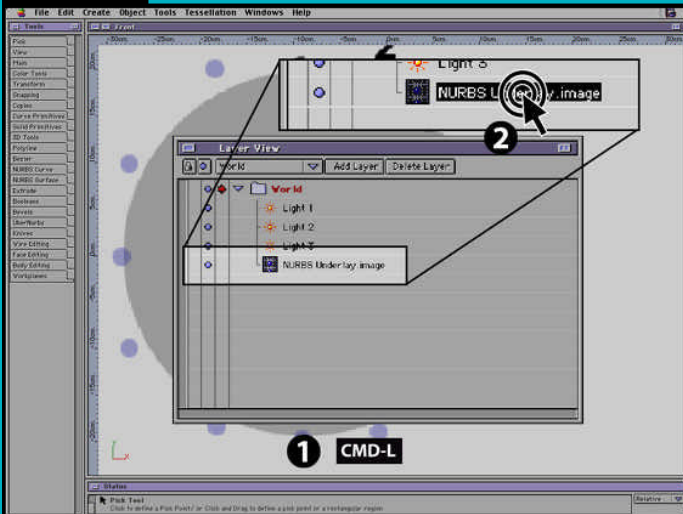
Select Image Template from the bottom of the list in the pop-up menu.





[DBL+CLK] on the underlay to load it.

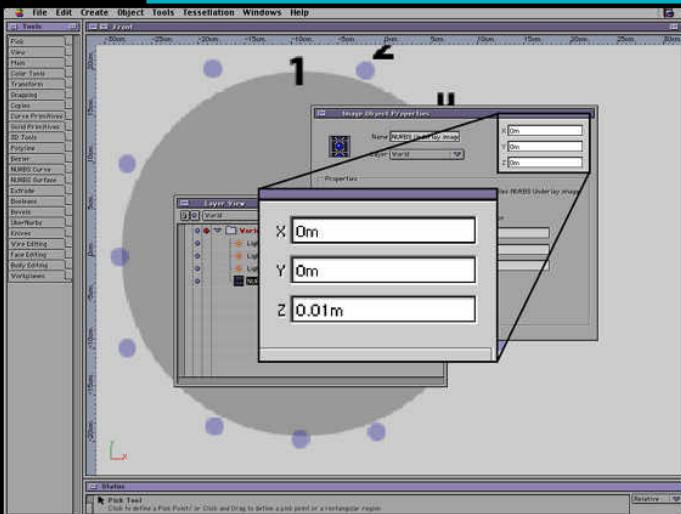




Press [**CMD/CTRL+L**] to open up the Layer View window.

[**DBL+CLK**] the Underlay image to open up the Image Object Properties window.



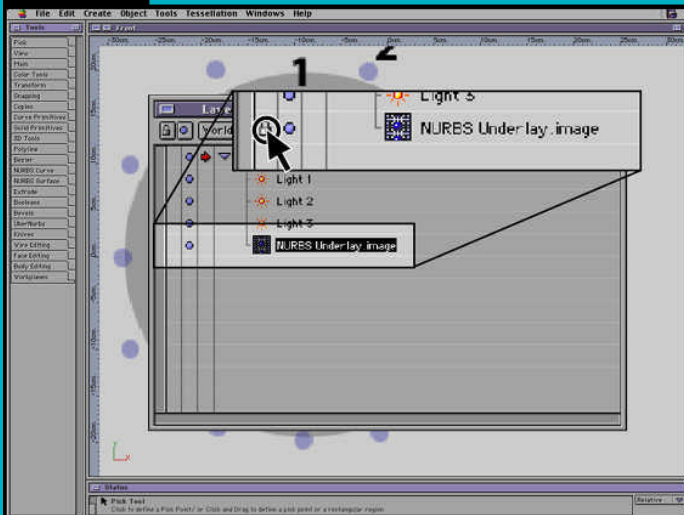


In the Z field, enter .1

Close this window.

Note: This will keep our underlay from interfering with the curves we draw.

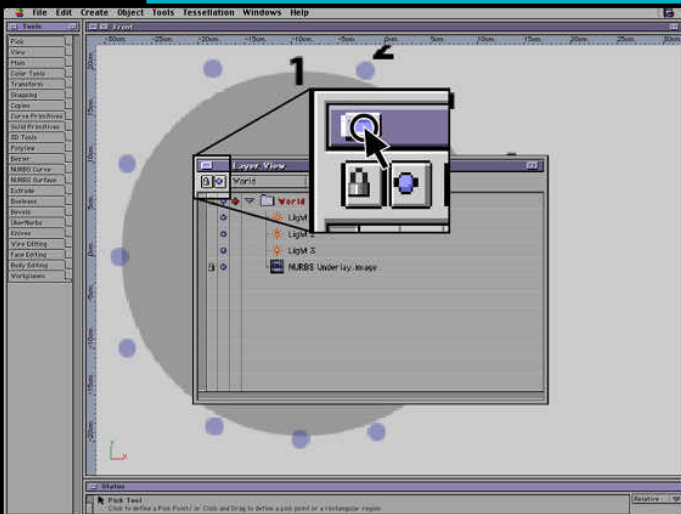




[CLK] on the first empty column to the far left of the NURBS_Underlay.img to lock it.

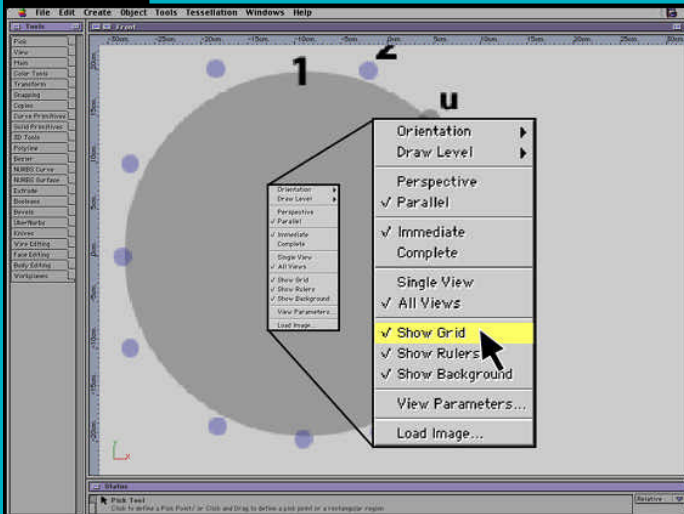
Note: A padlock icon will appear to denote that this layer is now locked.





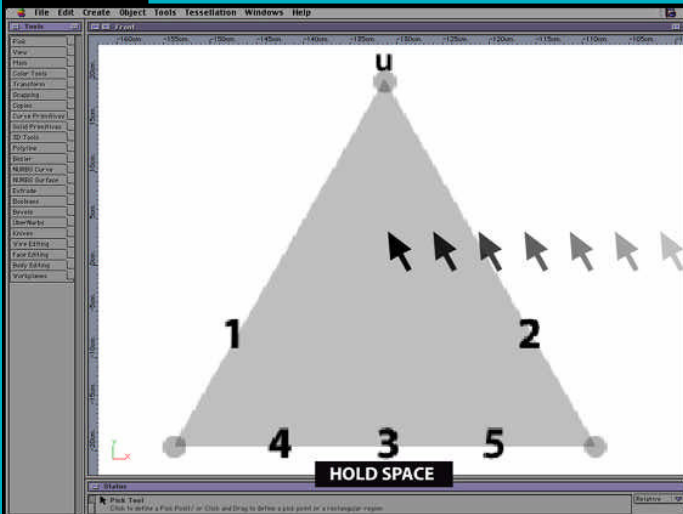
[CLK] on the button in the title bar to close this window.





[CTRL/R+CLK] in the window and select the Show Grid option.

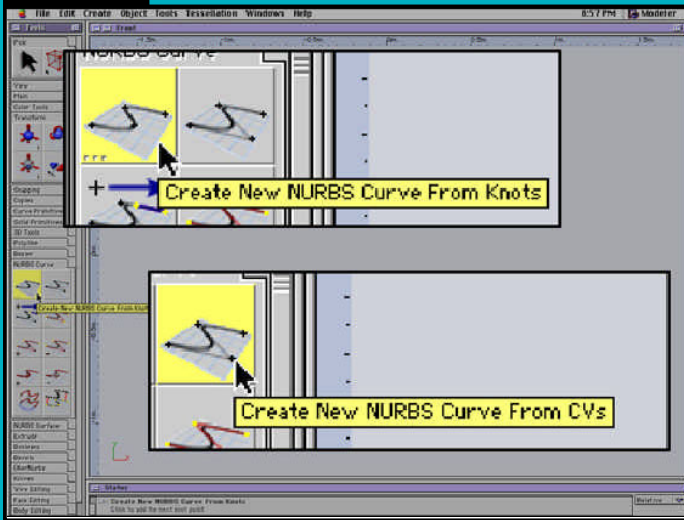




The first shape to trace is on the far left of this underlay. Press the **[SPACE]** and **[CLK+DRG]** in the window to the right to move the viewing area.

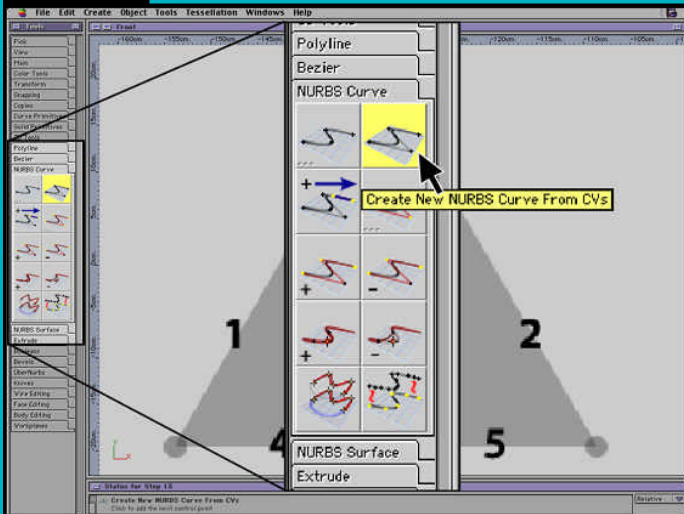
Position the triangle in the window so that it is clearly visible.





Now it's time to create our shape. In the modeler, there are two ways to approach creating a NURBS Curve. There is creating a NURBS curve from CVs (Control Vertices) or creating the NURBS curve from Knots. This tutorial only teaches you the Create NEW NURBS from CVs tool. We suggest that after you finish the tutorial, try it again using the Create New NURBS from Knots tool.

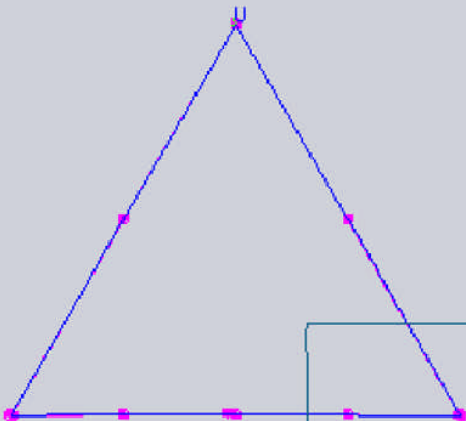




In the Tools palette, **[CLK]** on the NURBS Curve folder.

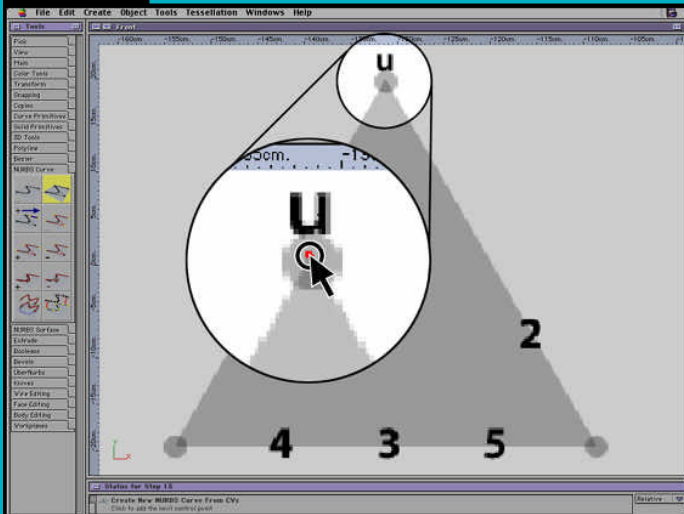
Select the Create New NURBS Curve from CV's tool from the NURBS Curve palette.





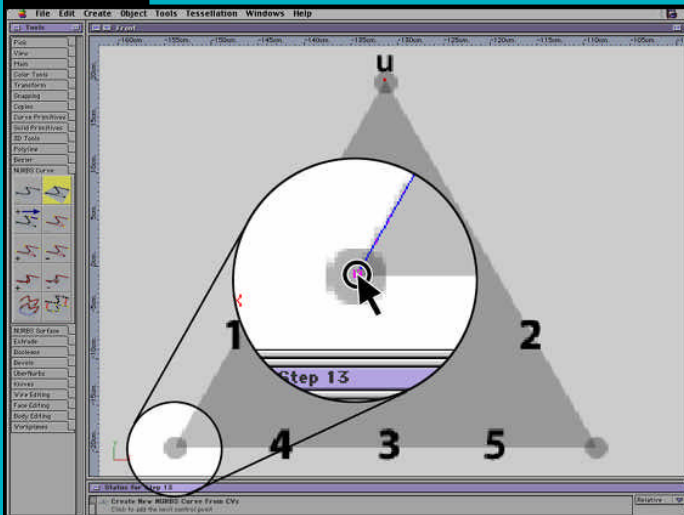
Our first shape is a Triangle. By the end of this section you will have learned to create a NURBS Curve from CVs, adding additional CV's to control the shape and weighting the CVs to tighten the corners of the shape.





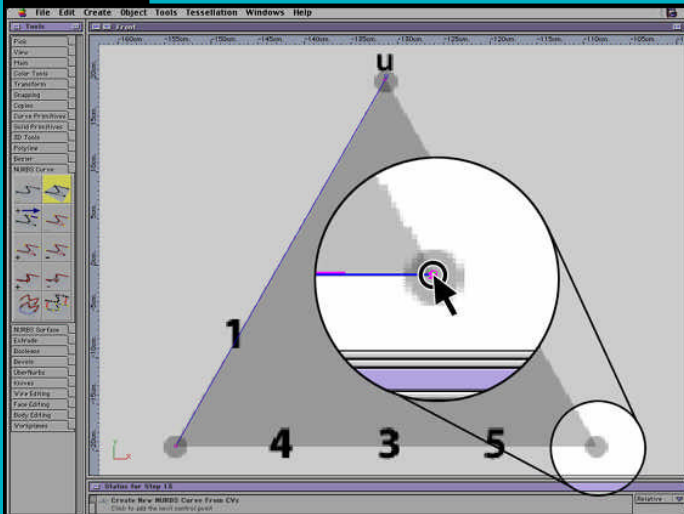
[CLK] at the U position to add a control vertex (CV).





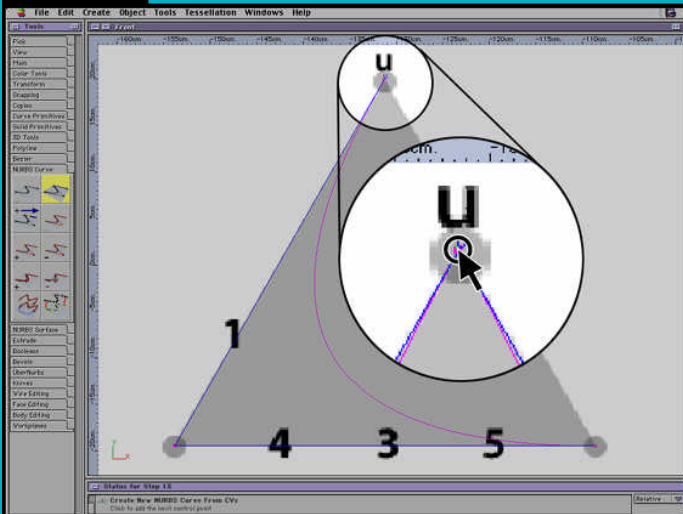
[CLK] on the bottom left corner of the triangle.





[CLK] on the bottom right corner of the triangle.

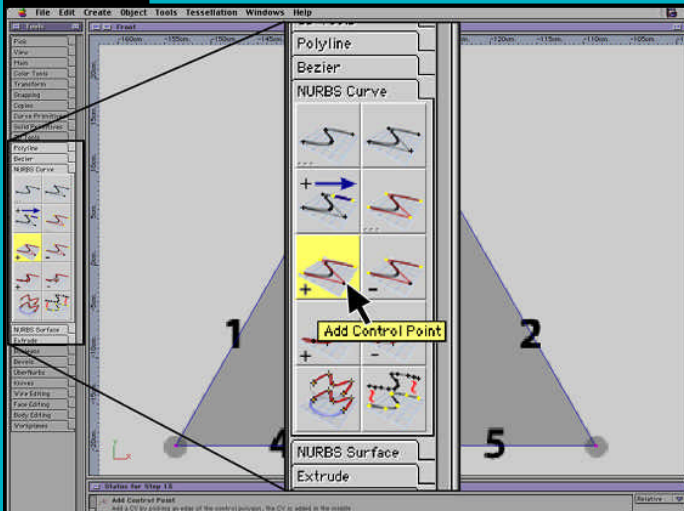




[CLK] on the starting control vertex at the U position to close the shape.

Note: Closing the shape sends our curve into edit mode. The Edit NURBS Curve tool is now selected in the tool palette.

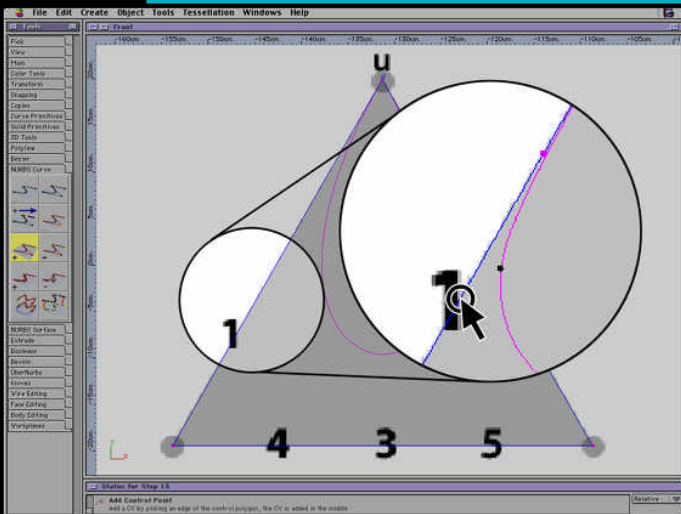




In the NURBS Curve palette, [**CLK**] on the Add Control Point button.

Note: Control Points (CVs) are added to control the distortion of the triangle shape when weight is added to the corner control vertices (CVs).



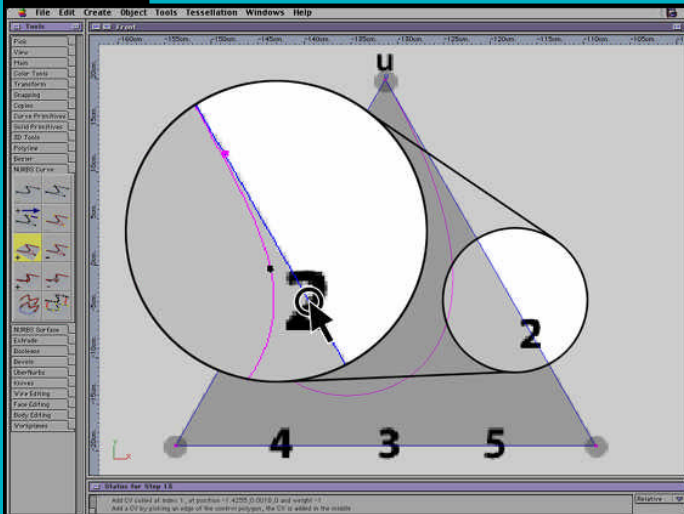


[CLK] on the cage* where it intersects the number 1 on the underlay.

Note: When the control vertex is added, it is placed in the center between the first two control vertices, not at the number 1 location. When adding control vertices, they will bisect the line between two control vertices.

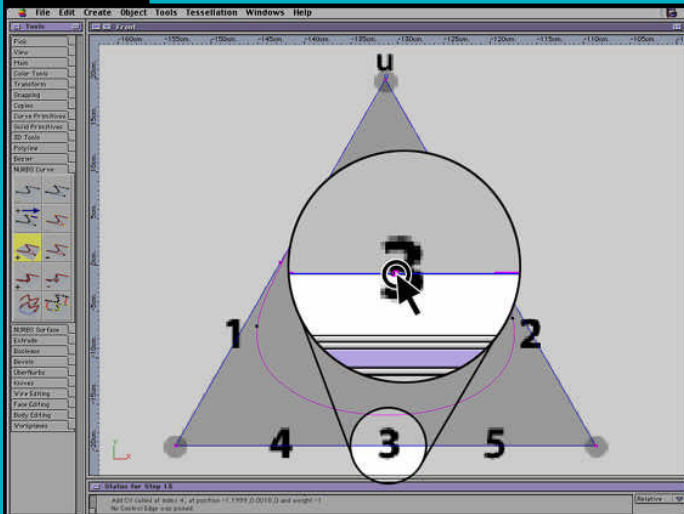
*A cage controls the shape of the spline that is created.





[CLK] on the cage where it intersects the number 2 position.

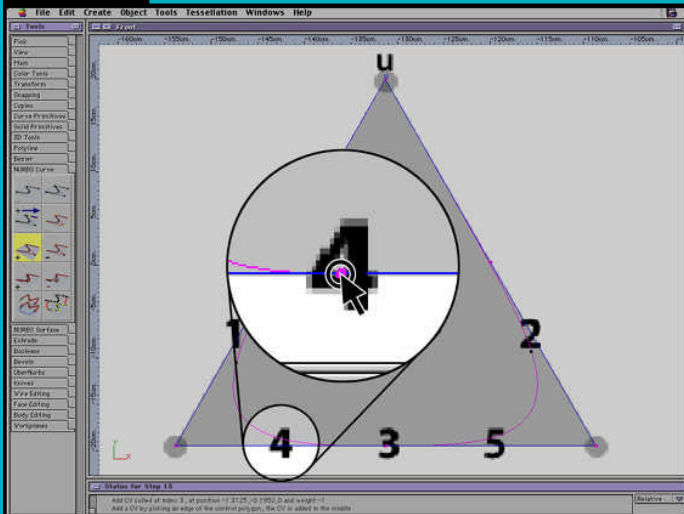




[CLK] on the cage where it intersects the number 3 position.

Note: This control vertex will hold the shape of the bottom of the triangle when the weight of the corner control vertices change.

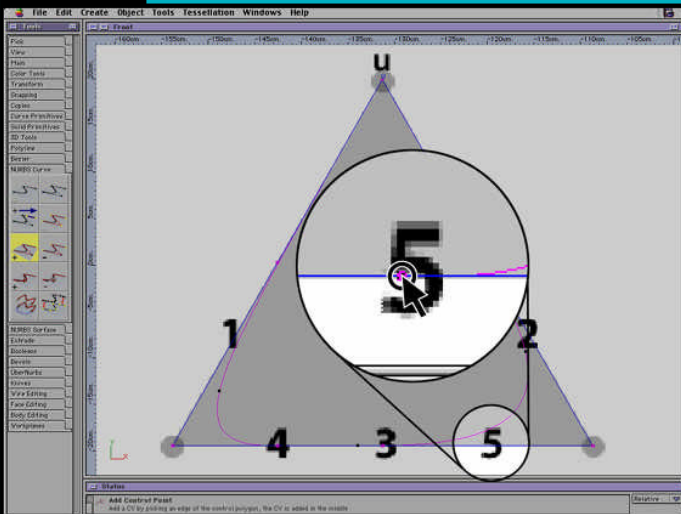




[CLK] on the cage where it intersects the number 4 position.

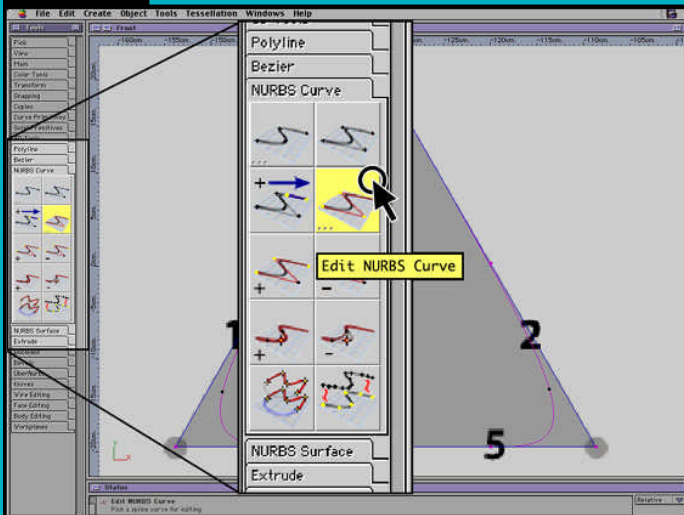
Note: Another control vertex is added here for finer control of the shape. Although control vertices could have been added near the number 1 and 2 positions, the control vertex at the U position is already at a sharp angle. There is no need for further control on the sides of the triangle.





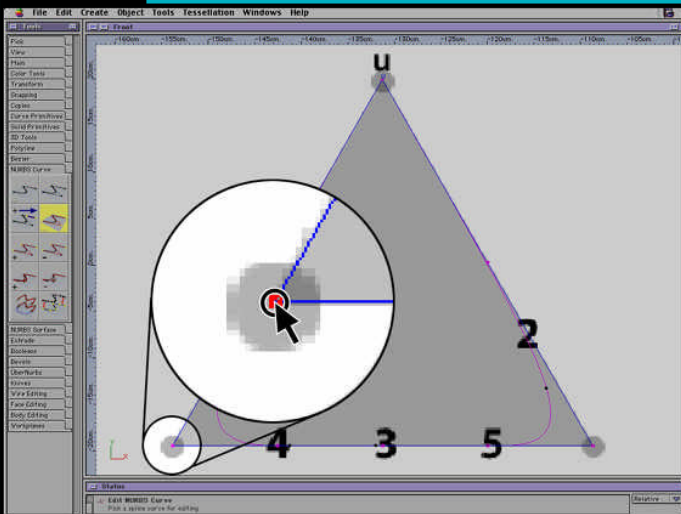
[CLK] on the cage where it intersects the number 5 position.





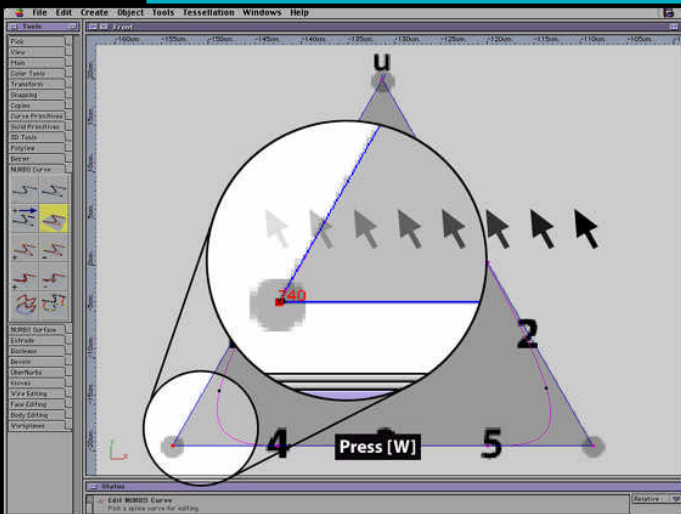
In the NURBS Curve palette, select the Edit NURBS Curve tool.





[CLK] on the control vertex to highlight it. The control vertex will turn red.

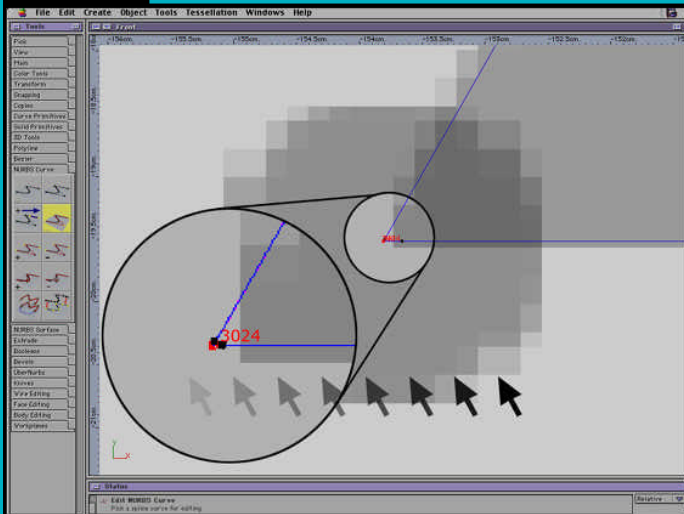




Hold down **[W]** and **[CLK+DRG]** anywhere in the window. A number next to the control vertex indicates the weight. Dragging to the right increases the weight while dragging to the left decreases it. Weight this control vertex to around 740.

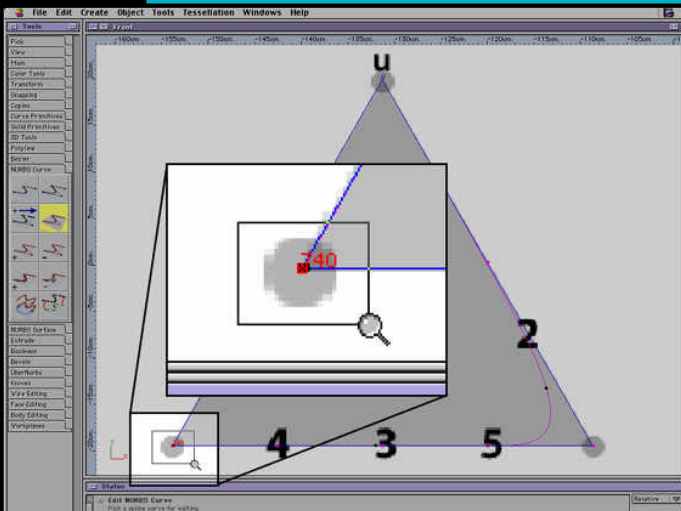
Note: When weighting Control vertices, notice that the inner line moves. The larger the weight number, the tighter the line will be to the weighted control vertex. The lesser the number, the more rounded the inner line will be.





Note: When weighting control vertices, never weight the control vertices so much that the knots (the black dots along the inner line) touch or cross over each other. If this happens, errors will result when using other tools.

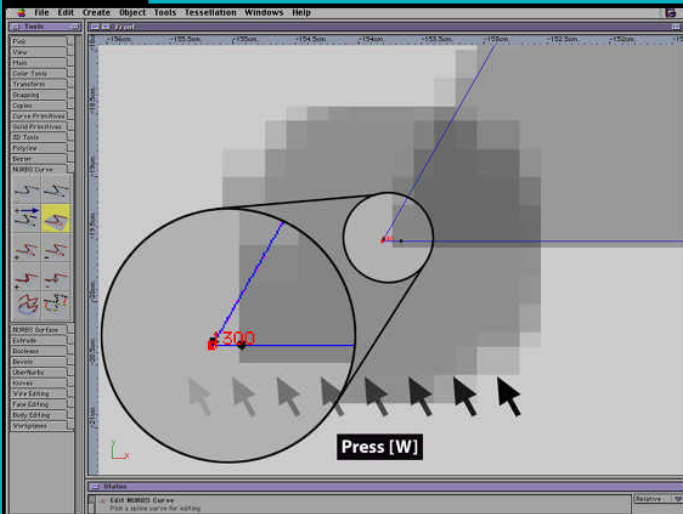




To fine tune this corner and to make sure the knots do not touch or cross over, [**OPT/ALT+DRG**] a rectangle around the lower left corner.

Note: The cursor turns into a magnifying glass when [**OPT/ALT**] is pressed.



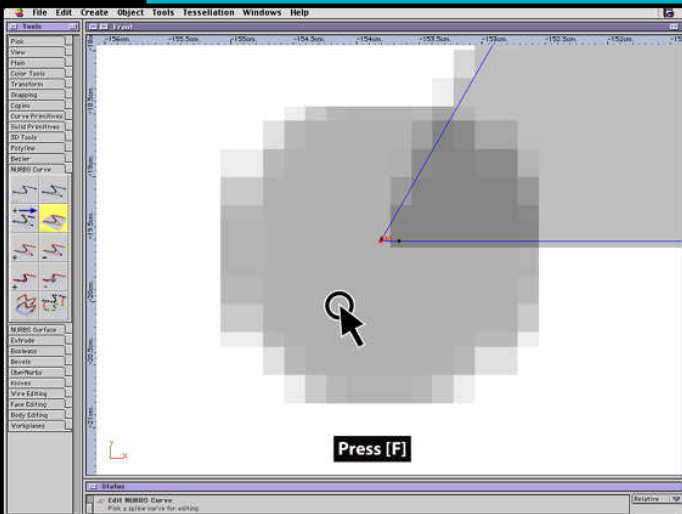


[CLK] on the control vertex to select it.

Hold down **[W]** and **[CLK+DRG]** anywhere in the window to increase the weight to around 1220.

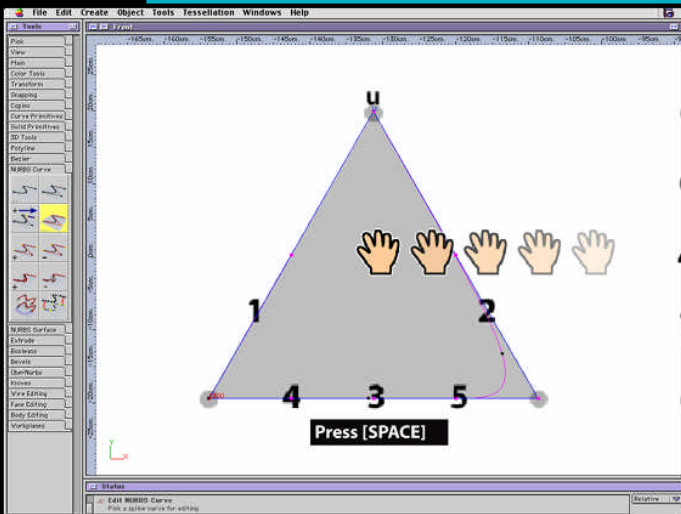
Note: To form a really tight, sharp corner, use more control vertices near the corner you are weighting.





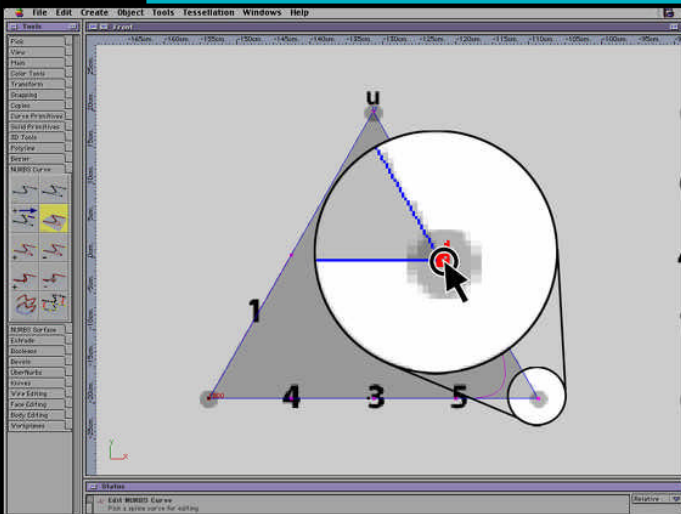
Press [F] and [CLK] anywhere in the window.





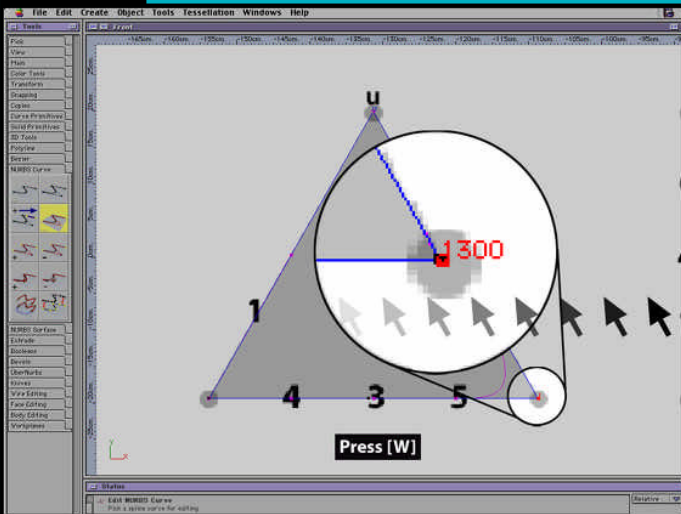
[SPACE] and [CLK+DRG] to the right in the window.





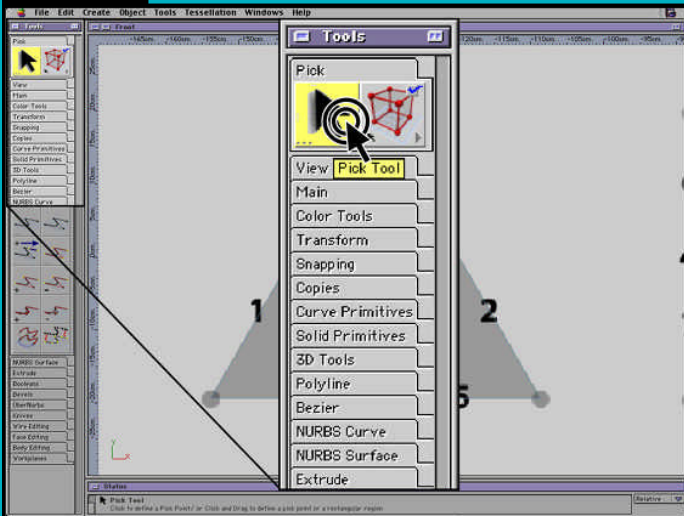
[CLK] on the lower right corner control vertex to select it.





Press **[W]** and **[CLK+DRG]** to the right to increase the weight of this CV to approximately 1300.



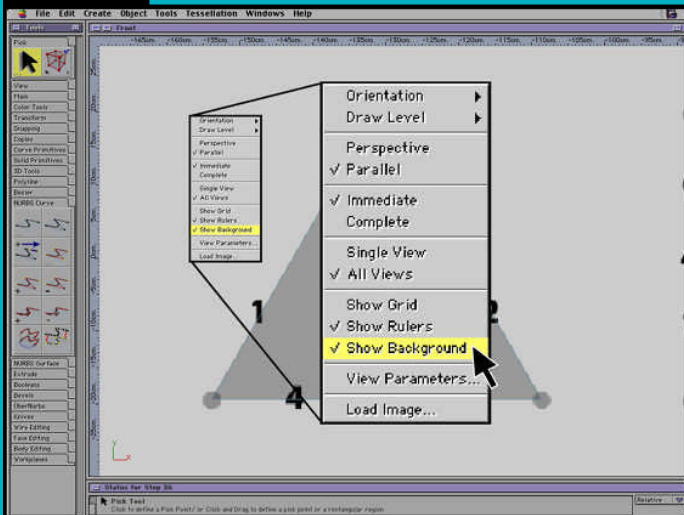


In the Tools palette, open the Pick palette.

[DBL+CLK] to select the Pick Tool.

Note: The Pick Tool did not highlight with the initial click, because the first click commits all of our actions to the NURBS curve. The second **[CLK]** actually selects the tool. **[DBL+CLK]** in the empty space will produce the same result.

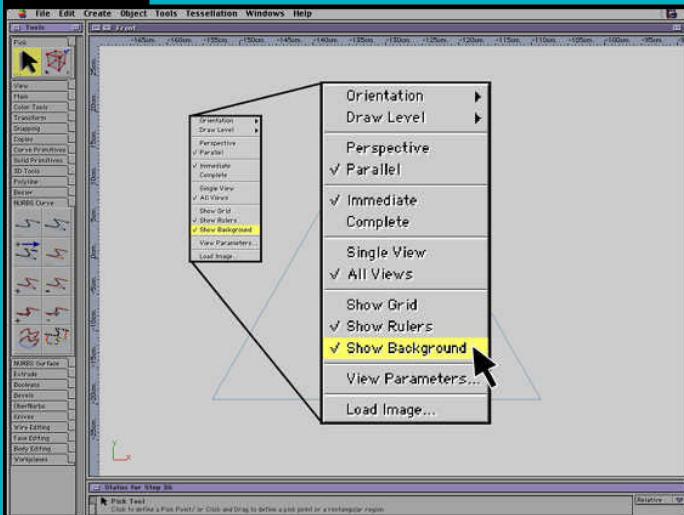




[**CTRL**/**R**+**CLK**] in the window.

Select Show Background to toggle off the underlay.

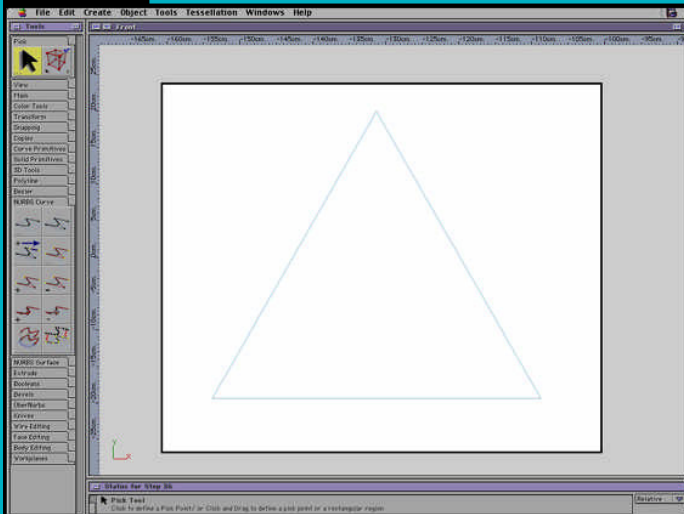




[**CTRL**/**R**+**CLK**] in the window.

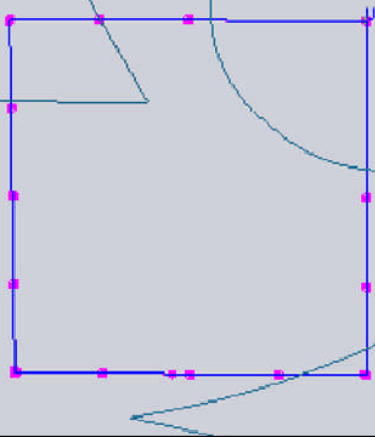
Select Show Background.





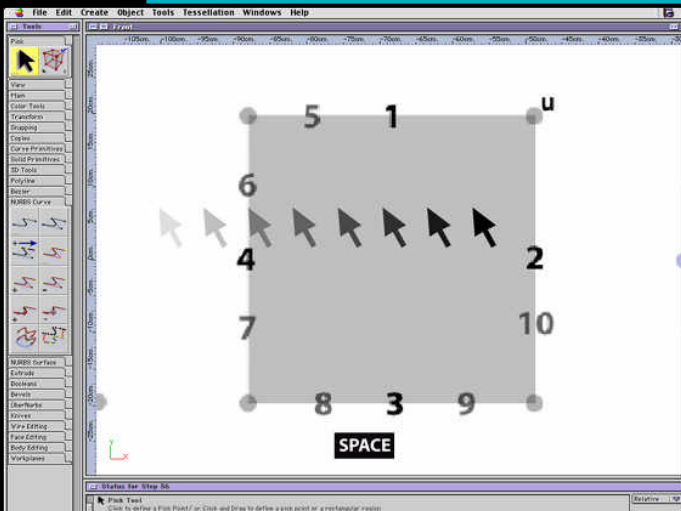
Congratulations, you have now created a triangle.





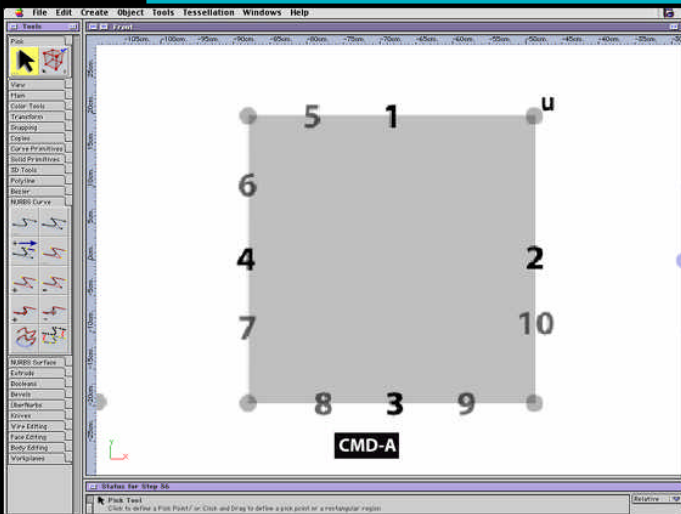
The next shape is a square. We will take our existing triangle and reshape the NURBS Curve so that it resembles a square. In this section we will move CVs around, add more CVs and adjust the weights to form the shape of a square.





[SPACE] and [CLK+DRG] to the left in the window and center the next shape, the square.

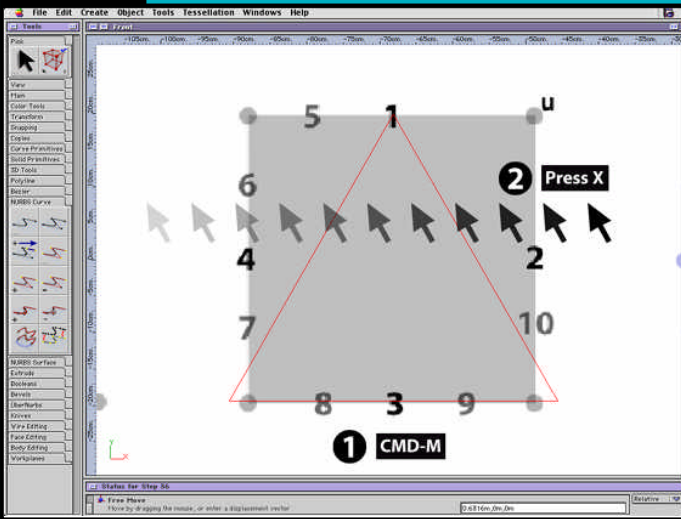




Select the Pick Tool if it is not already selected.

[**CMD/CTRL+A**] to select the off-screen triangle shape that was created previously.



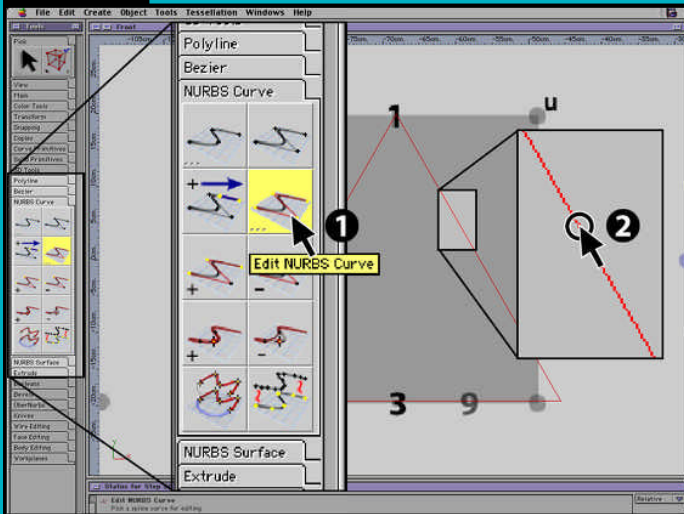


[**CMD/CTRL**+**M**] to select the Free Move tool.

Press [**X**] and [**CLK+DRG**] anywhere in the window to move the triangle shape to center it over the square.

Note: Pressing [**X**] constrains the movement to the X axis.

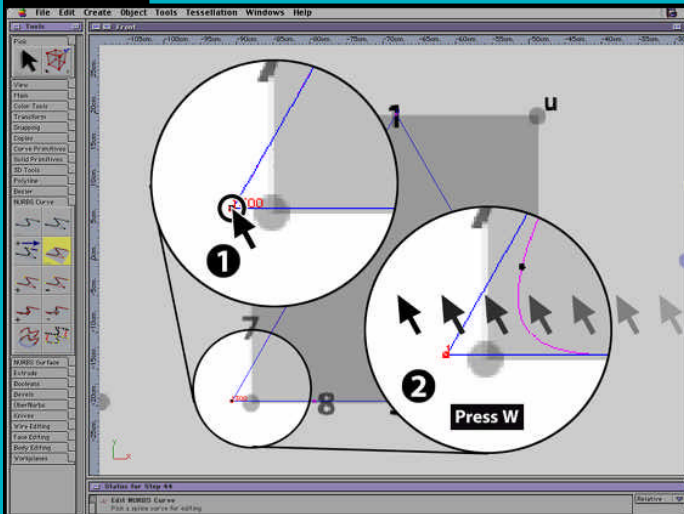




In the NURBS Curve palette, select the Edit NURBS Curve tool.

[CLK] on the triangle shape. It will turn blue.

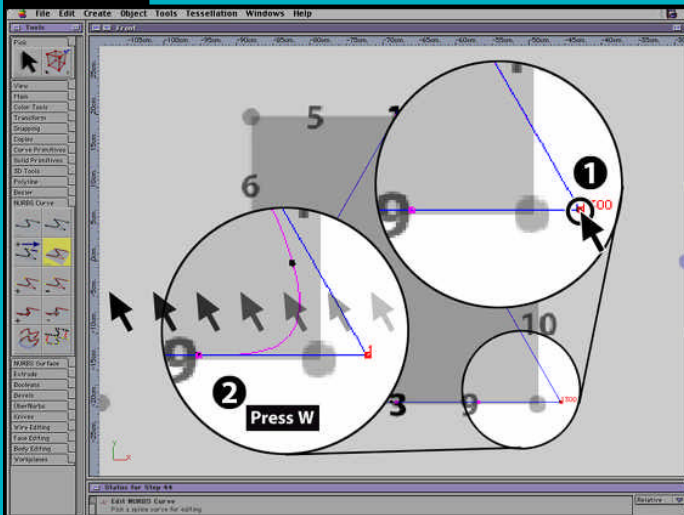




[CLK] on the lower left corner control vertex of the triangle to select it. It will turn red.

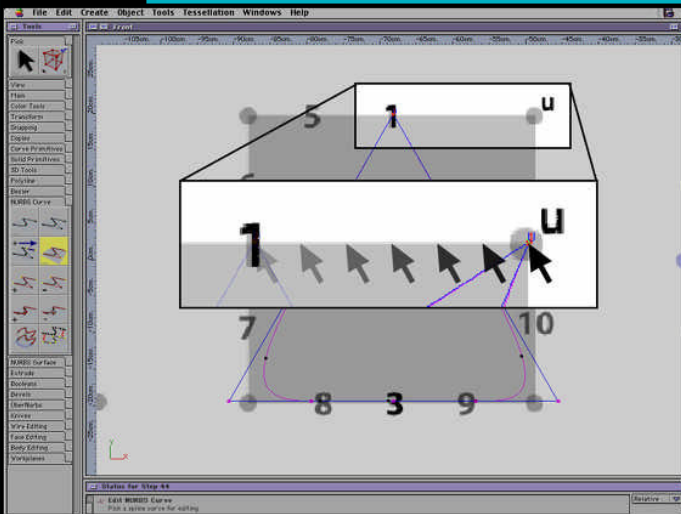
Press **[W]** and **[CLK+DRG]** to the left anywhere in the window. Reduce the weight back down to 1.





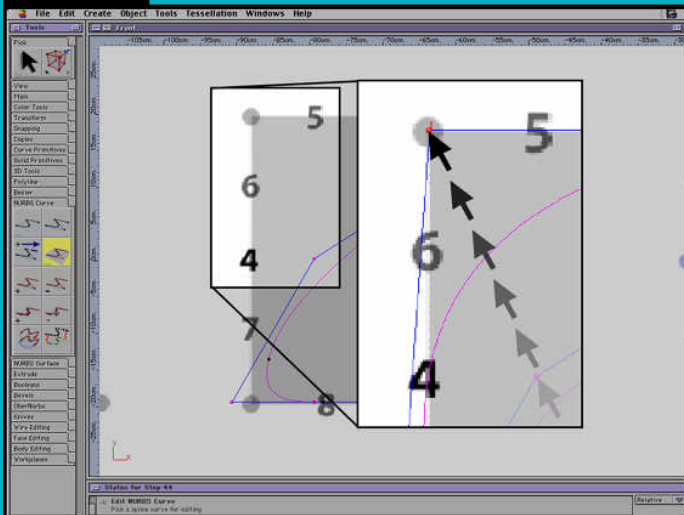
[CLK] on the lower right corner control vertex of the triangle and lower the weight of this control vertex to 1.





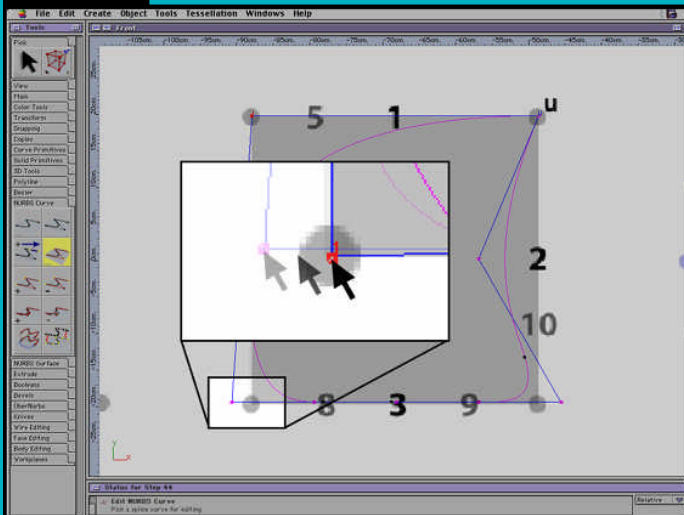
[CLK+DRG] the top control vertex to the right so that it is centered over the gray shaded dot on the top right corner of the square (Near the U).





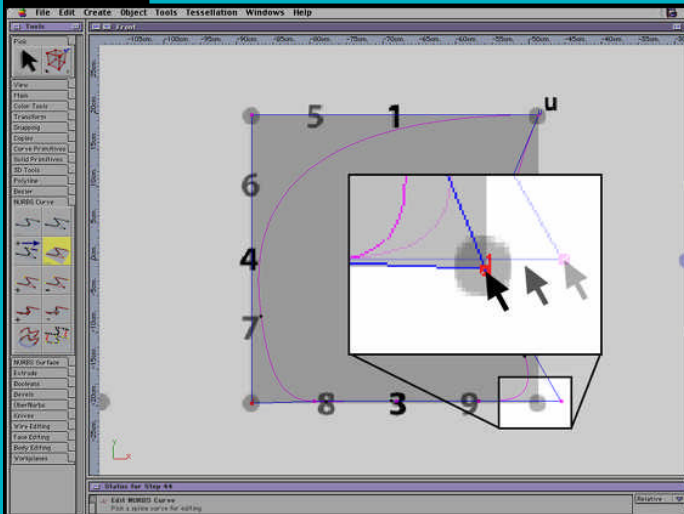
[CLK+DRG] the control vertex near the number 4 position (on the left side) to the top left corner so that it is centered over the gray shaded dot.





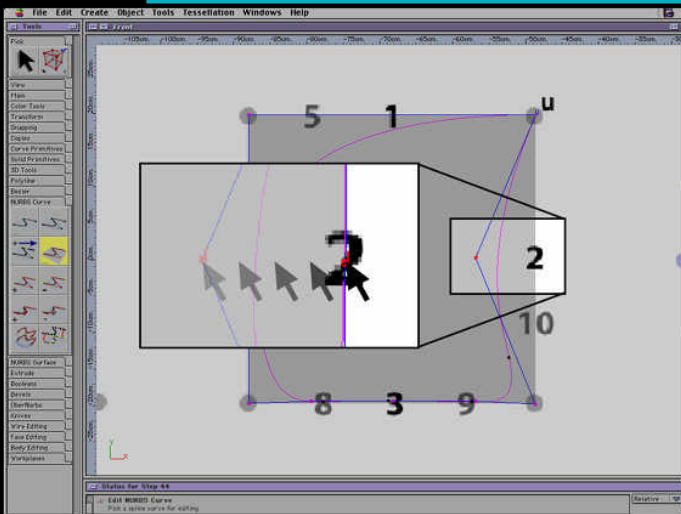
[CLK+DRG] the bottom left control vertex to the right so that it is centered over the gray shaded dot on the bottom left corner of the square.





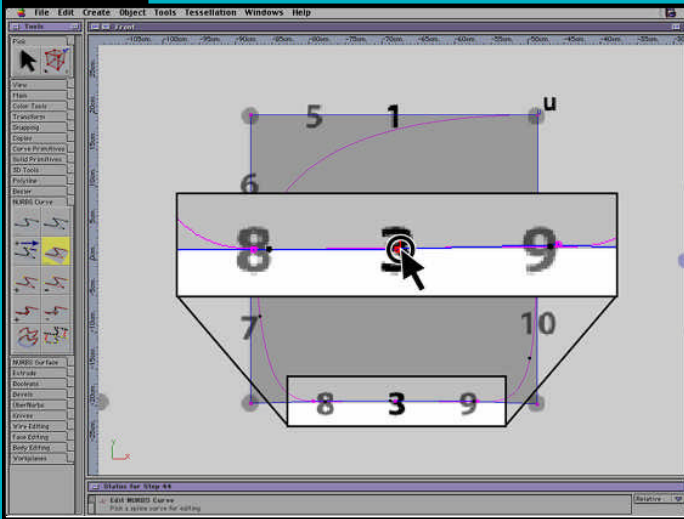
[CLK+DRG] the bottom right control vertex in to the left so that it is centered over the gray shaded dot on the bottom right corner of the square.





[CLK+DRG] the control vertex above the bottom right control vertex to the number 2 position.

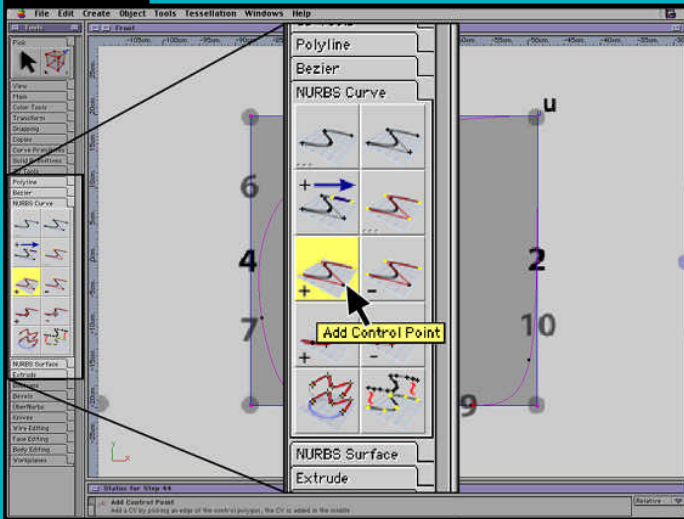




If needed, adjust the control vertices at the number 8, 3 and 9 positions down a bit so that a straight line forms between the lower left corner and lower right corner.

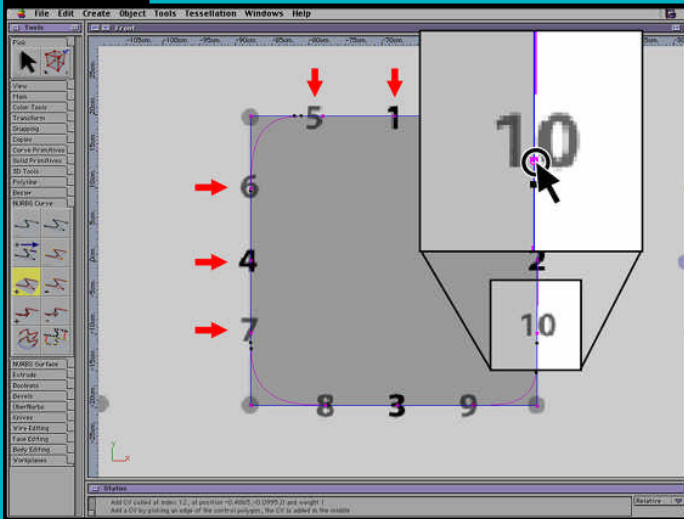
Note: The straight line will be the blue wire cage surrounding the pink curve.





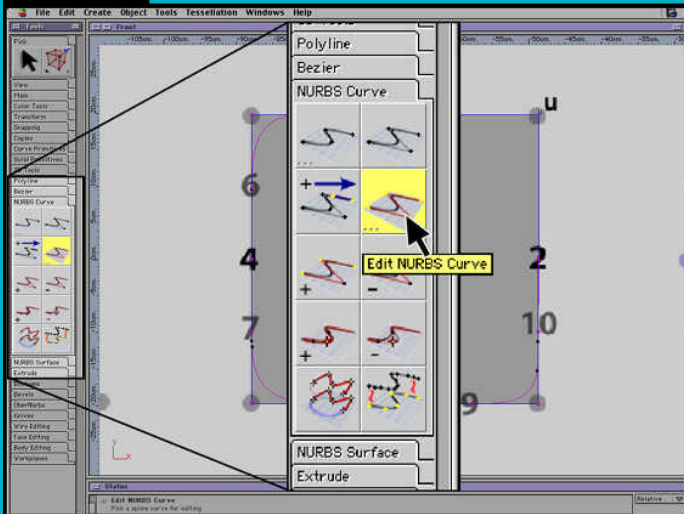
In the NURBS Curve palette, select the Add Control Point tool.





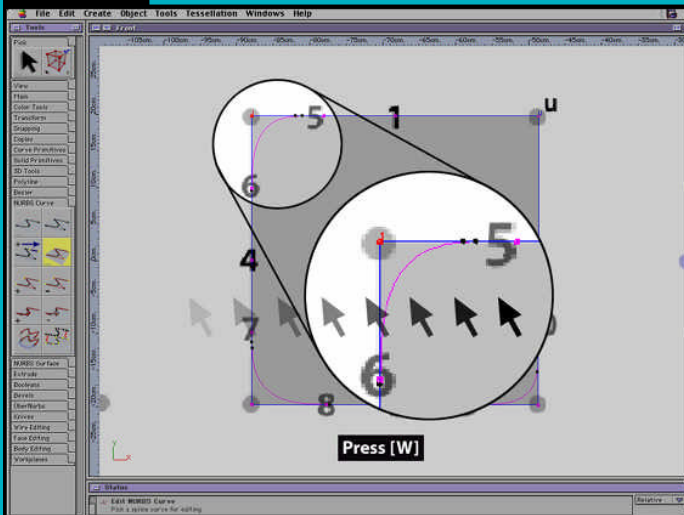
[CLK] on the edit cage where the numbers 1,4,5,6,7,and 10 are on the underlay to add control vertices at these areas.





In the NURBS Curve palette, select the Edit NURBS Curve tool.

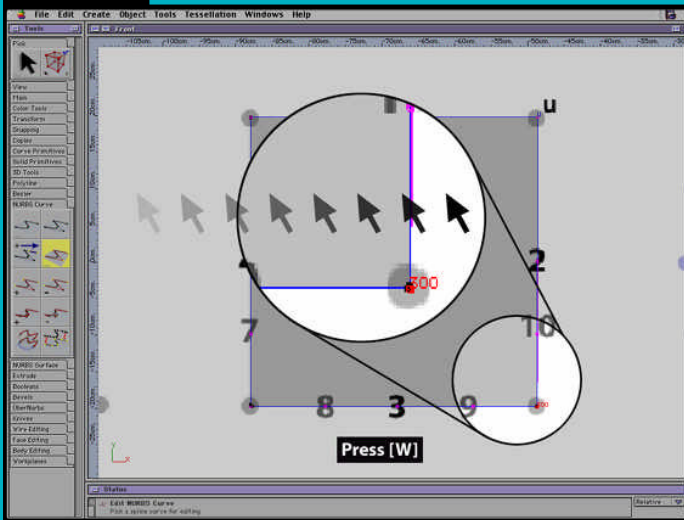




[CLK] on the control vertex in the top left corner to highlight it.

Press [W] and [CLK+DRG] to the right to increase the weight of this control vertex to 300.

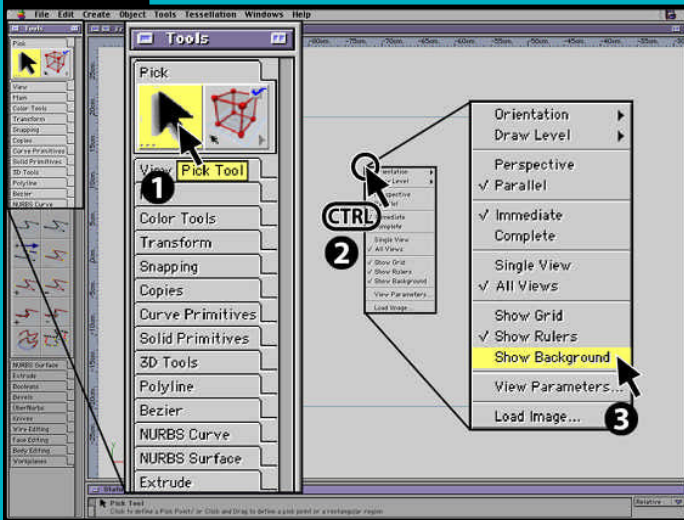




On the bottom left and right corners, increase the weight of each control vertex to approximately 300 respectively.

Note: The weight of the control vertex with the letter U does not need to be adjusted, since it already is a sharp angle .





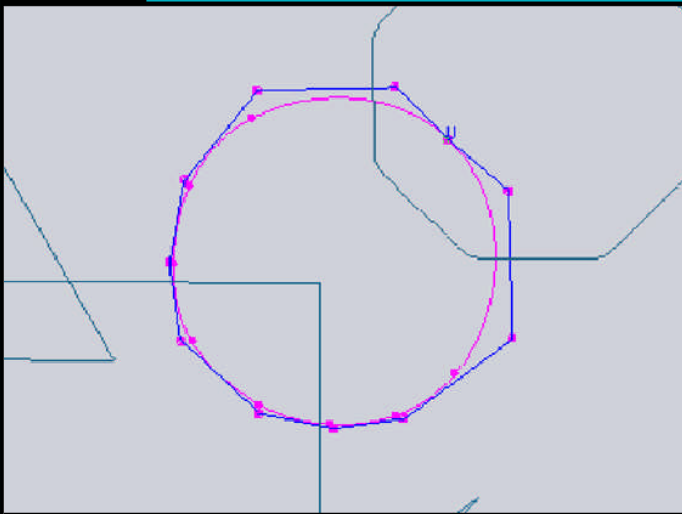
Select the Pick Tool from the Pick Tool palette.

[**CTRL/R+CLK**] anywhere in the view window.

Select Show Background to hide the background.

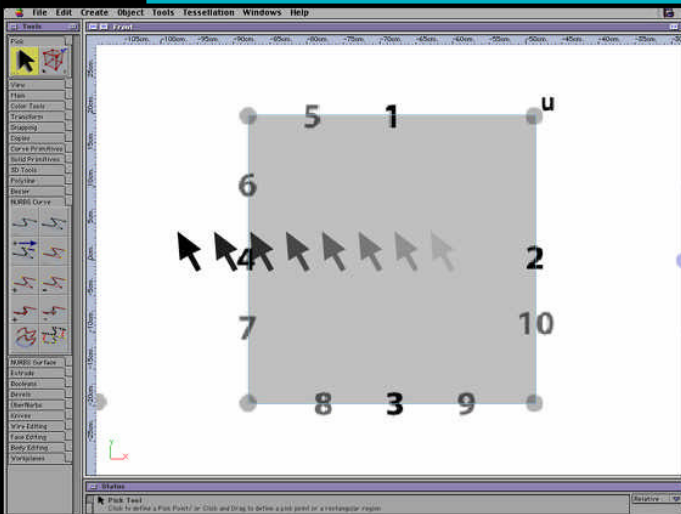
When finished viewing the shape, turn the background image back on.





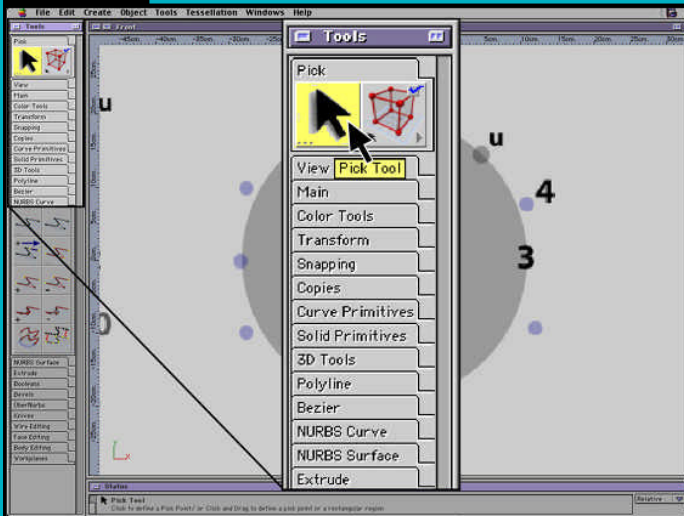
The next shape is a circle. This may seem more challenging than it really is. In this section we will remove some CVs, reduce the weight of the CVs, then reposition the CVs to form the shape of a circle.





[SPACE] and [CLK+DRG] to the left in the window and center the next shape, the circle.

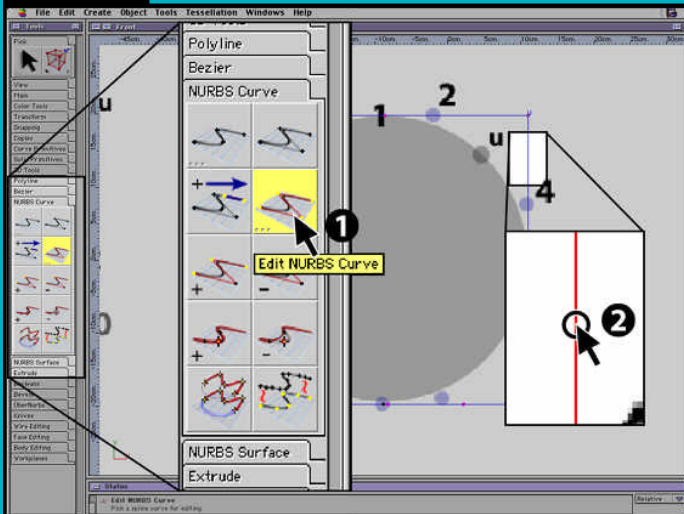




Open the Pick Tool palette.

Select the Pick Tool if it's not selected already.

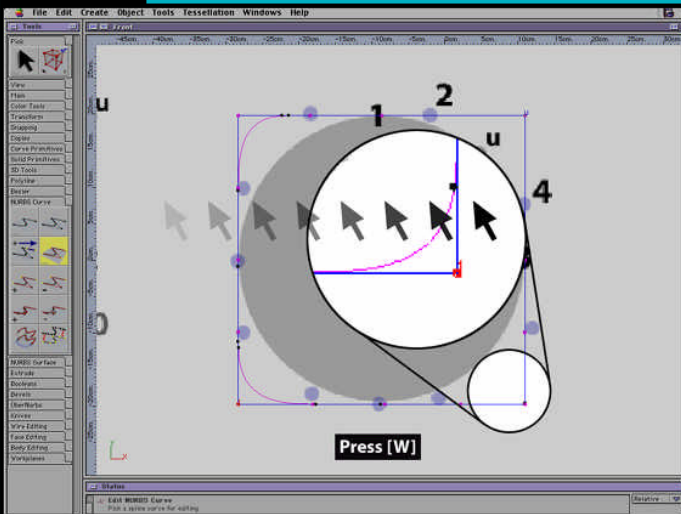




In the NURBS Curve palette, select Edit NURBS Curve tool.

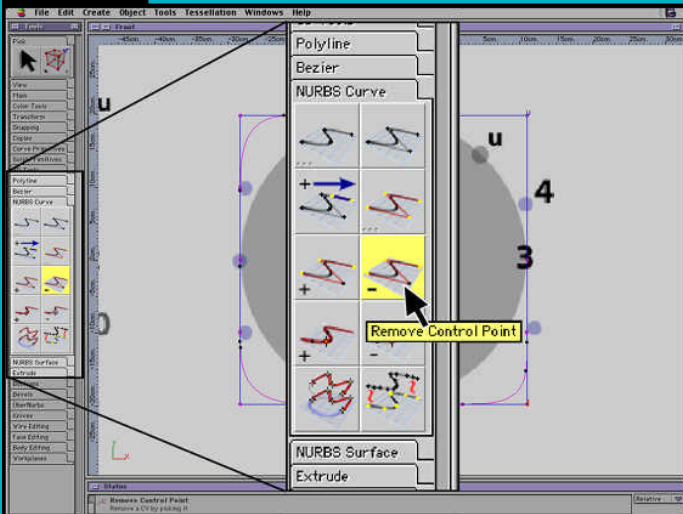
[CLK] on the square shape.





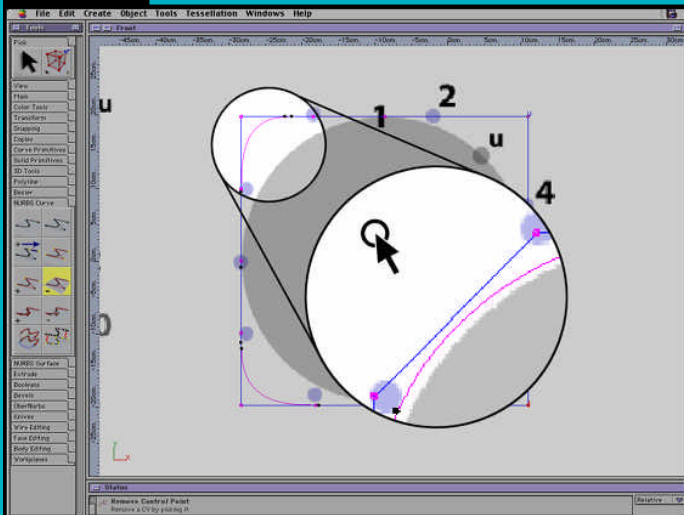
Decrease the weight of each corner control vertex to 1.





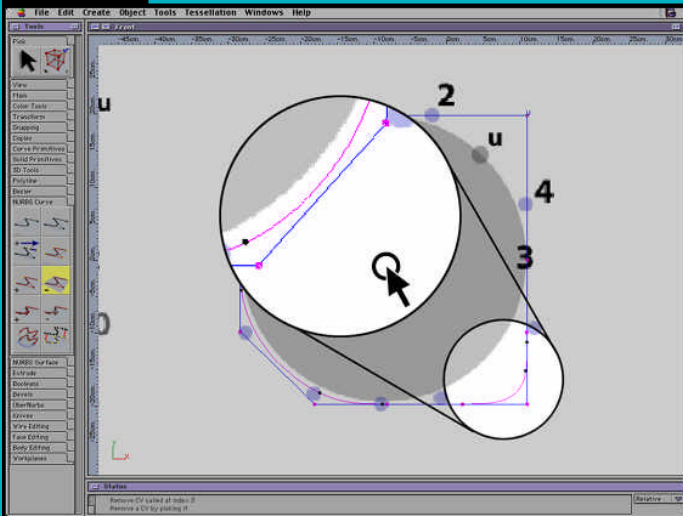
In the NURBS Curve palette, select the Remove Control Point tool.





[CLK] on the top left-hand corner control vertex to remove it.

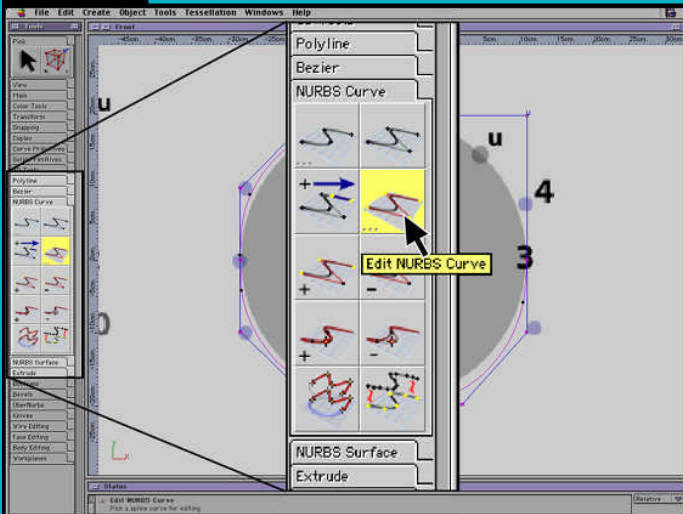




[CLK] on the bottom left-hand corner control vertex.

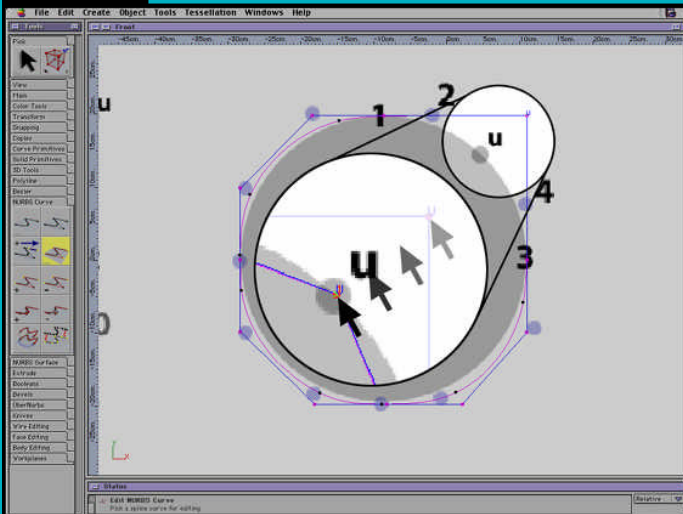
[CLK] on the bottom right-hand corner control vertex to remove these vertices.





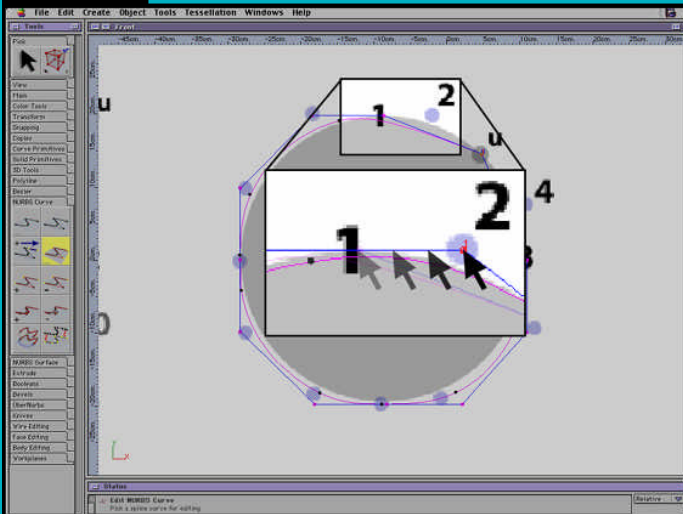
In the NURBS Curve palette, select the Edit NURBS Curve tool.





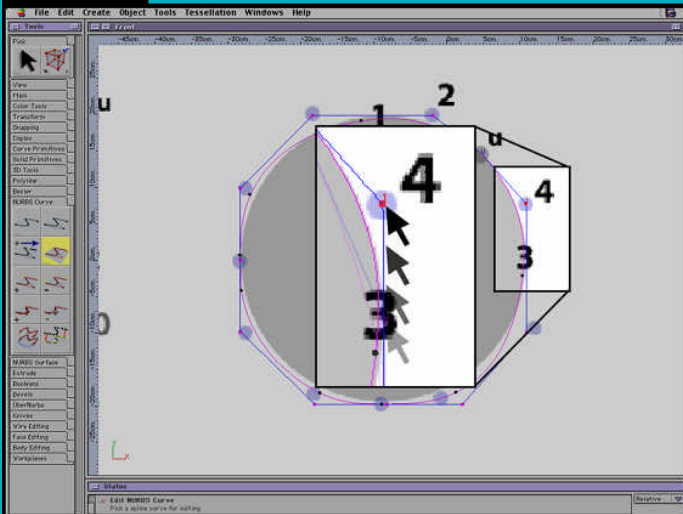
[CLK+DRG] the top right-hand corner control vertex (next to the U) down to the U gray shaded dot on the template.





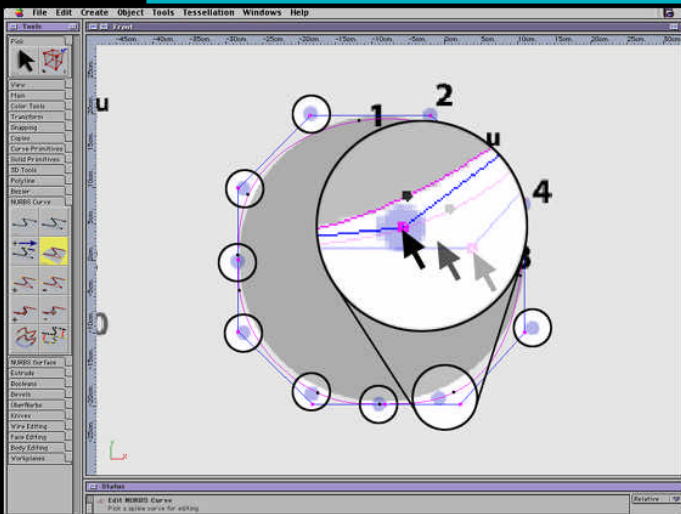
[CLK+DRG] the control vertex at the number 1 position to the number 2 blue shaded dot position.





[CLK+DRG] the control vertex at the number 3 position to the number 4 blue shaded dot position.

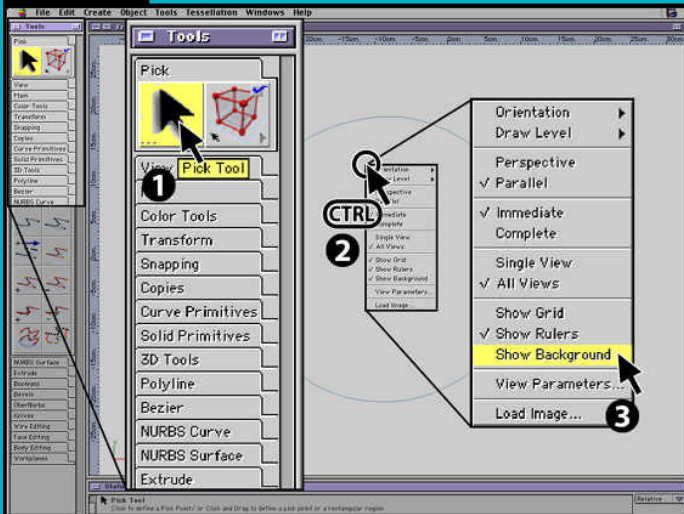




Adjust the other control vertices to their closest blue shaded dots to form the circle.

Note: For the circle to look like a circle, the placement of your CV's may not line up exactly with the underlay.





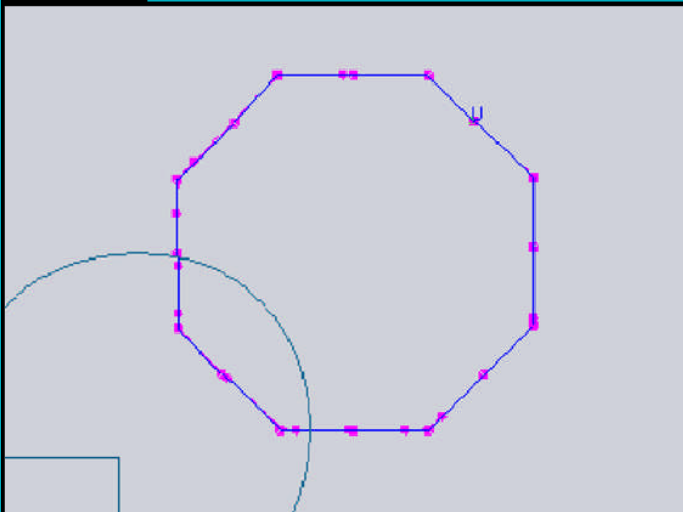
Select the Pick Tool from the Pick Tools palette or **[DBL+CLK]** in the empty space.

[CTRL/R+CLK] anywhere in the view.

Select Show Background to hide the background.

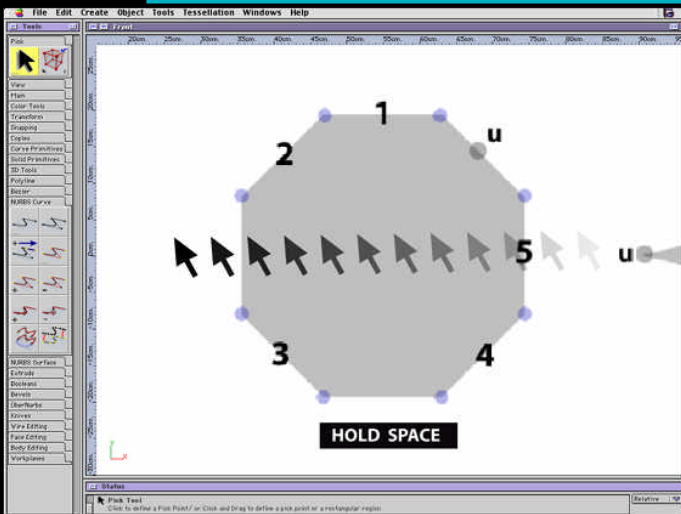
When finished, turn the background image back on.





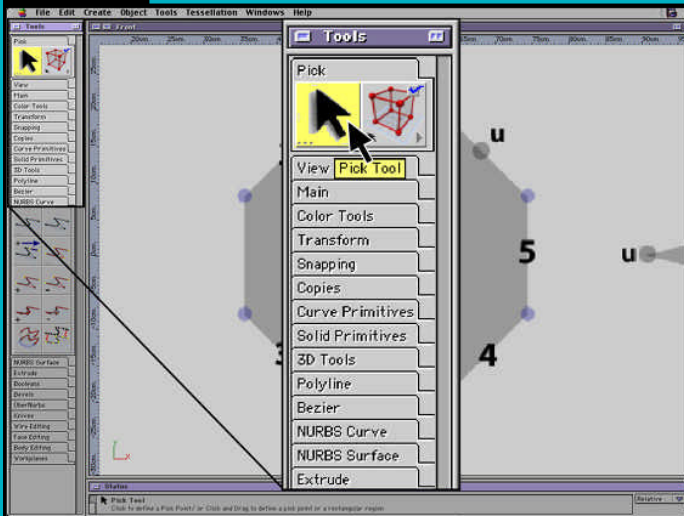
The next shape is an octagon. In this section of the tutorial we will reposition the CVs, add some new CVs, and adjust the weight of the CVs to form the octagon.





[SPACE] and [CLK+DRG] to the left in the window and center the next shape, the octagon.

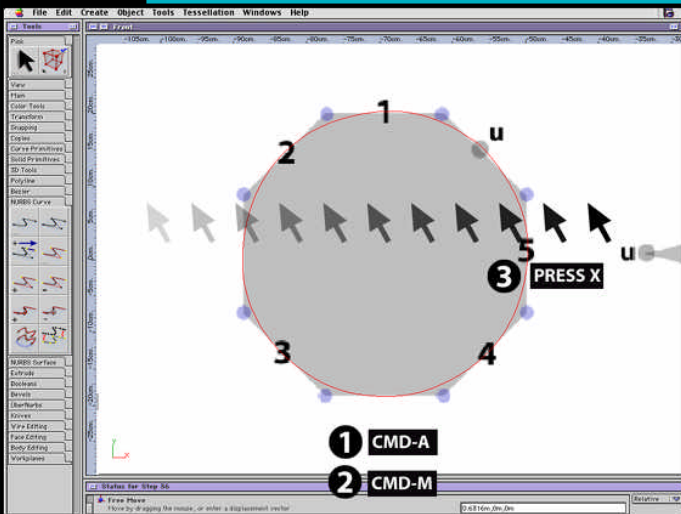




Open the Pick Tool palette.

Select the Pick Tool.



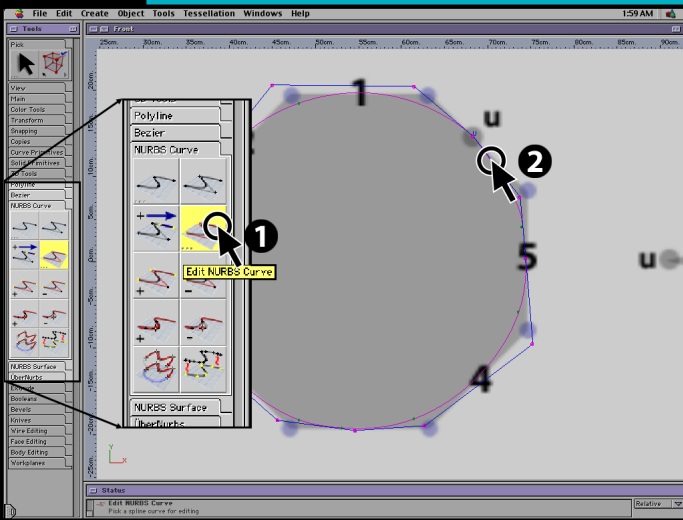


[CMD+A] to select the circle shape.

[CMD+M] to select the Free Move tool.

Press [X] and [CLK+DRG] anywhere in the window and move the circle shape so that it is centered over the octagon.

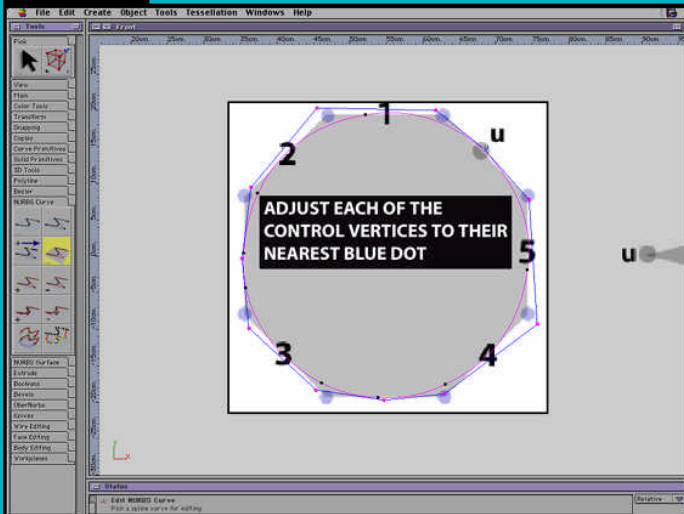




Select the Edit NURBS Curve tool from the NURBS Curve palette.

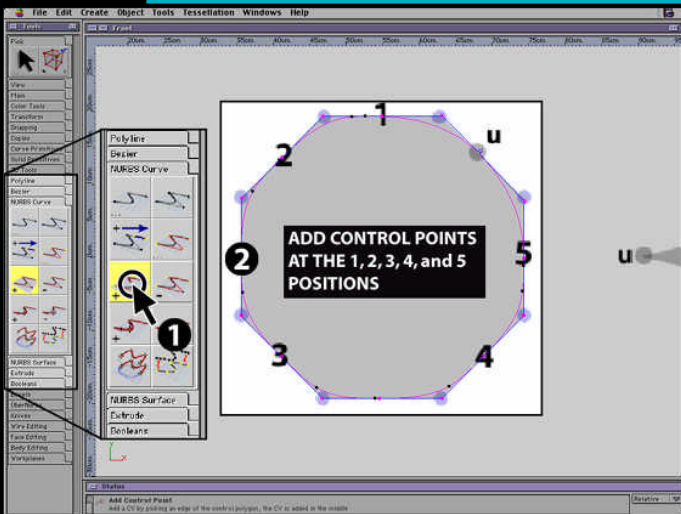
[CLK] on the circle shape.





Adjust each of the control vertices to their nearest blue shaded dot, making sure that there is a straight line connecting each corner. You may need to adjust the CV's that are in between some of the blue shaded dots.

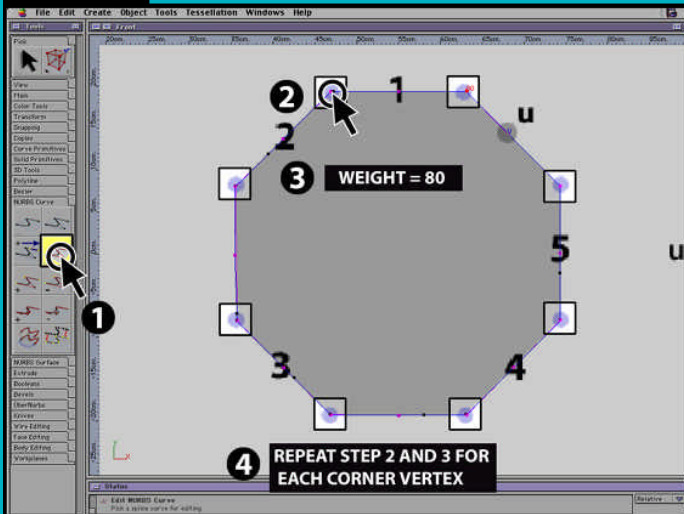




In the NURBS Curve palette, select the Add Control Point tool.

Add control points at the 1,2,3,4,and 5 positions.

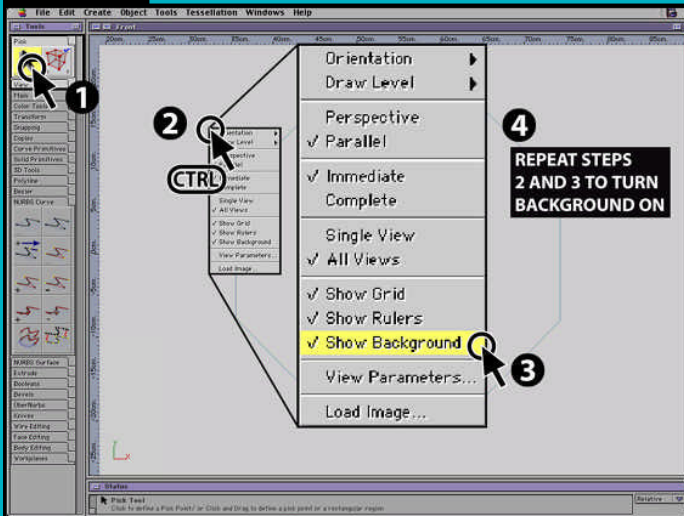




In the NURBS Curve palette, select the Edit NURBS Curve tool.

At each corner where the blue shaded dot is, weight the control vertices to approximately 80.





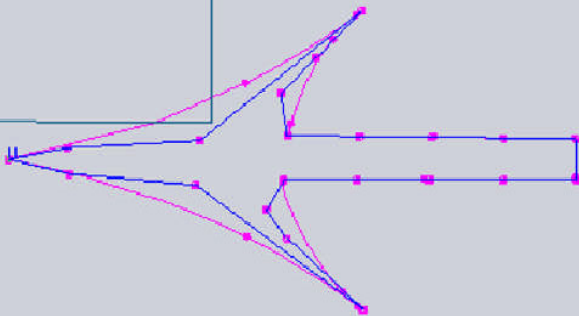
Select the Pick Tool from the Pick Tool palette.

[CTRL/R+CLK] anywhere.

Select the Show Background option to hide the background.

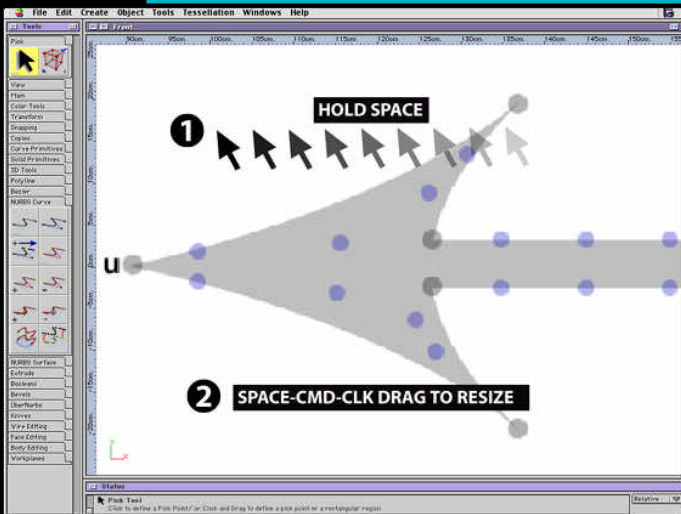
When finished viewing the shape, turn the background image back on.





The bonus shape is an arrow. This shape will be created from scratch using the Create New NURBS Curve from CVs tool. We will start off creating a simple outline of the shape and then modify this shape into the arrow using all of what we have learned so far.

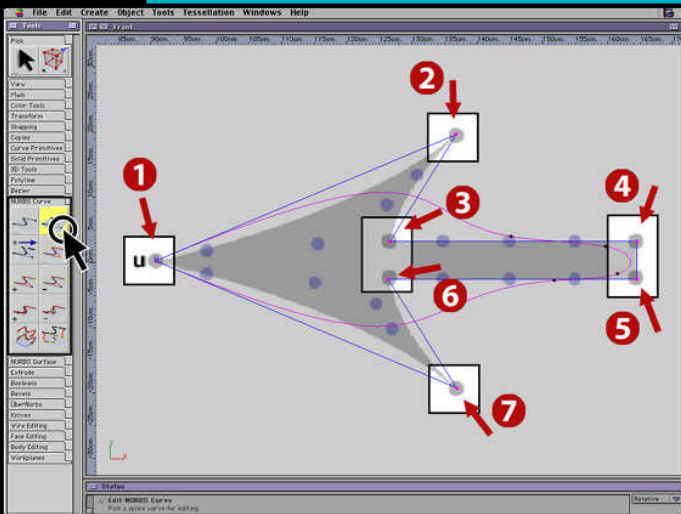




[SPACE] and [CLK+DRG] to the left in the window and center the next shape, the arrow.

To zoom out, [SPACE] and [CMD/CTRL+CLK+DRG] in the window to resize.



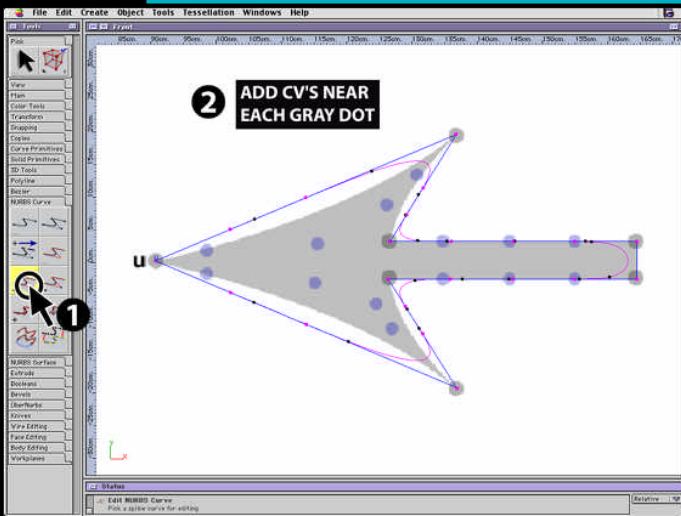


In the NURBS Curve palette, select the Create New NURBS Curve From CVs tool.

Moving clockwise, starting at the point, the U position, **[CLK]** to add control vertices at every gray shaded dot.

[CLK] on the starting control vertex to close the shape.





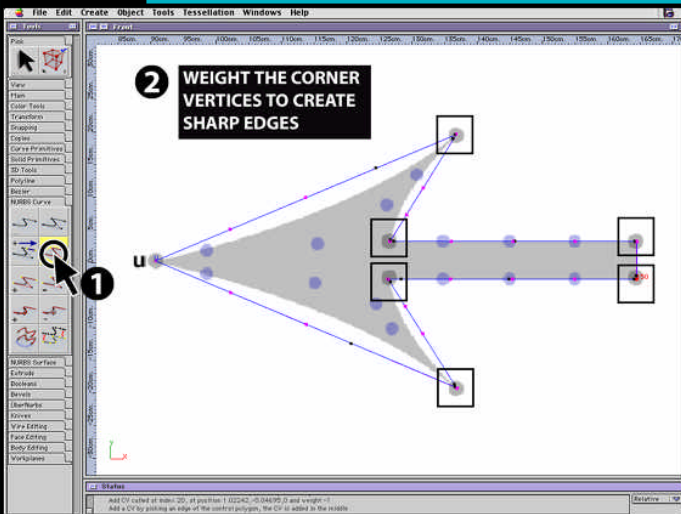
Select the Add Control Point tool from the NURBS Curve palette.

Starting clockwise, on the upper left of the cage, add two CV's on this segment and the next adjacent segment.

On the straight segment add 3 CV 's to both the upper and lower segments.

On the lower part of the arrow, add two CV's on each segment.





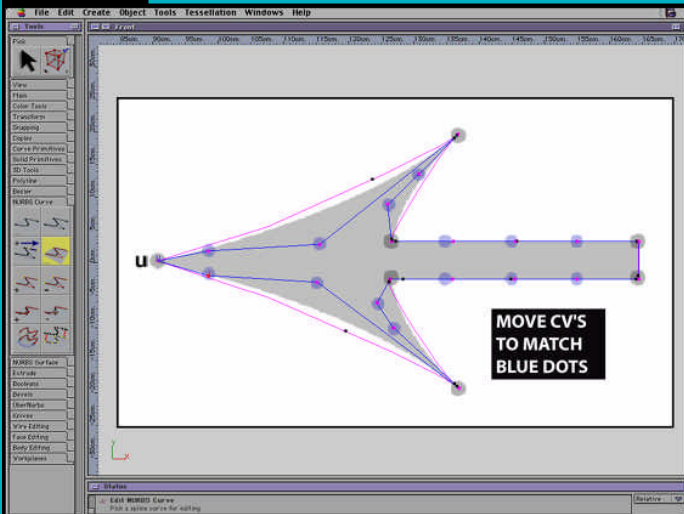
Select the Edit NURBS Curve tool.

Weight the top and bottom, outer gray shaded, CV's to create the sides of the arrow shape.

Weight the inner gray shaded CV's to tighten the angle of the arrowhead and the line section.

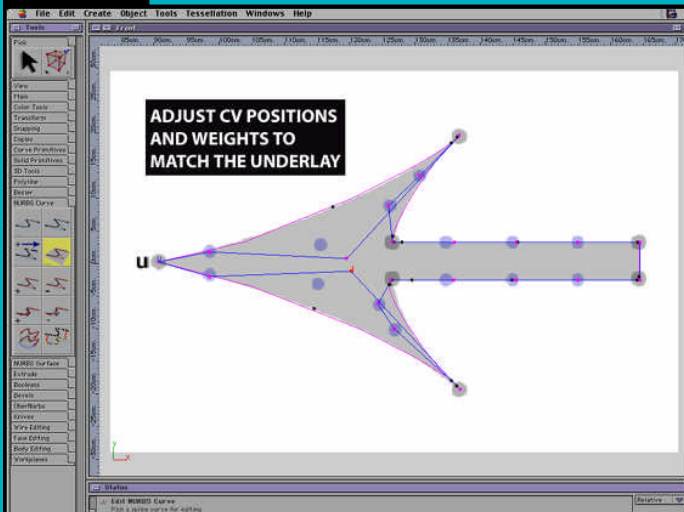
Weight the end gray shaded CV's to straighten out the end section of the arrow shape.





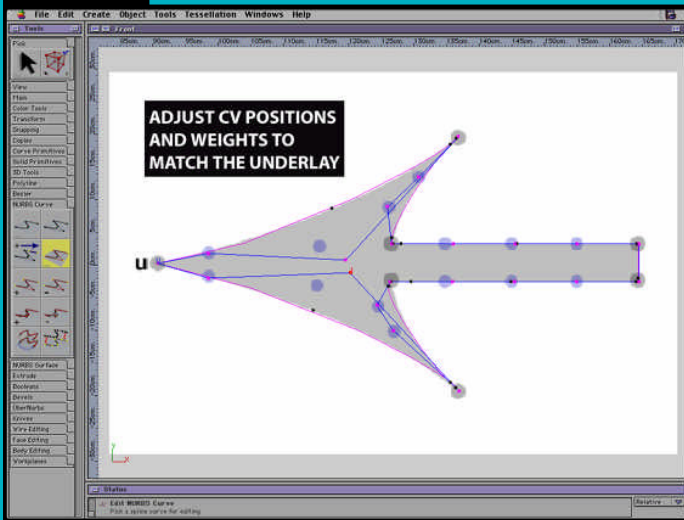
Position the added CV's to the nearest blue shaded dots without crossing the line.





If necessary, re-weight the CV's to a smaller number and, as needed, reposition the CV's to shape the arrow.





[DBL+CLK] in empty space to commit the NURBS action.

In the view window, [CTRL/R+CLK] anywhere.

Select the Show Background option to hide the background.

Very Important Note: You may notice that the NURBS Curve at the top and bottom edges of the arrow overlap. This is a problem. Use the Edit NURBS tool and correct this by reducing the weight of these corners and/or reposition the CV's near this point.

