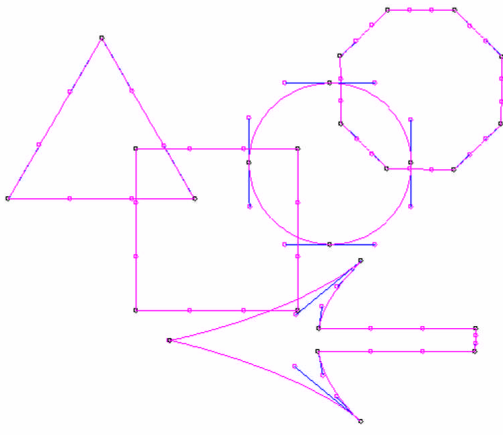


# 1

## Main Overview



In this tutorial, we are going to create a simple object from a single closed bezier curve. Then we will modify the curve into other simple shapes. We will create a bezier curve from scratch in the form of a triangle. We will then change the shape of this bezier curve into a square, a circle, an octagon. Then finally, on your own, you will reshape it into an arrow. Along the way, we will try to familiarize you with most of the tools in the Bezier palette. Most importantly though, we want to give you some basic understanding of how to use a bezier curve.

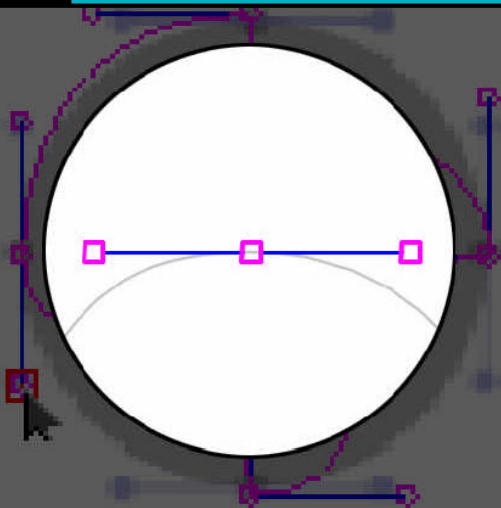


### Overview



## 2

## How a Bezier Curve Works



Bezier curves apply implicit control over a line. This means that instead of controlling every point on a line, you simply adjust control points that affect the outcome of the curve. As you reshape the curve, notice how the handles affect the curve. The curve is always tangent to the handles as it reaches the knot. The length of the handle controls the curve's approach to tangency. Remember from math class that tangency is when a line or curve (the bezier curve we are creating) meets with another line or curve (the handles) at a common point (the knot).

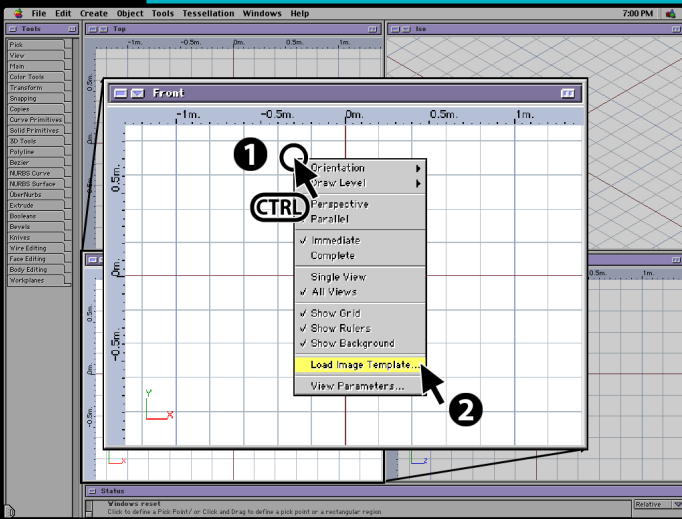
**Overview**



**[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**.

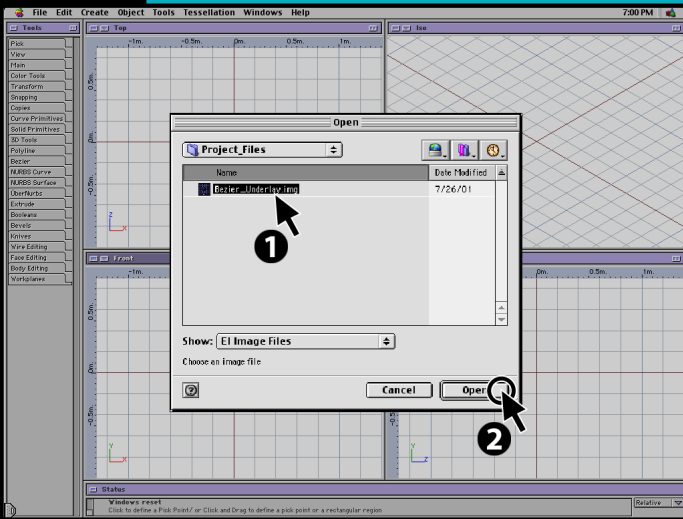




In the Front view window, [**CTRL/R+CLK**] in the window and in the resulting pop-up menu, select “Load Image Template...”

Note: We are going to use an underlay, or template, to assist us in creating our shapes.





Navigate to the Bezier folder.

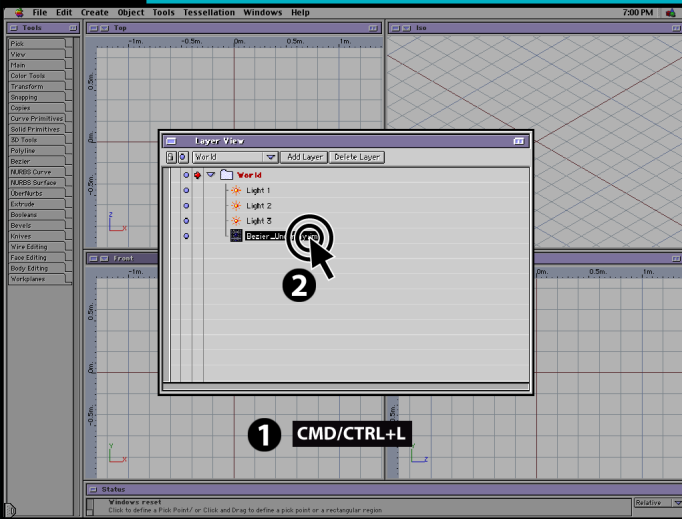
Select Bezier\_Underlay.img file.

[DBL+CLK] the file name, or [CLK] the “Open” button, or press [RTRN] to load the file.



## 6

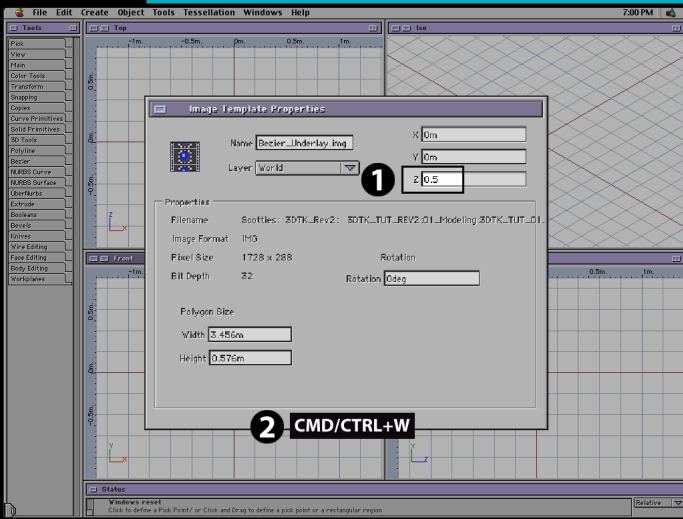
## Underlay Properties Window



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

[**DBL+CLK**] the Bezier\_Underlay.img layer.





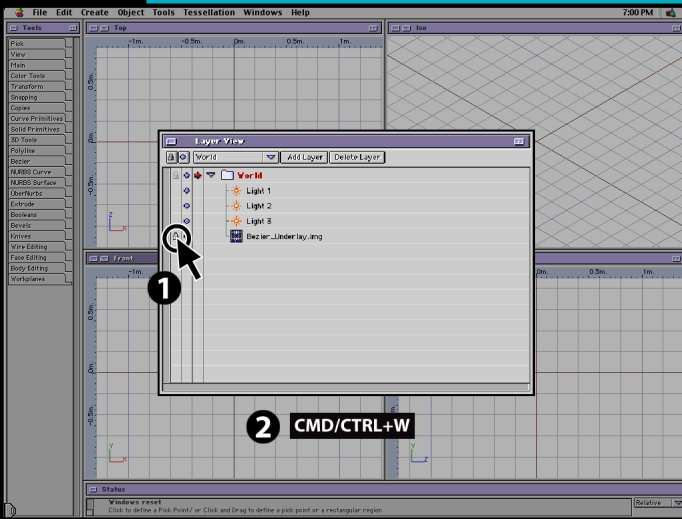
In the Image Template Properties window locate the Z value edit box.

Enter ".5m"

Close the Image Template Property window [**CMD/CTRL+W**].

Note: This moves the underlay back, away from the XY axis plane. We did this so that when we draw our 2D shapes, we can actually see them. If we did not move our underlay, it would obscure the lines we draw and make it difficult to proceed in our work.





In the Layer View window, on the Bezier\_Underlay.img layer, **[CLK]** in the column to the left of the blue ball (the visibility column).

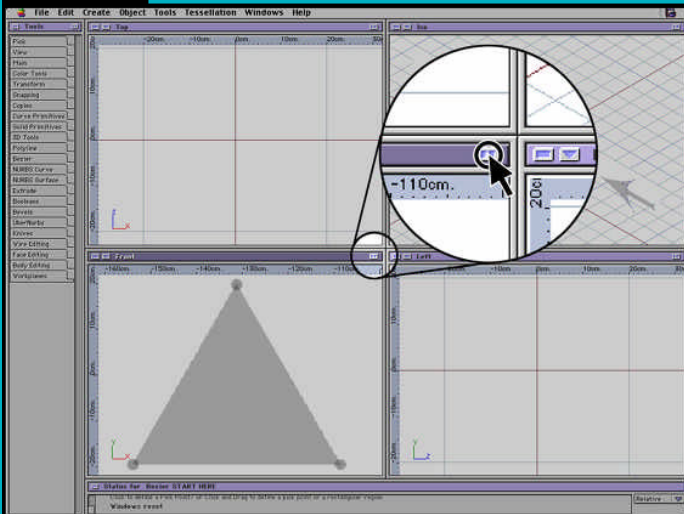
A lock should appear.

Note: This layer is now locked. We locked this layer so that you cannot accidentally select it and move it around while performing this tutorial.

Close the Layer View window **[CMD/CTRL+W]**.







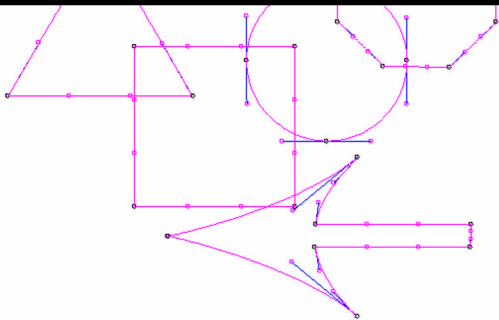
**[CLK]** on the button in the upper right of the Front View window.

Note: All of this tutorial will take place in the Front View window only.



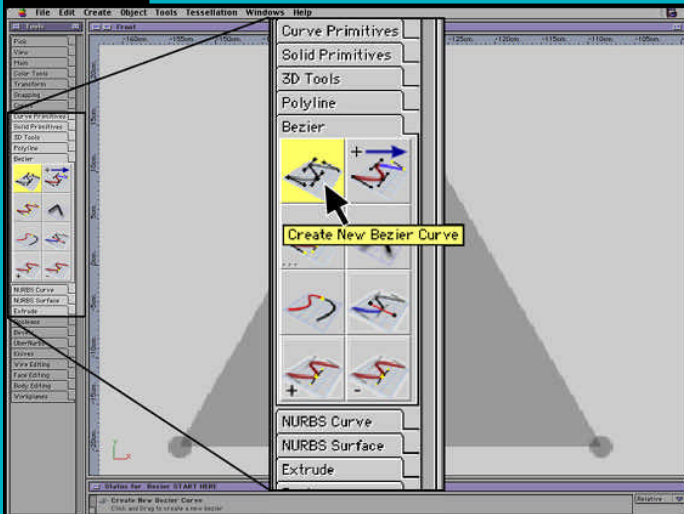
## Bezier

## Overview



The first shape we will create is a Triangle. We will outline the underlay, using the Create New Bezier tool. Next we will use the Smooth/Cusp tool to polish off the edges .

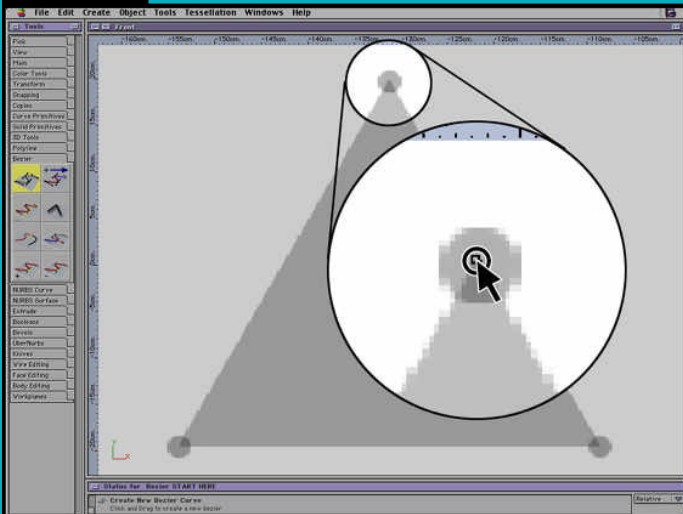




[CLK] on the Bezier palette to open it.

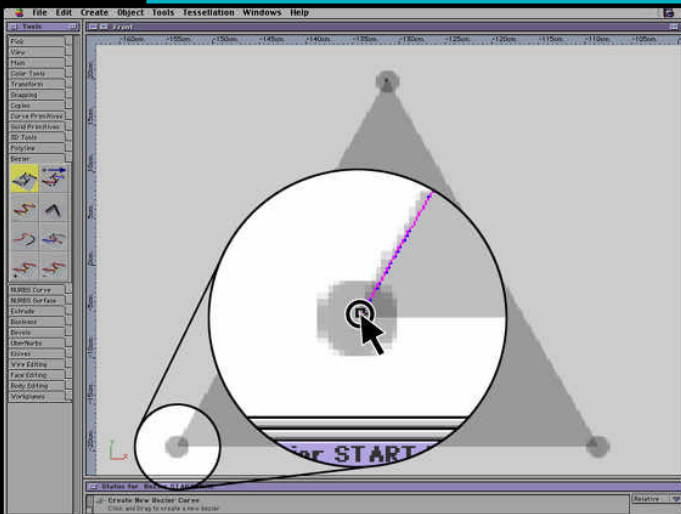
Select the Create New Bezier Curve tool.





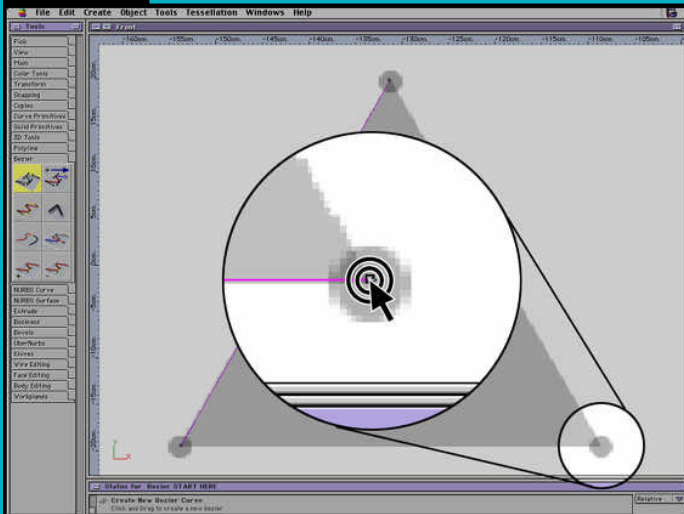
[CLK] on the top point of the triangle to add a knot.





[CLK] on the lower left point of the triangle to add a second knot.

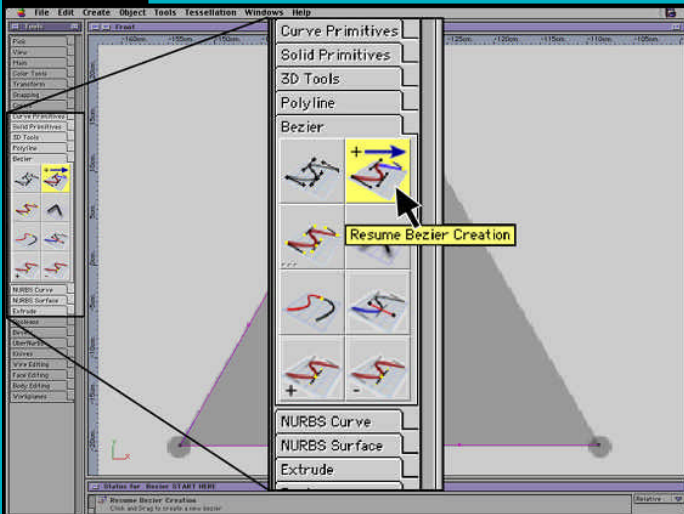




[DBL+CLK] on the lower right point to add a knot.

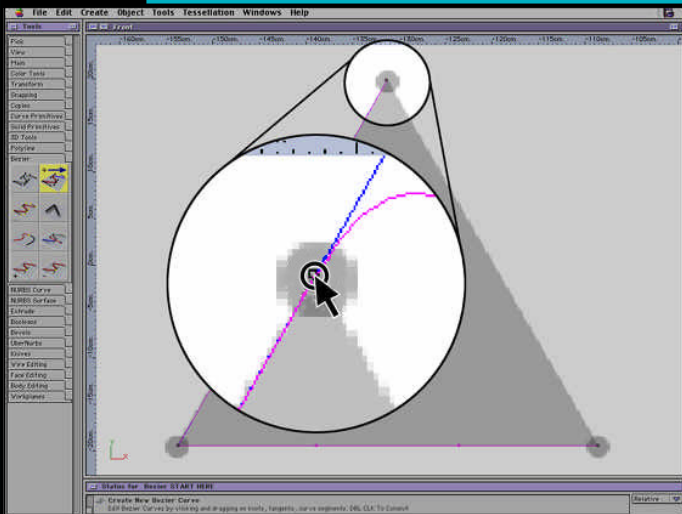
Note: We end the creation of our curve when we [DBL+CLK]. The tool automatically switches to the Edit Bezier tool. We can now edit this line if needed. The reason we ended our line here is to show you how to resume creating a line, in case we accidentally change into Edit Bezier mode.





**[CLK]** on the Resume Bezier Creation tool in the Bezier palette while the curve is highlighted and the Edit Bezier tool is selected.

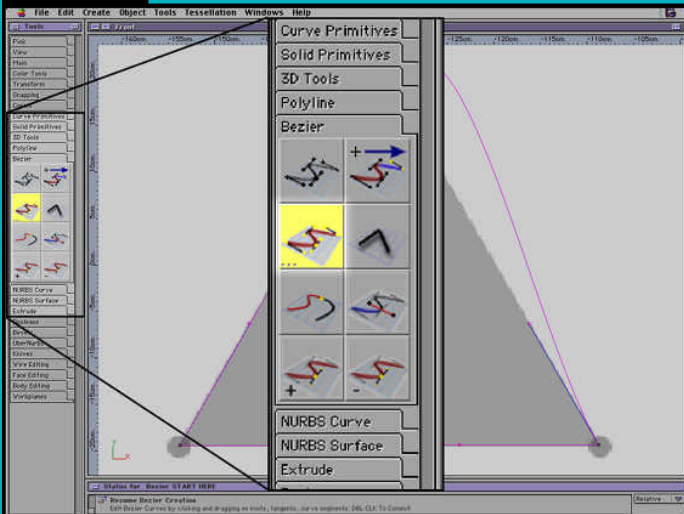




[CLK] on the first knot located at the top of the triangle.

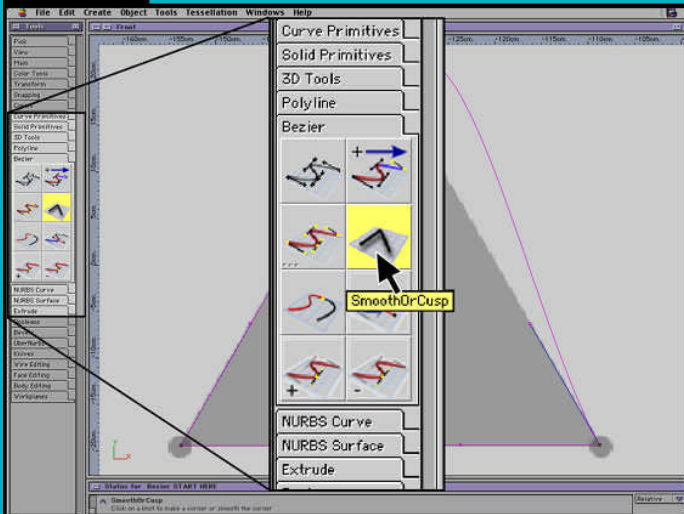






**NOTE:** When we close a shape, the bezier curve immediately goes into edit mode. Notice again that the Edit Bezier tool is selected in the Bezier palette.

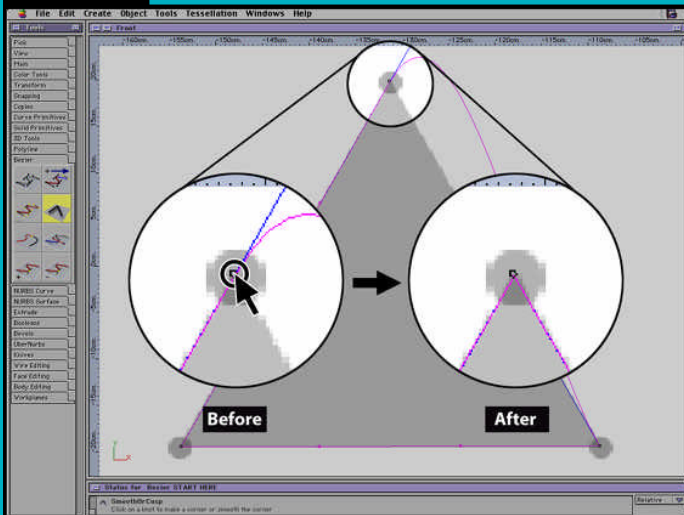




[CLK] on the SmoothOrCusp tool in the Bezier palette.

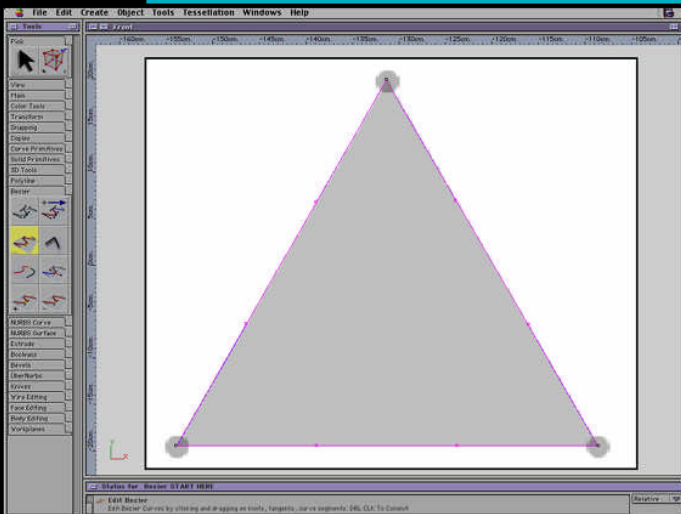
Note: Breaking the tangency of the line to create a tight corner usually results in errors later on down the modeling path. Instead of breaking the handles use the Smooth or Cusp tool to remove the curve information from the knot to create the tight corners.





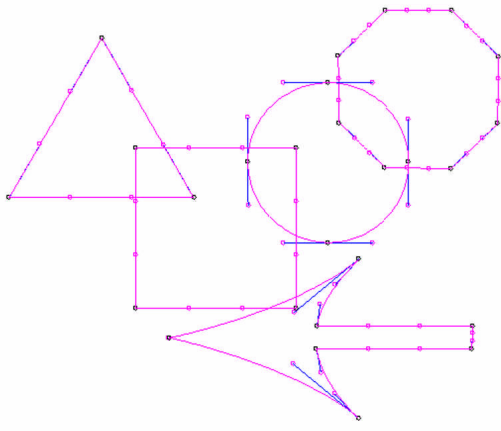
[CLK] on the first knot located at the top of the triangle.





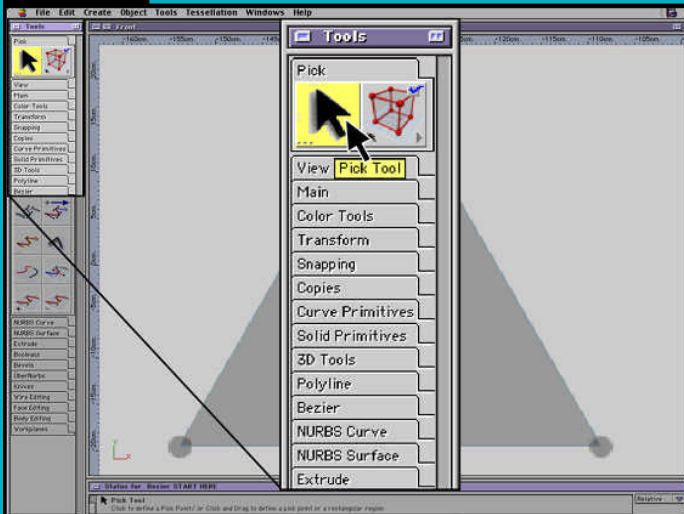
You should now have a triangle shape.





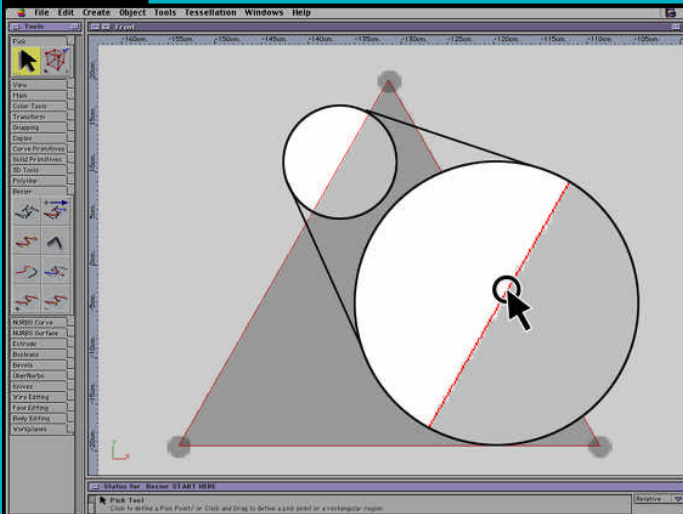
The next shape we will create is a square. We will reposition the screen to see the square underlay. Then we will take the triangle shape and position it over the square and reshape it. In this section, we will use the Edit Bezier tool and the Add Knot tool.





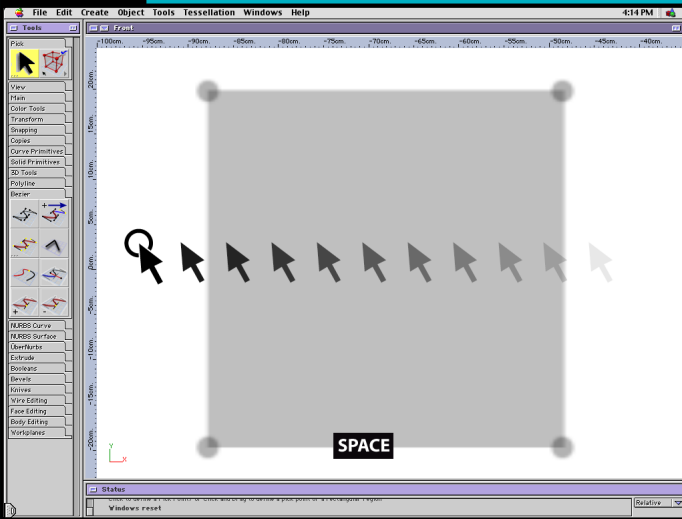
Select the Pick tool in the Pick palette.





[CLK] on the triangle we just created. It turns red when selected.



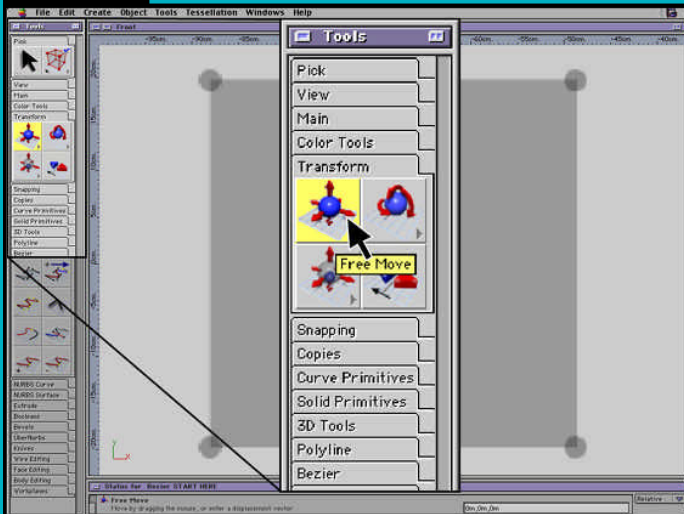


Press **[SPACE]** and **[CLK+DRG]** in the window to the left.

When the square appears, center it within the window.



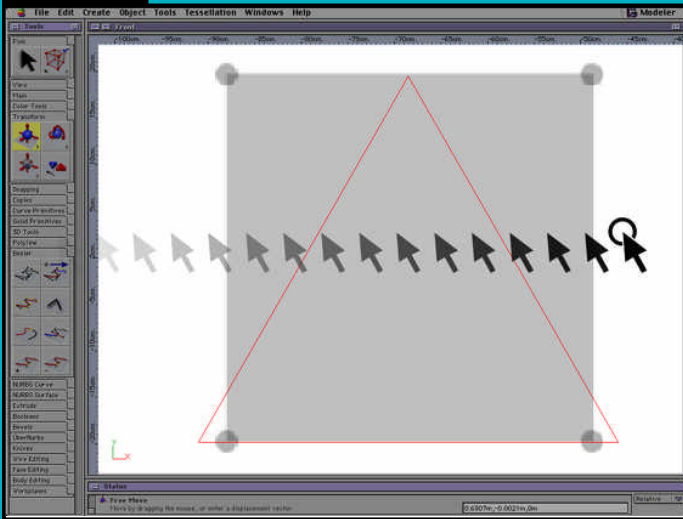




[CLK] the Transform palette.

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

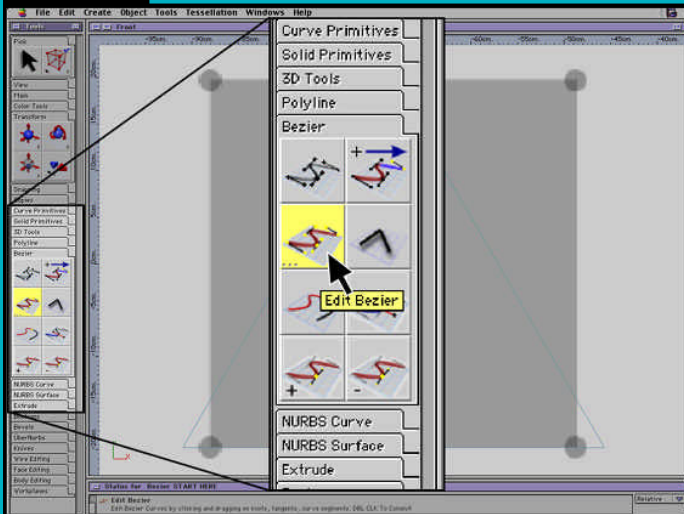




[CLK+DRG] from the left side to the right side anywhere in the window. The triangle should come into view.

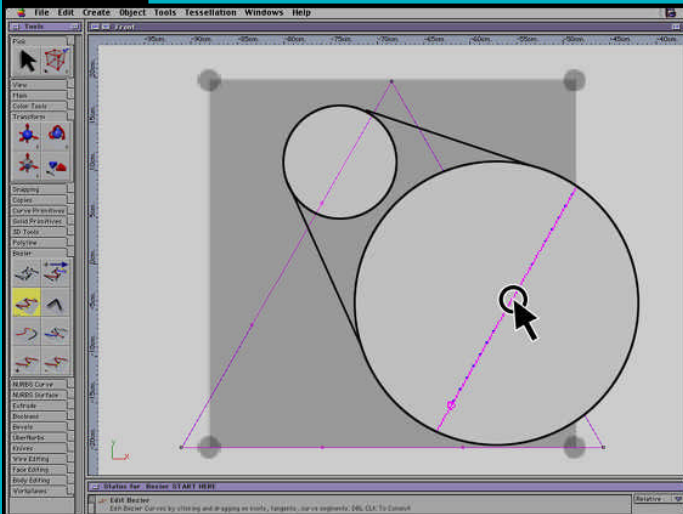
Position the triangle over the square shape.





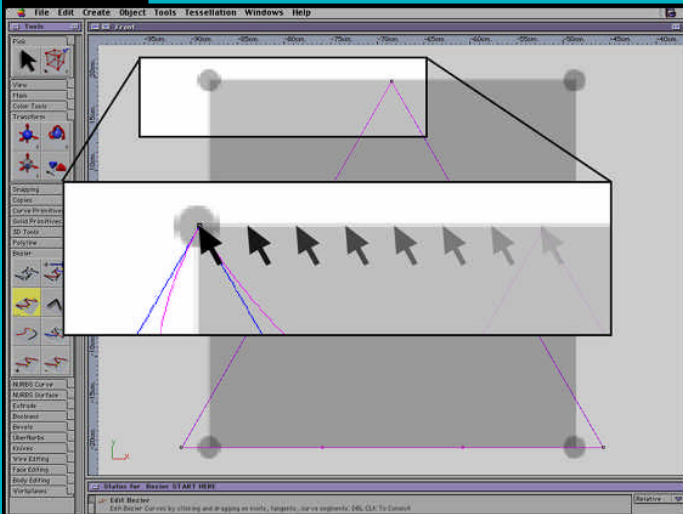
[CLK] on the Edit Bezier tool in the Bezier palette.





[CLK] on the triangle to activate the knots and handles for editing.

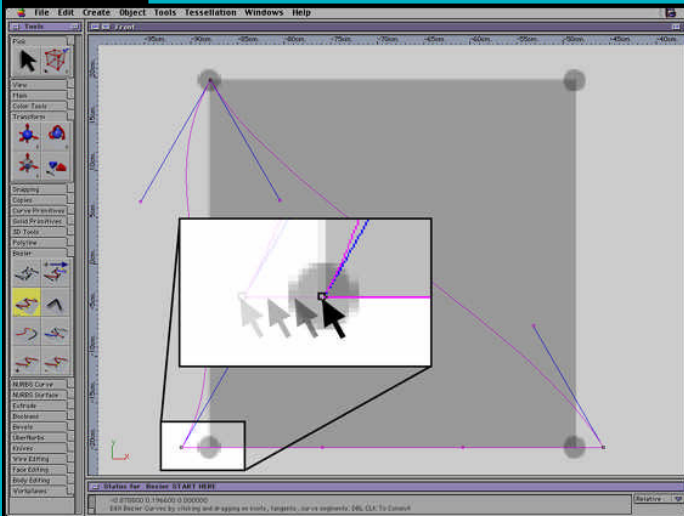




[CLK] on the top knot of the triangle.

[DRG] it to the top left corner of the square.

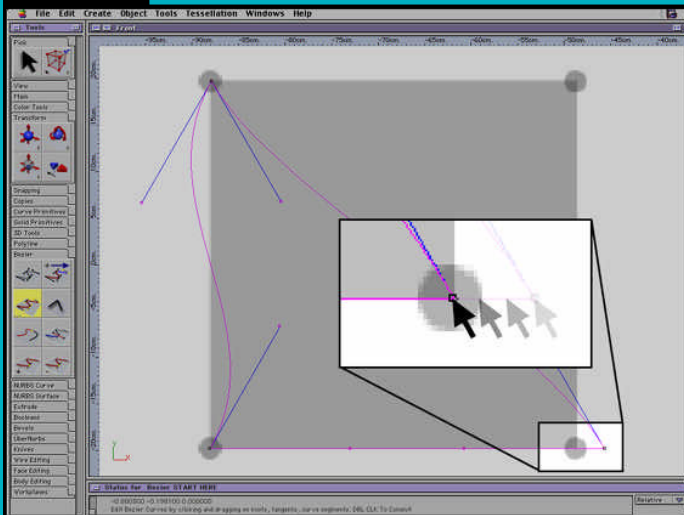




[CLK] on the lower left knot.

[DRG] this knot to the lower left corner of the square.





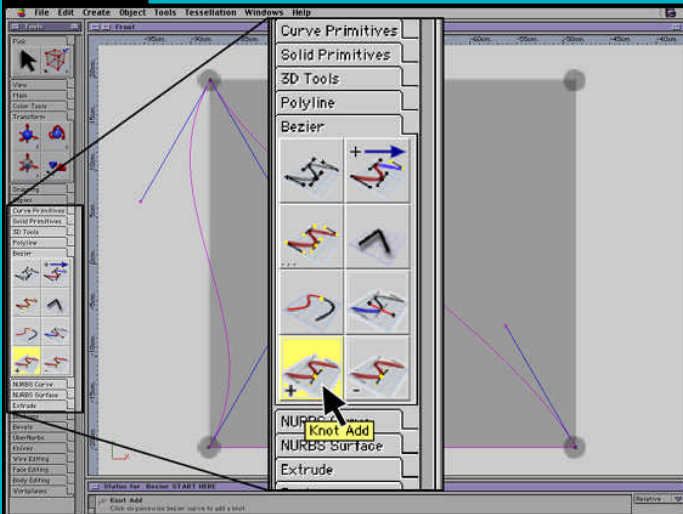
[CLK] on the lower right knot.

[DRG] this knot to the lower right corner of the square.



The Square

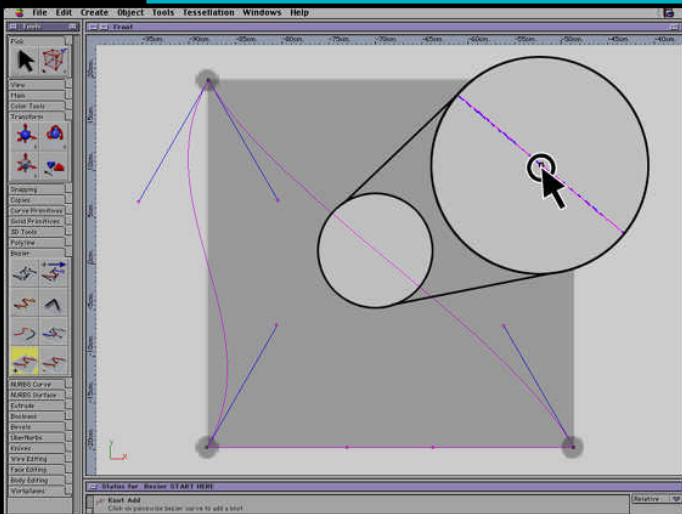




[CLK] on the Knot Add tool in the Bezier palette.

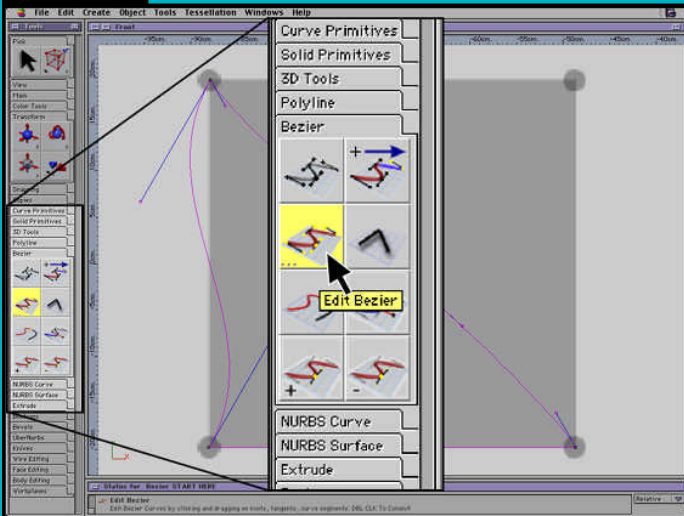






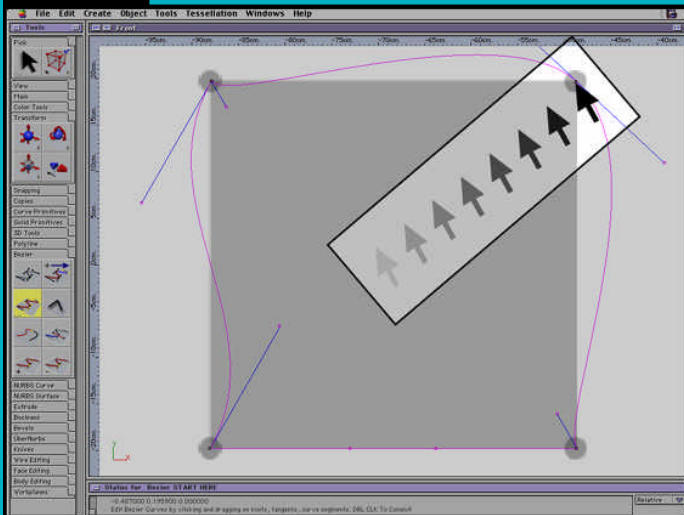
**[CLK]** on the curve between the lower right knot and the top left corner knot, somewhere around the center of the square.





Select the Edit Bezier tool in the Bezier palette.

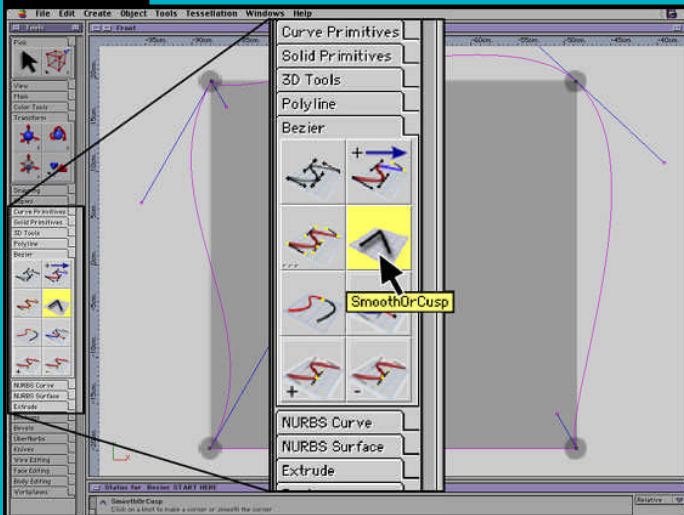




[CLK] on the newly added knot.

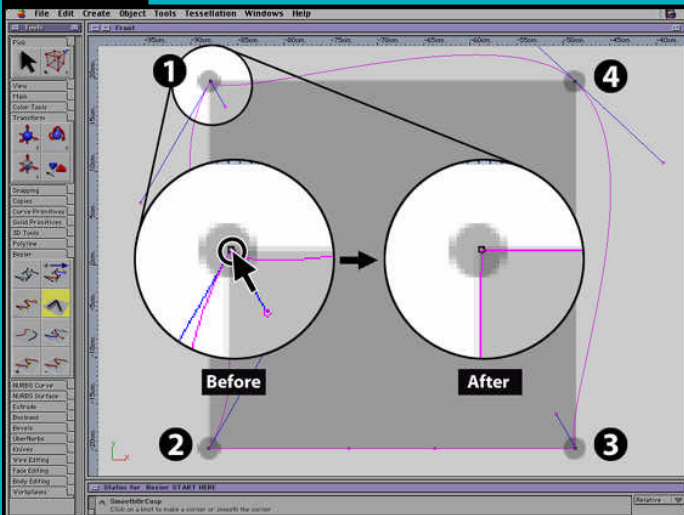
[DRG] this knot to the top right corner of the square.





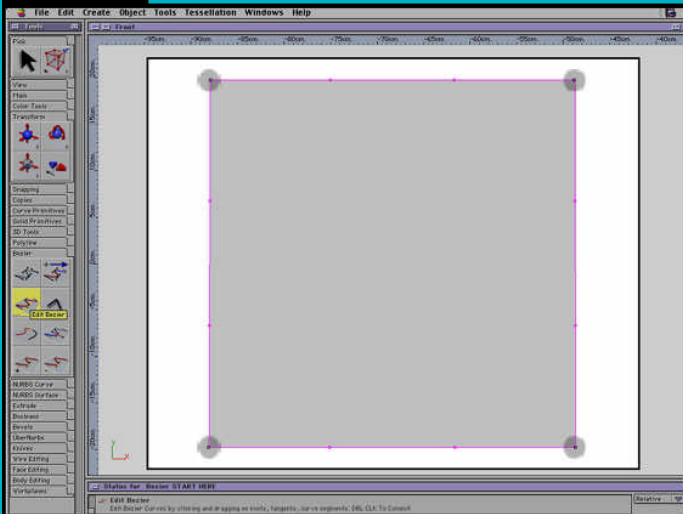
Select the SmoothOrCusp tool in the Bezier palette.





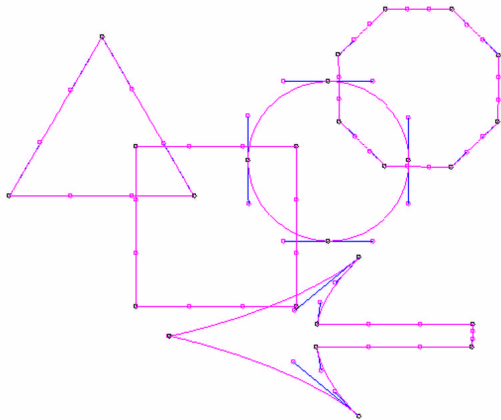
**[CLK]** on each knot to break the handles and make the knots sharp angles.





Here is the completed square shape.



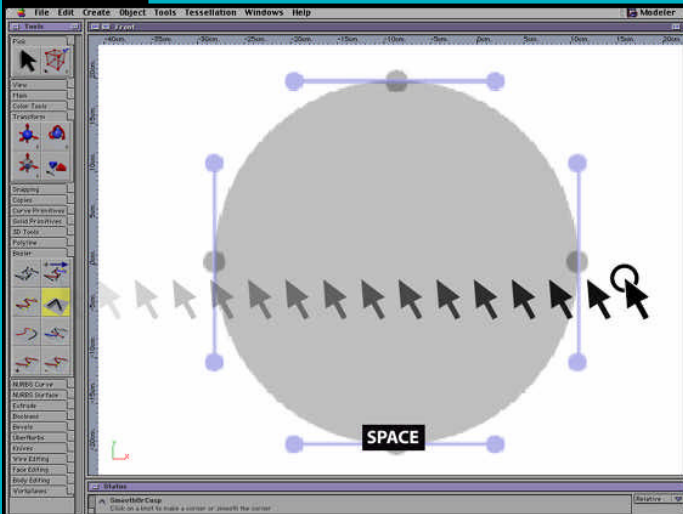


### The Circle

Our next shape is the circle. We will reposition the screen, move the square shape over the circle underlay, and then reshape the square into the circle. Up until now, the shapes had sharp corners. This shape is round, no corners. So, the key to this shape is the bezier handles.

Let's begin...



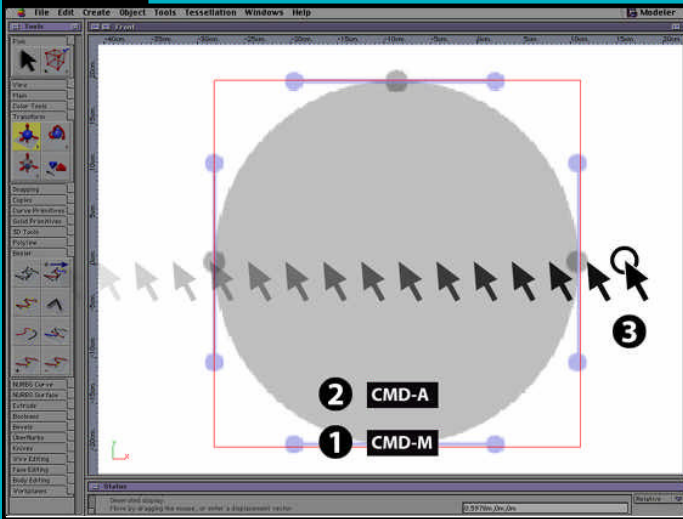


Press **[SPACE]** and **[CLK+DRG]** to the left in the window so that we can play with the next shape, the circle.

Center the next shape on the screen.





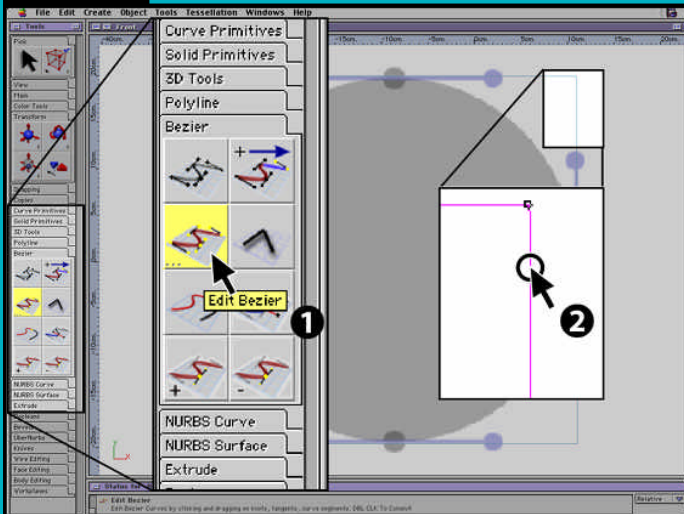


Press [**CMD/CTRL+M**] to select the Free Move tool.

Press [**CMD/CTRL+A**] to select the bezier curve (even if you cannot see it, it is selected).

[**CLK+DRG**] to the right and position the bezier shape around the circle underlay.

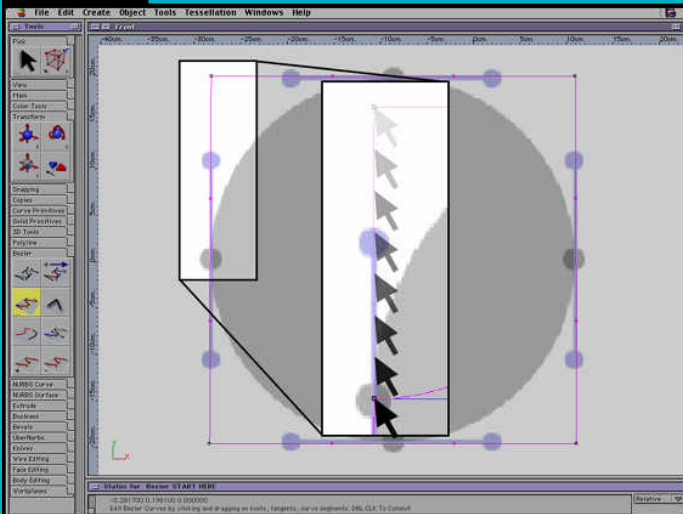




Select the Edit Bezier tool.

Then **[CLK]** on the square bezier shape to activate knots and handles.

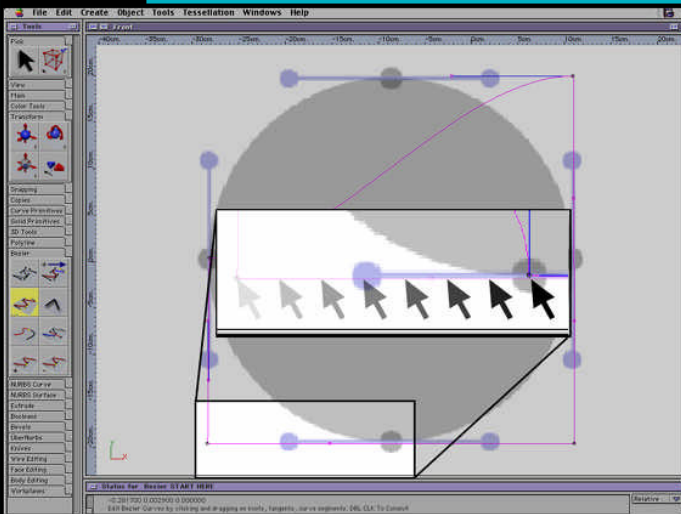




[CLK] on the top left knot.

[DRG] this knot down, centering it over the dark gray dot on the left edge of the circle template.

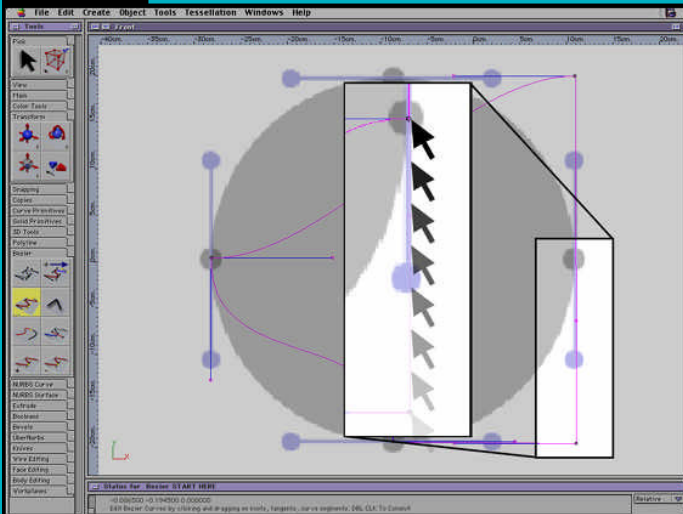




[CLK] on the lower left knot.

[DRG] this knot to the right, centering it over the small dot on the bottom side of the large circle template.

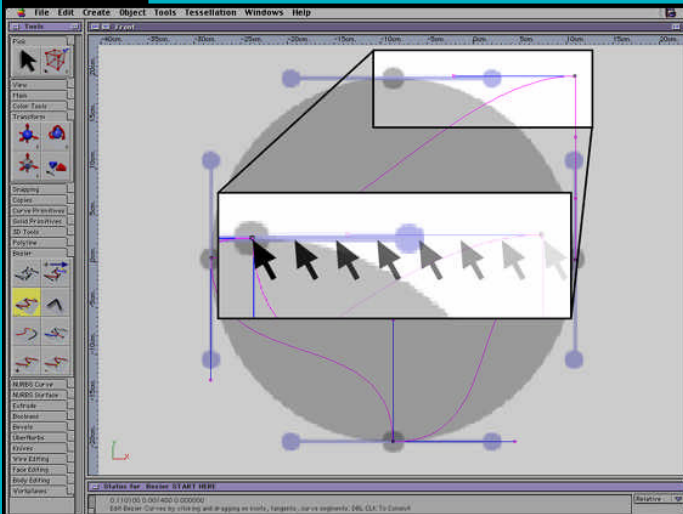




[CLK] on the lower right knot.

[DRG] this knot up, centering it over the small dot on the right side of the large circle template.

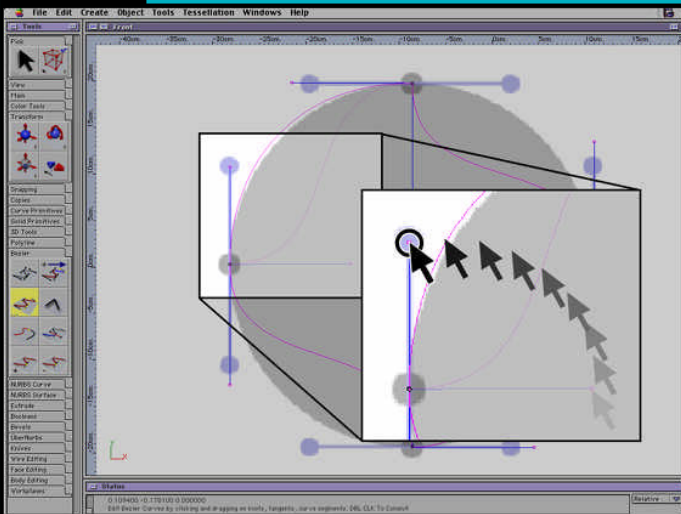




[CLK] on the top right knot.

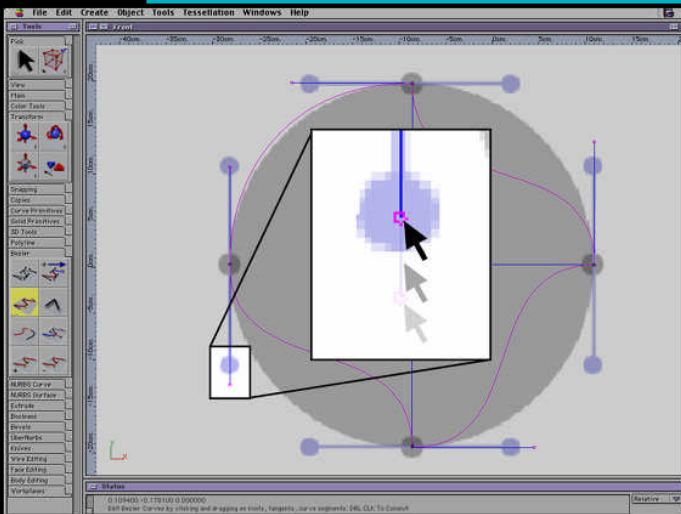
[DRG] this knot to the left, centering it over the small dot on top of the large circle template.





[CLK+DRG] the innermost handle of the left-hand knot.  
Pivot it counterclockwise so that both handles form a straight vertical line.



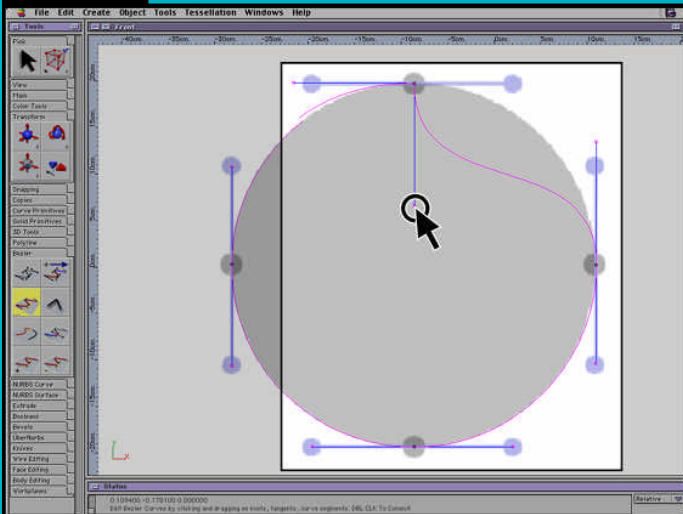


[CLK+DRG] on the opposite handle for the same left-hand knot.

Adjust the handle so that it lies in the center of the light blue circle of the template.

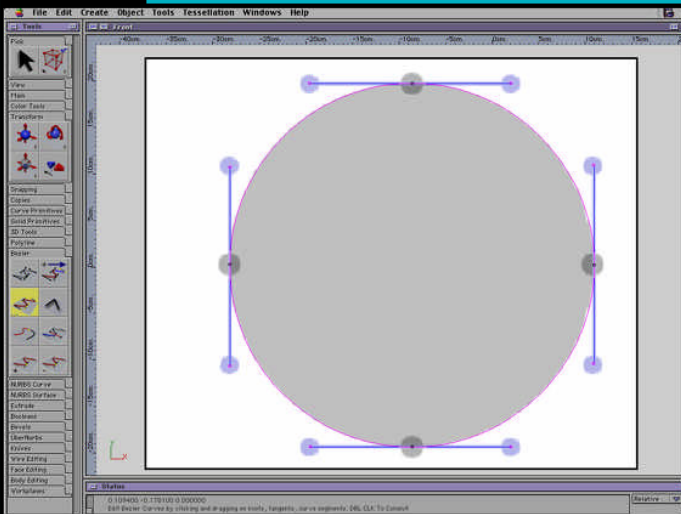






[CLK+DRG] the rest of the handles so that they lie in the center of the light blue dots of the underlay.

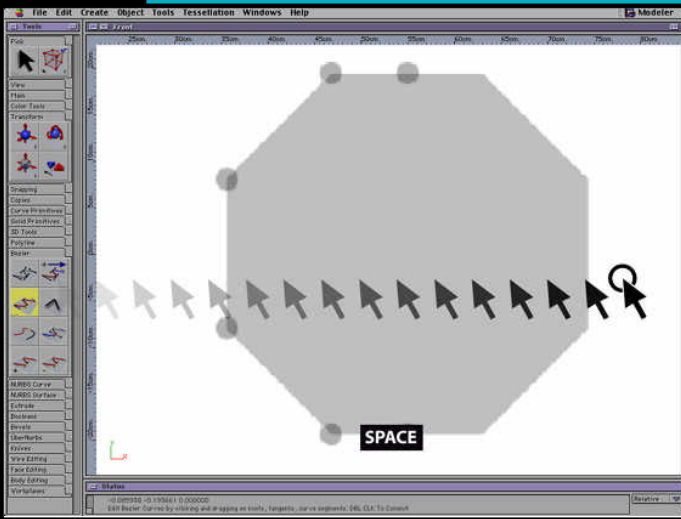




When finished, you should have a fairly decent circle.



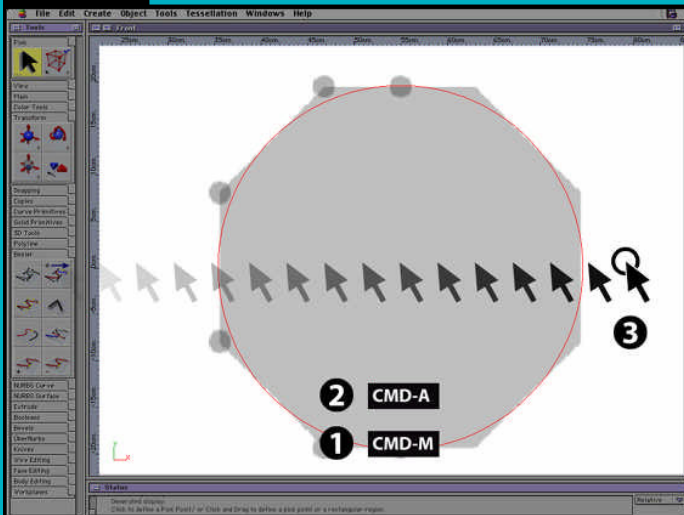




Hold down **[SPACE]** and **[CLK+DRG]** the screen to the left until the octagon is centered in the window.

Note: Notice the underlay has placement dots for only half of the octagon. We will create half of this shape, reflect it to the other side, and join both pieces together.



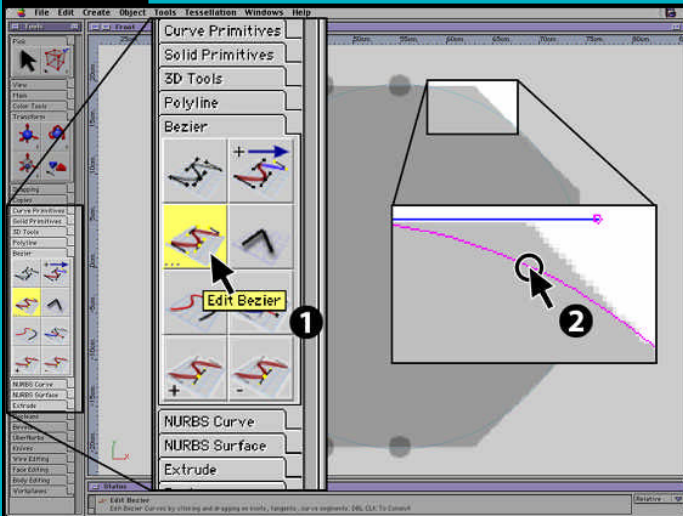


Press [**CMD/CTRL+M**] to select the Free Move tool.

Press [**CMD/CTRL+A**] to select the bezier curve (even though you cannot see it, it is selected).

[**CLK+DRG**] to the right and position the circular bezier shape around the octagon underlay.

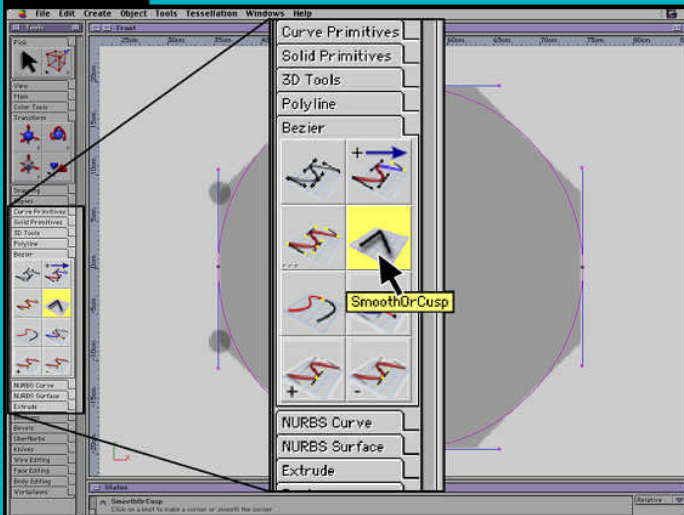




Select the Edit Bezier tool from the Bezier palette.

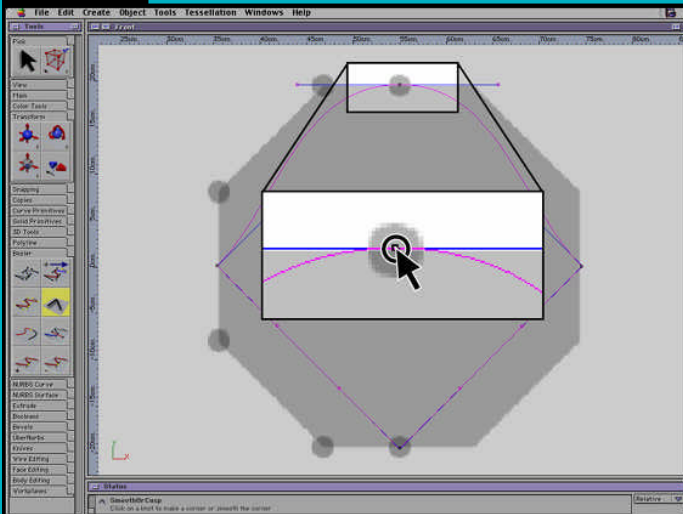
[CLK] on the circular bezier shape.





Select the SmoothOrCusp tool in the Bezier palette.

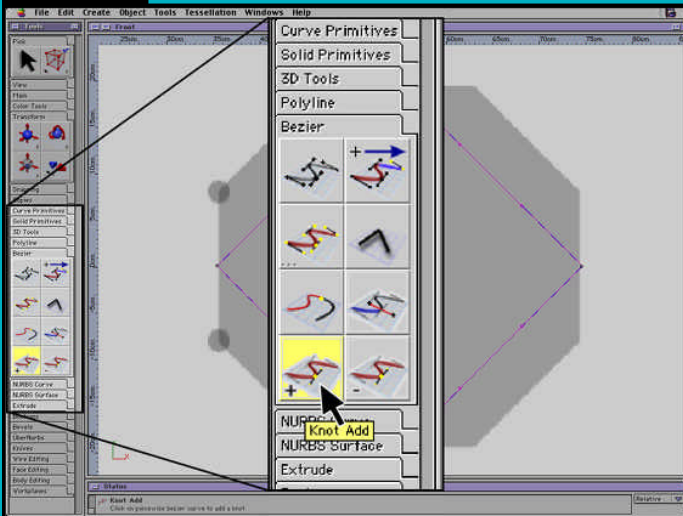




**[CLK]** on each knot. This creates a diamond shape, which makes it slightly easier to add knots to form the octagon shape.

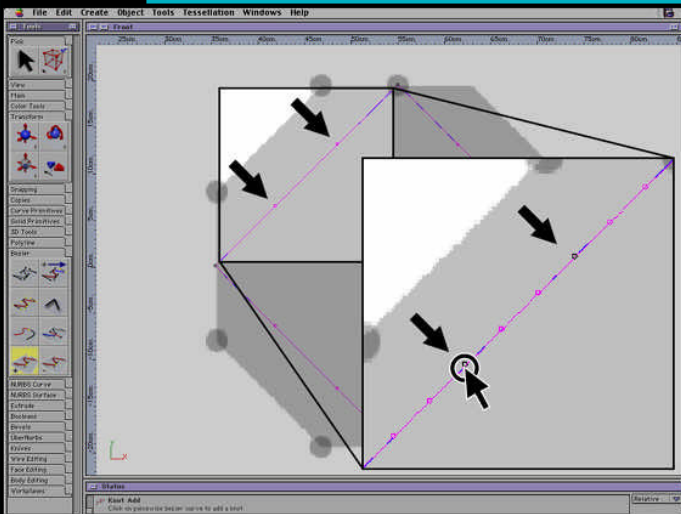






Select the Knot Add tool in the Bezier palette.

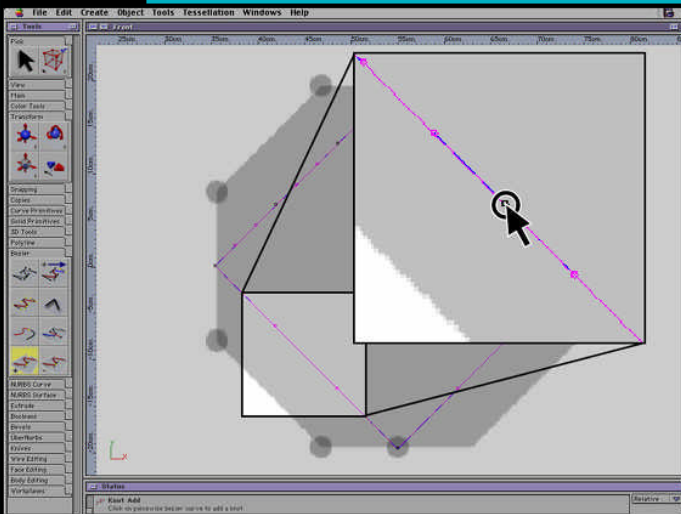




On the upper left side of the diamond shaped bezier curve, where the two handles are now residing, **[CLK]** on each of these handles to add knots at these locations.

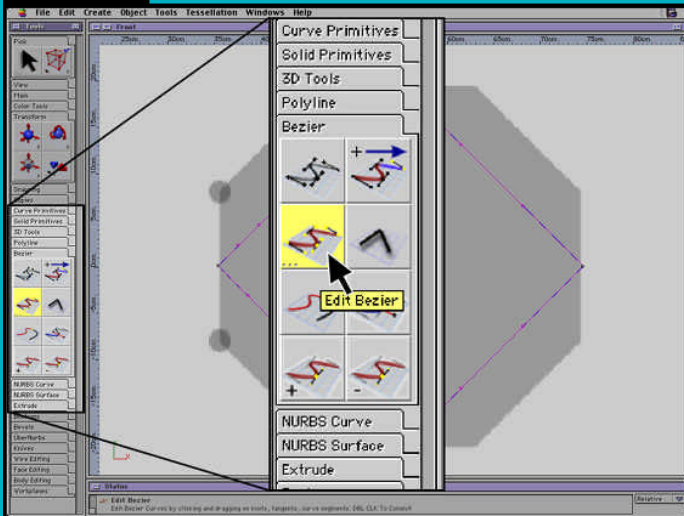
Note: When you click on one of the handles, the other handle where you want to add a knot moves. Just remember where the handle was originally and **[CLK]** in that space.





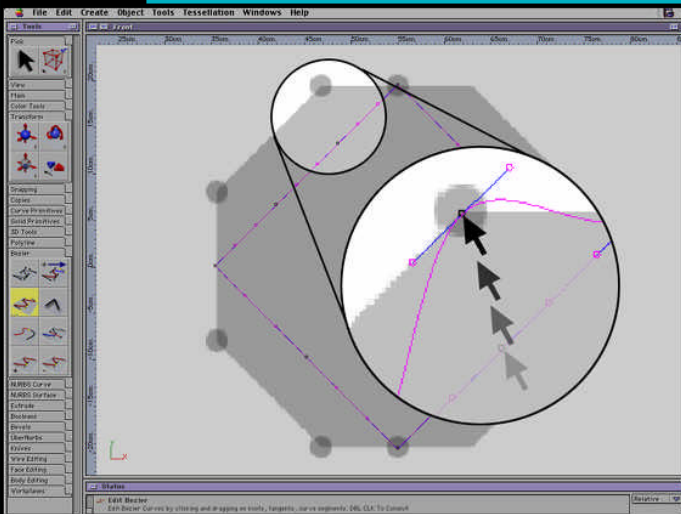
On the lower left bezier curve, **[CLK]** between the two bezier handles to add a single knot.





Select the Edit Bezier tool in the Bezier palette.

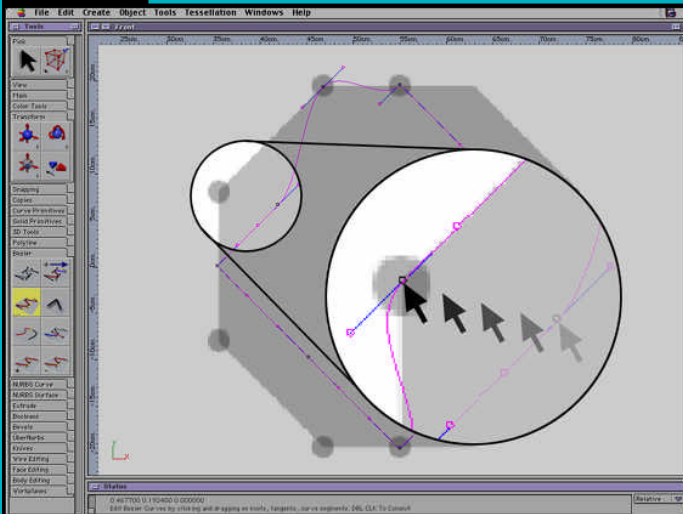




Starting on the upper left bezier curve, [**CLK+DRG**] the upper most knot just added to the very top left hand corner.

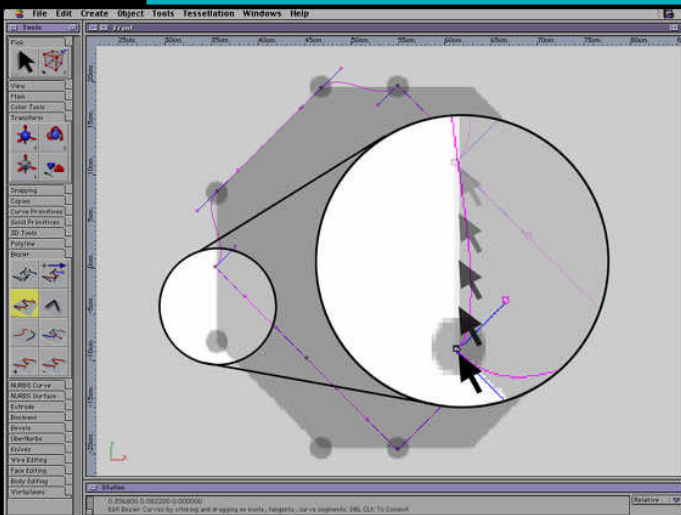
Note: Don't worry about mistakenly grabbing a handle; just find the knots (between the handles) and place them on the dark gray circles.





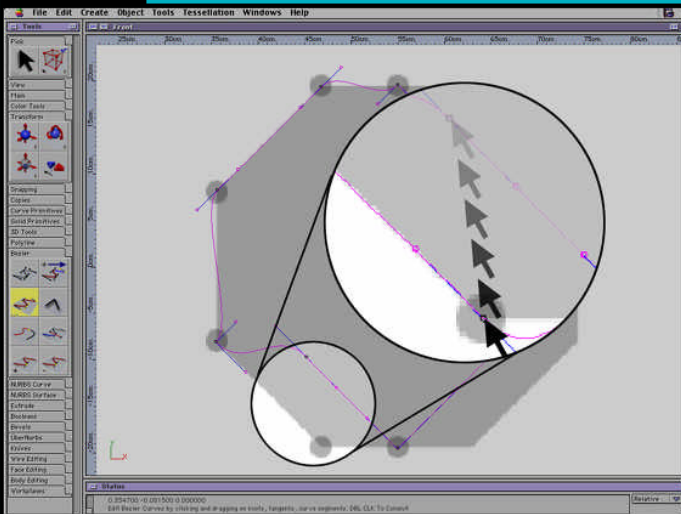
[CLK+DRG] the other added knot to the left upper corner.





[CLK+DRG] the knot directly beneath the knot we just moved down to the left lower corner.

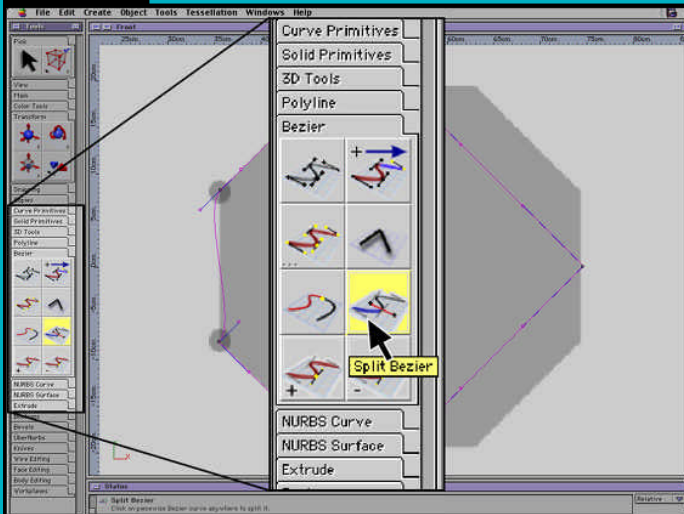




**[CLK]** on the lower added knot and move this to the bottom left corner.

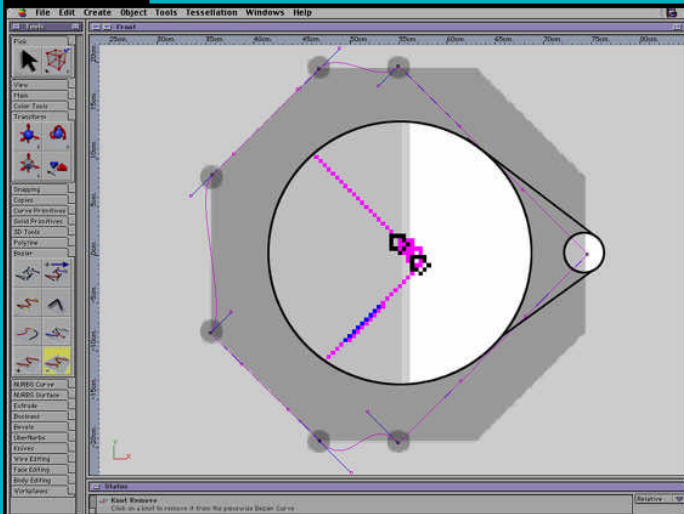






Select the Split Bezier tool in the Bezier palette.

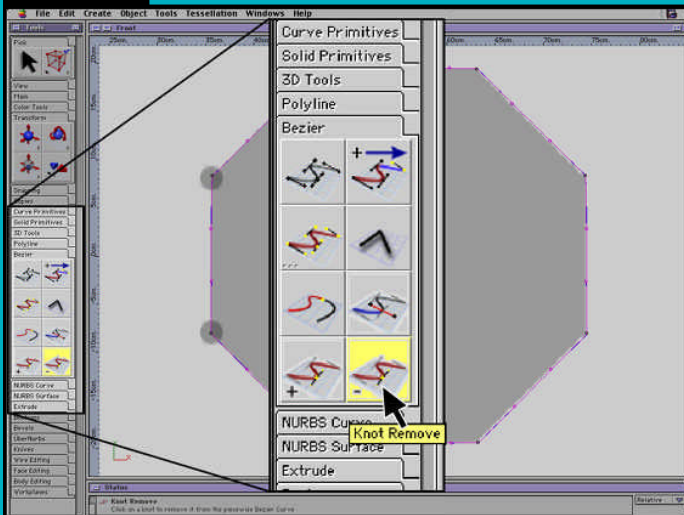




[CLK] on the far right knot.

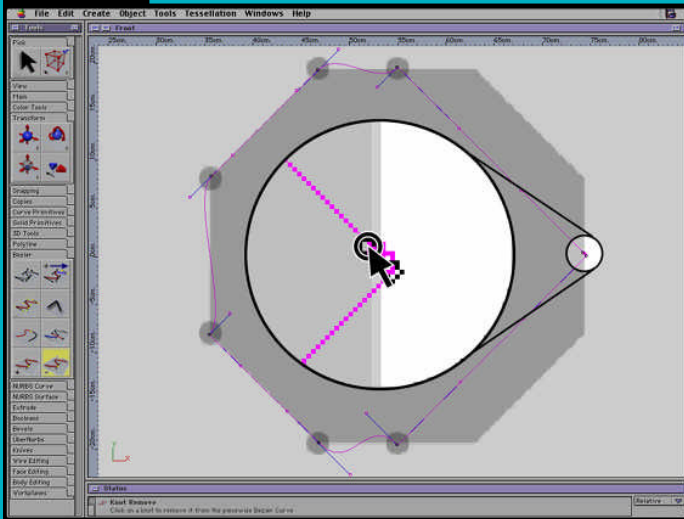
Note: When you click on this knot, it now becomes two separate knots that are not attached to each other anymore. This will become apparent when we remove the knots.





Select the Knot Remove tool in the Bezier palette.

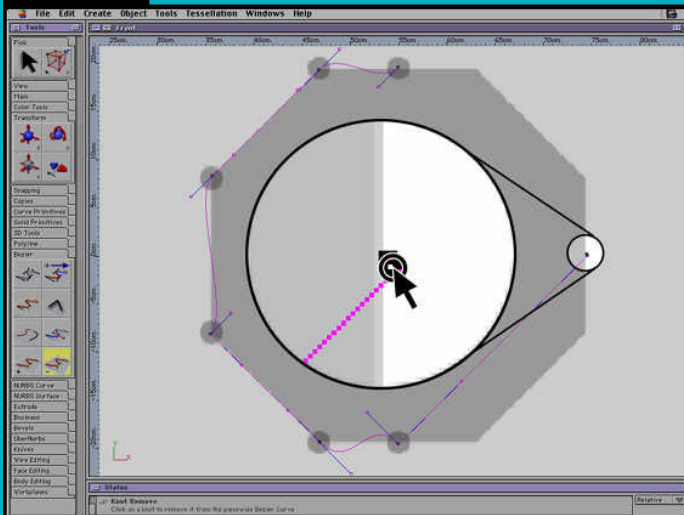




[CLK] on the knot that was just split.

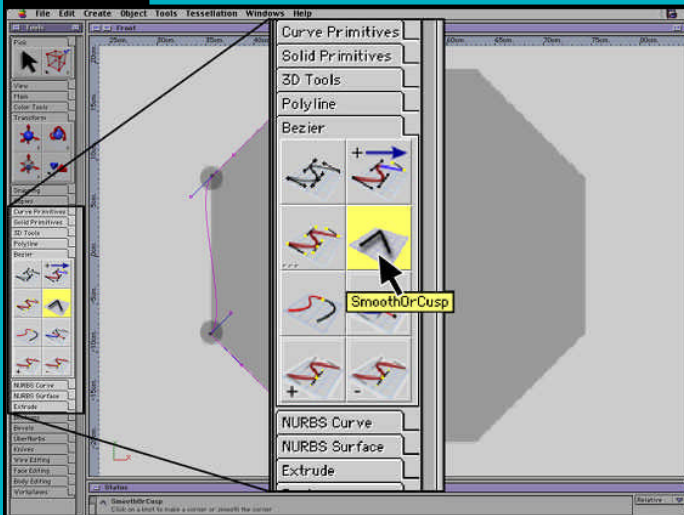
Note: Only part of the line vanished. As mentioned before, this happened because when we split the knot, it actually created two separate knots and we just clicked on one of them to remove the unwanted line.





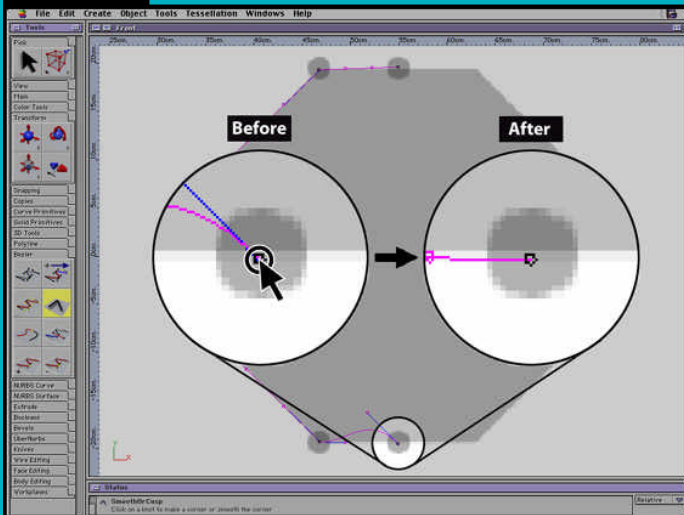
[CLK] on the remaining knot on the far right side.





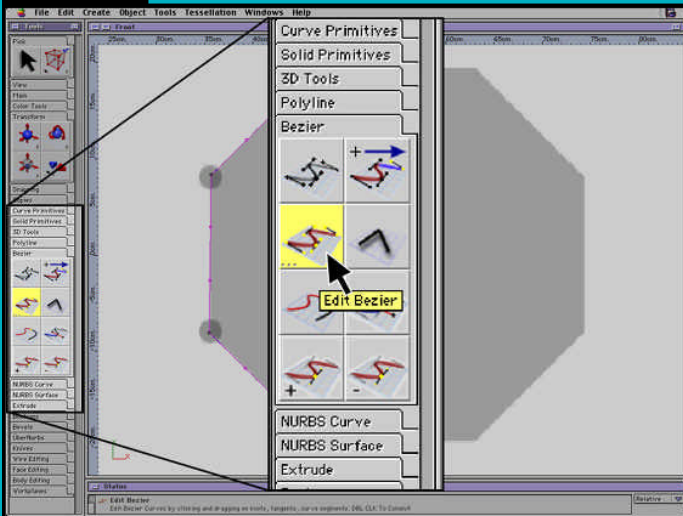
Select the SmoothOrCusp tool in the Bezier palette.





[CLK] on each knot along the shape to reset the cusp.

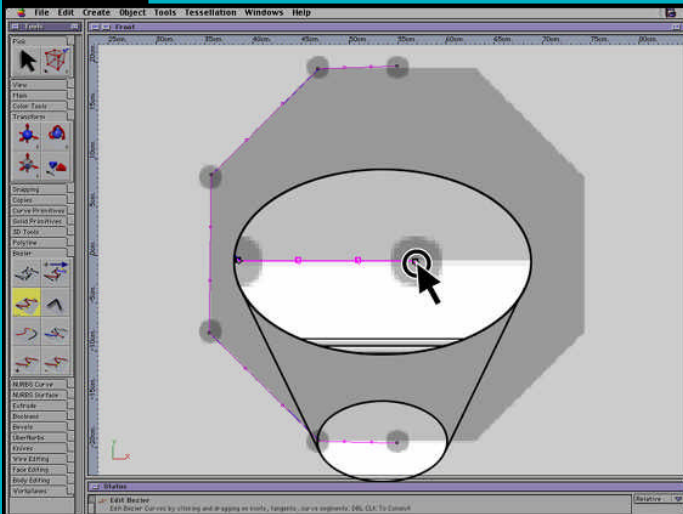




Select the Edit Bezier tool from the Bezier palette.

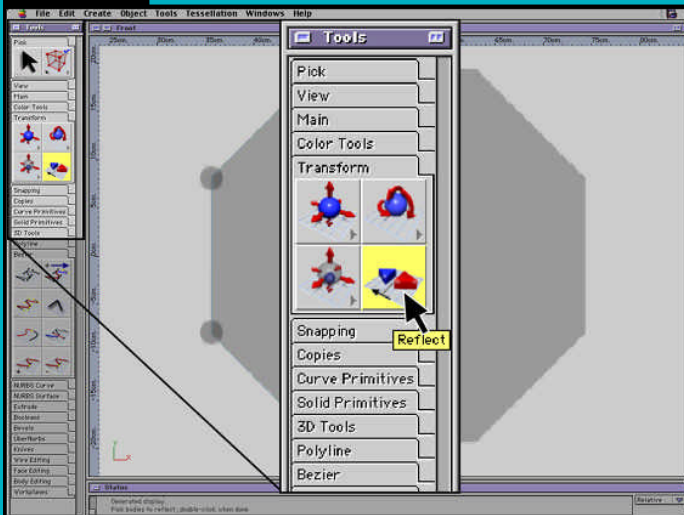






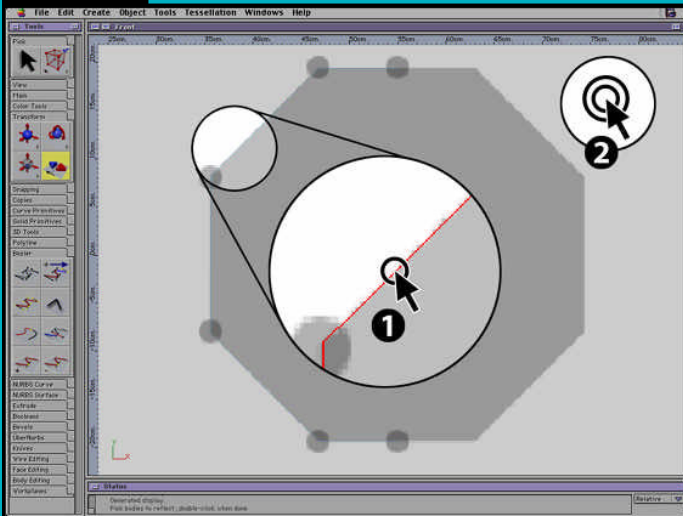
Position the knots so that every line between the knots is a nice straight line.





Select the Reflect tool in the Transform palette.

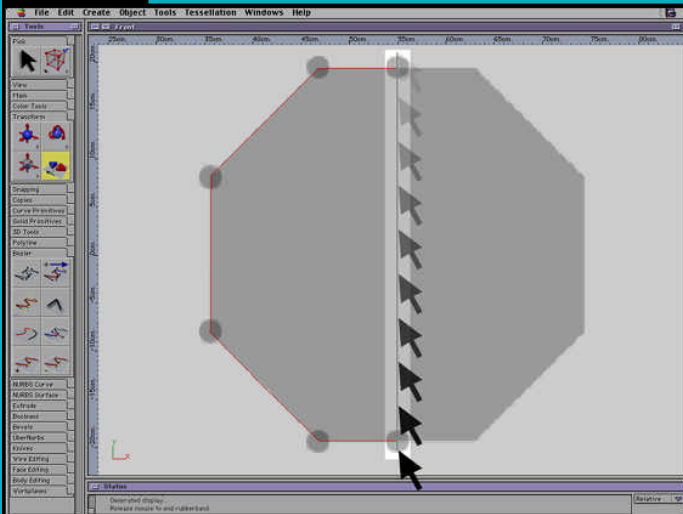




[CLK] on the bezier curve to highlight it.

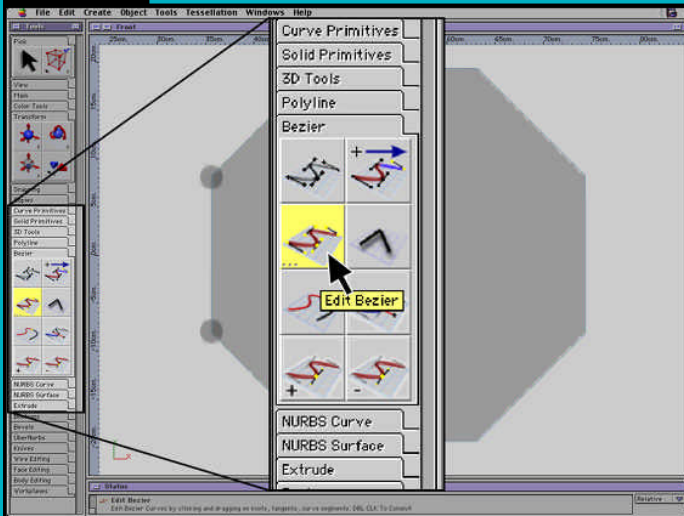
[DBL+CLK] anywhere in the window, but not on the bezier line itself, to finish selecting objects.





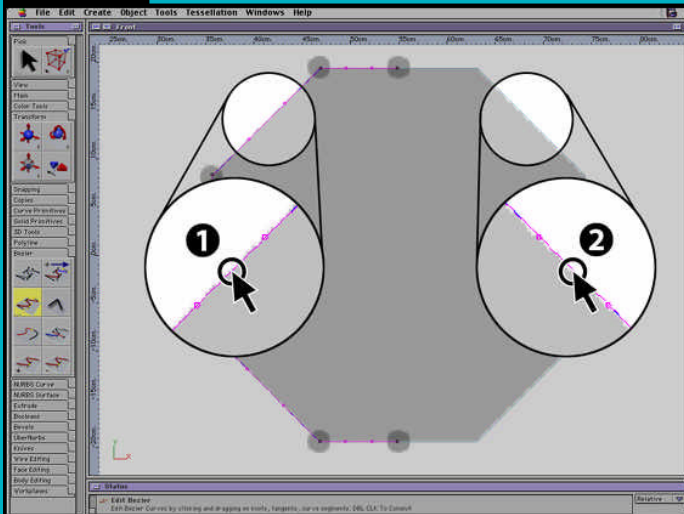
Along the right edge of the bezier curve, **[CLK+DRG]** a straight vertical rubber band somewhere near the center of the octagon underlay image. The length of the rubber band is irrelevant. The vertical orientation is what's important.





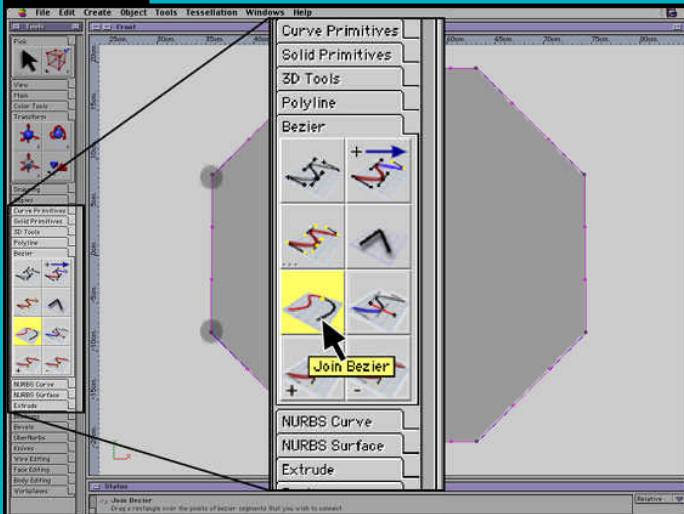
Select the Edit Bezier tool from the Bezier palette.





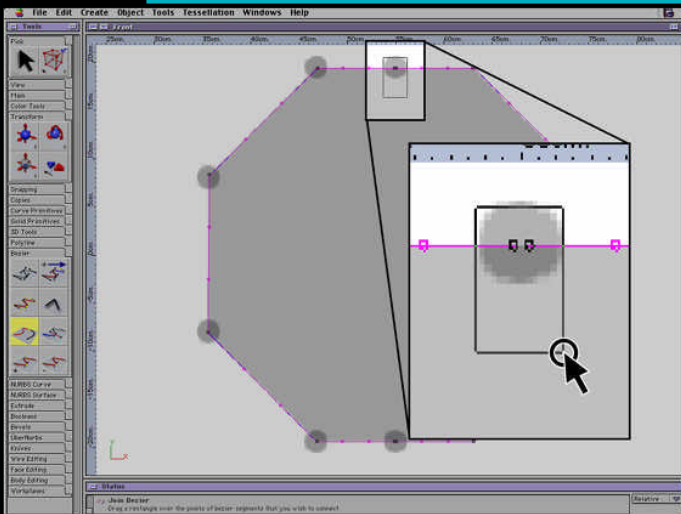
[CLK] on both of the bezier objects to highlight them.





[CLK] on both of the bezier objects to highlight them.

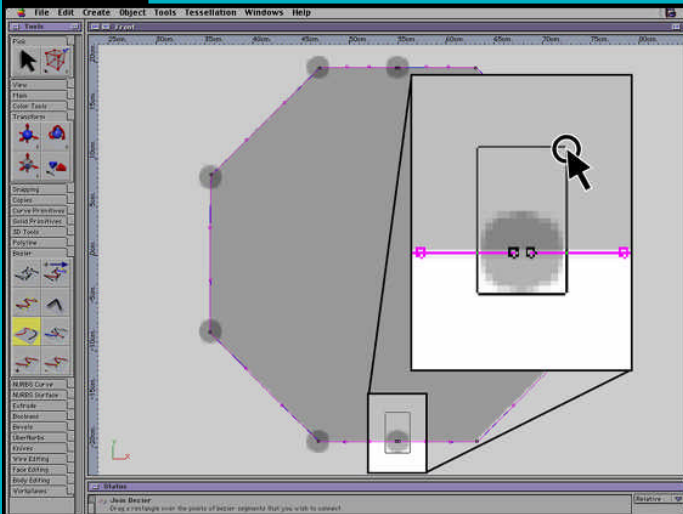




**[CLK+DRG]** a rectangle around the top two center most knots to join them together.

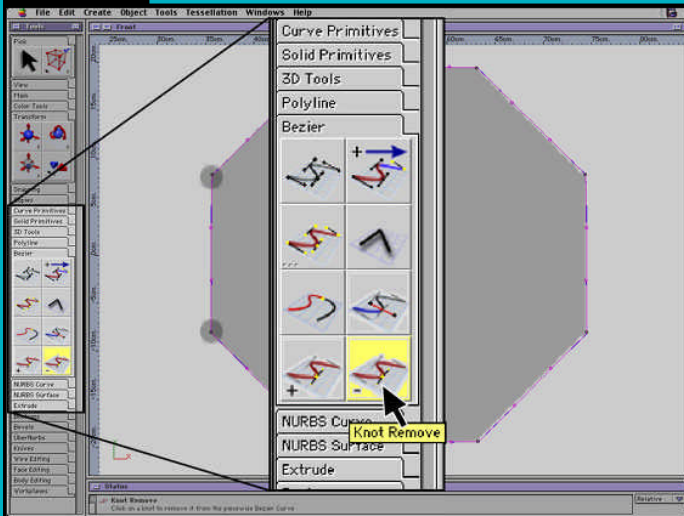






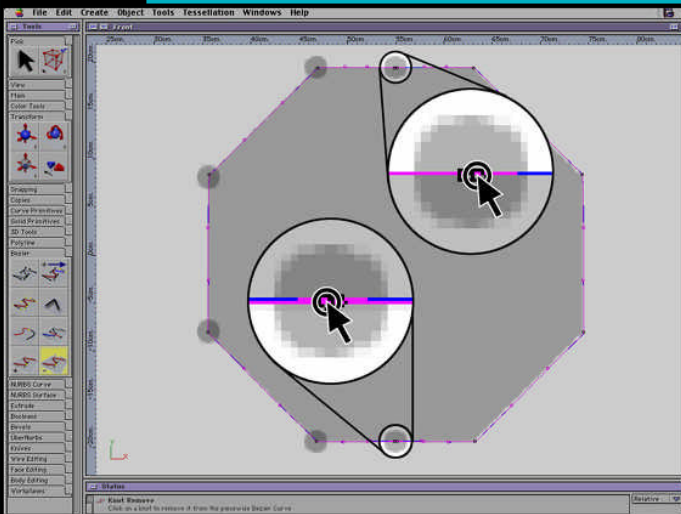
**[CLK+DRG]** a rectangle around the bottom two center most knots to join them.





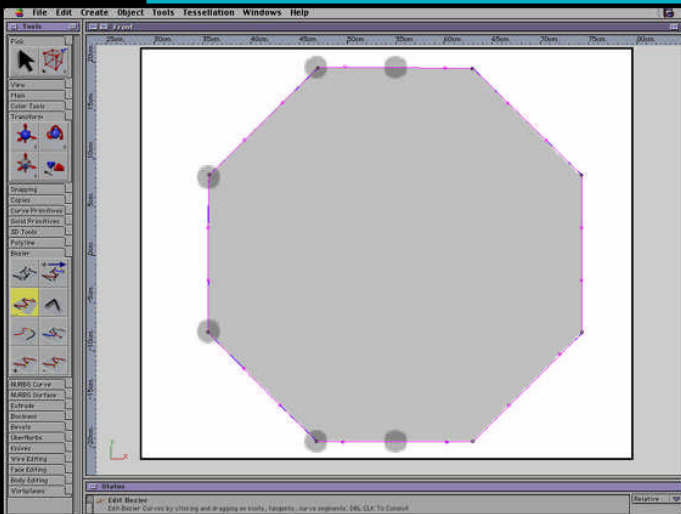
Select the Knot Remove tool from the Bezier palette.





**[CLK]** on each of the center knots that were just joined together to simplify the curve.



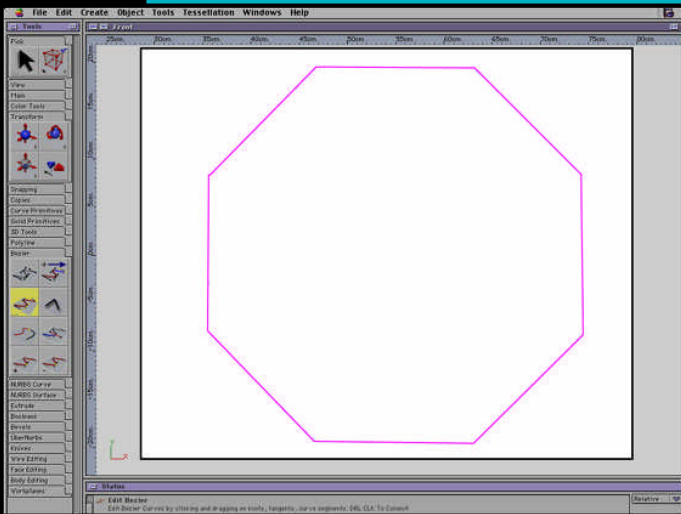


Select the Edit Bezier tool and **[CLK+DRG]** on the right most vertical line so that it touches the underlay.

**[CLK]** on the top right knot and move that in.

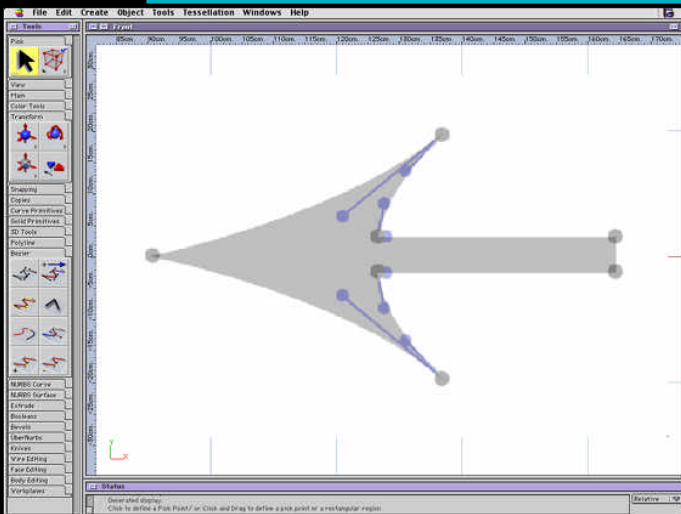
Do the same with the bottom knot.





The completed octagon shape.





Finally, let's look at the arrow. The arrow is so daunting that we couldn't do it, but we thought one of you out there could. Write a tutorial about it and we can include it in our next revision. Seriously though, we added this shape for you to try on your own. It combines many of the steps you have already done in this tutorial. The key to this shape is placing the knots where the line changes drastically (at every corner). From there, it's just adjusting the handles. Here's a hint: use the keyboard shortcut **[SHIFT+CMD/CTRL+DRG]** to break the handles and re-position them further. Go ahead and give it a try.

