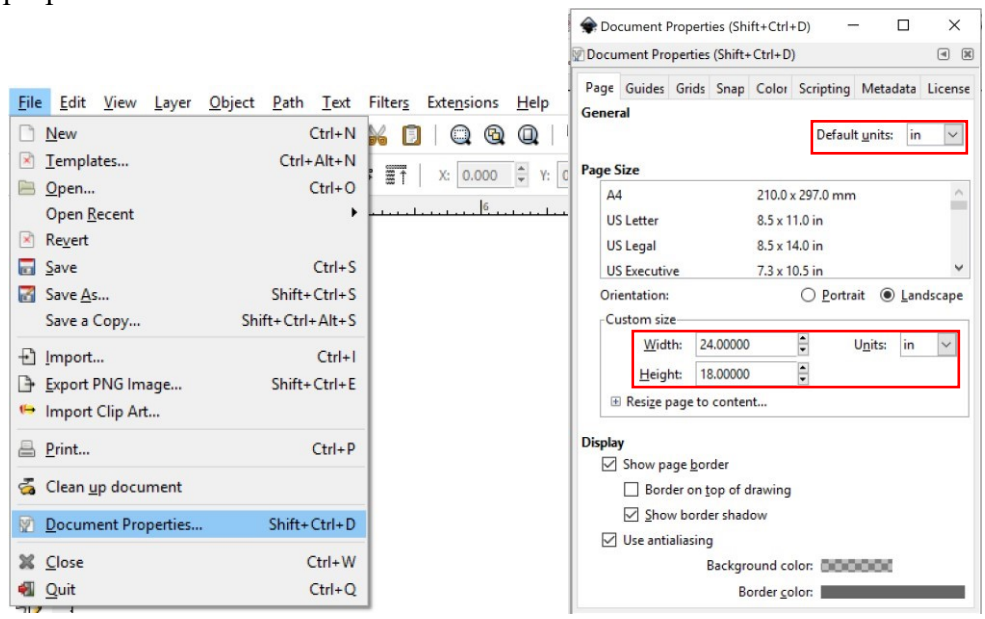
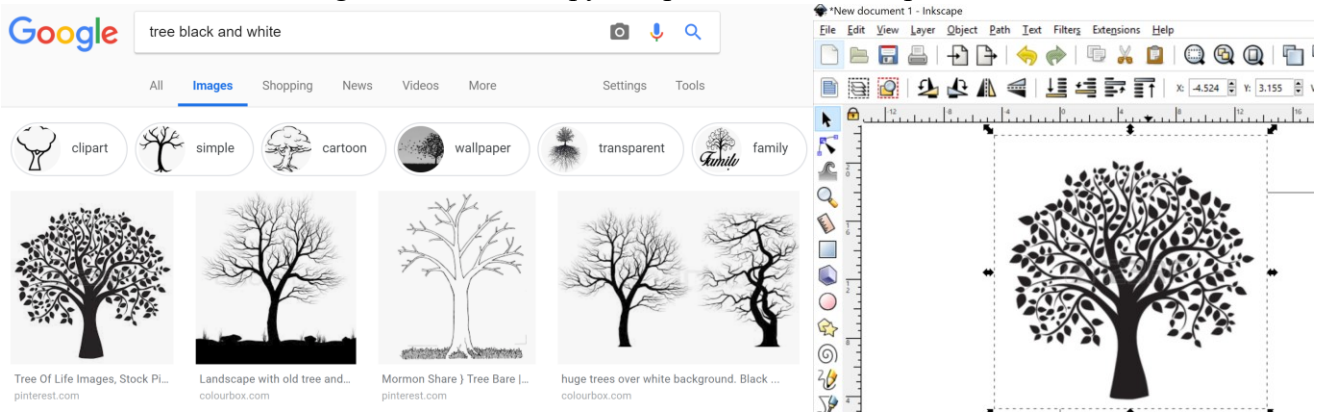
Advanced Laser-Cutting Workshop

This tutorial shows you how to do advanced techniques in Inkscape including color mapping, dynamic offsets, custom fills, placing text on paths, and path operations. We'll be making this 3D tree without the hearts using the laser cutter.

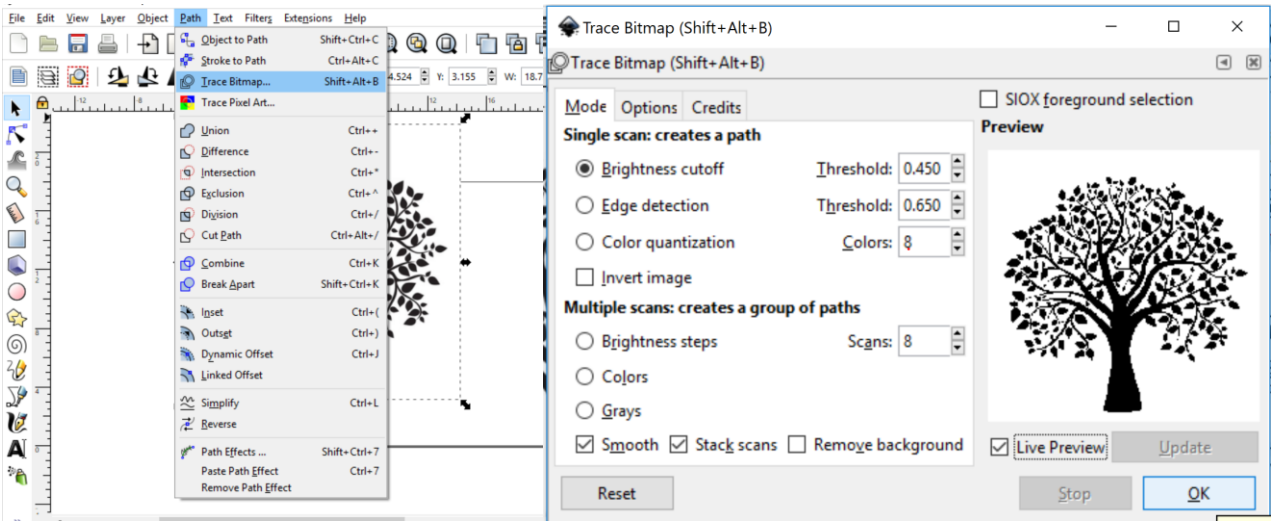
1. As we did in the first tutorial, change the document size to fit the size of the laser-cutter bed by going to document properties as shown below.

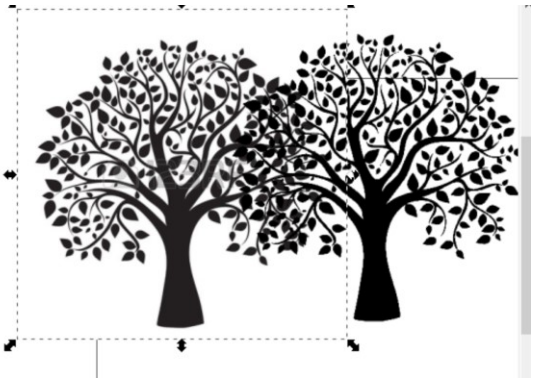


2. Find black and white image of a tree and copy and paste it into Inkscape.

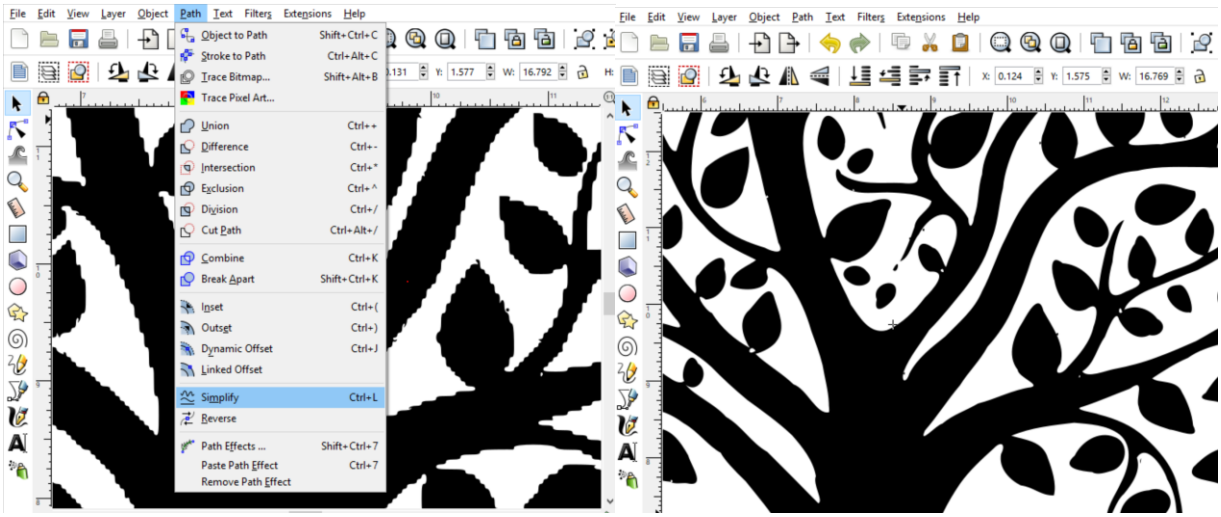


3. We want to turn the bitmap into a vector so that the laser knows how to trace out the tree. Thus, we are going to vectorize the image via “Trace Bitmap”. Since the image we’re using has high contrast, it is very easy for our function to detect the edges, so the default settings work for this case. You would need to play with the settings a bit in those cases where the picture doesn’t have as much contrast. Press “ok” and close the “Trace Bitmap” window. You can delete the original image once you have the vector representation.

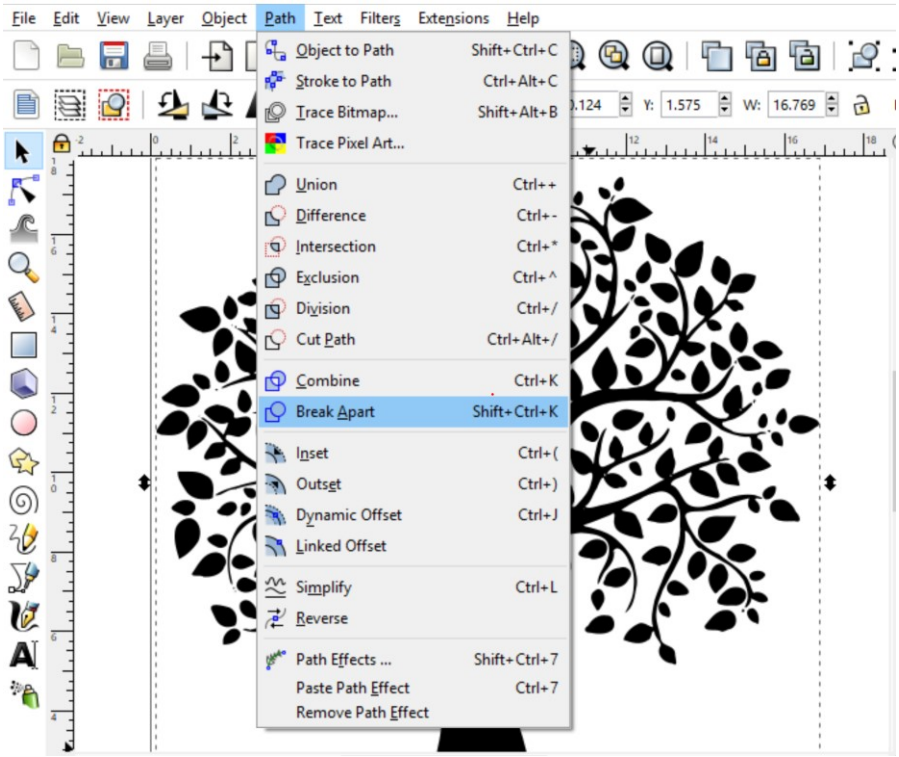




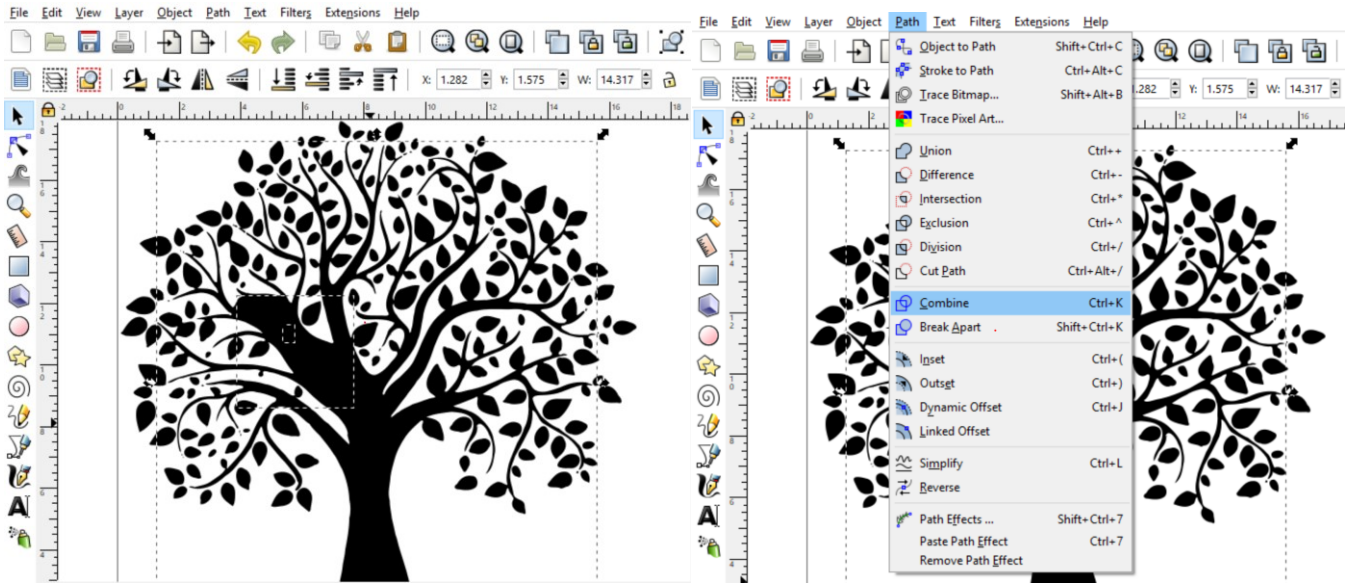
4. If the vector is jagged, you can go to Simplify under the Path tab to smooth out your edges. The number of times you need to do this depends on your simplify settings under “Preferences” under “File”, so repeat this process until it is how you like.

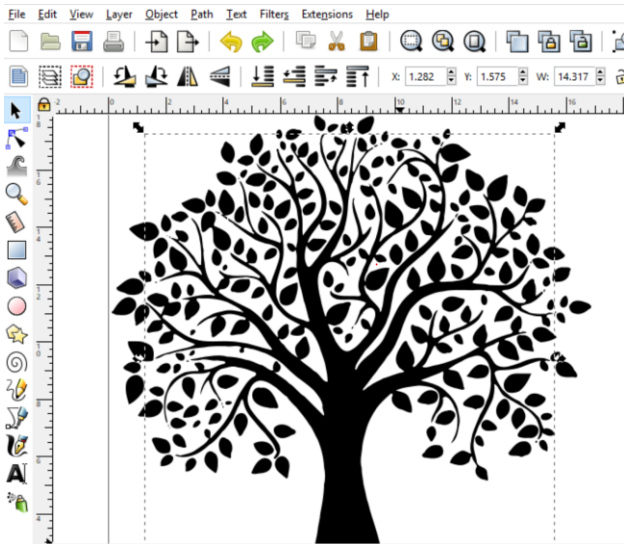


5. Depending on the image you chose, you might have a tree with detached leaves. If you look at the tree we have, you’ll notice that most of the leaves are detached from the tree. Now, we have to manually attach the leaves to the tree. In order to do this, we have to be able to move individual leaves. So they can be separately manipulated, use the “Break Apart” option shown below to separate the leaves and tree.

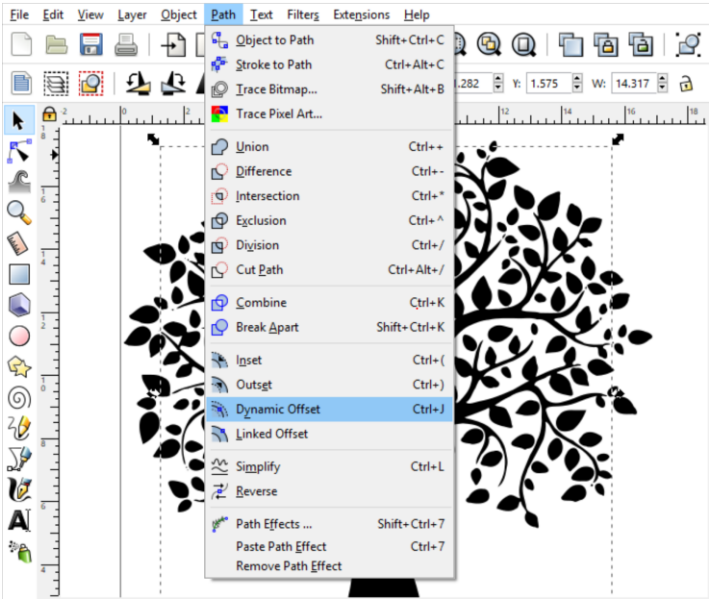


6. You'll notice that the tree is missing a chunk where the open space forms a closed loop. We need to recombine this cycle with the branches, so we are going to be using the "Combine" command shown below. Select the branch/trunk and the cycle shown below.

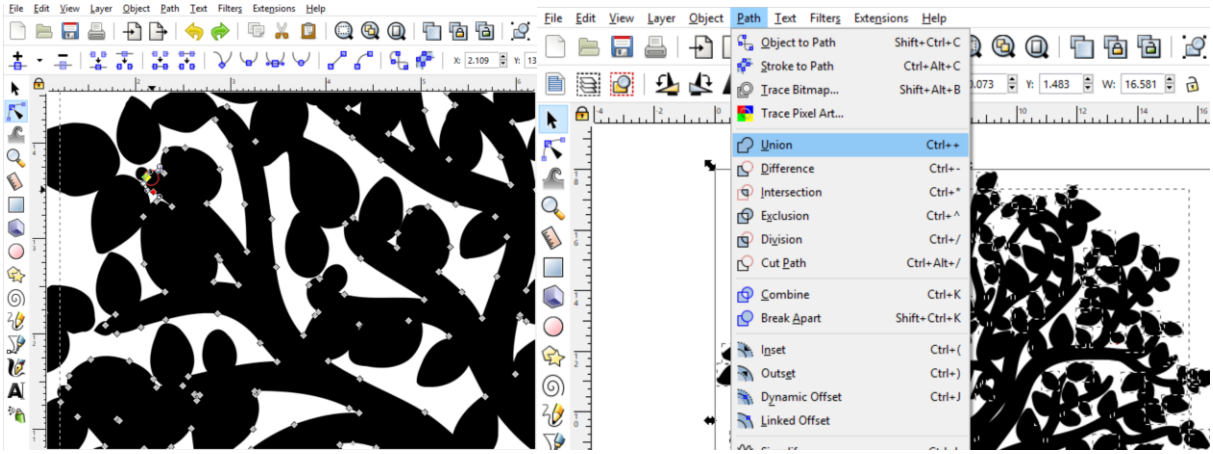




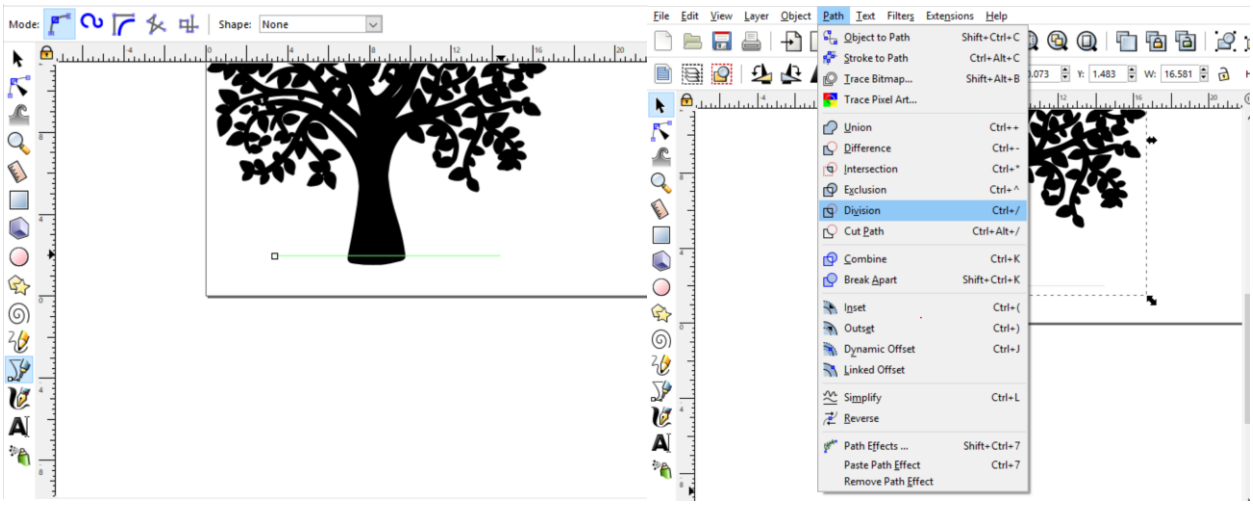
7. Now, we want to thicken each branch and leaf and hope that most of them get attached to the tree. This can be done using the "Dynamic Offset" option. So first press **Ctrl + A** to select everything and then apply the "Outset" option or the "Dynamic Offset" option. Everything should be much thicker at this point. This not only reduces the number of leaves we have to manually reposition but also thickens the stems and branches. This makes the branches sturdier and less likely to break off the laser-cut plywood model.



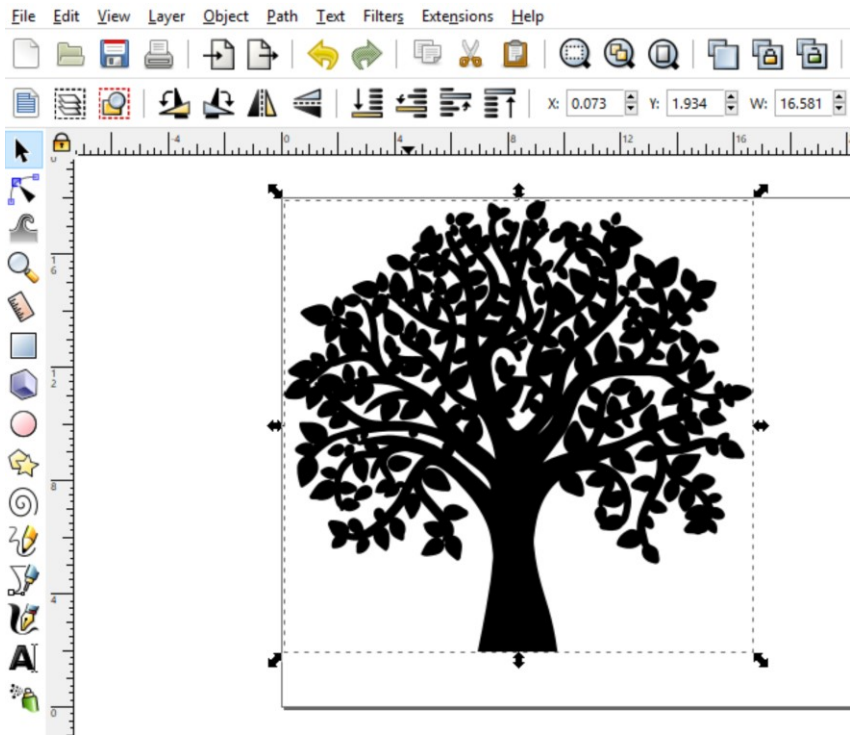
8. Now, we are going to move any disconnected leaves onto the tree. Once you have everything overlapping, select everything (**Ctrl + A**) and use the "Union" option shown below. This combines everything so that the leaves and trees are all in one piece.



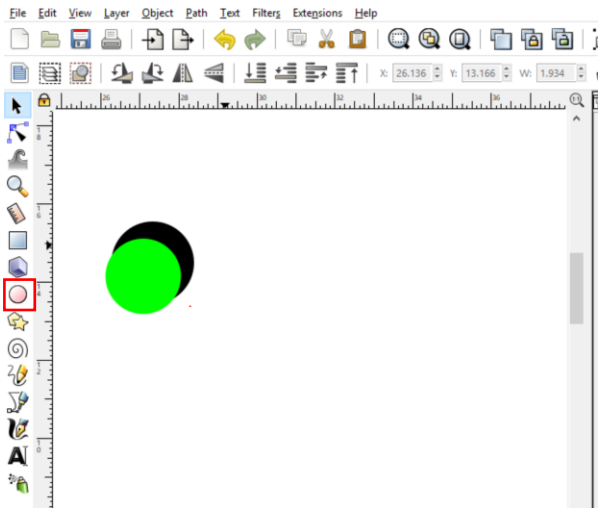
9. To make the tree trunk stand up, we first need to make sure that its base is flat. To do this, we are going to create a straight, horizontal line using the Bezier tool (highlighted on the left). While you draw the line hold **Ctrl** to keep it horizontal. Then select the line and tree and use the "Division" command to cut the base off.



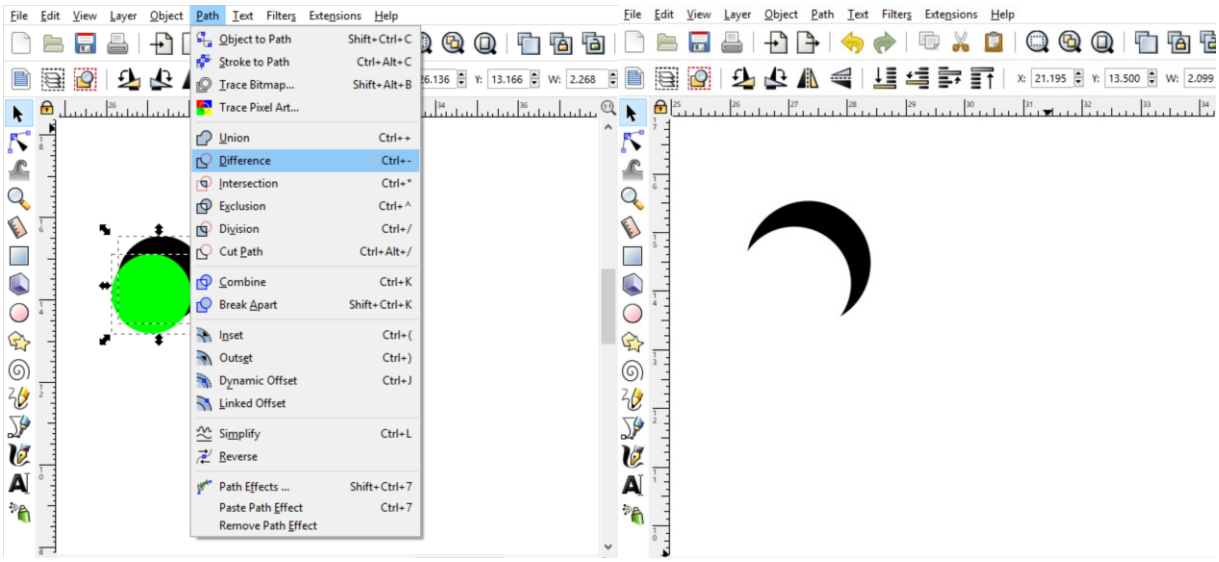
10. Delete the bottom piece, then select everything (**Ctrl + A**) and recombine them like we did before in **Step 8**.



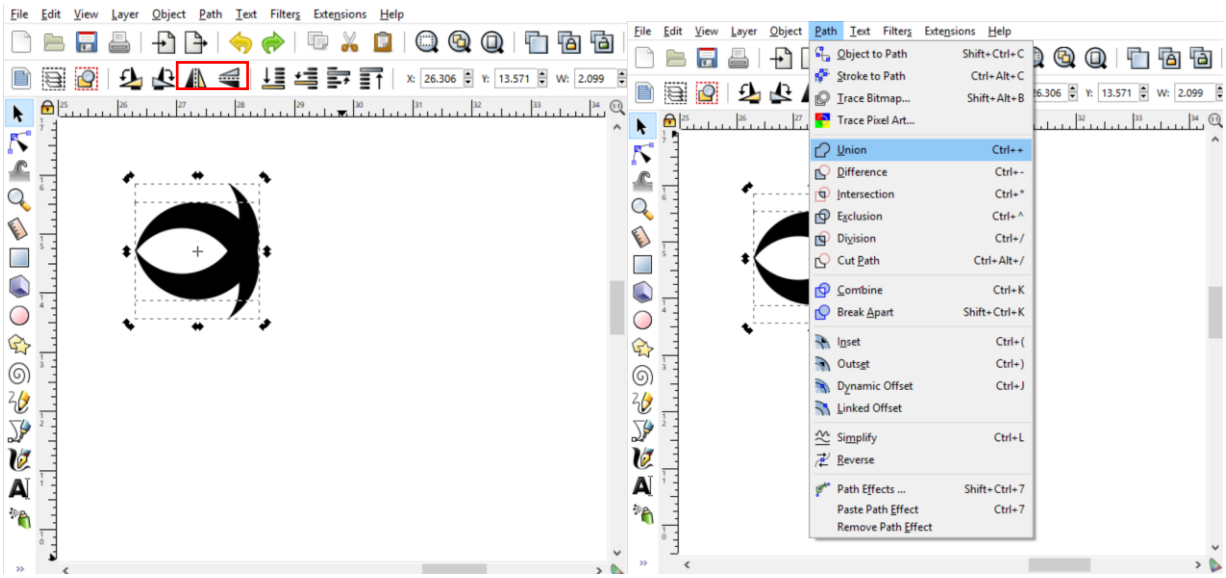
11. In the next steps, we are going to create a decorative base using a shape and creating tiled clones. We are going to start with two circles as shown below. The circle tool is shown in the red rectangle. At this stage, the size of the circles don't matter as the final base will be resized to fit the tree.



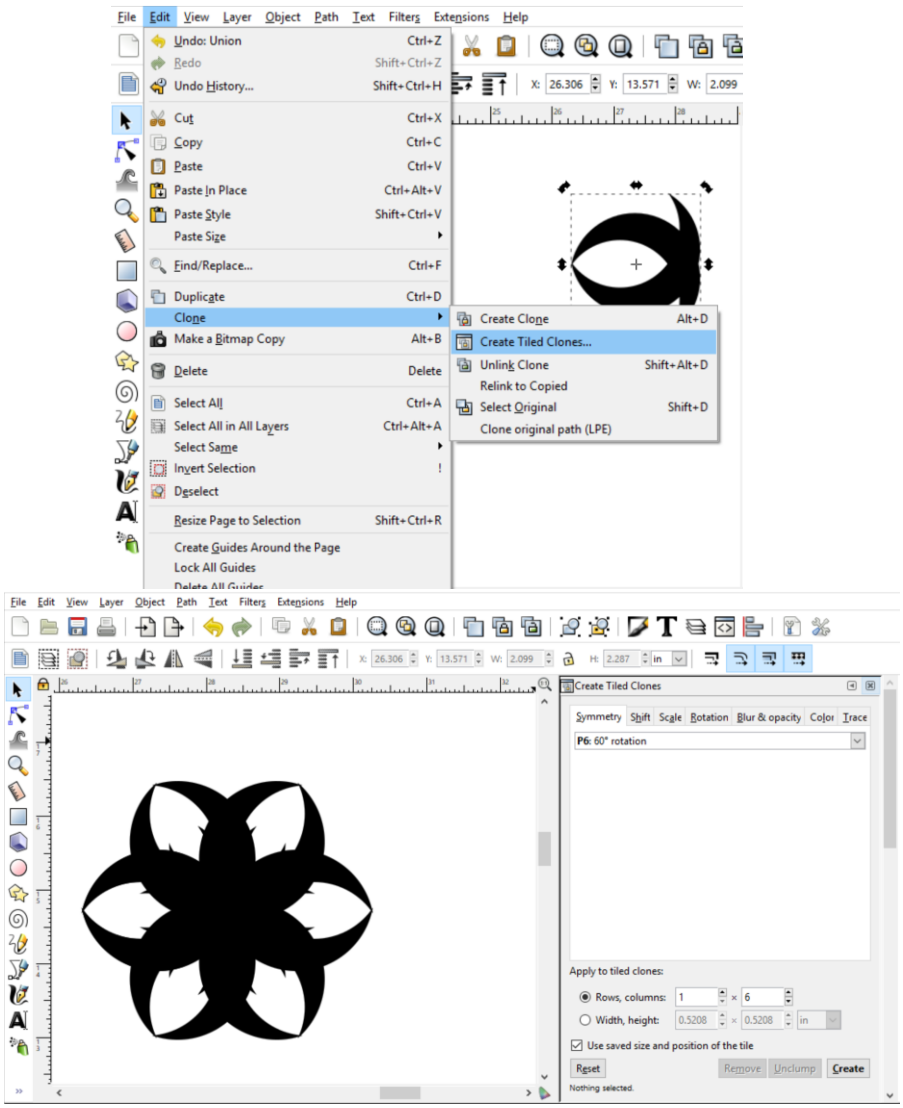
12. Select both circles and perform the “Difference” operation



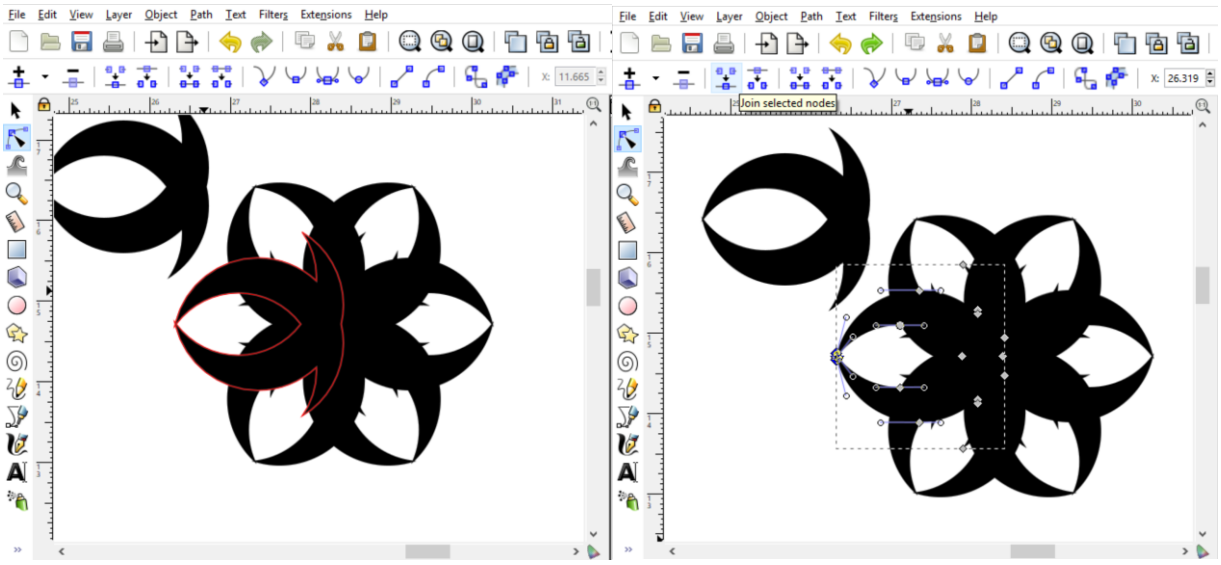
13. Then, make a copy and flip (shown in the red rectangle) and overlay the two as shown. Use the “Union” tool to combine them.



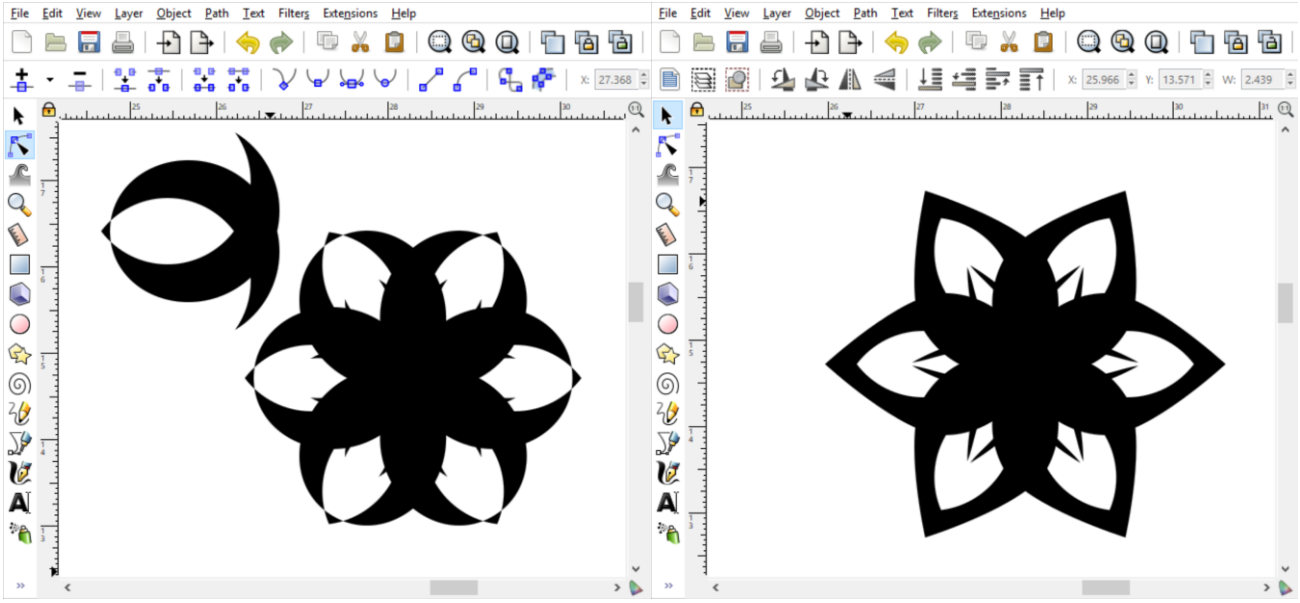
14. Create a tiled clone. Use the options shown. This allows you to create a radially symmetric design for the base for your tree.



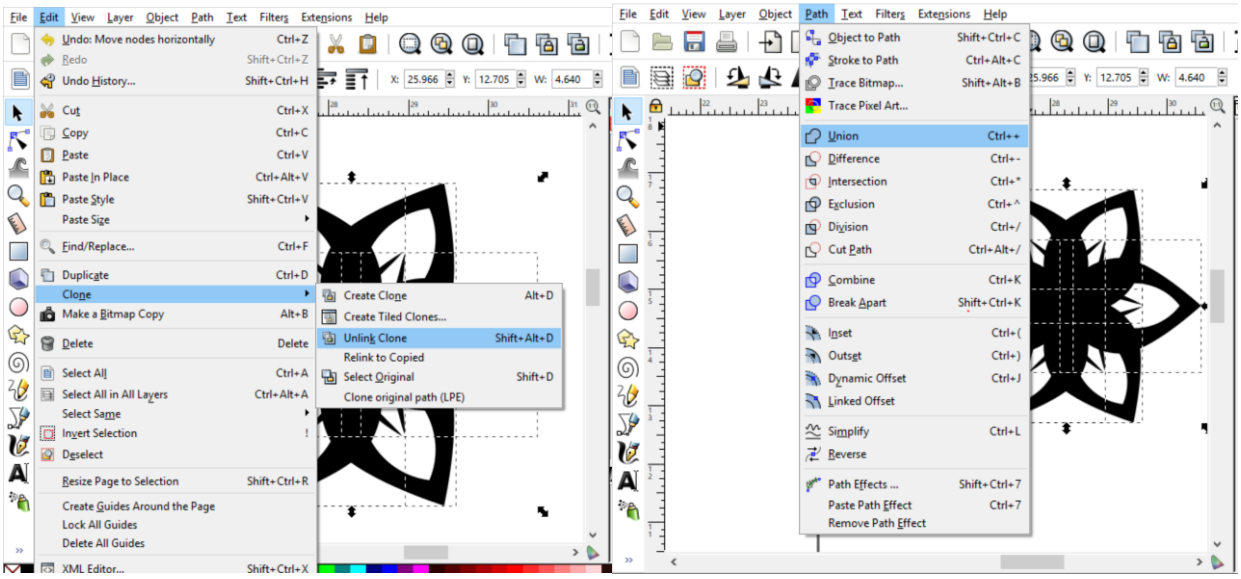
15. The tiled clone option allows us to modify the original copy and propagate the change to all the clones. So find your original by using the node tool (2nd tool). You should see a red outline around the original. When you click on the original, nodes (the gray diamonds and circles) should appear as shown.



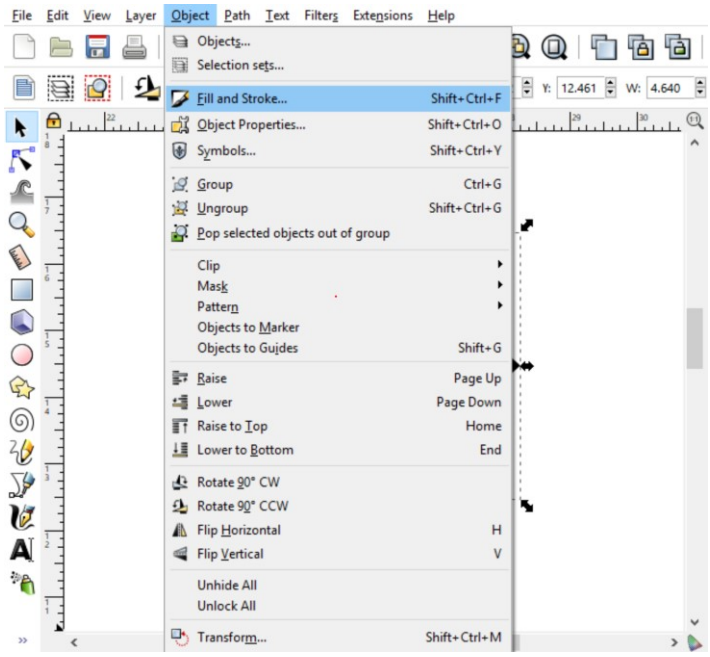
16. Select one of the nodes and move it around. Note how changing the original changes all of the copies. Adjust the nodes until you have a design you like. Example designs are shown below:

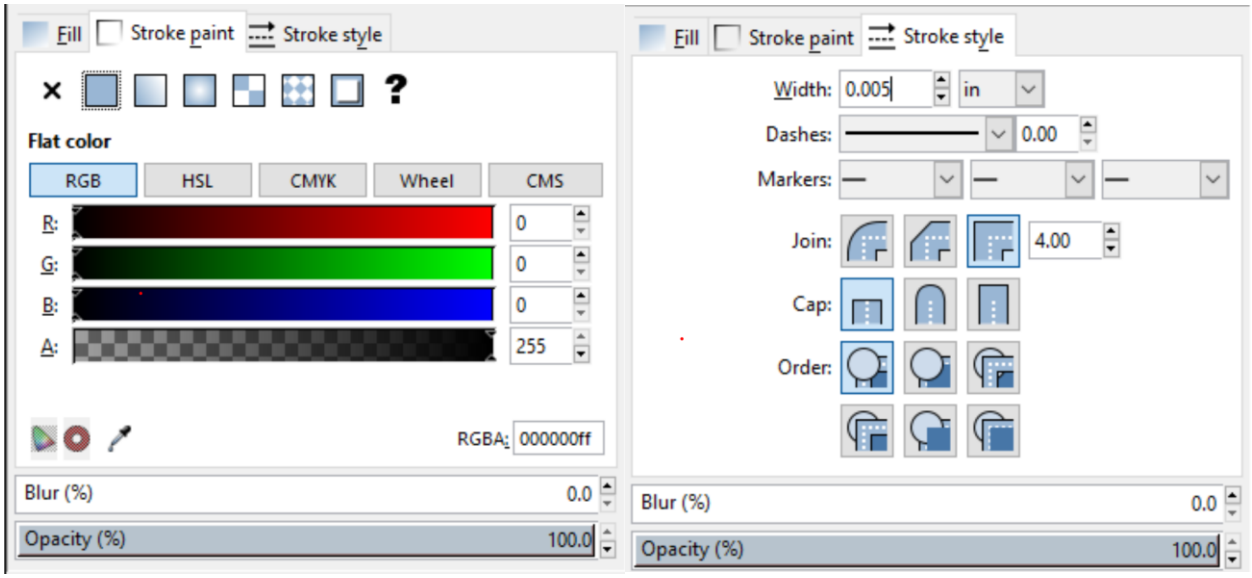


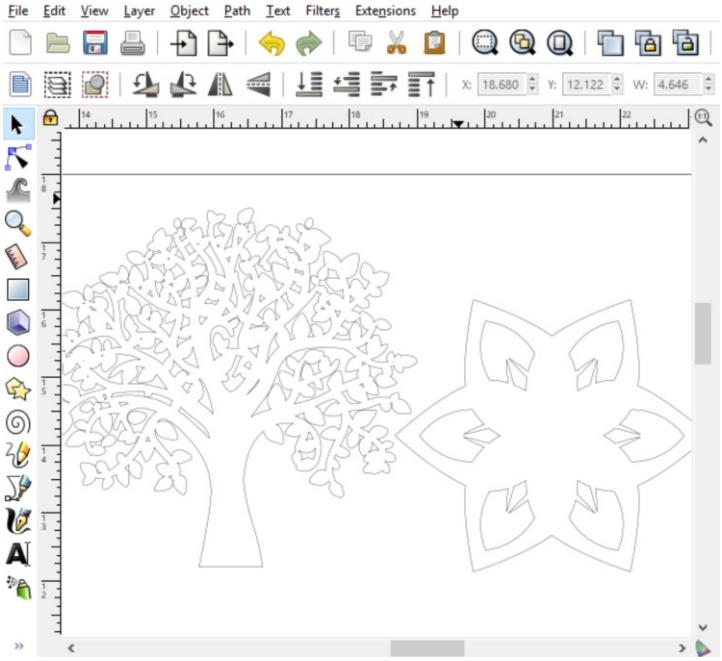
17. Now we want to join all the clones together so that the base will be a singular piece. If you actually turn off the fill and turn on the stroke, you'll see that each clone is still independent pieces. But to do that, we have to unlink them. Select all the clones and do the operation below. Join the pieces together using "Union".



18. Now turn off the fill and turn on the stroke to turn the object into an outline that can be edge cut on the laser cutter by doing the operations below:

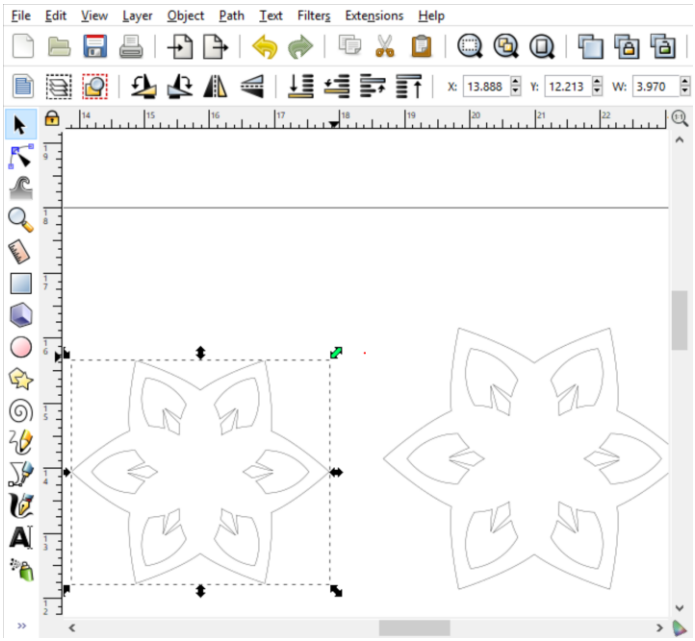




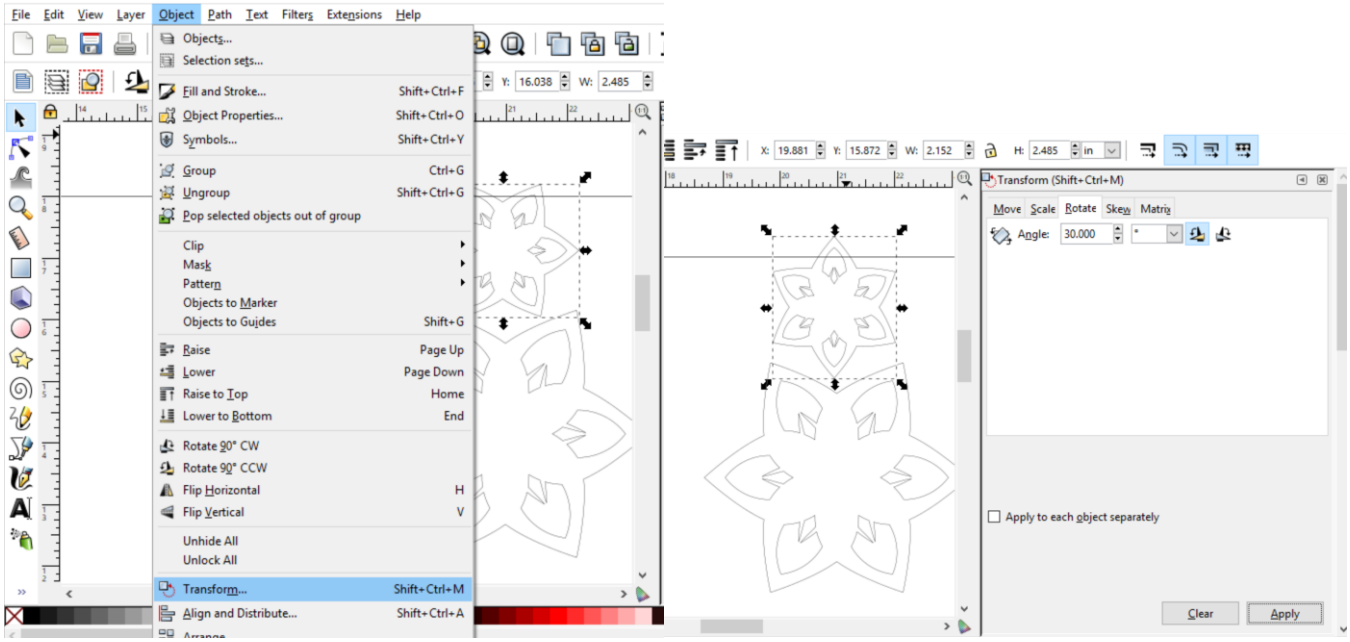


19. Now make another copy of the base. We're going to resize it and rotate it to make a more intricate multi-layer base. Follow the instructions below:

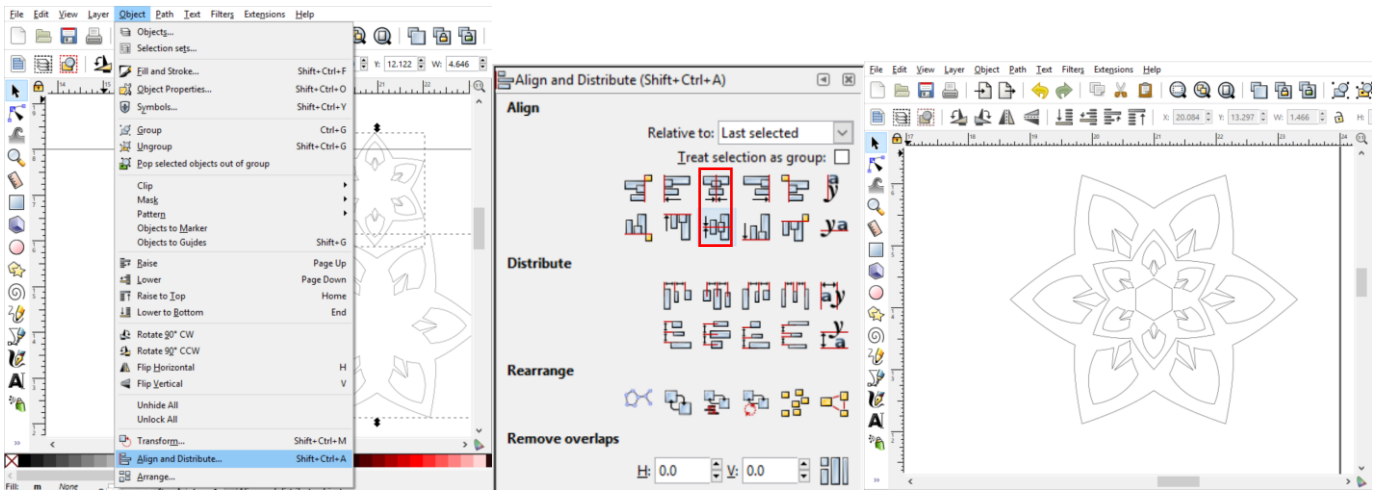
20. First, resize the second copy. This can be done by clicking on the copy and dragging the little arrow handles inward and outward. To keep the same proportions, hold down **CTRL**.



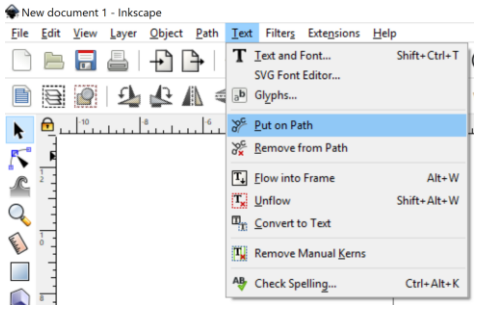
21. Now, rotate the base using the transform command as shown below. For this particular base, we are rotating it by 30º.

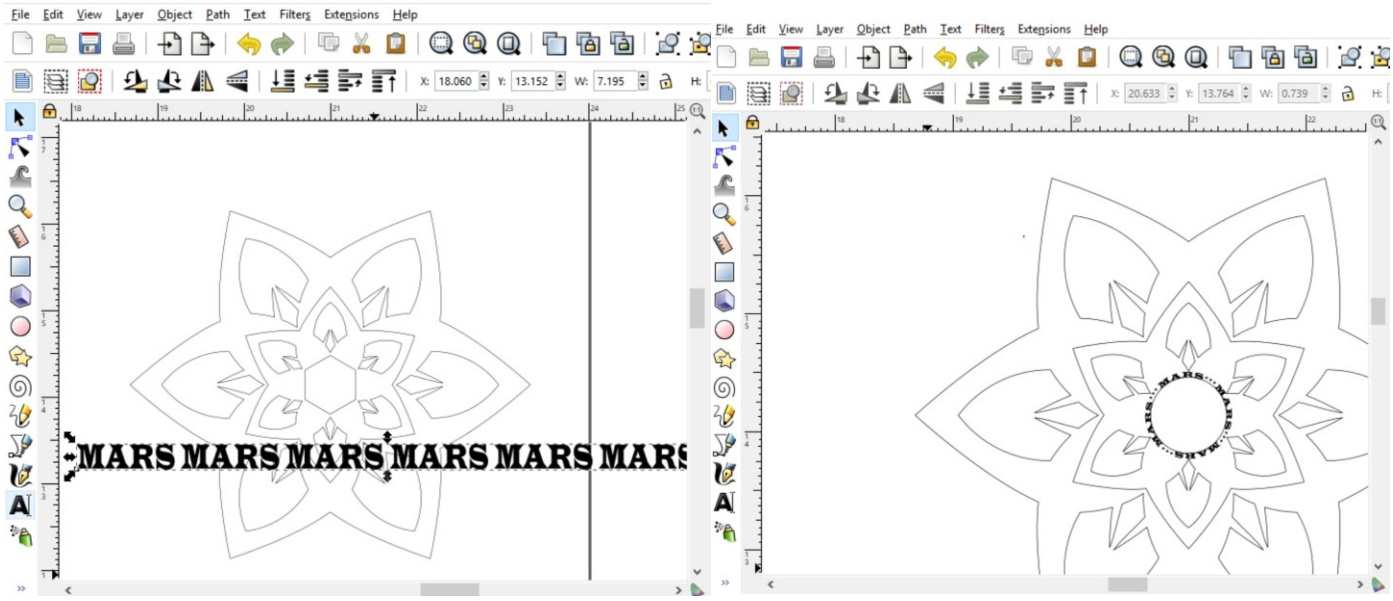


22. Finally, we are going to center the two bases using the align and distribute command as shown.

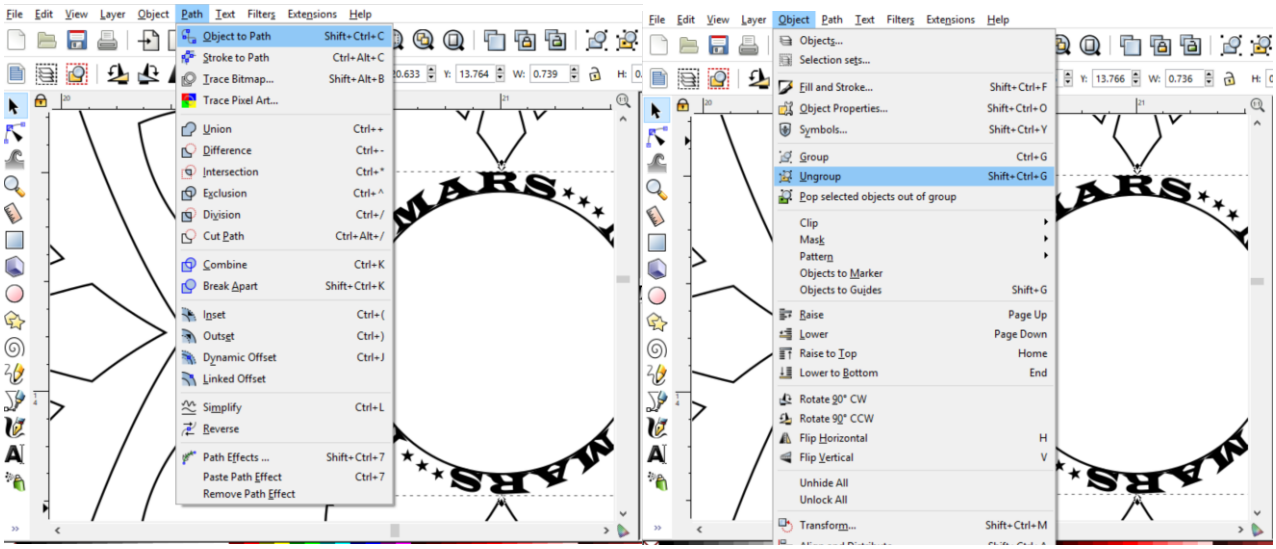


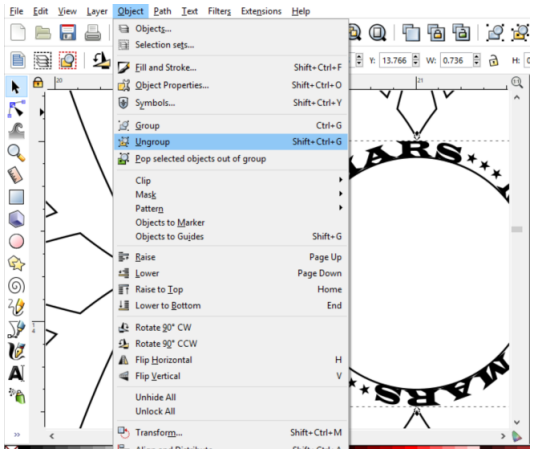
23. We are going to put text on the base using the text on path tool. Type whatever message you want and create a circle or some other shape you want to put the text on. Select the text and the shape you want to put it on, navigate to “Text”, then to “Put text on path”, and then you should see something similar to what is shown below:



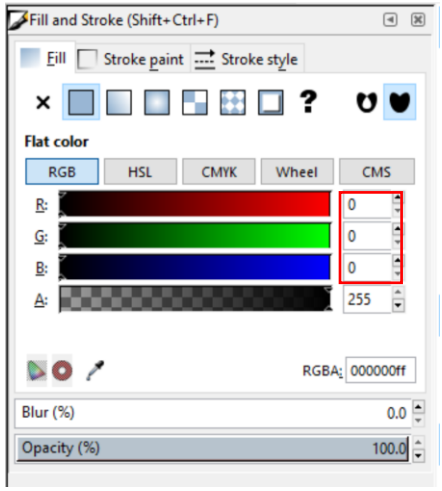


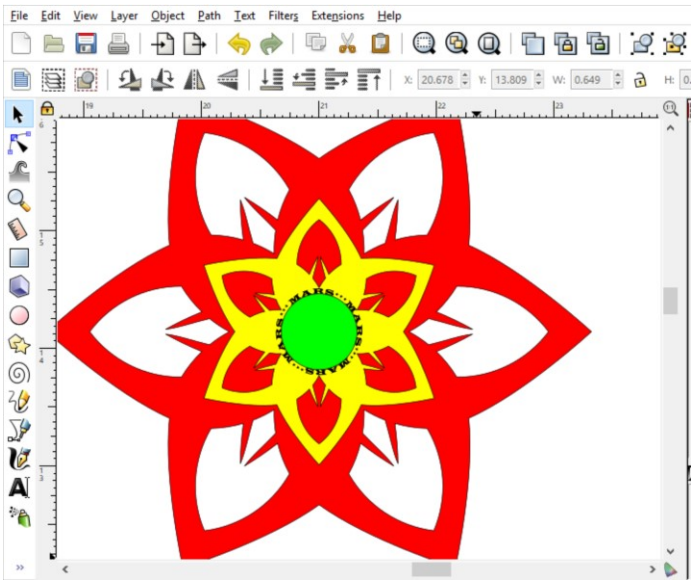
24. Now we are going to combine everything in the base into one path. Before we do this, we have to turn the text into a path using the commands shown below. Be sure to ungroup it after this operation.



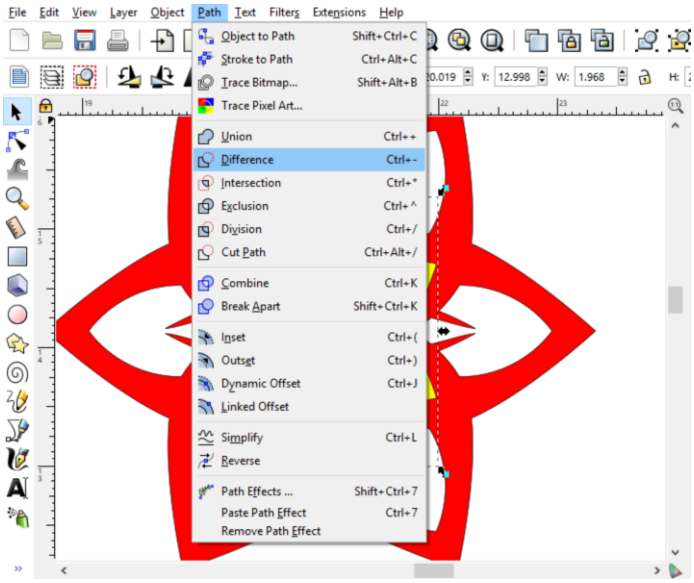


25. Color the parts of the base. This can be done by adjusting the RGB values for the fill.

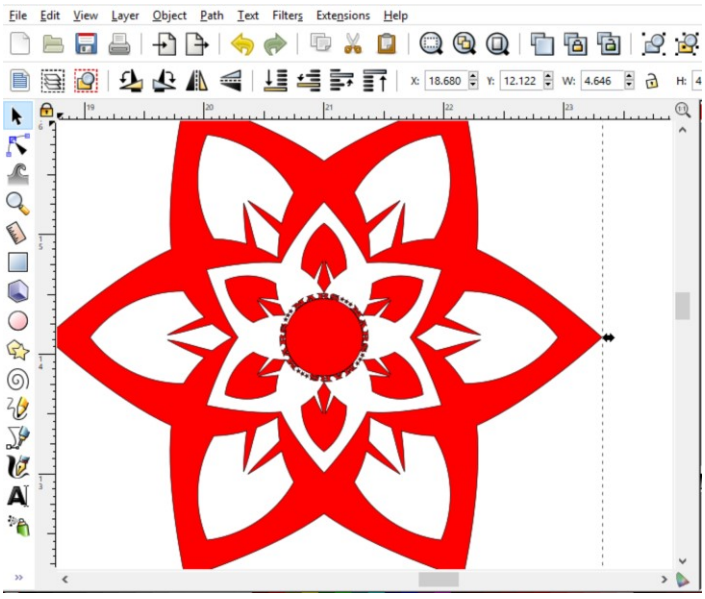




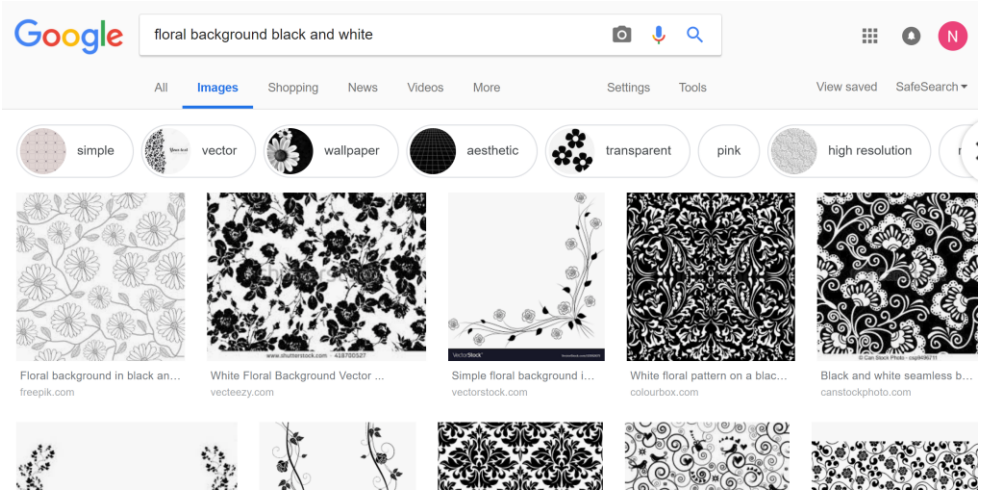
26. Now do the Boolean path difference in the following order. First, take the difference between the green circle and the yellow base. Then, take the difference between the black text and the yellow base. Finally, take the difference between the yellow base and the red base.

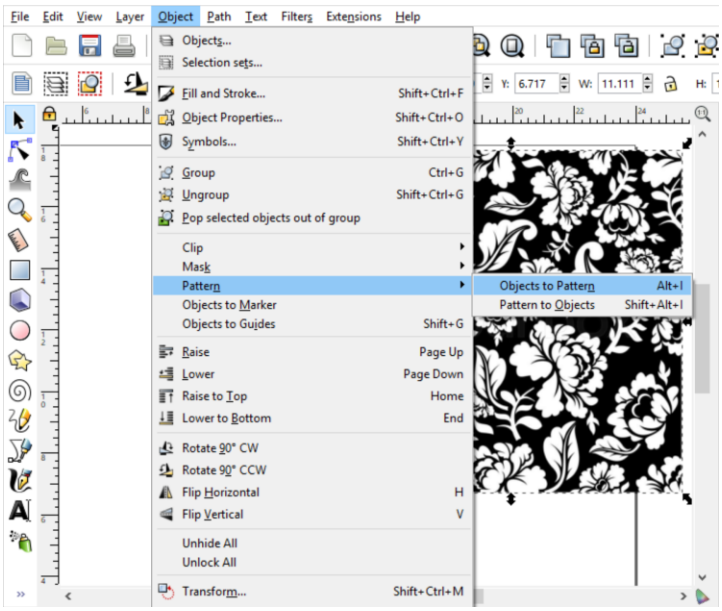


27. You should end up with the pattern shown below:

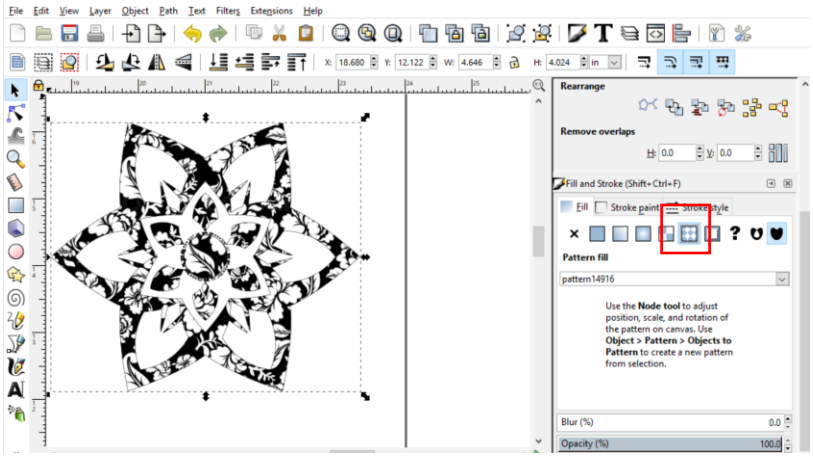


28. Now we are going to create a custom fill. This is done so that we can repeat an arbitrary pattern only on the inside of our object. This is purely decorative, but it can be useful in cases when you want to completely fill your design with some repeating pattern (like a brick pattern). Instead of having to copy the pattern over and over, you can use this technique instead. Find your desired fill online and copy and paste it into Inkscape. Use the “Object to pattern” command to create the custom fill.

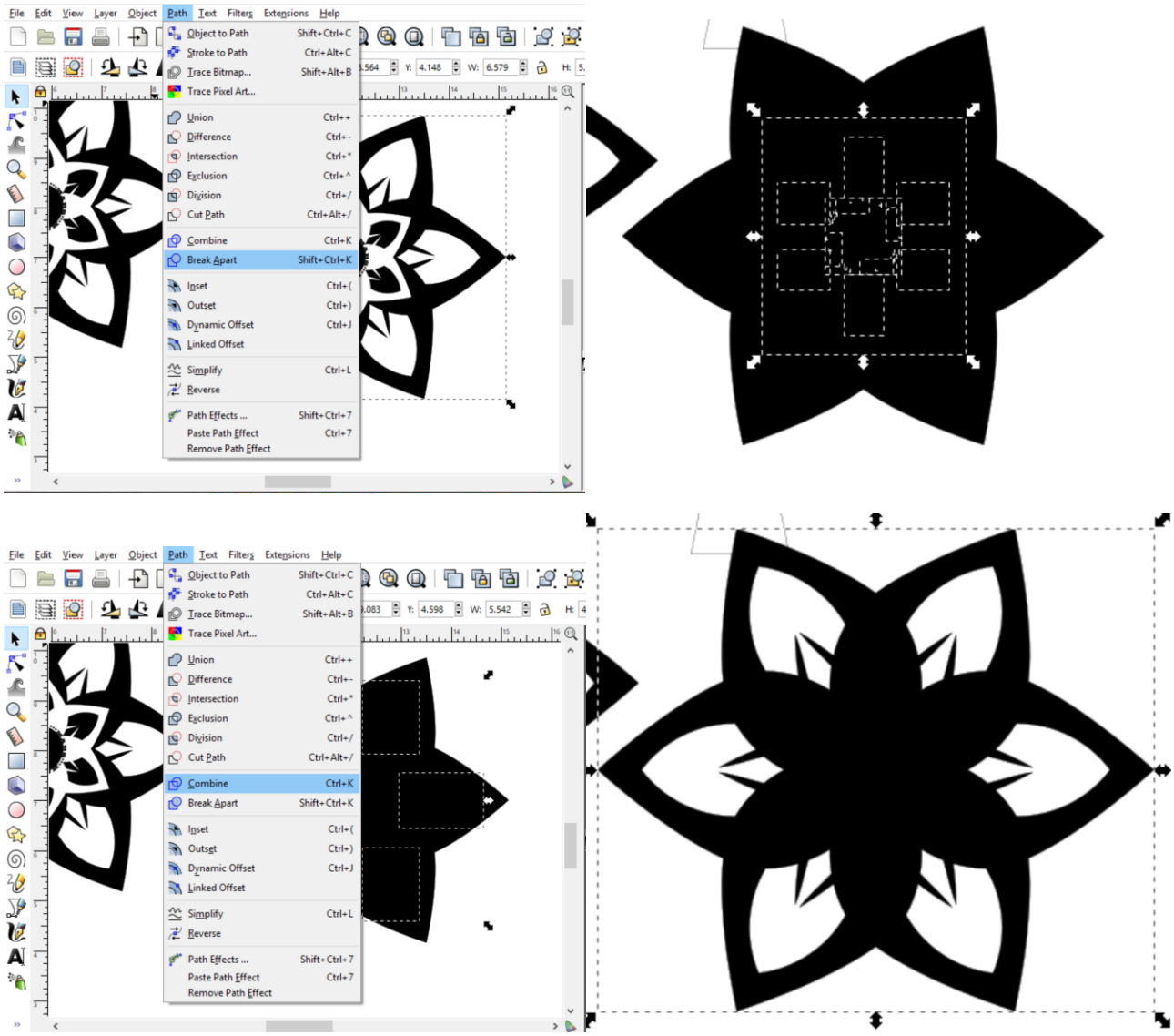




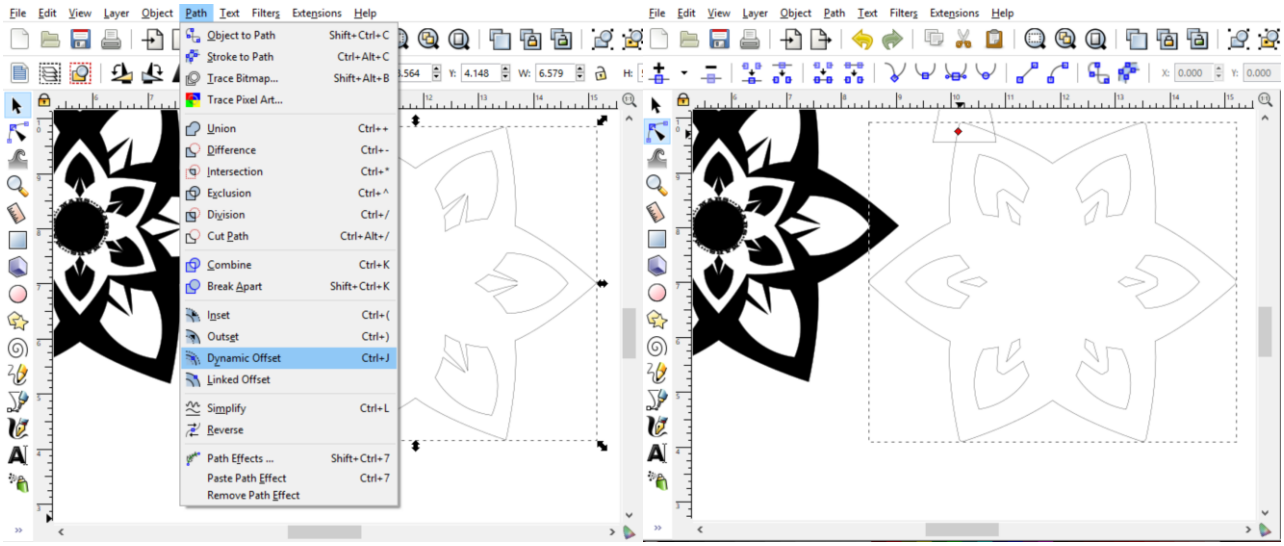
29. Change the fill to the pattern fill.



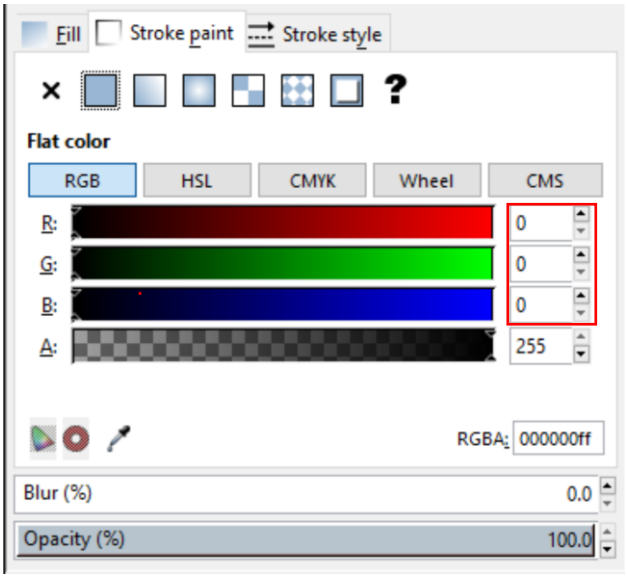
30. We want to create the parts of the base that we want to cut out. To do that, we make a copy of the base and break the copy apart. Delete any part of the path that you don't want to cut out (as shown) and recombine the remaining pieces. You should see whatever is left.

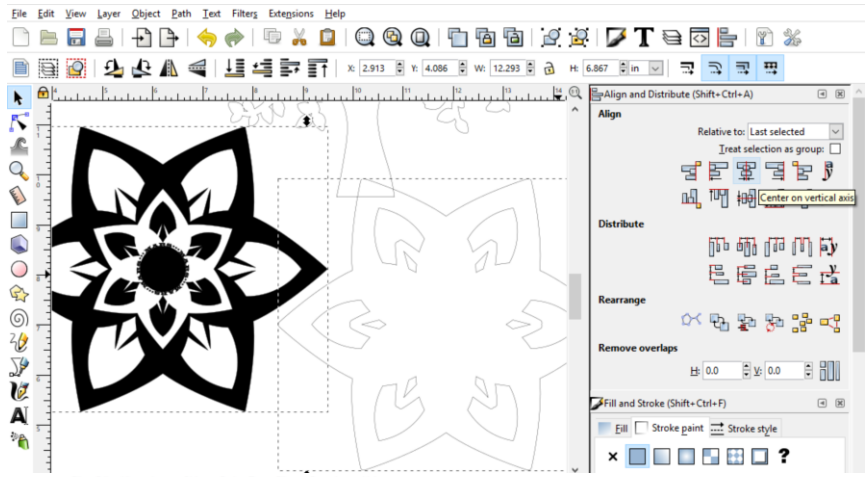


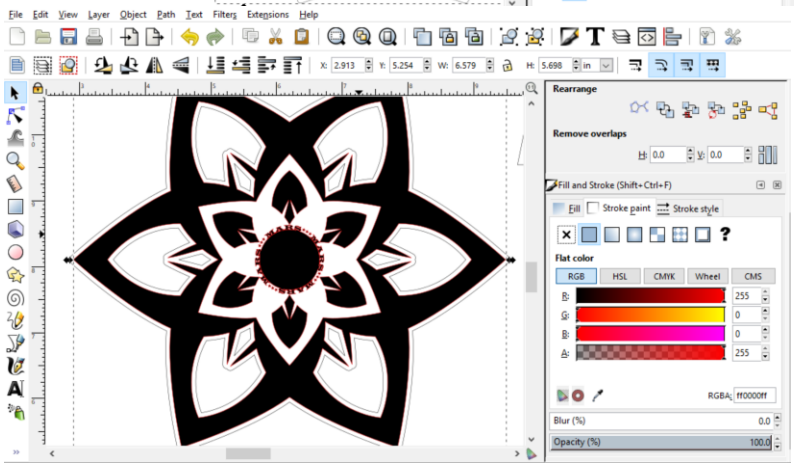
31. When creating a design for laser-cutting, keep in mind that engraving results in a lower surface than unengraved areas. In addition, engraving does not lead to a uniformly level surface even with the same settings or color value set for the fill. Normally, this isn't noticeable, but this is more apparent when the engraved surface meets the edge of the piece. To avoid this, we are going to create a little margin between where we are setting the laser to cut and where we are engraving. Perform a dynamic offset so we have a little margin between our design for the base and the part we are cutting out.

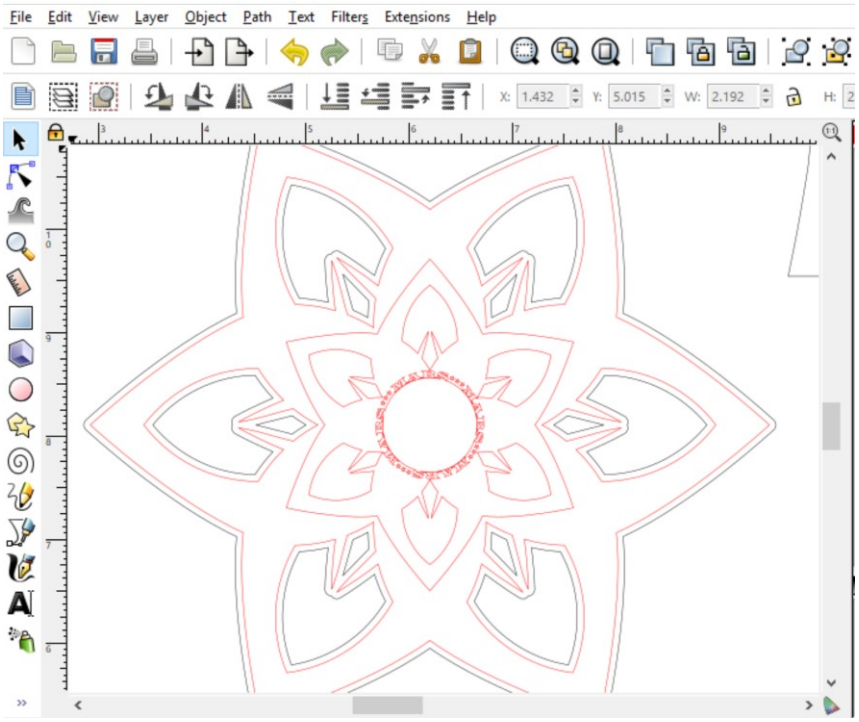


32. Center the cutting path with the base design as shown. Change the outline of the design to red by adjusting the RGB value under stroke to 255 R, 0 G, and 0 B. We are doing this so that when it comes time to laser-cut this design, we can specify specific settings for lines with that RGB value. This technique is called color mapping. We are color mapping this so that we can tell the laser to cut red lines to half the depth of the wood and to cut black lines all the way through. The main advantage to this technique is that it's faster than engraving and leads to cleaner lines. It's easiest to see this when there is no fill.

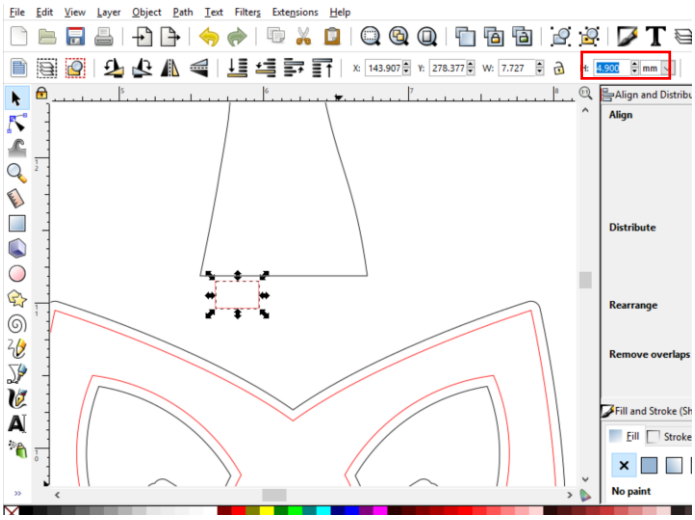



File Edit View Layer Object Path Text Filters Extensions Help
Align and Distribute (Shift+Ctrl+A)
Align
Relative to: Last selected
Treat selection as group:
Center on vertical axis
Distribute
Rearrange
Remove overlaps
Fill and Stroke (Shift+Ctrl+F)
Fill
Stroke paint
Stroke style

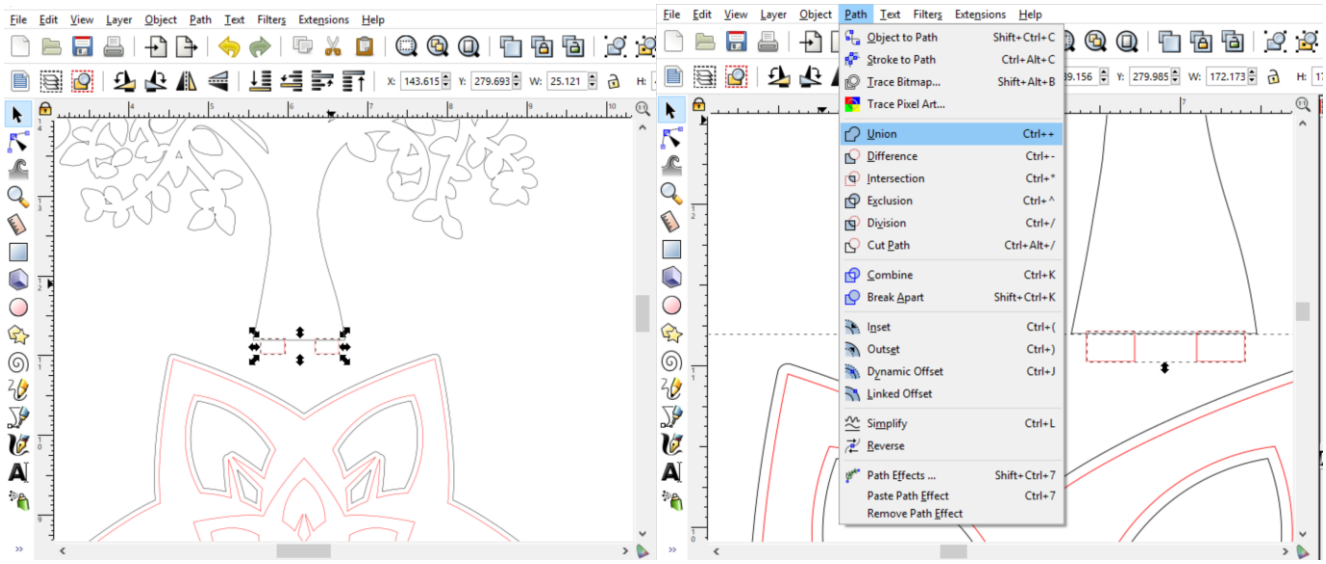

File Edit View Layer Object Path Text Filters Extensions Help
Rearrange
Remove overlaps
Fill and Stroke (Shift+Ctrl+F)
Fill
Stroke paint
Stroke style
Flat color
RGB
HSL
CMYK
Wheel
CMS
RGBA:
Blur (%)
Opacity (%)


File Edit View Layer Object Path Text Filters Extensions Help

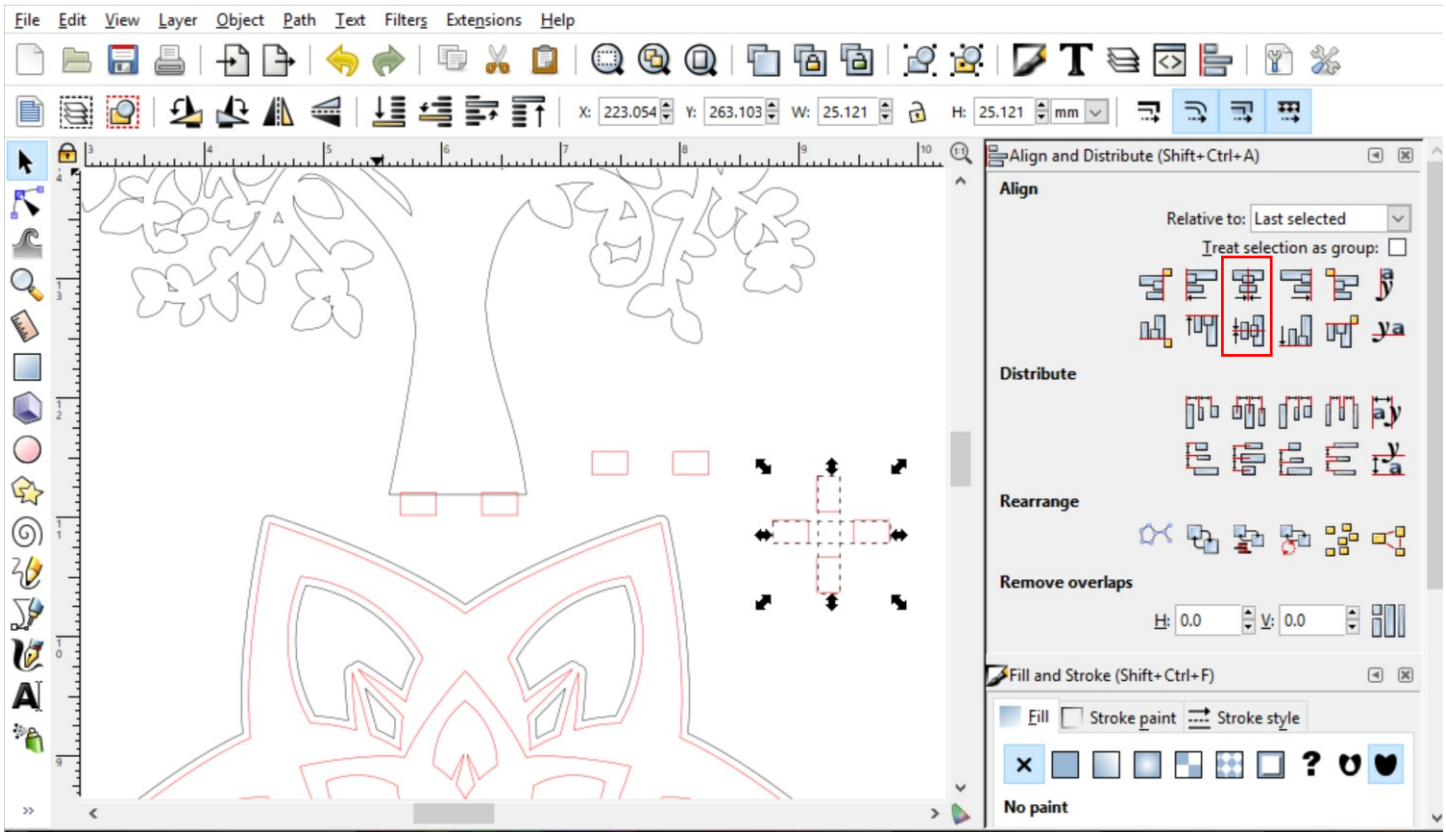
33. Now we need to connect the tree to the base. To do this, we are making a rectangle corresponding to the thickness of the material we're making the tree out of, which in this case is about 4.9 mm.



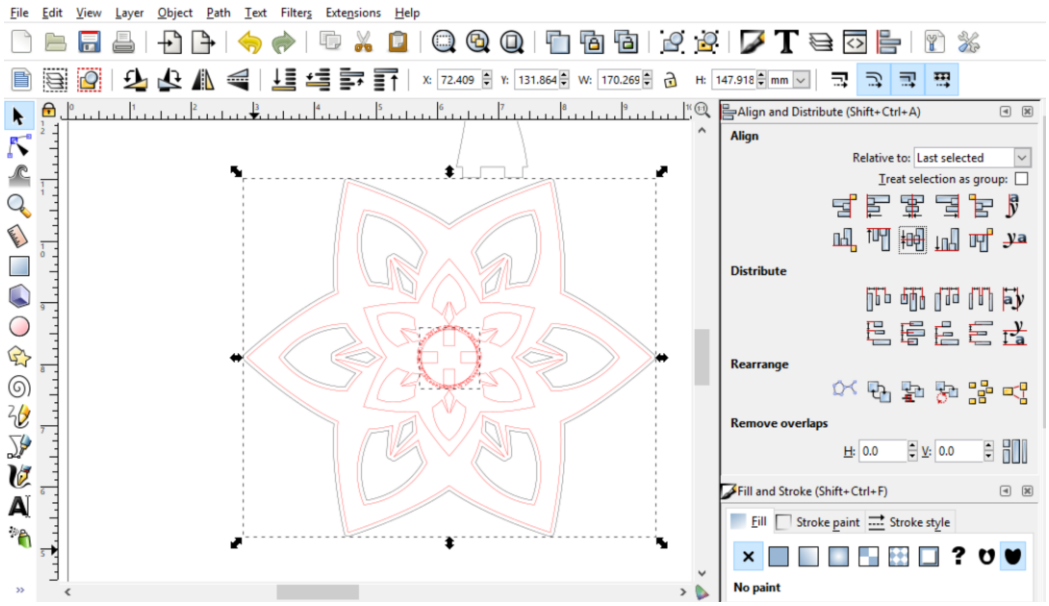
34. Make a copy of the rectangle, arrange them so that they are centered horizontally, and union them together. Make a few copies to be used for creating the inserts in the tree pieces and the base. Join the pair to the base of the tree using the "Union" command. Make sure there is a little overlap between the tree and the rectangles.

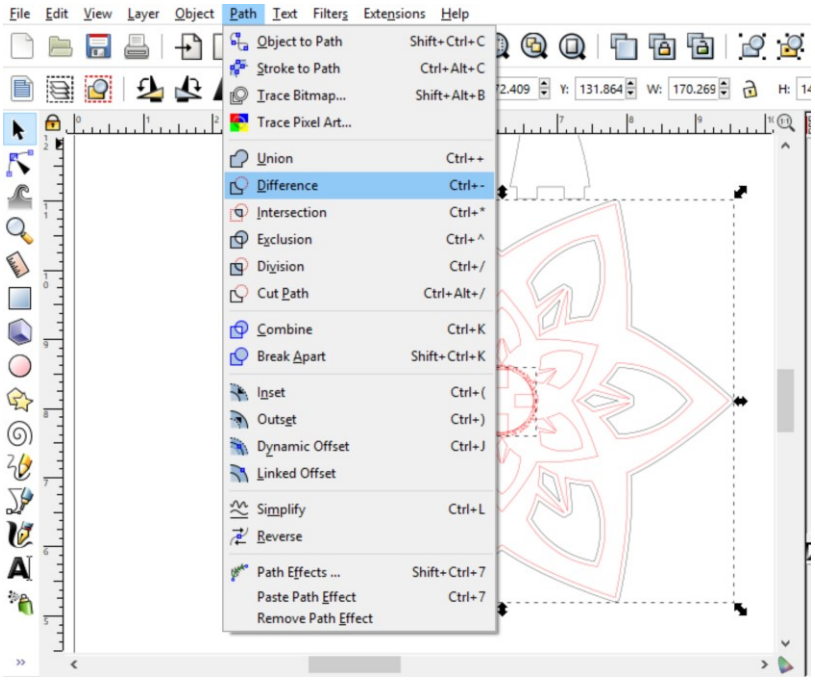


35. Take one of the rectangle pairs you copied and pasted earlier and rotate it by 90 degrees. Then center that group with another group. Join them together with the "Union" command. This will form a cross for the holes in the base.

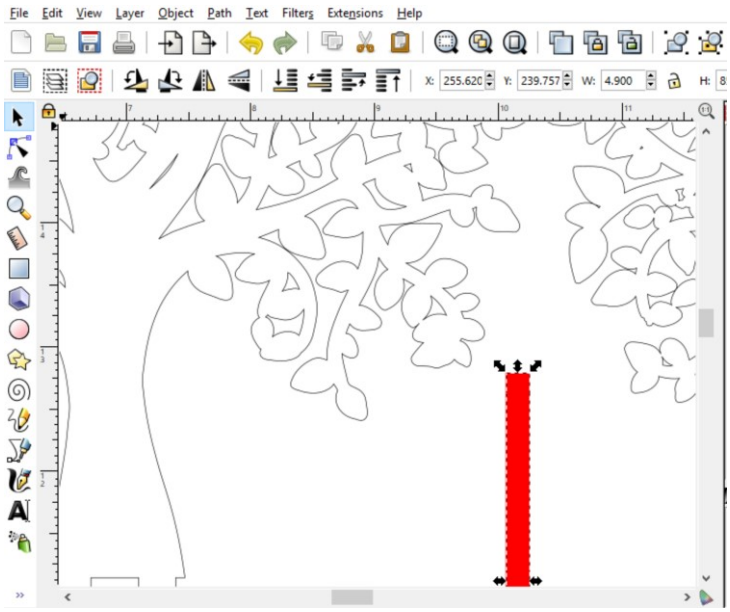


36. Center the cross shaped hole and the outside path (the black one) onto the base. Use the “Difference” command to cut the holes into the base. You should end up with something like what is shown below.

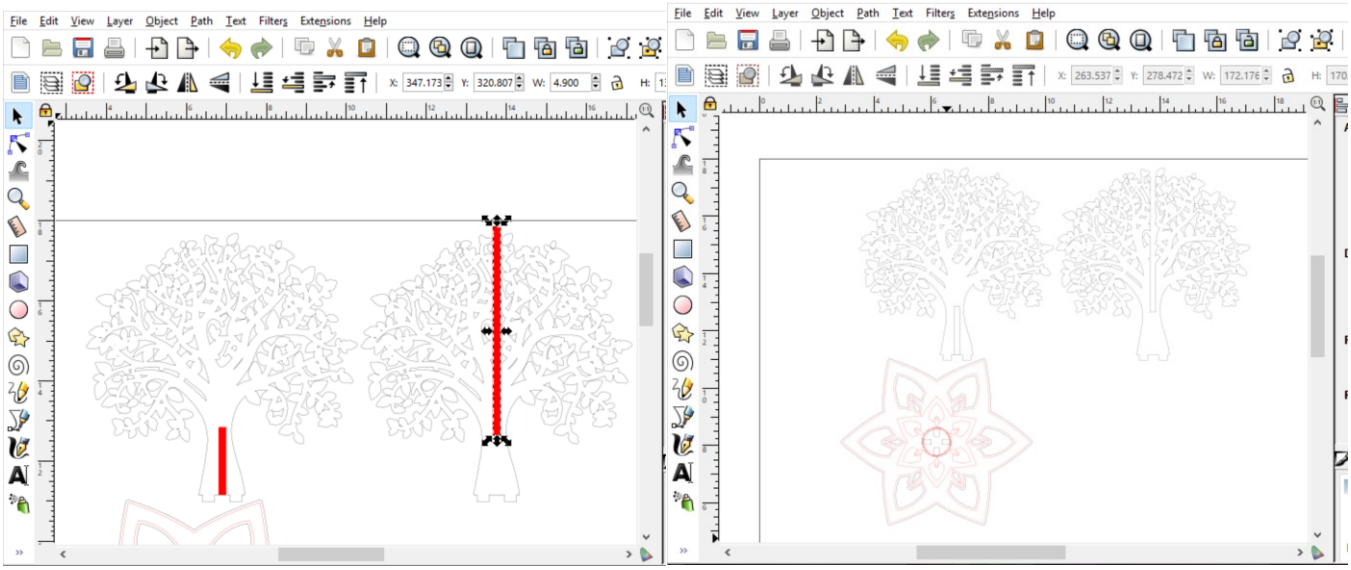
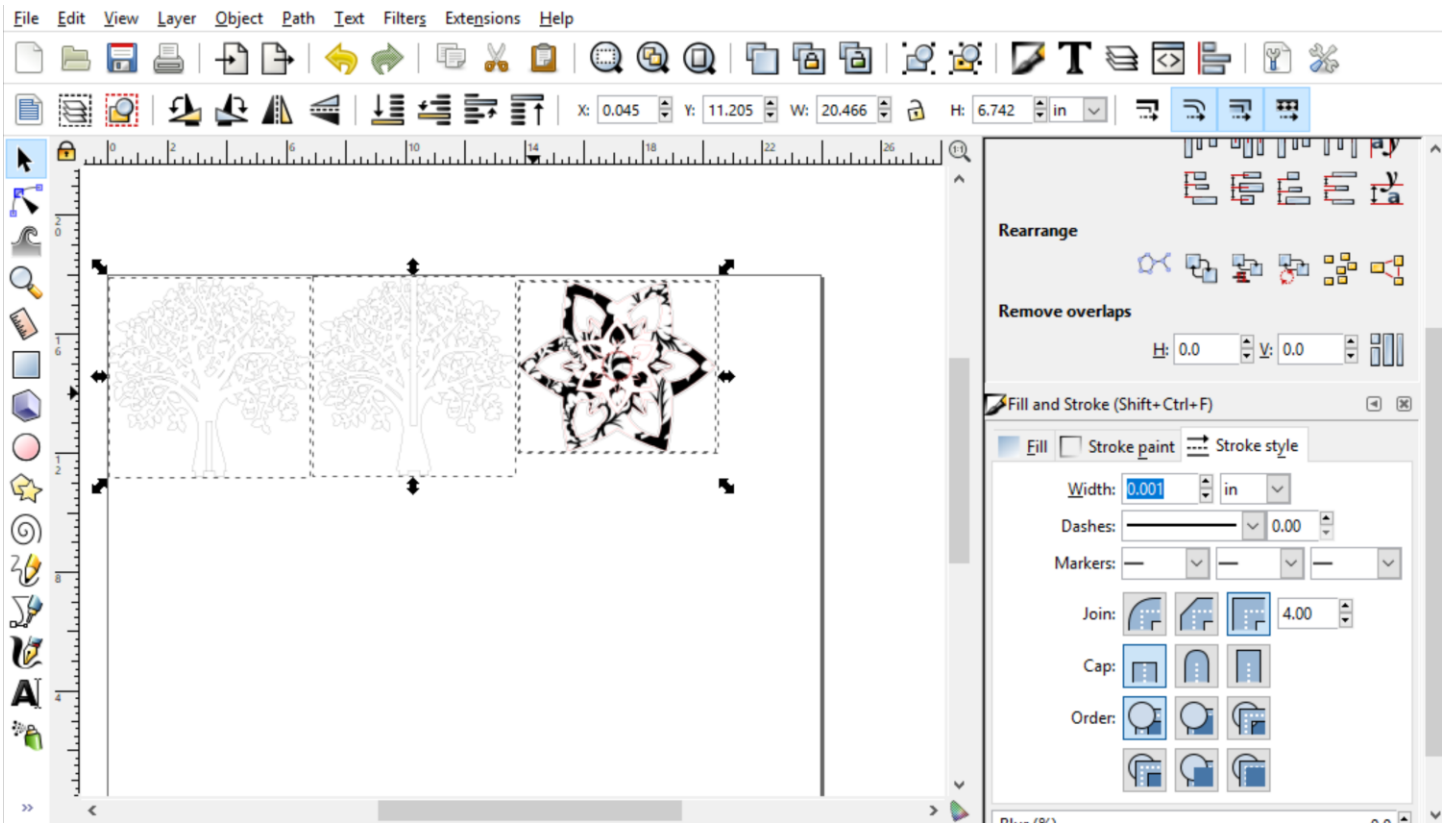




37. Now we want to make a slot to slide the halves of the tree together. First, make a copy of your tree. Then, create a rectangle with width of 4.9mm and a height a little more than half the height of the trunk. We will be using this to cut slots into each copy of the tree.



38. Place the rectangles so that they are centered between the tabs of the tree as shown below. Make one rectangle start from the bottom half of the tree and the other start from the top of the other tree. Make sure that there will be enough material on either side of the slit as well as above/below the slit so that the tree will not break apart upon being removed. Use the “Difference” command to cut those slits into the tree.



39. Finally, rearrange your pieces to fit within the board. Press “Ctr+A” to select all your pieces and go to “Stroke Style” under “Fill and Stroke”. Change “Width” to 0.001 in, and your file is ready to be exported as a pdf for laser-cutting. Congratulations on making a 3D tree out of 2D slices of wood!