FRINGE EFFECTS

By Tom Coates

He telleth the number of the stars;
he calleth them all by their names.
Psalms CXLVII

When I was a kid, I had a wonderful toy known as *Hoot-Nanny/The Magic Designer*. First produced in 1929, it drew complex looping patterns on circular pieces of paper. Turning a crank activated a set of gears that rotated the paper. A pen was attached to two struts which were attached to rotating gears in such a way that the pen moved back and forth across the paper in a regular fashion. The strut attachment points were variable as were the positions of the gears, allowing for an impossibly large number of potential patterns. This complicated *toy* probably encouraged my great fascination with patterns that continues to this day.

Canvas has a feature that is just as fascinating as my childhood toy. It's called the Multigon Tool. I'm pretty sure that most Canvas users have no idea what wonderful things it is capable of. You can read a little bit about it in the Canvas 7 User's Guide, starting on page 15.17. I've said before that the User's Guide is amazing for the amount of stuff it covers. But it often barely touches the surface of the remarkable capabilities that are built into the Canvas toolbox. The section on multigons is no exception. You only get two pages describing the basic use. And there aren't any examples of what it is good for. Unless you have played with multigons you probably have a very limited concept of what this little gem is good for. Hopefully I can step in where the User's Guide leaves off. The first part of this article will be a bit technical, talking about how the Multigon Tool works. Feel free to skip first to the examples at the end. They may get you inspired to want the details.

Let's start with a repeat of what the manual says. The Multigon Tool allows you to draw regular shapes that are based on polygons and stars. For those of you who skipped geometry, a polygon is a multiple sided shape (from the Greek roots poly=many and gon=angle.) Common instances are triangles, squares, pentagons, etc. Stars are related shapes that are the result of connecting the vertices on a polygon in a regular fashion. *Multigon* is a made-up word to describe the Canvas tool for drawing multiple types of shapes derived from polygons.

The Multigon Tool is the little star-shaped icon on the Specialized Drawing Tools Palette. You click the tool and draw multigons just as you would rectangles and ovals. The result depends on the current settings of the tool. You select those characteristics by double-clicking the tool, which pops up the Multigon dialog box, as shown on the next page. Once you configure the tool, you can draw multiple objects that have the same basic characteristics. The defaults will stay in effect until you re-configure the tool.

As you drag to create a multigon, you can press the Shift key to force the shape to be *regular*. That means that the polygons will have sides that are all equal. For example, you could draw a perfect equilateral triangle by drawing a three-sided Frame with Shift pressed. This can be very useful if you need to create precise geometric shapes.

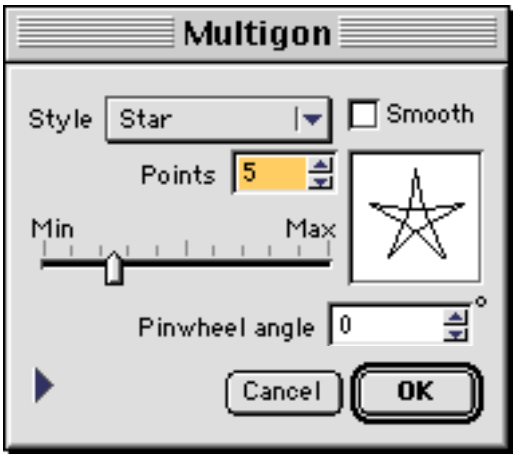
In many ways, multigon shapes behave like complicated vector objects drawn by the normal Polygon or Bézier Curve tools. You can stretch and rotate them just like rectangles and ovals. The lines can be drawn with any of the strokes and inks. The interior of the shapes can be filled with any of the ink types. For some of the styles of multigons, a fill ink may produce unexpected results. For example, a star-multigon will end up with only portions of the object filled, with the rest being transparent. The regions inside the points will always be filled, but other regions might not, depending on the exact characteristics of the star. This behaves much the same as if you drew a bézier curve that crossed over itself multiple times. Some regions get filled and some don't.

But in other ways, objects created by the Multigon Tool are not *normal* vector objects. After you create them, you can still adjust their multigon-specific characteristics. For example, you can change the number of points or the multigon-style. You do this by selecting the previously created multigon, and then double clicking the Multigon Tool. The dialog box that appears will show the settings of the selected object. Changing the settings and clicking OK will redraw the selected object with your changes. If I had one complaint to make about this tool it would be here. The dialog box disappears each time you apply the settings and you have to repeat this procedure over and over if you need to try several variations. An *Apply* button or a Preview checkbox would be really nice. That being said, there is also a way of interactively changing some of the settings. I'll describe that later.

One multigon characteristic that can seem odd is the object size as shown by the bounding box or in the Object Info dialog box. The dimensions often appear a bit larger than the shape. The reason for this isn't obvious, but the algorithm has a good use. If you draw a multigon and later want to make it perfectly symmetrical, use the Object Info controls to set the width to match the height. This works regardless of the the number of points, style, etc. If you really need the bounding box to exactly match the shape, use the function Object>Paths>Convert-To-Paths to turn the multigon into a normal vector object. Beware that you will lose the ability to modify the multigon-specific characteristics.

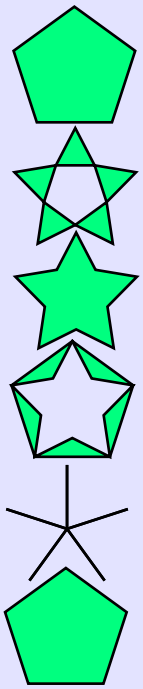
MULTIGON SETTINGS

The Multigon Dialog Box has five separate controls that define the shapes the tool will generate. When you are setting the controls, a small preview of the shape appears in the dialog box to give you an idea of what you are going to get. The preview is adequate for simple forms with only a few points, but lacks the resolution to show really complex combinations.



Multigons come in six different flavors, as selected by the Style popup menu. I've shown a five-point example of each of them below. Each type is generated in a different way, and each has different uses.

Beyond the Style of a multigon, the other most obvious characteristic is the number of points. The number can range from 3 to 100. Although point counts on the high end of this range can make for useful effects, you should keep in mind that it can take Canvas a long time to draw such complex shapes, especially with complicated strokes. I once made a 100 point star with a complicated parallel-dashed line stroke and it took several minutes to draw on a relatively fast machine! It was very pretty to look at when it was done, but I became worried that Canvas had frozen during the wait.



Multigon Styles

Frames are used to generate simple polygons with a given number of sides. Pressing shift forces the tool to draw a *regular* polygon, that is, all of the sides will be the same length, and all of the interior angles will be the same. A fill ink fills the entire interior of the Frame.

A **Star** draws a set of lines connecting the vertices (points) of a polygon. The exact algorithm for which vertices get connected is a bit complicated, and depends on the number of points. Furthermore, the lines can be bent into three segments in ways that depend on the settings of the other controls. Various regions may or may not be colored with a fill ink.

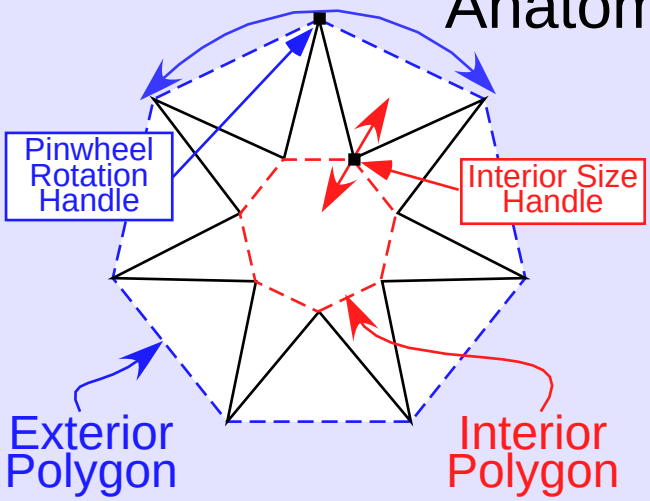
Star Outline is the same as a Star except that the internal structure is not drawn. A fill ink colors the entire shape.

A **Framed Star** is the same as a Star Outline, with an external polygon connecting all of the outside points. This can also be viewed as a set of interconnected triangles between the points of the star. With this style, the interior of the star resists a fill ink, while the triangles get colored in.

The **Spoke** style appears as a set of radial lines from the center of the shape. This is actually a special case of the Star style where the star's points are made very narrow and the center area of the star is reduced to nothing.

A **Wheel** is the same as a Spoke style combined with a frame.

Anatomy of a Star

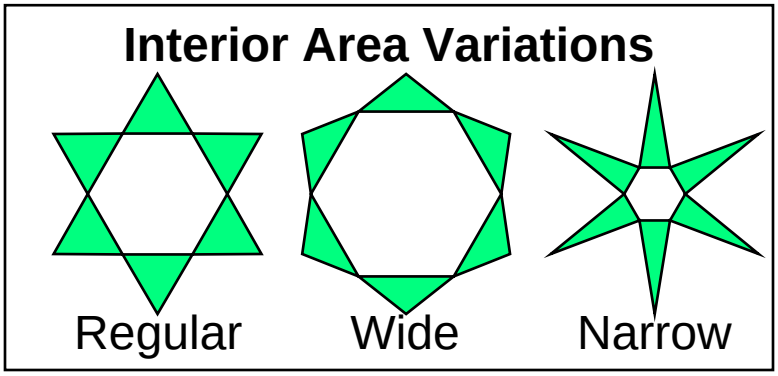


A Star Outline results from connecting the vertices of two polygons. The size of the *Interior Polygon* can be varied to make the starpoints sharp-and-deep or blunt-and-shallow. The *Exterior Polygon* is rotated to give the pinwheel effect.

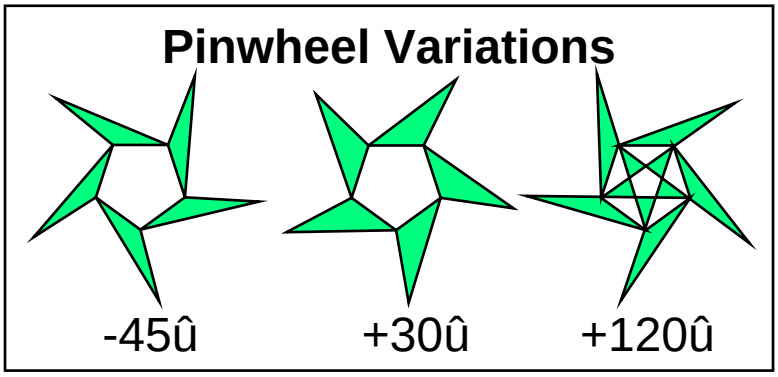
A *Normal* Star also has lines connecting some of the vertices of the Interior Polygon. This structure is dropped for Framed-Star and Star-Outline styles.

Double clicking a Star shape reveals two dragable handles for controlling the pinwheel angle and the size of the interior polygon.

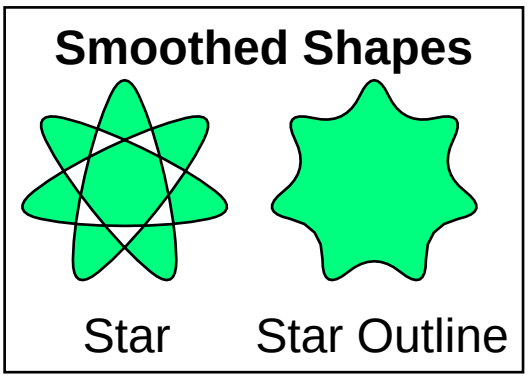
Two of the multigon controls affect the way stars are drawn. These are only available if the style is Star, Star Outline or Framed Star. According to the manual, the Min-Max slider controls the "interior area of stars." The effect is hard to describe. It helps to think of a star as connecting the points between two polygons, neither of which may be visible. (See Anatomy of a Star.) The Min-Max slider controls the size of the interior polygon relative to the exterior one. You can see this effect in the six-point examples in *Interior Area Variations*. Narrow interiors result in long narrow points. Wide interiors give blunt points.



The other stars-only control is the Pinwheel Angle. This causes the points of a star to tilt relative to the interior polygon. The pinwheel angle is created by rotating the outer polygon by the specified number or degrees. See *Pinwheel Variations* for examples. Positive values push the points clockwise, while negative values shift counter-clockwise. Some very interesting effects occur with large pinwheel angles. At some point the starpoints start to cross over the interior of the star, generating complex networks of lines. Some of the most interesting, and unpredictable shapes are the result of this effect.

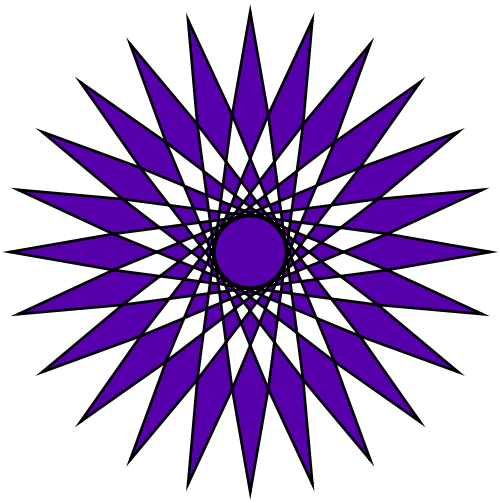


The two star-shape controls can also be adjusted graphically on an existing multigon object. Double click the object and two control handles will appear, one on a tip of a starpoint (on a vertex of the exterior polygon) and one at the base of a starpoint (on a vertex of the interior polygon). Drag the pinwheel control clockwise or counterclockwise to change the pinwheel angle. Drag the interior handle radially (in or out from the center) to change the size of the interior polygon. It is possible to drag the interior handle *outside* of the exterior one, which results in some very interesting effects. This is somewhat like turning the star inside-out. You can't do this with the Min-Max slider in the Multigon Dialog box, so some of the effects I show later can only be implemented by dragging the handles.



The final multigon control is **Smooth**, which changes the algorithm used to draw the shapes. Bézier curves are used instead of straight segments. You can see some simple examples in *Smoothed Variations*. I don't pretend to understand exactly how the smoothing is done, but it can produce some stunning effects.

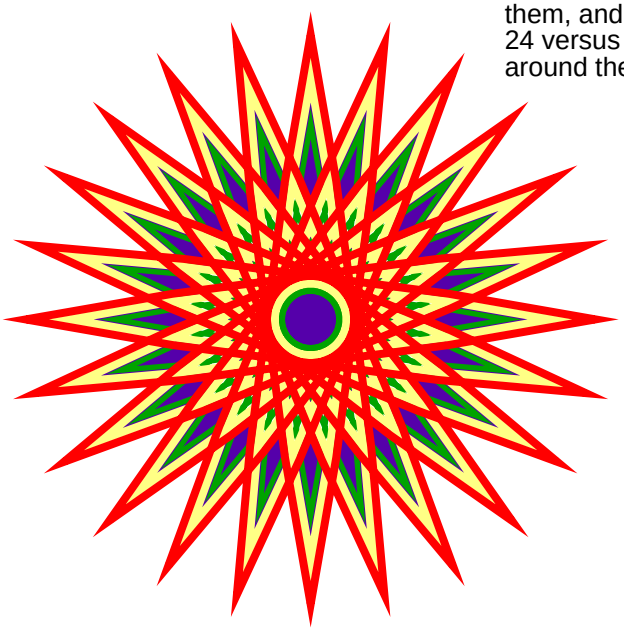
Most users can quickly see how the multigon controls can be used to generate basic shapes. What's not so obvious is what happens when you combine the controls, push them to their limits, and use them with other Canvas tools. That's where the fun starts, so let's move on to some examples.

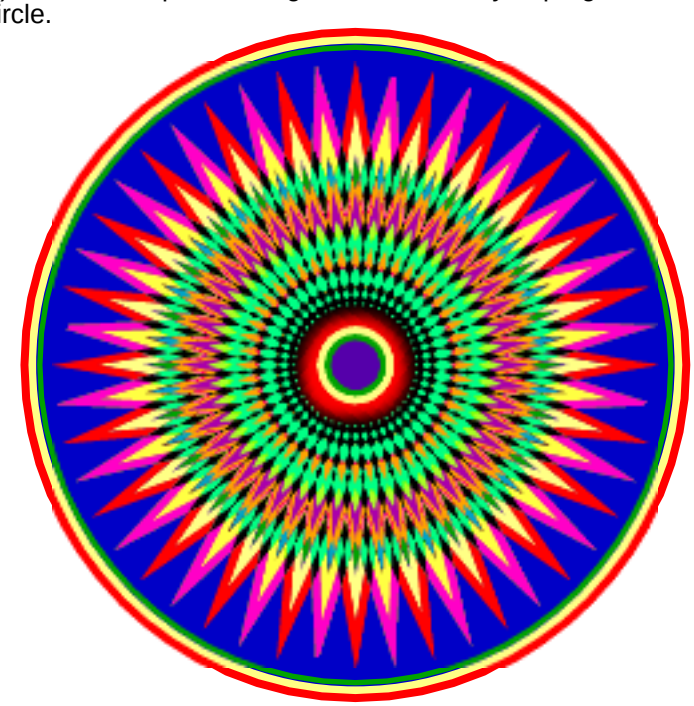


COLLIDING STROKED STARS

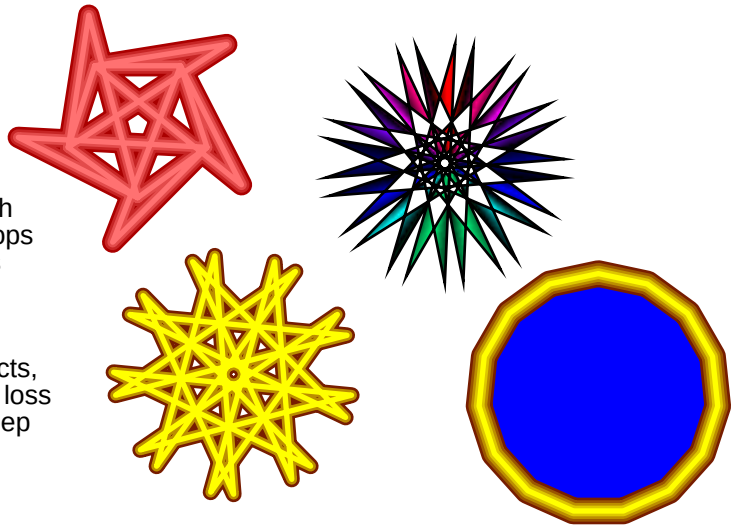
If you draw a simple star and give it a complicated stroke, the results can be much more interesting than a straightforward multigon. Here I've created a basic 24-point Star with a solid black stroke and a blue fill. As you can see, some of the voids in the star get the blue fill, while others don't. The result is geometrically busy, but pretty boring. Next, I defined a parallel stroke ink with red, yellow, and green portions of 3 points each, and applied it to the star. Now we have something much more visually interesting. You can start to see interactions between the multiple strokes and the star pattern, resulting in circular bands of color.

To make things even more interesting, I duplicated the star and rotated one copy by 7.5 degrees. That's 360/24/2, which gives exactly a half starpoint rotation. I overlaid the two stars. For the top star I activated the Difference Transfer Mode on the Transparency Palette. This allows the color patterns of the two stars to interact. I also made the center of the top star transparent to let the central *eye* show unaffected. Placing the result over a colored background gave the final result. It's still very geometric, but in a much more intense, intricate and chaotic way. Tiny adjustments to this setup can give wildly different results. Interesting variations include slightly offsetting the two stars instead of rotating them, and changing the number of points on one versus the other (say 24 versus 25) so the stars pass through each other as you progress around the circle.



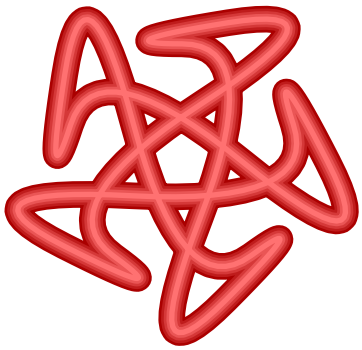


SMOOTHIES

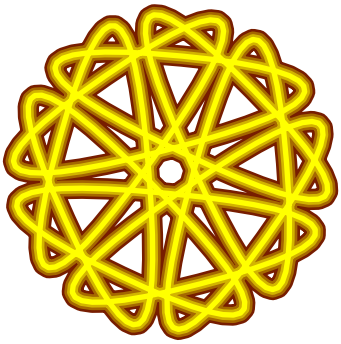


Complex Multigon shapes get another twist when the Smooth option is turned on. Sharp angles become rounded coils, loops and knots. Neon and parallel strokes can really enhance this effect. The angular shapes to the right were all smoothed to make the objects below. Each is a single multigon

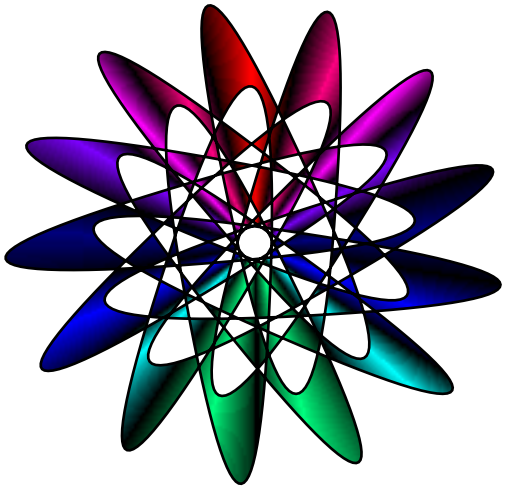
One thing to keep in mind is that since these are vector objects, they can be scaled up or down as needed, without annoying loss of detail. Stroke widths may need to be scaled as well, to keep the appearance the same.



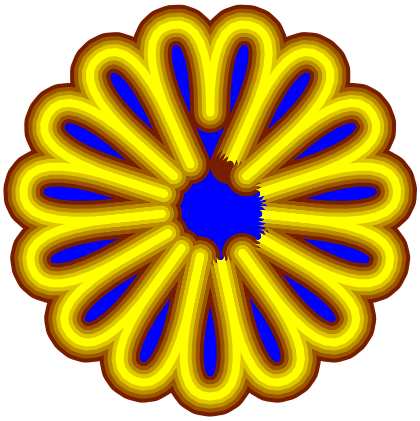
A five point Star, with 120û of pinwheel, smoothed into this shape. The neon stroke gives it a very fluid look. As you add more points these forms can get VERY complex, sometimes taking a long time to draw.



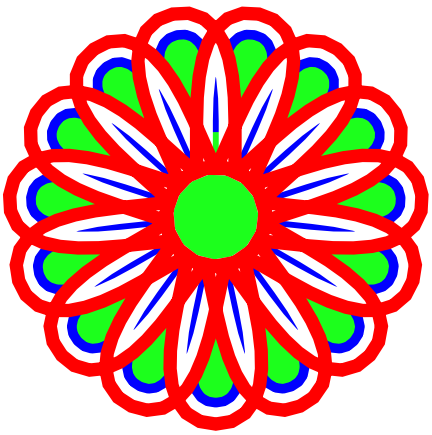
This complex knot is a smoothed, nine point, Star Outline multigon with a pinwheel angle of +151û The interior handle was dragged outside of the shape to invert the star. A Neon stroke completed the effect. The same design was stretched and used in the creation of the Fringe Effects title image for this article.



Here's another smoothed Star Outline multigon. This one has 13 points and a pinwheel of +171û Again, the interior handle was dragged outside of the shape. Instead of a Neon stroke, it was given a rainbow radial gradient fill ink from the stock Canvas gradient palette.



The glowing daisy is a smoothed, 15 point, Wheel-style multigon with a neon stroke and a solid blue fill. The spokes on smoothed Wheels never reach the middle and always produce a design with an open center. They also look great with parallel line strokes as the multi-colored doily shows.



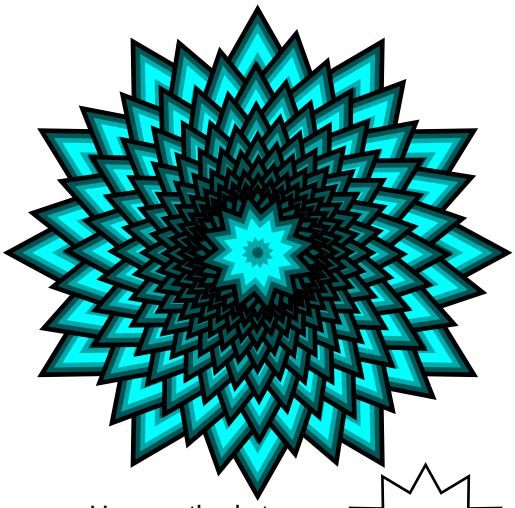
ROSETTES

My final set of images are what I call rosettes. These were all created the same way, using the Replicate Tool to make multiple overlapping multigons. The multigons were Star Outlines with lots of points; sometimes smoothed, sometimes not; with a large internal area. The stroke is what really makes the effect work. Broad neons or parallel lines give the *petals* texture and let you see their edges against each other.

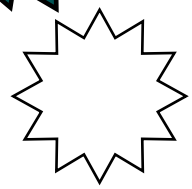
To make a rosette, first create a multigon in the normal fashion. This can be either the largest or the smallest ring of petals depending on the look you are after. Then invoke the Edit>Replicate function. Specify the number of copies you want, and indicate that each duplicate should be scaled by some percentage over the others. For example, if I start with the largest ring, I'll want each layer to be shrunk to something like 90% of the previous one. If you start with the smallest ring and stack larger ones on top of that, use a number larger than 100% to make them grow. The total number of layers depends on how thick the stroke is, and what effect you are after. Another useful option is to rotate each layer by a number of degrees. This gives the final pattern a swirling nature. And you can specify an offset to each replica to make the pattern shift in a specific direction.

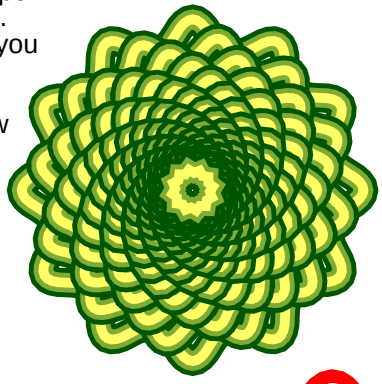
As with any such complicated effect, it isn't possible to give an exact recipe. You have to experiment with the technique to get an idea of how it works. Then make a few iterations on your actual project to get the exact effect you want. Fortunately this is usually a very quick process.

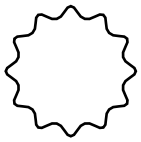
For each of the samples, I've shown the multigon I started with plus a few comments.



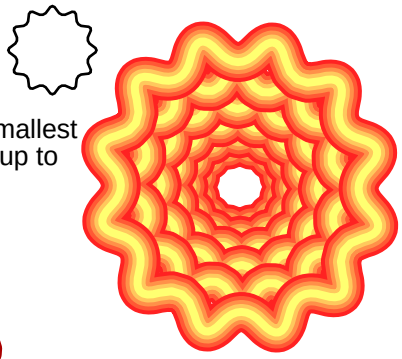
Unsmoothed star outline. Twenty copies. One-third star-point rotation.



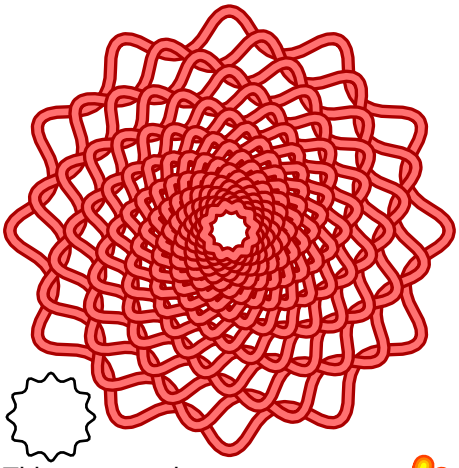




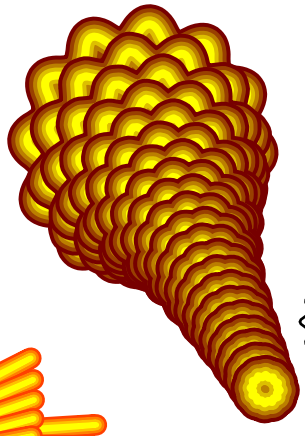
Same as blue dahlia above, only smoothed.

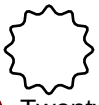


Started with smallest ring, and built up to the top.

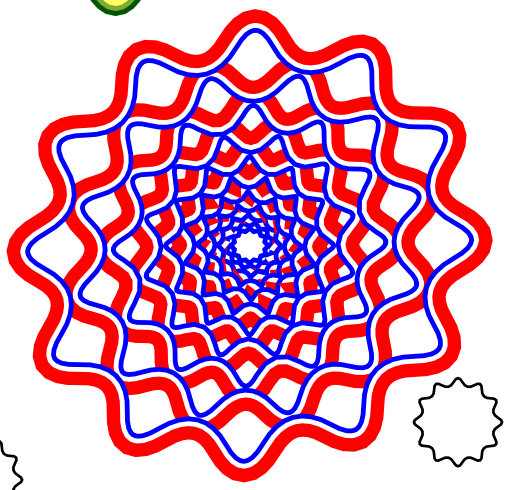


Thin neon stroke gives open, crochet-like texture.

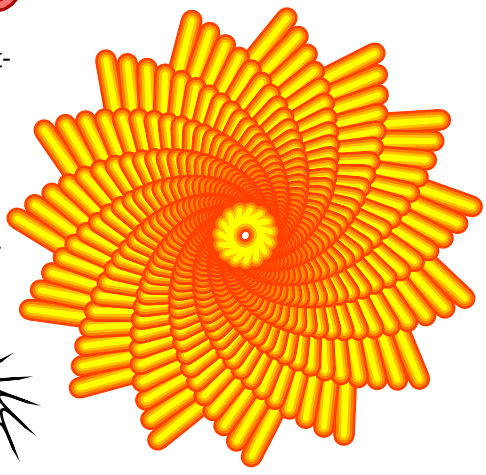




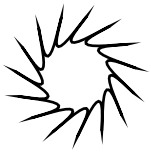
Twenty copies, shrinking, rotating and offsetting.



Parallel line stroke. Built from smallest up.



A smoothed star outline with lots of pinwheel angle. Neon stroke. Thirty replicas, 4 degree rotation on each.



FINAL WORDS

This article ended up a lot longer that I initially planned. It also took a lot longer to write than I expected, because I kept playing with the Multigon Tool and coming up with more ways to use it. That's the nature of a good tool. It seems so simple but is capable of some amazing feats. I hope you found some of the techniques worth adding to your bag of Canvas tricks.