# Needle Fans and Blade Fans

There are a variety of versions of porcupine images (where if *P* increases by 1 the image is a single line) given multiple jumps but one of the most interesting to watch being formed is something that might be called needle fans, in reference to the folding fans. The smallest *n* for such a fan is 9 and the jumps that are used to create this are 1,2 (or 2,1). The smaller side is where the "gathering point" is for the fan blades (in this instance needles) come together at almost a point. The image on the left has a much larger small side than the one on the right because of the difference in jumps between small and large jump. Both image have 120 needle points, 20 on each side. Similar images can be made by increasing the larger jump by 1 and *n* by 3 (notice *J₂* increased by 4 in going from left to right and *n* increased by 12). Watch these images being drawn by clicking *Drawing Mode*.

(9,20,59,J(1,2))

(21,20,59,J(1,6))
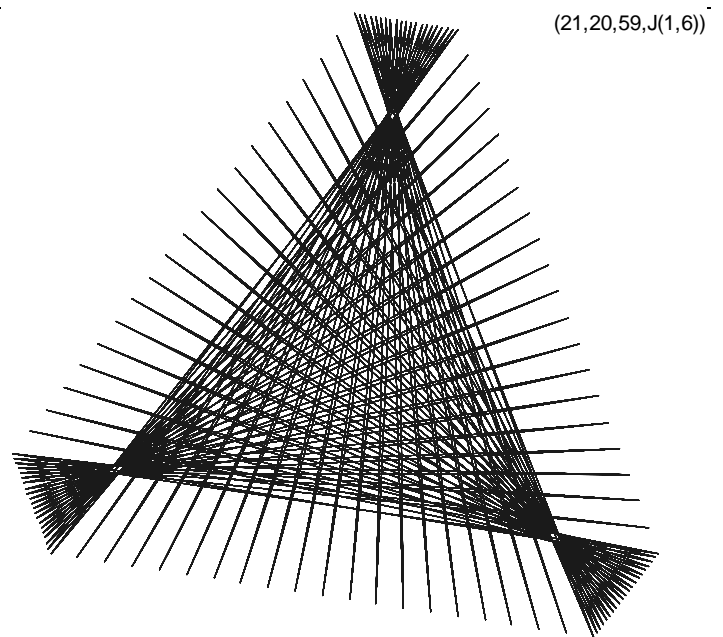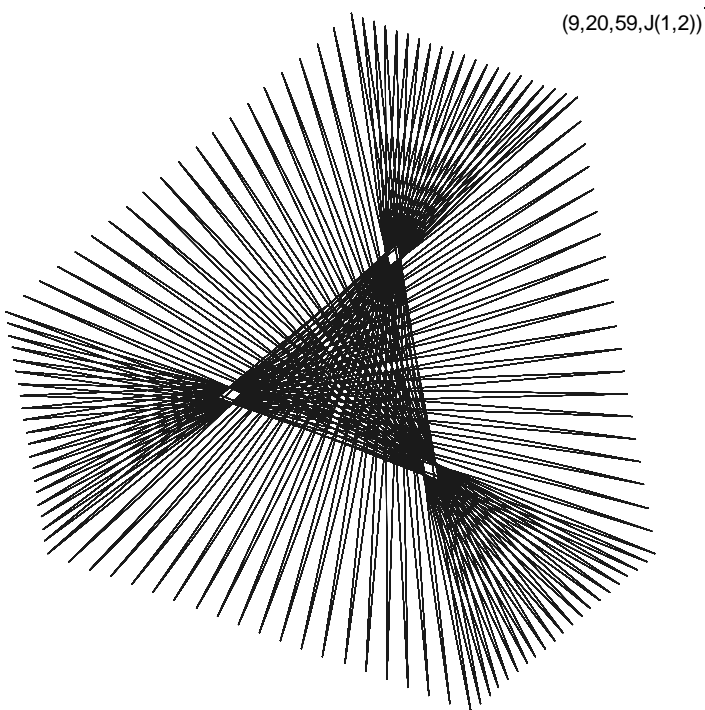
One can increase the size of the diamonds in the above images by decreasing *S* by 1 to 19.

Variations on this theme. The above images use **VCF** > 1 to create different density areas *within* the image. In the above images, **VCF** = 3 on the left and 7 on the right (since the images above rotationally repeat 3 times) 3**VCF** = *n*.

(12,20,79,J(1,2))

> **Changing overall density:** Images can be made more or less dense by adjusting *S* and *P*.

> **Changing the type of polygon**: Other odd polygons can be created by following similar tactics, but even polygons lead to Blade Fans like at right rather than folding needle fans. Here are a couple of examples.

Porcupine images with even *n* include the 4-Blade Fan to the right, or its cousin this 6-Blade Fan.

Here are additional examples. Pentagram needle fan, Pentagon needle fan, 7-gram needle fan, 7-gon needle fan. Finally, here is a **VCF = 1 needle fan based on a 23,5-star**.