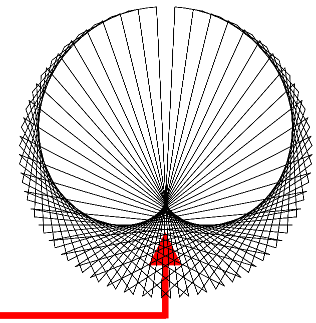
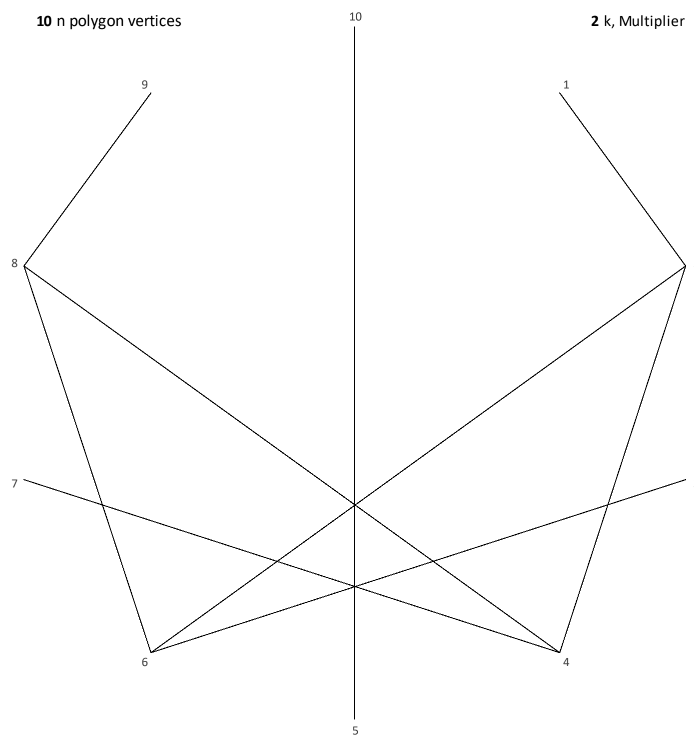
Cardioid Basics

Cardioids can be created in a number of ways (as a quick perusal of Wikipedia will confirm), but the method employed here is to use a series of straight lines (starting at each of the polygon's ***n*** vertices) to create the image.



If the cardioid is based on a **n**-gon (like the ***n*** = 99 version shown to the right), then a maximum of ***n***-1 lines are used to create the final image. (This is a maximum because some lines may overlap, and some "lines" may start and end at the same point.) Unlike the images in **PART I**, lines are drawn one at a time and need not be connected to one another. When ***n*** is large enough, the individual lines appear to create a symmetric image with a single **cusp** or gathering point.



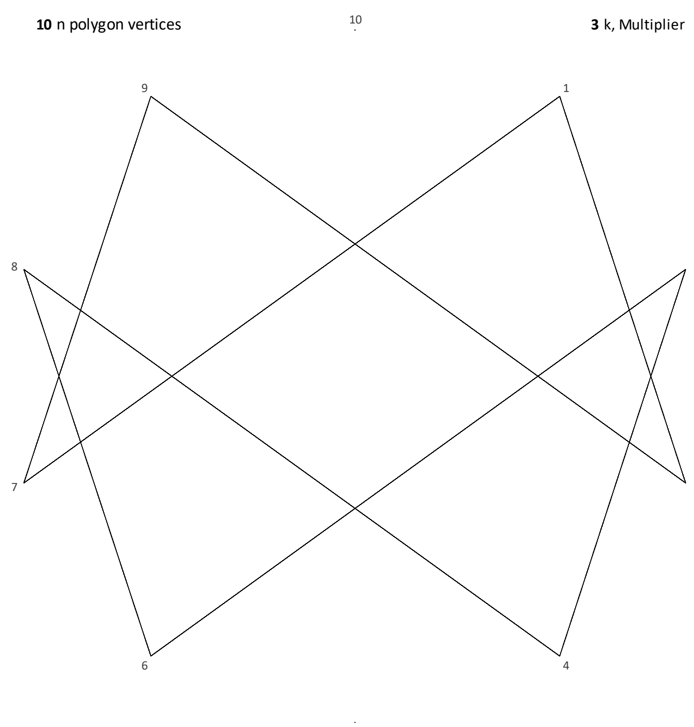
Creating a classic cardioid. The rule for drawing lines is simple: Consider each vertex ***j*** from 1 to ***n***-1 to be a starting point of a line segment. The other end of that line segment is at vertex 2***j***. Call this line (***j***, 2***j***).

When ***j*** > ***n***/2 then 2***j*** > ***n***, and the end point is 2***j*** – ***n***. More generally, the end point is the remainder once 2***j*** is divided by ***n***. NOTE: There is no need to check for ***n*** as a starting point because if the starting point is ***n***, the ending point, 2***n***, is the same as ***n*** once we subtract ***n***.

The image to the right shows the 9 segments created by following this rule given ***n*** = 10. This value of ***n*** is particularly easy to work with because one subtracts 10 from the endpoint by simply ignoring what is in the 10's place in the final number. The 9 lines are:

(1, 2), (2, 4), (3, 6), (4, 8), (5, 10), (6, 2), (7, 4), (8, 6), (9, 8).

Notice the vertical symmetry in the resulting image.



Extending the basic model. We obtain equally interesting images if we replace the final end point multiplication factor, ***k***, by values of ***k*** other than 2.

The image to the right shows the 8 lines created given when ***n*** = 10 and ***k*** = 3. These lines are:

(1, 3), (2, 6), (3, 9), (4, 2), (6, 8), (7, 1), (8, 4), (9, 7).

It is worth noting a couple of points in this instance:

a) 7 connects with 1 because 1 is the remainder of 21 (21 = 3·7) once 21 is divided by 10. A similar statement could be made about the lines starting at 8 and 9.

b) There is no line starting at 5 because that starting point coincides with its ending point. The remainder of 15 (15 = 3·5) upon division by 10 is 5.

c) If you examine larger values of ***n*** given ***k*** = 3 you will see that now there are two cusps rather than one. What happens when ***k*** = 4, or 5, or …? Use the file to find out. The file allows ***n*** ≤ 360 and ***k*** ≤ 360.