

ICS4U

Grade 12s:

We are going to do a fractal by outputting dots, starting with the coordinate (0,0). We shall then transform them 4 different ways under 4 probabilities.

The coordinates are transformed using matrix multiplication:

$$f(x,y) = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} e \\ f \end{bmatrix} = (ax + by + e, cx + dy + f)$$

- The first probability is to occur 1 % of the time, and will transform (x,y) as follows:

$$f(x,y) = \begin{bmatrix} 0.0 & 0.0 \\ 0.0 & 0.16 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0.0 \\ 0.0 \end{bmatrix}$$

- The second probability is to occur 85 % of the time, and will transform (x,y) as follows:

$$f(x,y) = \begin{bmatrix} 0.85 & 0.04 \\ -0.04 & 0.85 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0.0 \\ 1.6 \end{bmatrix}$$

- The third probability is to occur 7 % of the time, and will transform (x,y) as follows:

$$f(x,y) = \begin{bmatrix} 0.2 & -0.26 \\ 0.23 & 0.22 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0.0 \\ 1.6 \end{bmatrix}$$

- The fourth probability is to also occur 7 % of the time, and will transform (x,y) as follows:

$$f(x,y) = \begin{bmatrix} -0.15 & 0.28 \\ 0.26 & 0.24 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0.0 \\ 0.44 \end{bmatrix}$$

Once this is achieved, we must also discard all points outside the range:

$$-2.1820 < x < 2.6558 \text{ and } 0 \leq y < 9.9983$$

A word of caution at this point. We cannot output values that are negative. To include them, feel free to shift all x values right by -2.1820.

Lastly, you should scale your points to print on a square. In Turing, I chose length = maxy and height = maxy since maxx is larger. Think of your x or y values as positions in the range. Define them as a percentage of the possible values they may be i.e., score y values by dividing them by 9.9983 and multiplying them by maxy (or the height of your canvas in p5). Score x values accordingly i.e., $\frac{x+2.1820}{2.6558+2.1820} *$ maxy (or width of your canvas) Run your loop an infinite amount of times.

Only one of Turing or P5.js. Your choice. Try both!

Copied code off the internet will result in a mark of zero. I should not have to remind you of such things.

I randomized the variable num on the set of integers from 1 to 100. I used 1% as "if num==1", 85% as "if 1<num or num <=86" etc... You don't have to do it that way.

Please help each other