Project 1: Getting to know Matlab

In the coffee.m example, we created an array of values $x(n)$ satisfying

$$x(n+1) = x(n) - \frac{1}{N} \cdot x(n). \tag{1}$$

In this project we will study the [1]equations

$$x(n+1) = x(n)^2 - y(n)^2 + c, \tag{2}$$
$$y(n+1) = 2x(n)y(n) + d. \tag{3}$$

Unless otherwise specified, let $c = -0.8$ and $d = 0.156$.

a. Modify (or write your own) code to solve the above equations.

b. For specific starting point `x(1)` and `y(1)` (let's say, `x(1)=0.1, y(1)=0.1`), plot the first 22 values of `x(n)` versus `n`.

c. For specific starting point, plot first 22 values `y(n)` versus `x(n)`.

d. Write code to create 100 numbers, uniformly randomly selected from the interval (-2,2).

e. For `NStartingPoints=100` uniformly random in (-2,2), plot `x(1)` versus `y(1)`. Note this means there are 200 random numbers. This should be a uniform random spread of dots.

f. For `NStartingPoints=100` uniformly random in (-2,2), compute the equations for 22 steps. Check if each `x(22),y(22)` was outside the box (-2,2). If so, plot the corresponding `x(1),y(1)` in red. If not, plot it in blue.

g. Do this for `NStartingPoints=1e5`.

h. Change parameter value c and d (to whatever you want) and repeat.

i. Bonus Part: Make a version that records what n each initial x,y leaves the (-2,2) box. Call this `n_at_exit`. Then, when you plot the points that exist, color the points by the `n_at_exit`.

[1]first studied by Gaston Julia, not to be confused with JuliaLang.