

Project 1: Getting to know Matlab

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

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

In this project we will study the ¹equations

$$x(n+1) = x(n)^2 - y(n)^2 + c, \quad (2)$$

$$y(n+1) = 2x(n)y(n) + d. \quad (3)$$

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`.

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