Assignment2

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(Dated: January 2020)

1. 3.1

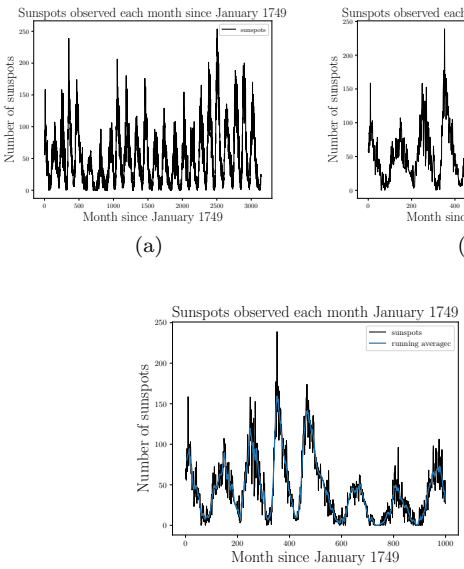

FIG. 1: Sunspots observed in each month since January 1749. a) shows all available data. b) for the first 1000 months since January 1749. c) shows the first 1000 data points in black and the running average in cyan

See 1. Part a and b of this problem are quite straightforward. In part c, running average is defined as the average of monthly number of sunspots observed over the 5 months before and after. So I used a nested *for* loop on each months starting from the fifth month since Jan 1749. For each month, the nested *for* loop return the sum of sunspots number from the 5_th month before it and 5^th month after it. The running average for each month is thus calculated. A list was created to hold each value for each month.

2. 3.2

See 2.

For this exercise, I first created a list of θ values, then calculated the values of $r(\theta)$ and stored them in to a list. Next I converted the polar coordinate of each $r(\theta)$ to Cartesian coordinate using $x = rcos\theta, y = rsin\theta$.

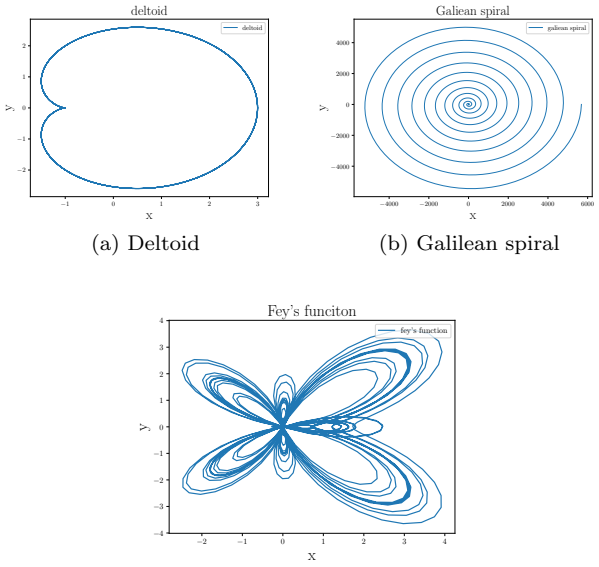

FIG. 2: Three curved functions in xy graphs. a) deltoid curve. b) the Galilean spiral. c) "Fey's function"

3. 3.6

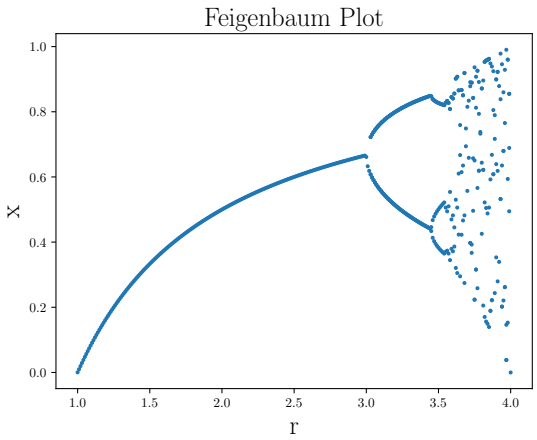

FIG. 3: Feigenbaum plot

I defined a function to calculate the result of logistic map x' with a given r and x. I used a *for* loop and iterated over 1000 times. Each iteration, x' is redefined using its value from the previous iteration by $x = rx(1x)$. I checked if x' settled to a fixed point or oscillated in a cycle by comparing the last two x' value (is the difference greater than 0.1). If it is a fixed point, the function returns only the last x'. If it is in a cycle, then the func-

tion returns the last two x' in a list. Before I did another 1000 iterations, I checked whether the result from the first 1000 iterations was a fixed point or a cycle. And for all x' I calculated their logistic result using the function defined previously. Again, I checked if each result was a fixed point or a cycle, plot all new x' according. I defined a function for the last step.

4. SURVEY QUESTION

It took me about 9 hours to finish this problem set. I learned reading data from a *txt.* file, using *matplot* library for plotting in python including using fonts and different types of plots. I also learned how to put images in Latex, which is more complicated than I expected.