Introduction to Scientific Computing, PSCB57, Fall 2018
Assignment 3
The Standard Map and Root Finding Methods

Instructions

- You must submit the assignment electronically via Quercus. The deadline for this assignment is Monday, October 22nd, 9am. Late assignments will not be accepted unless accompanied by supportive documentation.
- This assignment comes in multiple parts. Submit all your answers in one Jupyter Notebook file with the file type `ipynb`.
- Use mark-down cells to add your name, student number. Also use mark-down cells and python comments to describe your code! Well documented code might help you with the quiz.
- Do not use any packages or libraries other than numpy and matplotlib in this assignment.
- You must be present at the tutorial on Tuesday where you will be quizzed about your assignment. If you do not show up or fail to pass the quiz, your assignment might be marked as 0% even if it was correct.
- Plagiarism is taken very seriously. However, you are not expected to work in solitude and are encouraged to talk to your classmates. But keep in mind that if you submit an assignment, you have to fully understand it in order to pass the quiz.

Part 1

Implement the standard map

$$\begin{aligned} p_{n+1} &= p_n + K \sin(\theta_n) \\ \theta_{n+1} &= \theta_n + p_{n+1}. \end{aligned}$$

Then find one value of K and and two pairs of initial conditions (p_0, θ_0) such that one of the orbits is regular and the other chaotic. Try to find these values yourself (don't use values from a text book). Iterate the map $N = 10000$ times in both cases and plot the results using matplotlib.

Part 2

Implement the bisection method and Newton's method for finding roots in functions. Choose a polynomial function $f(x)$ of degree 6 and a finite interval $[a, b]$ such that the function f has exactly one root in the interval. Then find the root numerically with the bisection method and Newton's method. Get the location of the root accurate to within 1 part in 10^{-8}.

Part 3

Find a function $g(x)$ and a finite interval $[c, d]$ such that the function has exactly one root in the interval. This time, find a function g for which the bisection methods works, but Newton's method fails. Explain why it fails.