Assignment 3

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Due: 25 February.

1 Stability

(*10 Points*) Graph the potential[1] for the following systems and identify all equilibrium points:

- $\dot{x} = 0$.

- $\dot{x} = x^2$.

- $\dot{x} = x - x^3$.

2 Python

The following problems are for you to become familiarized with Python's syntax.

1. (*5 Points*) Randomly generate two lists and write a program that returns a list that contains only the elements that are common between the lists (without duplicates). Make sure your program works on two lists of different sizes.

2. (*10 Points*) Ask the user for a number and determine whether the number is prime or not.

3. (*10 Points*) Nelson Vargas moves in a plane starting from the origin. He can only move toward UP, DOWN, LEFT or RIGHT with certain given steps written by the user on a .txt file. Write a program to compute the euclidean distance from the starting point to the end point. If the distance is a float, then return the nearest integer. An example of the .txt file with the instructions could be:

   UP;2

   RIGHT;7

   LEFT;8.56

   UP;12.5

   END

3 Symbolic Computation

The whole idea of this exercise is to use the computer, not solving the problems by hand.

- (*5 Points*) Solve the following differential equation

$$x\frac{df(x)}{dx} + f(x) - f(x)^2 = 0.$$

- (*5 Points*) Solve the following system of equations

$$\begin{aligned} x + y &= 2 \\ 2x + y &= 3. \end{aligned}$$

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[1]You will need to find $V(x)$ such that $-\frac{dV}{dx}$ equals to the right hand side of each equation.

- (*5 Points*) Find the eigenvalues and eigenvectors of the following matrices

    1. $A_1 = \begin{bmatrix} 0,8 & 0,3 \\ 0,2 & 0,7 \end{bmatrix}$

    2. $A_2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

Remarks:

- Please upload in a single PDF file your solutions and the source code in another file. You can use LATEX or scan hand-written work or images for parts of solutions only if they are extremely *clean* and *legible*[2].

- Please use the reference books that are in our library: "Python for scientists" by Stewart, John M (Located at 001.6424 / S829) and "Numerical methods in engineering with python 3" by Kiusalaas, Jaan (Located at 001.6424 / K488).

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[2]You will be constantly dealing with mathematical notation and LATEX is the best for that. If you do not know how to use it, I will be more than happy to help you. For more information visit http://www.ctan.org/tex-archive/info/lshort/. I personally use LyX, which combines the power and flexibility of TEX/LATEX with the ease of use of a graphical interface. See http://www.lyx.org.