PerturbedSZR_PhasePortrait_GUI

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#!/usr/bin/env python
# -*- coding: utf-8 -*-

"""This program attempts to create a simple interactive window to draw the␣
↪phase portrait of SZR Model

  Perturbed SZR Model, Phase Portrait Generator

  Reference: Allen, Robert F., Cassandra Jens, and Theodore J. Wendt. 2014.
  "Perturbations in Epidemiological Models". Letters in Biomathematics 1 (2),␣
↪173-80.
  Link- https://doi.org/10.1080/23737867.2014.11414478.

  Part of MS Thesis at Universität Koblenz-Landau

  Instructions: After running the code, please input the required values in␣
↪the text
  fields of the newly generated window and then click on 'Generate Phase␣
↪Portrait'
  to create and show the drawn phase portrait on the window. You can change or␣
↪update the values
  to draw new portraits. You can save the image separately from the␣
↪interactive window.

  Please only input numerical values in the given fields. Otherwise, the␣
↪program will fail to run.
  Please only input numerical values for the fields- Alpha, Beta, Zeta, Mu,␣
↪within the range between 0 and 1.
  Please only input integer value for the field Population N.

  Note: this program uses the following libraries- Tkinter, Numpy, Scipy,␣
↪Matplotlib
"""

# importing libraries
from tkinter import *
import numpy as np
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from scipy.integrate import odeint
import matplotlib.pyplot as plt
from matplotlib.backends.backend_tkagg import FigureCanvasTkAgg,␣
 ↪NavigationToolbar2Tk
from matplotlib.figure import Figure


# defining class
class MyWindow:
    def __init__(self, win):
        # header text and equation text with their positions in the window
        lble1=Label(window, text="Generate Phase Portrait of the SZR Model",␣
 ↪fg='black', font=("Helvetica", 16))
        lble1.place(x=300, y=20)
        lble2=Label(window, text="S\' = -\u03b2SZ")
        lble2.place(x=650, y=80)
        lble3=Label(window, text="Z\' = \u03b6(N - S - Z) + \u03b2SZ -␣
 ↪\u03b1S\u207D\u00b9 \u207a \u1d58\u207eZ")
        lble3.place(x=650, y=100)
        lble4=Label(window, text="Differential Equation", fg='black',␣
 ↪font=("Helvetica", 14))
        lble4.place(x=650, y=60)

        # input field titles
        self.lbl1=Label(win, text='Alpha '+ u"\u03b1")
        self.lbl2=Label(win, text='Beta '+ u"\u03b2")
        self.lbl3=Label(win, text='Zeta '+ u"\u03b6")
        self.lbl4=Label(win, text='Mu ' + u"\u03bc")
        self.lbl5=Label(win, text='Population N')

        # input fields
        self.t1=Entry(bd=3)
        self.t2=Entry(bd=3)
        self.t3=Entry(bd=3)
        self.t4=Entry(bd=3)
        self.t5=Entry(bd=3)

        # setting up titles and input fields positions
        self.lbl1.place(x=100, y=50)
        self.t1.place(x=200, y=50)
        self.lbl2.place(x=100, y=100)
        self.t2.place(x=200, y=100)
        self.lbl3.place(x=100, y=150)
        self.t3.place(x=200, y=150)
        self.lbl4.place(x=100, y=200)
        self.t4.place(x=200, y=200)
        self.lbl5.place(x=100, y=250)
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        self.t5.place(x=200, y=250)

        # setting up button
        self.b1=Button(window, text=' Generate Phase Portrait ', command=self.
↪plot)
        self.b1.place(x=100, y=300)

    # defining function for the main calculation
    def plot(self):
        # getting paramaeter values
        alpha = float(self.t1.get())
        beta = float(self.t2.get())
        zeta = float(self.t3.get())
        mu = float(self.t4.get())
        N = int(self.t5.get())

        # equation set up
        x = np.arange(0, 800, 1)
        y = np.arange(0, 800, 1)
        S, Z = np.meshgrid(x, y)
        S_dash = -beta*S*Z
        Z_dash = zeta*(N - S - Z) + beta*S*Z - alpha*(S**(1 + mu))*Z

        # drawing figure
        fig = Figure(figsize=(5,3.5), dpi=100)
        a = fig.add_subplot(111)
        a.clear()
        title = "Phase Portrait with " + u"\u03bc" + "= "
        a.set_title(title + str(mu))
        a.set_xlabel("Humans")
        a.set_ylabel("Zombies")
        a.streamplot(S, Z, S_dash, Z_dash, density=1.0)

        # figure on tkinter canvas and navigation toolbar
        myCanvas = FigureCanvasTkAgg(fig, window)
        toolbar = NavigationToolbar2Tk(myCanvas, window)
        myCanvas.get_tk_widget().place(x=200, y=330)
        myCanvas.draw_idle()
        toolbar.place(x=350, y=700)
        toolbar.update()

# loading tkinter
window=Tk()
mywin=MyWindow(window)
window.title('Phase Portrait of Perturbed SZR Model') # tkinter window title
window.geometry("900x800+10+20") # tkinter window dimension
window.mainloop()
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__author__ = "Md Tariqul Islam"
__version__ = "1.0.1"
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__status__ = "Production"
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