CS9.427: INTRODUCTION TO NEURAL AND COGNITIVE MODELING

ASSIGNMENT 2

Marks: 60 (Assignment) + 40 (Evaluation) = 100 Marks

Simulation Exercises on LIF & Hodgkin-Huxley (HH) Models

Due: 25-Sept-2022 (Sunday by 11:55 PM)

Note: You can use resources from Wulfram Gerstner's Course Material. You can install and use the resources from the Python package called *Brian* to do the simulation exercises in this Assignment. Submit the answers to these questions in a pdf file with your name, roll no on the first page and **clearly indicating the exercise number**.

I) Look at the Python Exercises for LIF and Submit the answers to exercises 1.1-1.4 (including subparts: these numbers correspond to Gerstner's exercise series 1)
LIF Python exercises link: (20 Marks) https://neuronaldynamics-exercises.readthedocs.io/en/latest/exercises/leaky-integrate-and-fire.html
1.1 LIF Exercise: minimal current (subparts 1.1.1 and 1.1.2)
1.2 Exercise: f-I Curve (subpart 1.2.1)
1.3 Exercise: "Experimentally" estimate the parameters of a LIF neuron (subpart 1.3.1)
1.4 Exercise: Sinusoidal input current and sub-threshold response (subpart 1.4.1 visuallyestimate the phase and calculate the amplitude; 1.4.2; 1.4.3; 1.4.4)

II) Look at the Python Exercises Dendrites and the passive cable equation and submit answers to Exercises in 4.1-4.4 (including sub problems: these numbers correspond to Gerstner's exercise series 4)
Dendrite & Cable equation Python exercises link: (20 Marks)
https://neuronaldynamics-exercises.readthedocs.io/en/latest/exercises/passive-cable.html
4.1 Exercise: spatial and temporal evolution of a pulse input (subpart 4.1.1)
4.2 Exercise: Spatio-temporal input pattern (subpart 4.2.1)
4.3 Exercise: Effect of cable parameters (subpart 4.3.1)
4.4 Exercise: stationary solution and comparison with theoretical result (subparts 4.4.1, 4.4.2, 4.4.3)

III) **Look at the Python Exercises with Numerical integration of the Hodgkin-Huxley model (HH) model of the squid axon and submit answers to Exercises in 5.1-5.4 (sub problems therein" these numbers correspond to Gerstner's exercise series 5)**

HH Python exercises link: (20 Marks)

http://neuronaldynamics-exercises.readthedocs.io/en/latest/exercises/hodgkin-huxley.html

5.1. Exercise: step current response (subparts 5.1.1 and 5.1.2)

5.2. Exercise: slow and fast ramp current (subparts 5.2.1; 5.2.2; 5.2.3)

5.3. Exercise: Rebound Spike (subpart 5.3.1)

5.4. Exercise: Brian implementation of a HH neuron (subpart 5.4.1)