Lab M: Analysis of hippocampal data

In this assignment you will analyse real data recorded from four hippocampal neurons while rat was running in a maze. The experiment is described in the following paper:

Matthew W. Jones & Matthew A. Wilson (2005) Theha rhythms coordinate hippocampal-prefrontal interactions in a spatial memory task. PLoS Biology, 3, 2187-2199.

It will be imporant for you to know the shape of the environment in which the rats were running, and it will be helpful to understand the task. Hence could please read at least the first paragraph of section 'Behaviour' on page 2188, and look at Figure 1.

The data can be downloaded by clicking here with this giving example code snippets for loading (many thanks to the student who provided the code snippets and converted the data from .mat). The data describe the position of a rat and the firing times of the hippocampal neurons. The file contains the following matrices:

- time - time when the position of the rat was measured, in units 1/10000 second
- x and y - the position of the rat in the above moments of time
- neuron1, neuron2, neuron3 and neuron 4 - times when the four neurons fired spikes

You can do whatever analyses of the data you wish, and the more interesting things you do and find, the higher the mark will be. Below I list some ideas for analyses:

- Generate plots showing positions in which each neuron fired.
- Plot auto-correlograms of neurons
- Plot cross-correlograms of pairs of neurons
- Calculate firing rates of each neuron (in each 1 second interval), and plot histograms of the firing rates
- *See how much information firing rates of individual neurons encode about being in a particular part of a maze, e.g. divide the maze in half, and calculate d' for each neuron

Please note that idea with * is difficult. Please do not limit yourself to these ideas - and feel free to try other analyses.

Write a brief report (no longer than 3 pages including figures). Submit it in the pdf format together with the Python code by the deadline given in the SAFE system.