Analysis of hippocampal data

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The aim of this coursework was to analyze data coming from four hippocampal neurons of a rat that was running around a maze. I plotted the positions in which each neuron fired as it can be seen in the plots below.

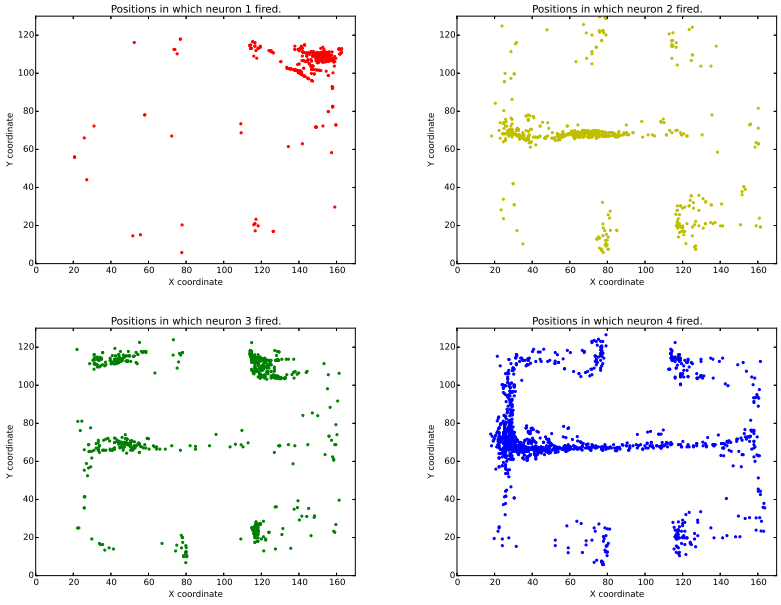

Figure 1

The four plots in figure 1 present the position in which each neuron fired. I decided to plot each neuron individually instead of having the data from the four neurons in one plot because it is easier to interpret it.
I also plotted histograms of the firing rates of each neuron. These plots can be seen in figure 2.
From the plots in figure 1 and figure 2 it can be seen that Neuron 4 fired the most. Also, Neuron 2 and Neuron 4 seem to be firing at the same time, with Neuron 4 having a higher firing rate. This means that both neurons are involved

in the same process. Looking at Figure 1 we can see that both neurons fire after the rat is forced to take a turn, meaning that the neurons might be involved in remembering the direction in which the rat has to go.
Neuron 1 is very active during stages 3 and 4, when the rat is arriving or leaving the reward point C1. I think Neuron 1 is used for linking the choice the rat had to make in stage 2 with whether it receives a reward or not.
Neuron 3 spikes when the rat reaches any of the four reward points (C1, C2, F1, F2). It means that Neuron 3 is associated with the remembering process, the neuron is active at the start of the maze when the rat has to "hold in mind" the location of the starting reward and also active at both C1 and C2 where the rat is expecting to receive a reward if it took the right turn during the decision stage of the maze.

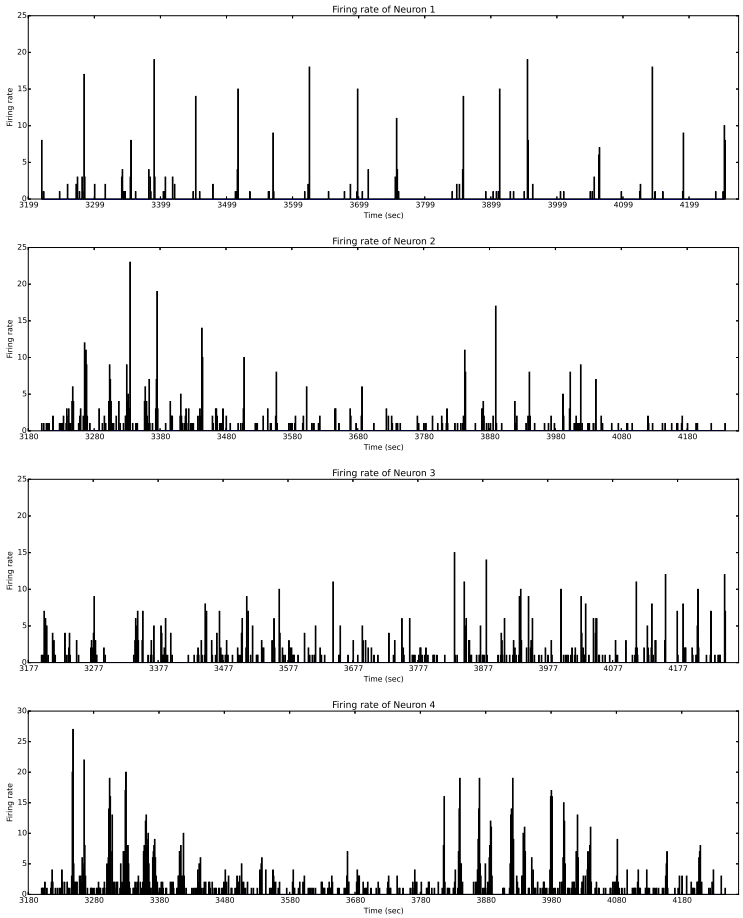

Figure 2

I also wanted to see how the 4 neurons correlate to each other so I plotted auto-correlograms for each neuron and cross-correlograms for each pair of neurons. The most interesting results can be seen in Figure 3.
The cross-correlogram between Neuron 1 and Neuron 3 has only one peak and is almost symmetric on the y-axis at 0. It suggests that the two neurons are triggered by a common event.
The cross-correlogram between Neuron 2 and 4 suggests that one of the neurons affects the other.

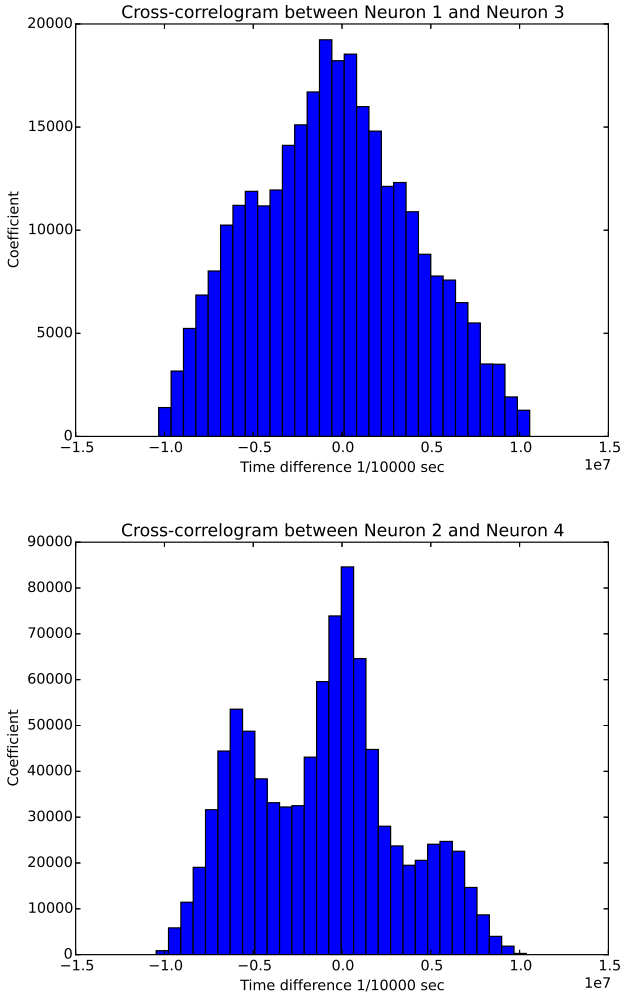

Figure 3