Exercise 3: Local inhibition vs. local excitation

In this exercise we will study the effect of local connectivity on the distribution of pairwise correlation coefficients by completing the template `exercise3.py`. The template already contains almost all the necessary parameters.

a) Create the layers

Use the provided layer dictionary to create two populations of integrate and fire neurons, one inhibitory and one excitatory. Extract the ids of the nodes in each population for later use.

b) Connect the layers

To investigate the effects of connectivity, your model must be able to alternate between random and local connectivity for each population. Write your code in a way that you can alternate easily between the following configurations:

1. Both populations are randomly wired.
2. The excitatory population is randomly wired but the inhibitory population connects locally.
3. The Inhibitory population is randomly wired but the excitatory population connects locally.
4. Both populations connect locally.

When implementing the random connectivity use the function `Connect()` with a fixed_outdegree rule . The local connectivity kernel has to have the following properties:

1. The number of connections has to be roughly the same as in the random case.
2. Use a circular mask to add a cutoff to kernel.
3. The kernel is Gaussian with the parameters given in the template.
4. Use divergent connections.

In order to check that the connectivity is the one that you were looking for, make use of the plotting functions of the topology module to visualize the network.

c) Analyse the activity

Use the functions that you implemented in exercise 1 to visualize the activity of the network. It is sufficient for the purpose of this exercise to record from the excitatory population only. In addition:

- add a population stimulus time histogram (PSTH) to observe the summed activity of the whole population
- Use the function `getccs()` to get the list of pairwise correlation coefficients and plot its histogram.

d) Effect of local and random connectivity

Investigate the effect of the different connection configurations on the network activity. What do you observe? Does the mean of the distribution change with the different configurations? What happens to the spread of the distribution?

If you want to learn more detailed analysis about the effect of broad degree distribution on neuronal network dynamics read Pernice et al. (2011).