

**Kohonen (SOM) Algorithm** Try to get both Part A and Part B in by June 9, however the penalties for lateness are as indicated..

**Part A (Due June 9)** (-5 points by June 16, -15 by June 15, additional -10 for each week afterwards).

This project requires you to implement the Kohonen (SOM) algorithm. **You should use your own code.** You are responsible for experimenting with and finding the appropriate parameters that make it work well. You may submit with a partner. You can not share code between groups, but you can discuss the problem freely on the forum or whatsapp group.

1. Implement the Kohonen algorithm and use it to fit a line of neurons to a disk. (That is, the data set is  $\{(x,y) \mid 0 \leq x \leq 1, 0 \leq y \leq 1\}$  for which the distribution is uniform while the Kohonen level is linearly ordered.) Do this when you use only a few neurons (15), when you use many (200)?

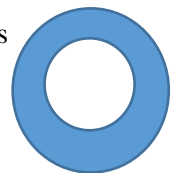


What happens as the number of iterations of algorithm increases?

Do the same with at least **two non-uniform distributions** on the disk. (For example, when the likelihood of picking a point in the data set is proportional to the size of  $x$ , but uniform to the size of  $y$ .)

You should report with snapshots of the space as the Kohonen map evolves as the number of iterations grows..

2. Now do the same experiments as above for fitting a circle of neurons on a "donut" shape i.e.  $\{x,y \mid 1 \leq x^2 + y^2 \leq 2\}$ . The line of neurons has 30 neurons. Be sure to report on the results of your different attempts. (Give snapshot as the map evolves over iterations.)



Part B (Due June 30, -10 if done by July 7, -20 if done by July 14 (last submission time:.) You may find it helpful to look over the diagrams in the chapter at [https://www.ks.uiuc.edu/Services/Class/PHYS498TBP/spring2002/neuro\\_7.pdf](https://www.ks.uiuc.edu/Services/Class/PHYS498TBP/spring2002/neuro_7.pdf)

Now reproduce the experiment on the "monkey hand" as described in class. For this part you can use your own code or the Kohonen algorithm in a package (like the SOM package in Matlab). Be sure to state what code you are using  
In more detail:



1. given diagram like the following; where the data is  $\langle x,y \rangle$  is inside the "hand" which is located as a subset of  $\{x,y \mid 0 \leq x \leq 1, 0 \leq y \leq 1\}$  and the Kohonen space is 225 neurons arranged in a  $15 \times 15$  mesh. [That means data points are only within the "hand" .]. Show how the mesh is superimposed on the plane that contains the hand and how it changes over iterations. (You can use any "hand like" figure with 4 "fingers" you wish.)

2. Now "cut off a finger" (i.e. data points come only from the "hand with 3 fingers" and then continuing from the stopping point in the previous section. Show over snapshots how the mesh is rearranged.

