Project II 2022 Prof. Manevitz.

Kohonen (SOM) Algorithm Due June 8 (Late project accepted to June14 with -10 points). No further extension.

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 as in the first project. You can not share code between groups, but you can discuss the problem freely on the forum or whatsapp group.

Submit your work as a pdf, similarly as a report as you did in Project 1. (That is, on first page are the names and T.Z. of all the submitters. You can submit parts A and B together or separately. Indicate in the name of the file what you are submitting. Be sure to include both your summary and conclusions as well as your illustrations of results and code(s).

Part A. 1. Implement the Kohonen algorithm and use it to fit 1) a set of 100 neurons in a topology of a line to a disk.
(That is, the data set is {(x,y) | 0 <= x <= 1, 0<=y<=1} for which the distribution is uniform while the Kohonen level is linearly ordered.) You can obtain data by sampling the data set.

Now do the same when the topology of the 100 neurons is arranged in a two dimensional array of 10 x 10.

Describe what happens as the number of iterations of algorithm increases?

2. 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. A second example could be where the likelihood of a point being chosen as a data point is proportional to the distance from the center of the disk. You can use other non-uniform distributions if you wish.)

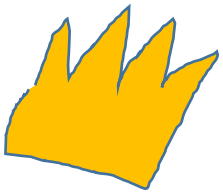
You should report with snapshots of the space as the Kohonen map evolves as the number of iterations grows.

3. Now do the same experiments as above for fitting a circle of neurons on a "donut" shape i.e. {<x.y> | 2<= x^2 +y^2 <= 4}. The line of neurons has 30 neurons organized as a circle topology.
Be sure to report on the results of your different attempts. .(Give snapshots as the map evolves over iterations.)

Part B 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

Reproduce the experiment on the "monkey hand" as described in class. For this part you can use your own code or you may use 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 a diagram like the following; where the data is <x,y> is inside the "hand" which is located as a subset of {<x,y> | 0<= x <= 1, 0<=y <= 1} and the Kohonen space is 225 neurons arranged in a 15 x 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.