# Map Analysis

*SOM*:
SOM (Self Organising Map) is considered an Artificial Neural Network (ANN) which uses unsupervised learning as training mechanism. SOM performs Dimensionality Reduction i.e. maps from higher dimensional feature to a low dimensional map. It outputs a discretized 2-Dimensional Map or representation of input samples.

*Implementation Outline Overview:*
Following is the high-level implementation outline which has been used in the question:
(*Libraries has been imported initially*)

1) Create a dataset of 24 different shades of 6 colors (Red, Green, Blue, Yellow, Teal and Pink)
   - Using Pandas and Numpy.
2) Dataset Normalization
   - Divide the whole dataset by 255
3) Function '***I_W_distance'*** has been defined to calculate distance between Input sample vector and weight vector.
4) Created the Grid of 100 x 100 neurons and random weights has been initialized.
5) Computed the index of minimum value element from Winner Neuron Array using ***"idx_min"*** function in order to calculate distance and subsequently update neighborhood weights.
6) Training has been performed using ***"Train_SOM"*** function.
7) Results (Sequentially).

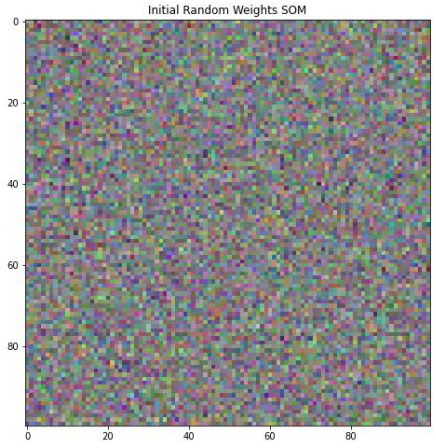
(*Detailed explanation has been provided in code file)*

*Observation and Results:*

*'Sigma': Radius of different Neighborhood in the grid,*
*'Learning Rate': How much weights will be updated in each epoch*

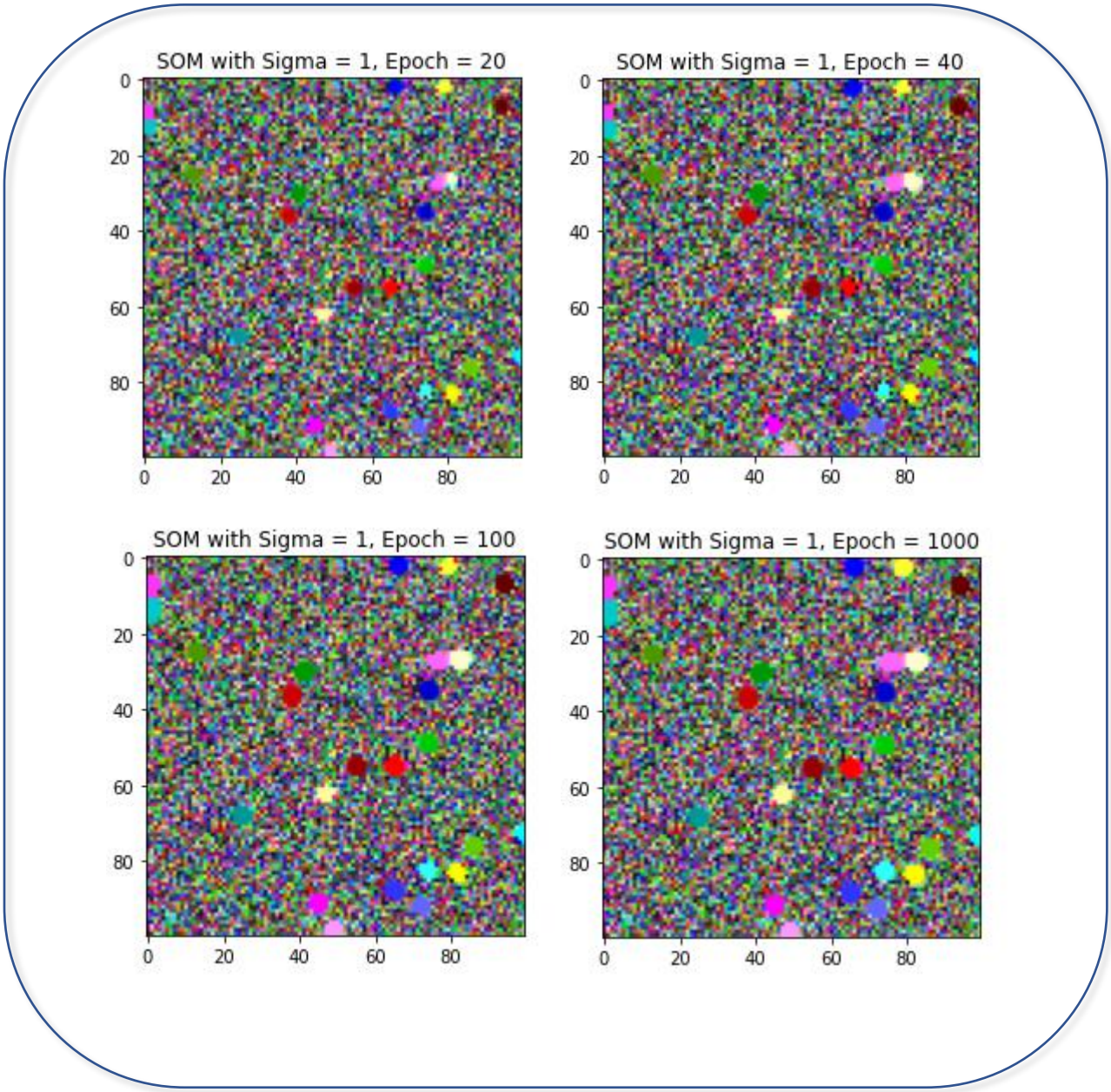
For different Sigma's, different SOM has been obtained. For each sigma, 4 different SOM has been generated at epoch 20, 40, 100 and 1000. (*Total Epochs = 1000*)

**Initial Random Weights SOM:**
(*Since there is no update, all the colors are distorted, so as SOM*)



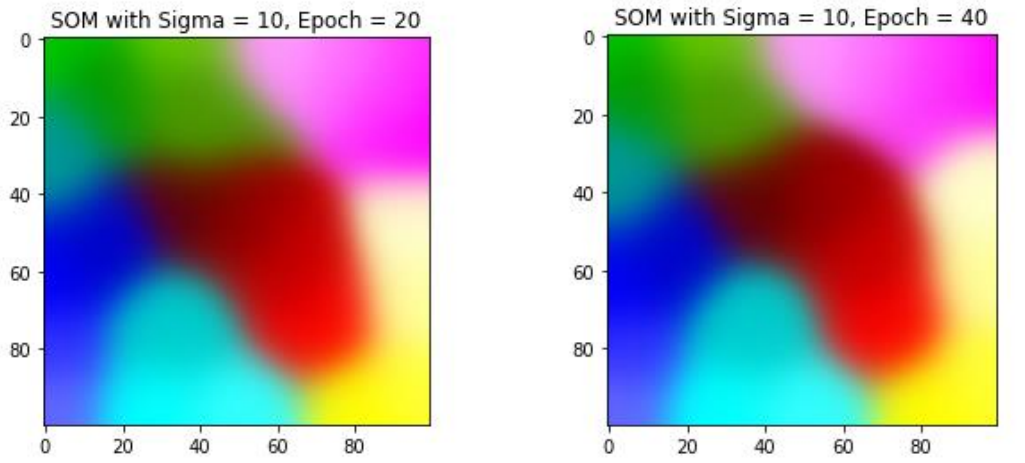
**1) Sigma = 1 (Poor Results)**

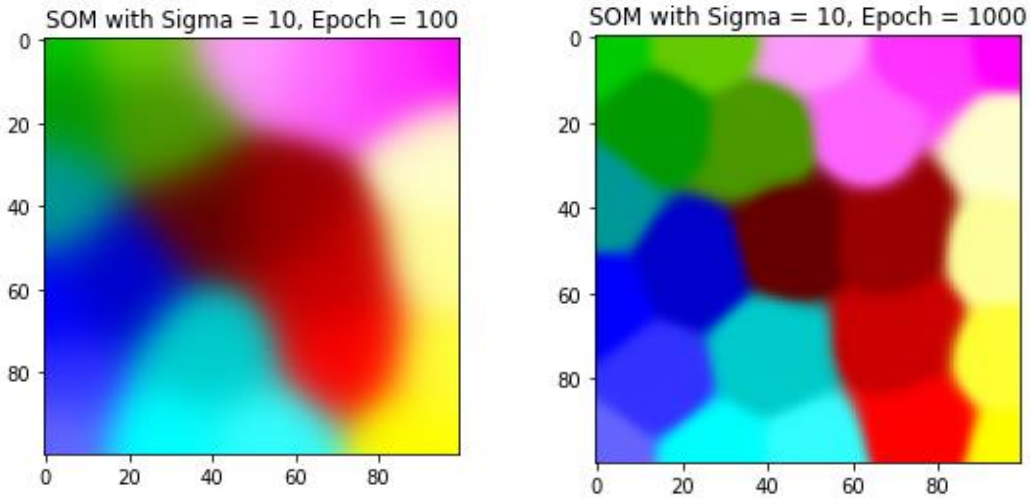
- Sigma =1 represents that radius of neighbor vector will be 1 i.e. any input vector will search for the neighbor within the specified radius. Since radius or nrighborhood is so small, any input vector will not be able to find lot of similar neighbors and only small clusters of color will be created as seen in below mentioned figures.
- With the increase in epochs, sigma increases
- Low values of sigma are not favourable in the case of non-linear data i.e. color clusters will be constructed using only few neighbors and weights, which will eventually result in poorly converged maps.



**2) Sigma = 10**

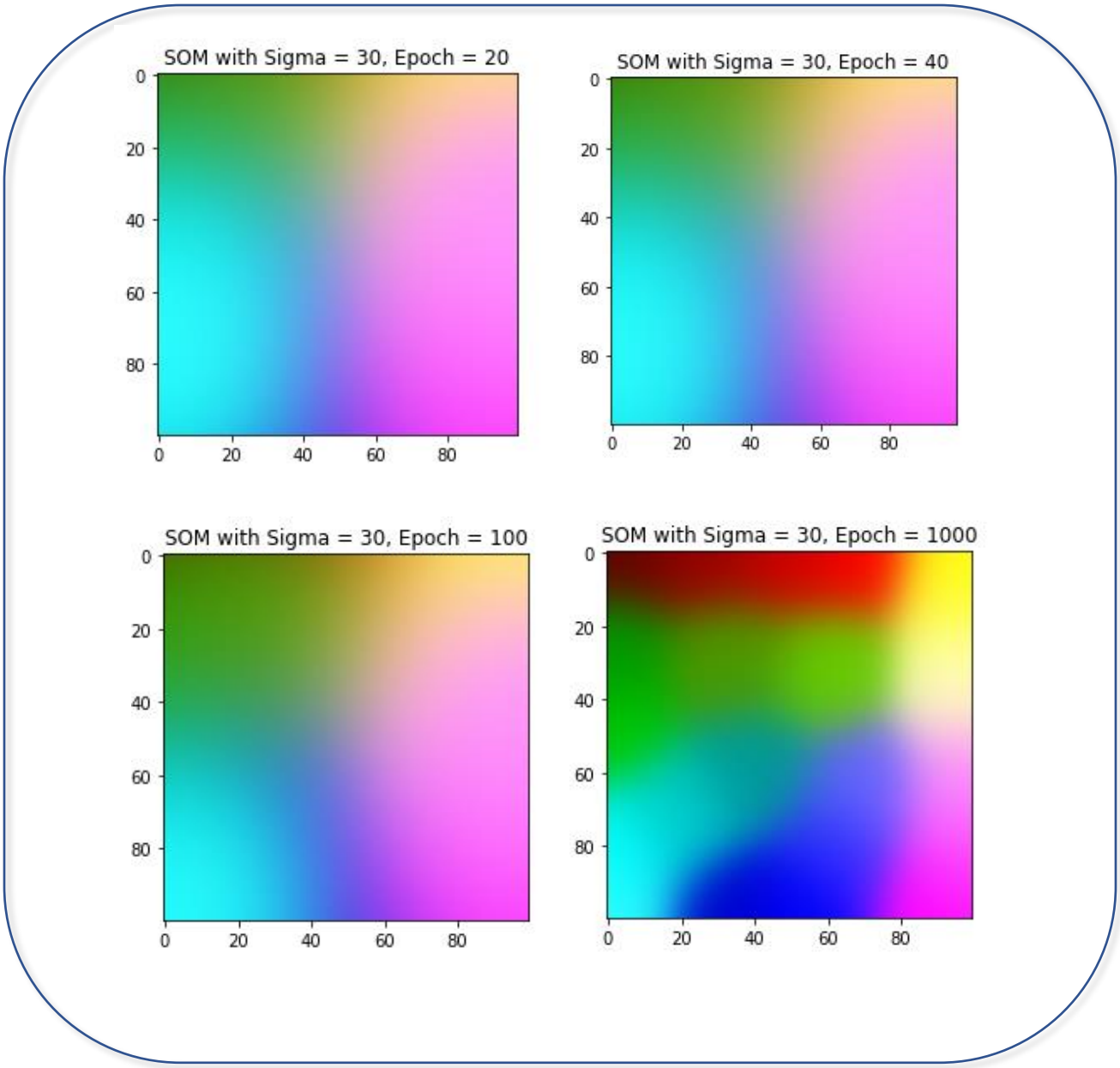
- Now, Sigma is 10 i.e. radius has been increased significantly which leads to much better result than sigma=1, however as visible from below mentioned figures, there ***exists some overlapping between Teal and Blue shades.***
- With the increment in epochs, generated SOM becomes smoother and clearer. At epoch 1000, small individual multiple clusters of same color at different positions are observed.



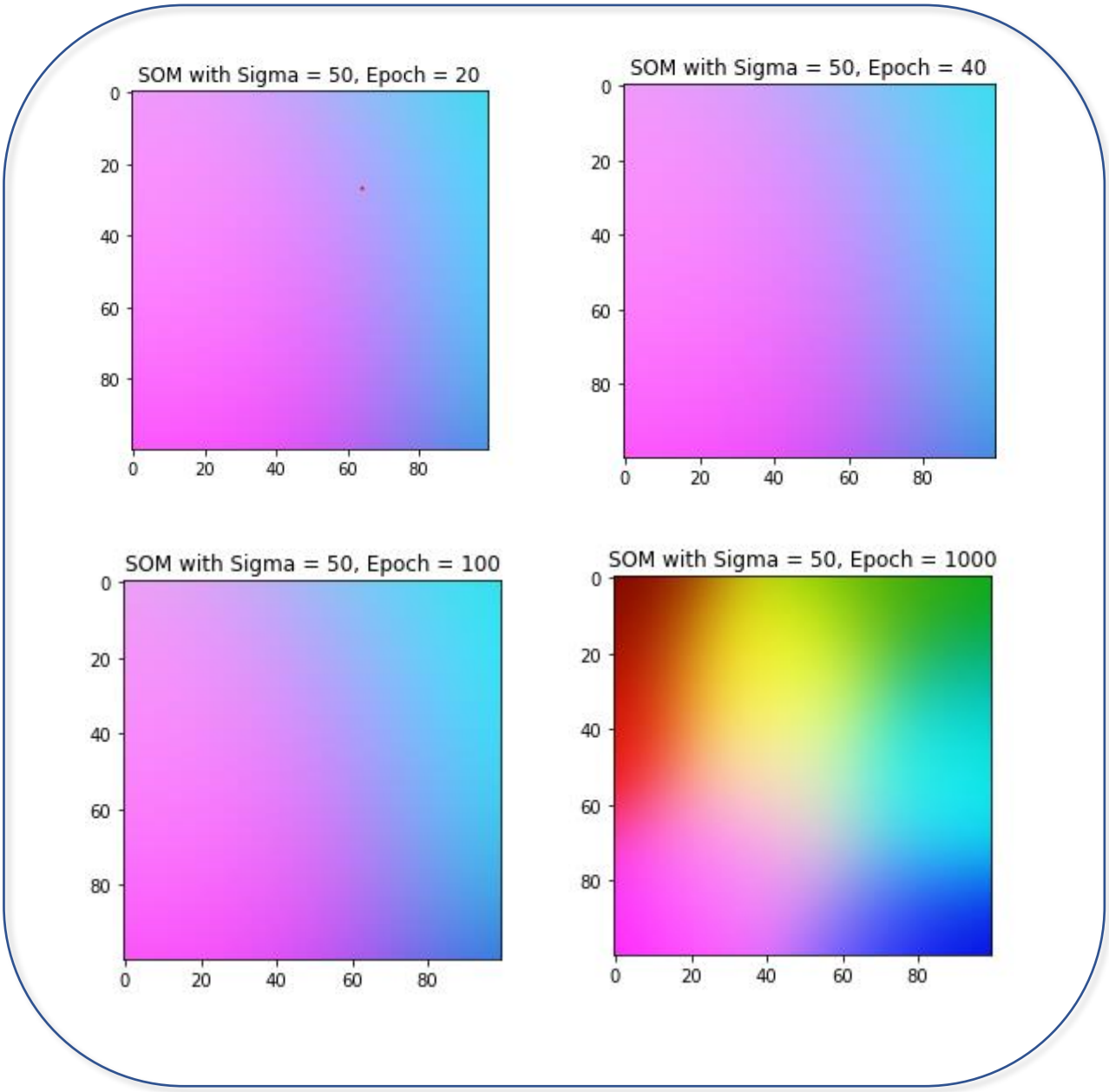
### 3) Sigma = 30

- On further increasing the sigma to 30 from 10, well converged maps are obtained as value of radius of neighborhood has been increased i.e. a greater number of weights and input samples can be taken into consideration to find the winner neuron and update the weights to create well formed clusters.
- At epoch =1000, separate clusters of all colors are observed nicely.



**4) Sigma = 50**

- At epoch =1000, different clusters of all 6 colors are obtained i.e. a well converged map of all the input samples into their own color clusters, ***however during epoch =20, 40 and 100 results were not up-to the requirement (i.e. only pink, blue and teal combination has been observed and not all the colors just as observed in the case of sigma =30)***



**5) Sigma = 70**

- During initial epochs, since spread parameter has a very large value, it will take more time to train and converge to form color clusters. As we can see, only major portion of Pink and slight portion of blue has been observed in SOM's of epoch 20, 40 and 100.
- At epoch = 1000, nicely converged map including separate cluster of all 6 colors has been observed.