

ANALYSIS REPORT

Parameter:

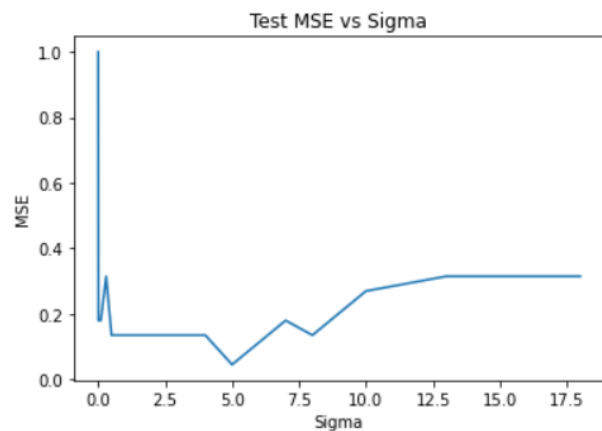
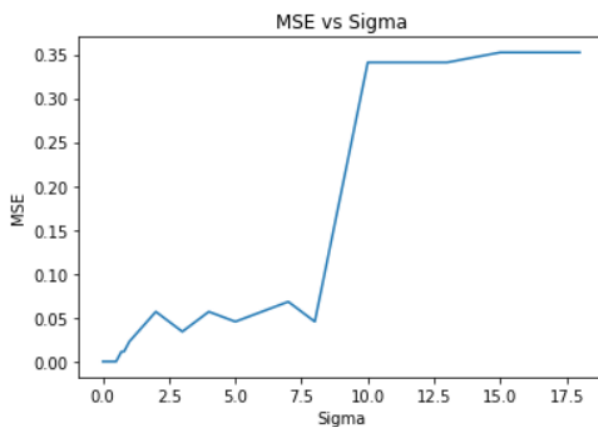
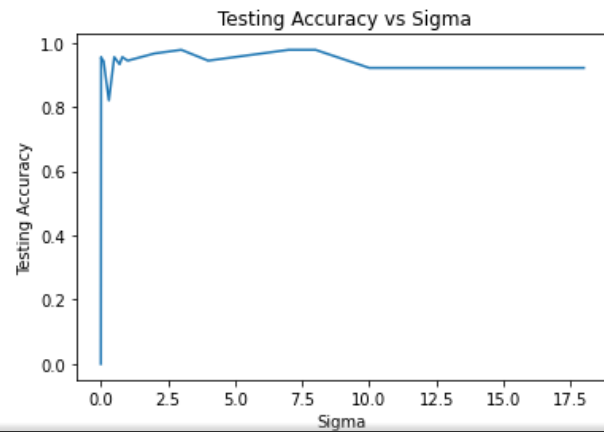
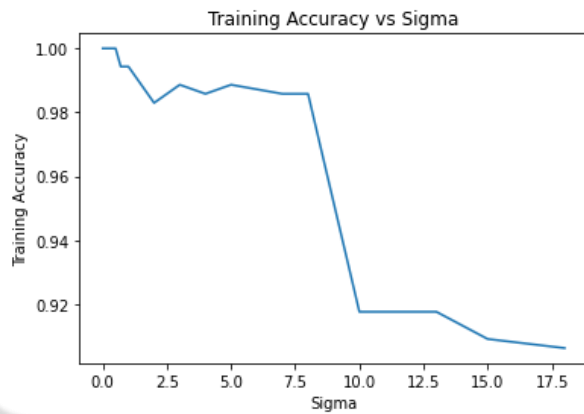
Following Sigma's has been used in all the 3 parts:

Sigma = [0.001, 0.01, 0.05, 0.08, 0.1, 0.3, 0.5, 0.7, 0.8, 1, 2, 3, 4, 5, 7, 8, 10, 13, 15, 18]

[NOTE: After 18-20, accuracies for all parts were coming constant]

Part (1): Using all points in the training set as centers for the RB Function

(FYI: Complete Outputs (All Accuracies and MSE) are available in Submitted Code File)



Training Analysis:

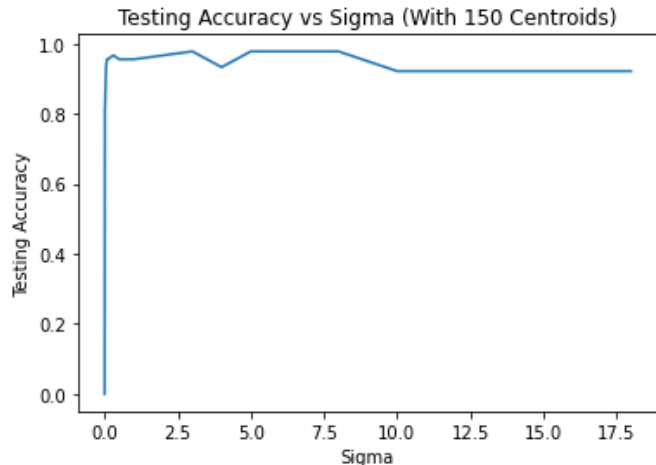
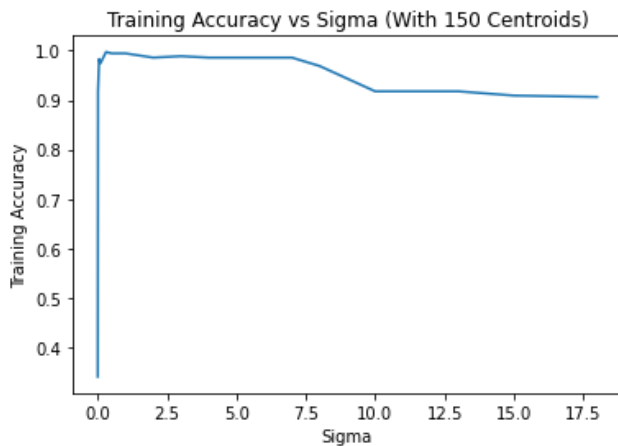
- Best Training Accuracy of 99.71% is obtained in the range of $\sigma = 0.7$ because of good interpolation at higher widths. i.e. close to the real gaussian curve.
- After 0.5, Training Accuracy has been decreased slightly till $\sigma = 8$, after which sudden decrement in accuracy is observed.
- Range of Mean Square Error: $[0 - 0.375]$

Testing Analysis:

- Best Testing Accuracy has been observed at $\sigma = [3, 7, 8]$
- Range of Mean Square Error: $[0.089 - 1.00]$
- Minimum Mean Square Error 0.034 has been observed at accuracies 3, 7, 8, reason being approximation by RBF Function could be identical or real close to real curve.
- Less Accuracy has been observed for initial σ 's because of poor interpolation at lower widths.
- Overfitting case might be observed at $\sigma = [0.001 - 0.05]$, where for training we have 100% accuracy with 0 MSE and for testing we received 0% accuracy with 1 MSE.

Part (2A): Using 150 random centers from input data for the RB Function

(FYI: Complete Outputs (All Accuracies and MSE) are available in Submitted Code File)

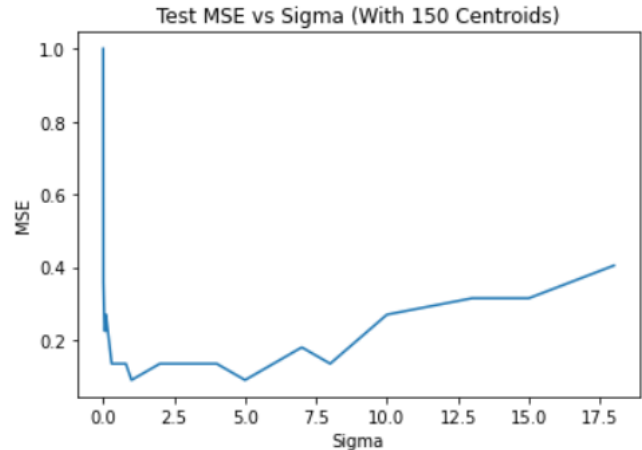
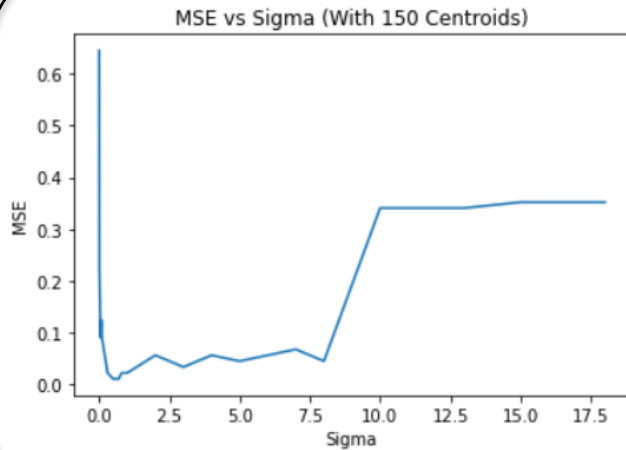


Training Analysis:

- Best Training Accuracy of 99.715% is obtained for $\sigma = 0.3$ with Mean Square Error = 0.011
- For initial σ 's, training accuracy has been increased drastically i.e. from $\sigma = 0.001$ to 0.05, after which accuracy remained approximately between 98 - 99% till $\sigma = 8$, where after steep decrease in accuracy from 97 to 91% has been observed.

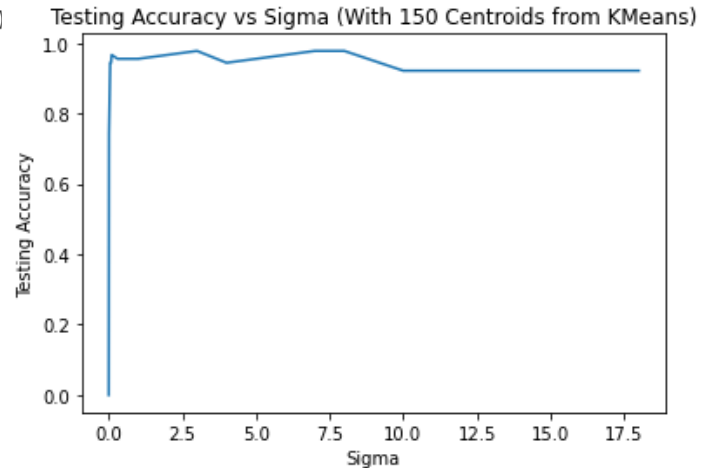
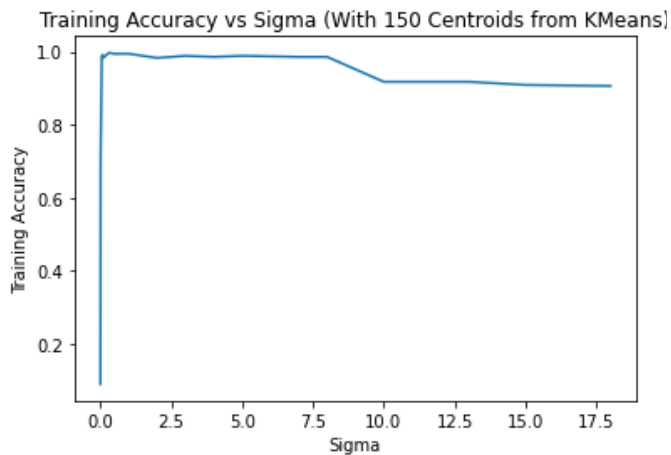
Testing Analysis:

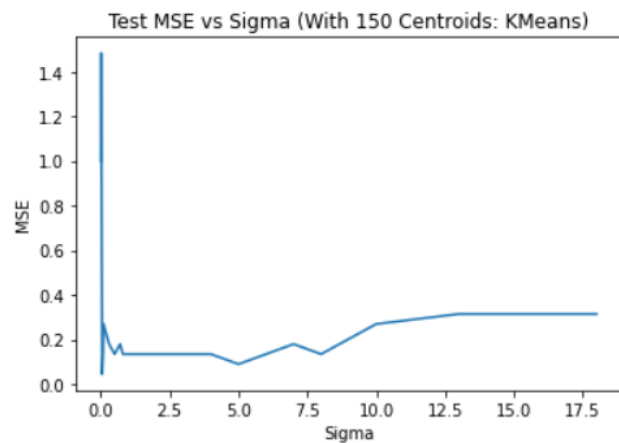
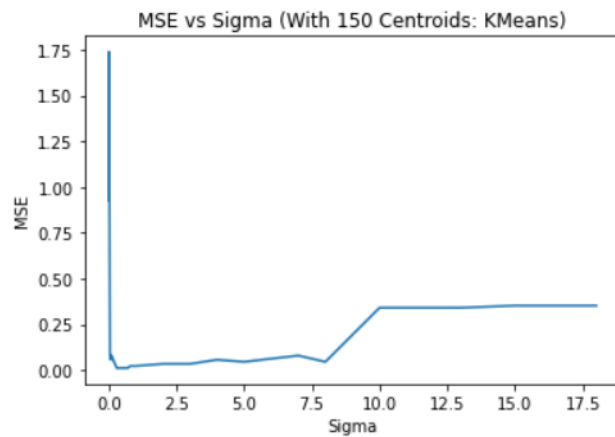
- Best Testing Accuracy of 97.75% is obtained for Sigma = 3, 5, 7, 8 with Mean Square Error = 0.089
- Significant increase in accuracy for initial sigma's till 0.1, after which accuracy remained in the range of approximately 96-97% and starts decreasing after sigma =8.



Part (2B): Using 150 random centers from KMeans Algorithm for the RB Function

(FYI: Complete Outputs (All Accuracies and MSE) are available in Submitted Code File)





Training Analysis:

- Maximum Training Accuracy is 99.715% at sigma = 0.3, 0.5 and 0.7, with MSE = 0.011.
- Training Accuracy faces a steep increase with the increase in initial sigma (0.001, 0.01, 0.05) (*Red Highlighted*)

```
For Sigma: 0.001
Accuracy: 7.3863636363637
Mean Square Error: [0.92613636]
-----
For Sigma: 0.01
Accuracy: 56.53409090909091
Mean Square Error: [1.73863636]
-----
For Sigma: 0.05
Accuracy: 98.011363636364
Mean Square Error: [0.07954545]
```

- Accuracy starts drooping after sigma = 3 and steep decrement occurred from sigma = 10. (*Blue Highlighted*)

```
-----
For Sigma: 3
Accuracy: 99.14772727272727
Mean Square Error: [0.03409091]
-----
For Sigma: 4
Accuracy: 98.57954545454545
Mean Square Error: [0.05681818]
-----
For Sigma: 5
Accuracy: 98.86363636363636
Mean Square Error: [0.04545455]
-----
For Sigma: 7
Accuracy: 98.011363636364
Mean Square Error: [0.07954545]
-----
For Sigma: 8
Accuracy: 98.86363636363636
Mean Square Error: [0.04545455]
-----
For Sigma: 10
Accuracy: 91.47727272727273
Mean Square Error: [0.34090909]
-----
For Sigma: 13
Accuracy: 91.47727272727273
Mean Square Error: [0.34090909]
```

Testing Analysis:

- Maximum Testing Accuracy is 98.87% at $\sigma = 0.05$, with $MSE = 0.044$, i.e. at lower sigma higher width has been obtained leading to better interpolation as compared to other sigma values.
- Testing Accuracy also faces steep increase with the increase in initial sigma (0.001, 0.01, 0.05) (*Red Highlighted*)
- During the mid range of sigma, Accuracy fluctuated between approximately 94-97%.
- During the last sigma values, accuracy become constant at 92.13%.

```
For Sigma: 0.001
Accuracy: 0.0
Mean Square Error: [1.]
-----
For Sigma: 0.01
Accuracy: 62.92134831460674
Mean Square Error: [1.48314607]
-----
For Sigma: 0.05
Accuracy: 98.87640449438202
Mean Square Error: [0.04494382]
```

Final Remarks:

- ✓ Sigma 3 can be considered as optimal sigma since one of the highest accuracies has been observed for the same, i.e. curve created by RBF NN is close to the real gaussian curve.
- ✓ On comparing all three cases, it is observed that taking 150 random centroids has shown the best optimal accuracy with minimum sigma as compared to taking all 441 centroids.