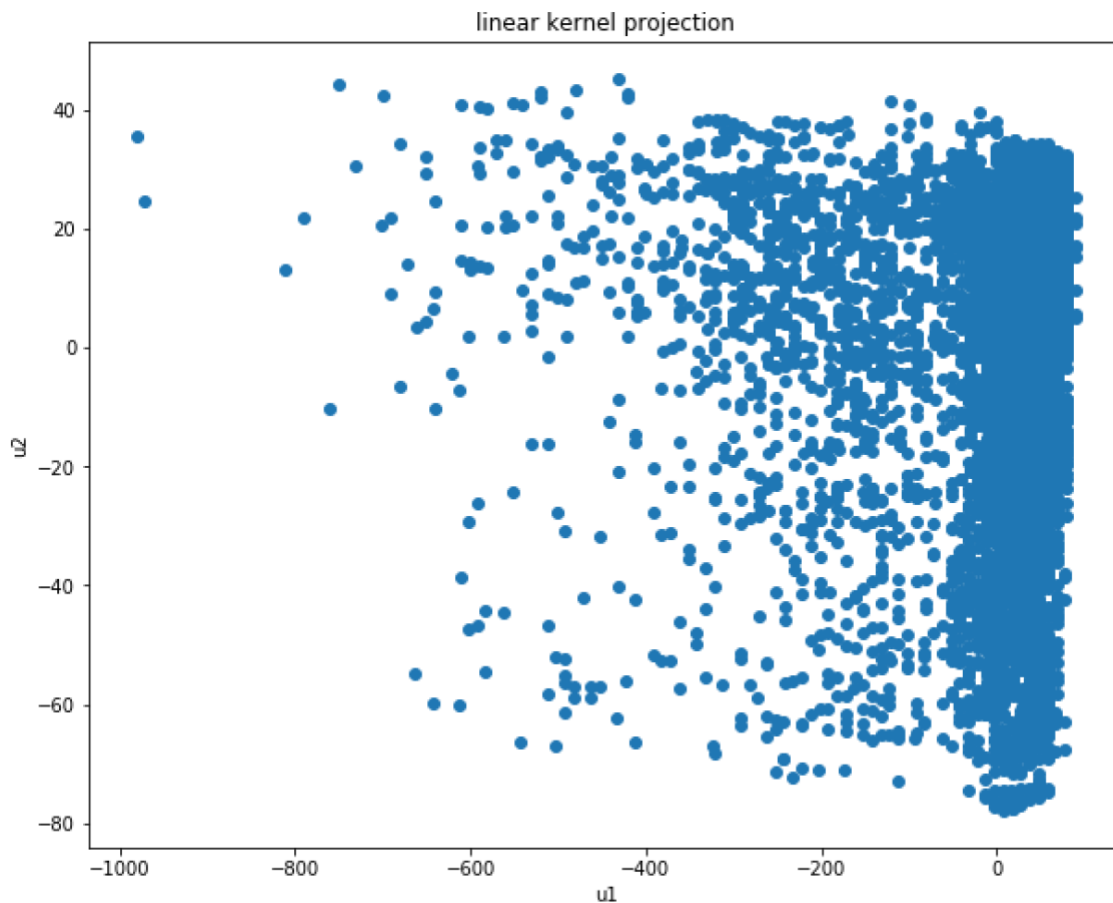


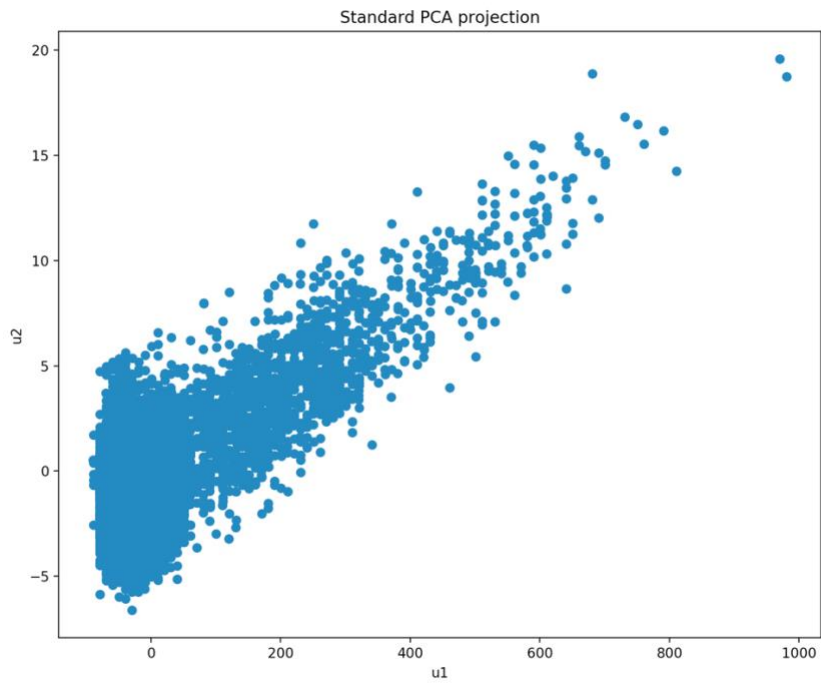
HW3 --- Part1

For the first 10000 data, when ALPHA is equal to 0.95. The reduced dimension of Linear Kernel is same as the Standard PCA one, which is 3. And for the eigenvalue, the linear kernel one is much greater than the Standard PCA .I also print the first two rows eigenvector and the first two columns eigenvector for the scatter points projection. The column eigenvector projection of Standard PCA is same as the linear kernel projection, which we can conclude the linear kernel PCA has the same meaning as the Standard PCA.

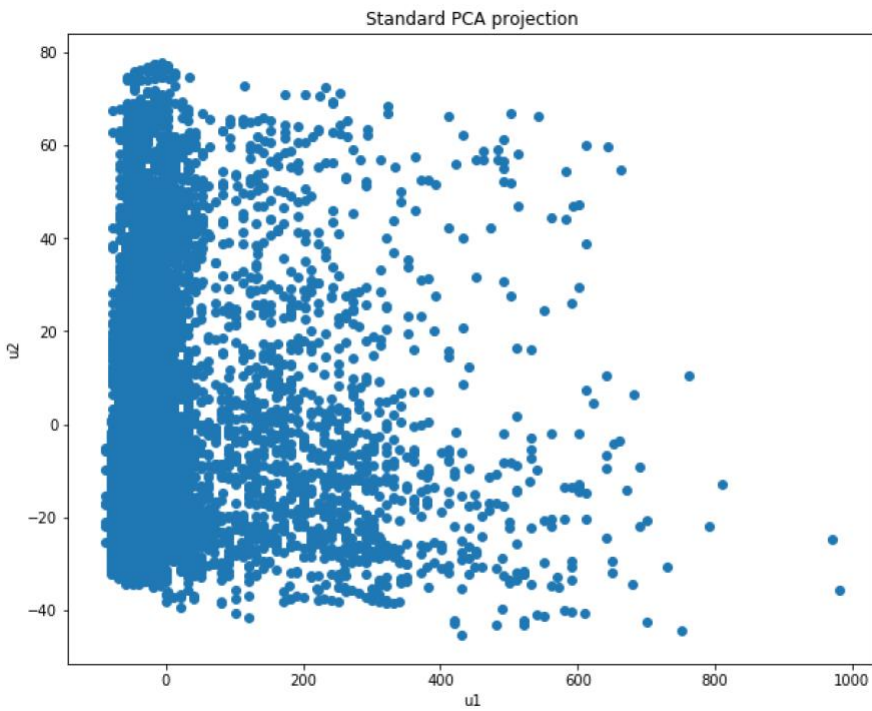


The reduced dimension for linear Kernel PCA is 3
The reduced eigenvalue for linear Kernel PCA is [118331500.26708171, 5782233.757285606, 2118852.693596055]

The first two rows of eigenvector projection



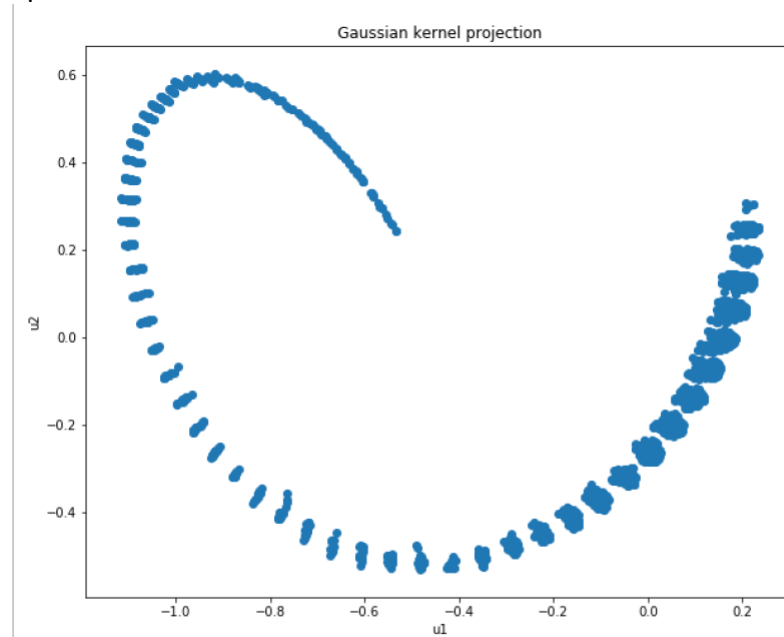
The first two columns of eigenvector projection



The reduced dimension for Standard PCA is 3
The reduced eigenvalue for Standard PCA is [11834.33346005 578.28120385 211.90646001]

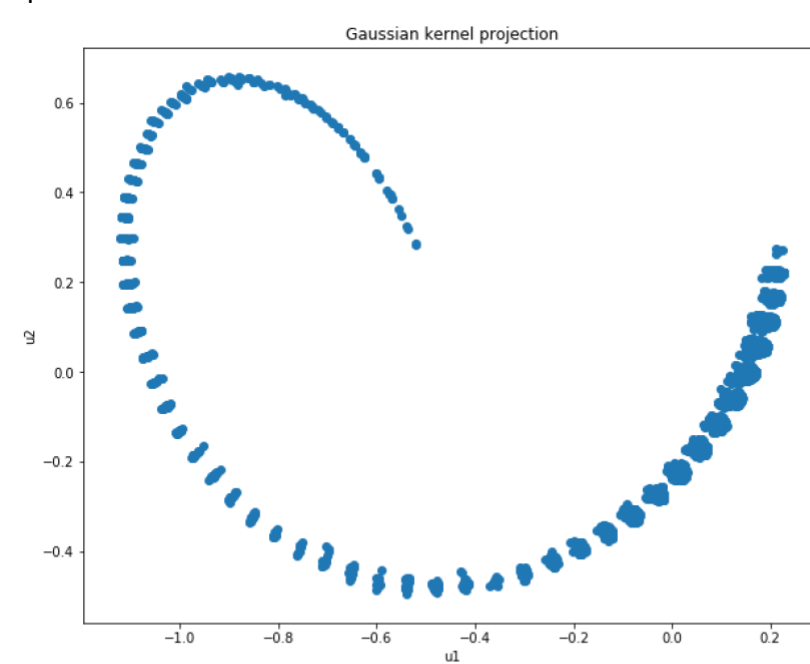
For Gaussian Kernel PCA for the first 5000 data. (10k is too large)

Spread = 15000



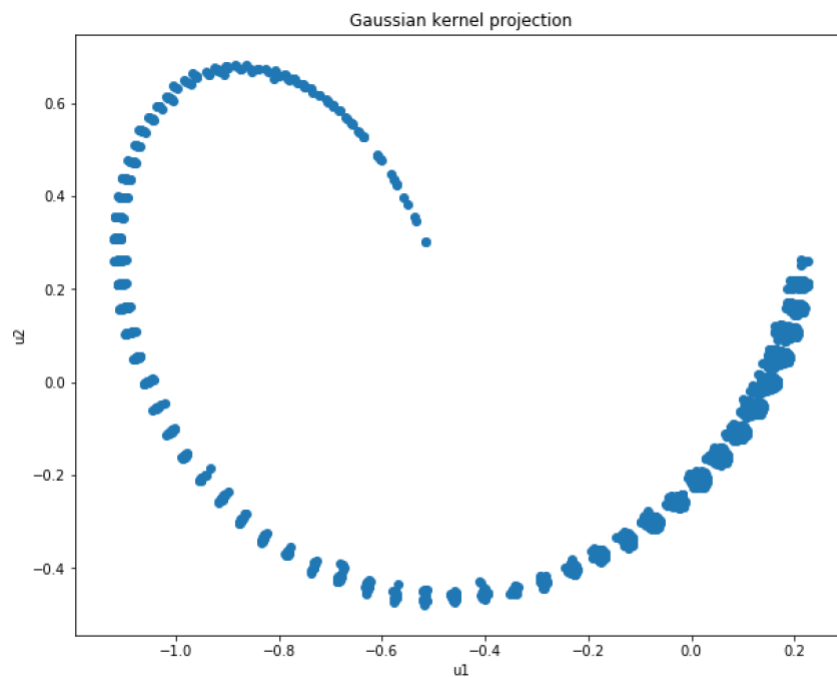
The reduced dimension is 15
the reduced eigenvalue for Gaussian kernel is [674.1281708821554, 254.37924984507936, 86.12959174476711, 56.38978768616408, 47.58807975607663, 46.68826670028732, 36.58587755850196, 28.32466920359655, 23.05526059096667, 20.546571226376123, 16.80153187140428, 13.462030108100594, 8.445927047422172, 7.157261011842971, 5.908893896819917]

Spread = 20000



The reduced dimension is 13
the reduced eigenvalue for Gaussian kernel is [653.763482382523, 216.90598358890276, 73.78866579256649, 43.86060105839257, 36.33483522202432, 33.63801263488408, 28.4797201305889, 21.95291673536019, 17.837243351097662, 16.028349321172826, 11.493333623667183, 10.190387944729533, 5.546923684688127]

Spread = 22000



The reduced dimension is 12
the reduced eigenvalue for Gaussian kernel is [644.0297513993709, 205.11834643844804,
69.17819521626885, 40.30194853845963, 33.38133292708286, 29.706200650338747, 26.13214251968642,
20.13490731208295, 16.359143180180965, 14.744007295966156, 10.308649231982676, 8.972646020715404]

The reduced dimension does not change too much, so I stopped.

HW3 --- Part2

When I randomly generate the data for two times, they all have the similar R^2 which is approximal to 0.16, a very small number.

```
The weight vector for the traning data : [ 36.25444292  1.94873279 -2.7096659  15.05658707 -17.44935468
-13.58144263  26.43899295  4.23074987 -3.24255728  0.28019541
  0.68377889  0.12115146  7.35547448  0.31299303  1.24105981
-1.55214583  9.16056001 -4.48834164 -16.30283603 -0.87204642
-11.4340267  0.19234497 -1.29585379  1.74395943  0.15134298
  6.14198669 -0.05581407]
The L2 norm weight for the traning data : 58.06164256497741
+ Part II
The SSE is 121592284.31836121, MSE is 10548.982104011586, R Square is 0.16565710365209707
+ Part II
The SSE is 51713771.59525069, MSE is 10421.530268444118, R Square is 0.16178966369841966
```

```
The weight vector for the traning data : [ 16.95582529  1.93611888 -0.69215163  15.02820652 -15.88373664
-12.73572576  26.07492725  4.25547525 -5.30057702 -0.55943411
  1.34875135  0.15146942  7.60337426  0.38404197  1.23426765
-1.5609127  8.30194349 -4.96473846 -16.11674194 -0.88794949
-10.68395105  0.1826588 -1.11898526  1.92172708  0.16581402
  5.16910724 -0.02778172]
The L2 norm weight for the traning data : 47.14052540497057
+ Part II
The SSE is 124487005.54517603, MSE is 10785.91191051705, R Square is 0.16455808191055435
+ Part II
The SSE is 48880638.623253666, MSE is 9868.028987285428, R Square is 0.16327114128413975
```