Jingxia Zhu (jingxia6)

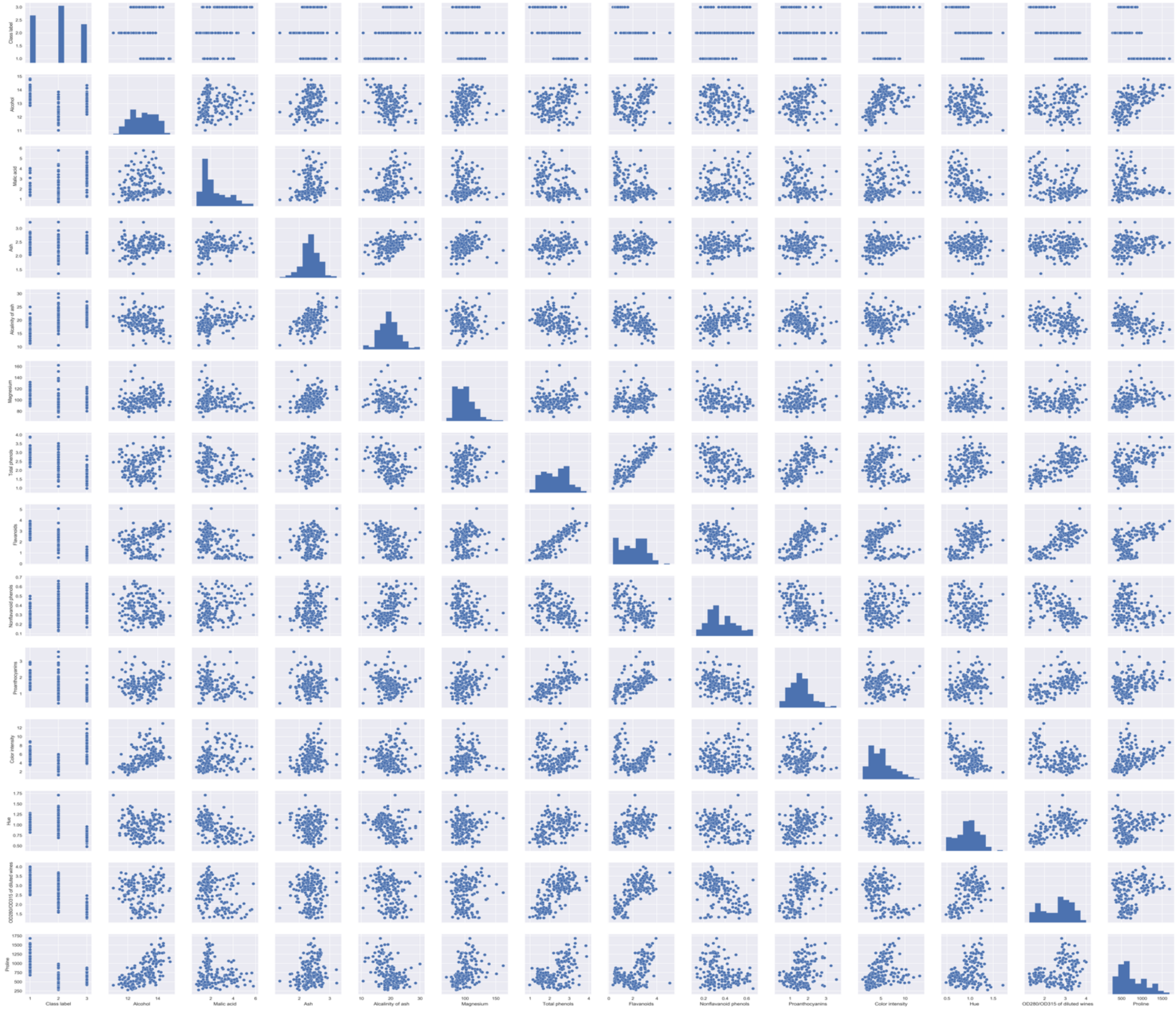
IE598 MLF F18

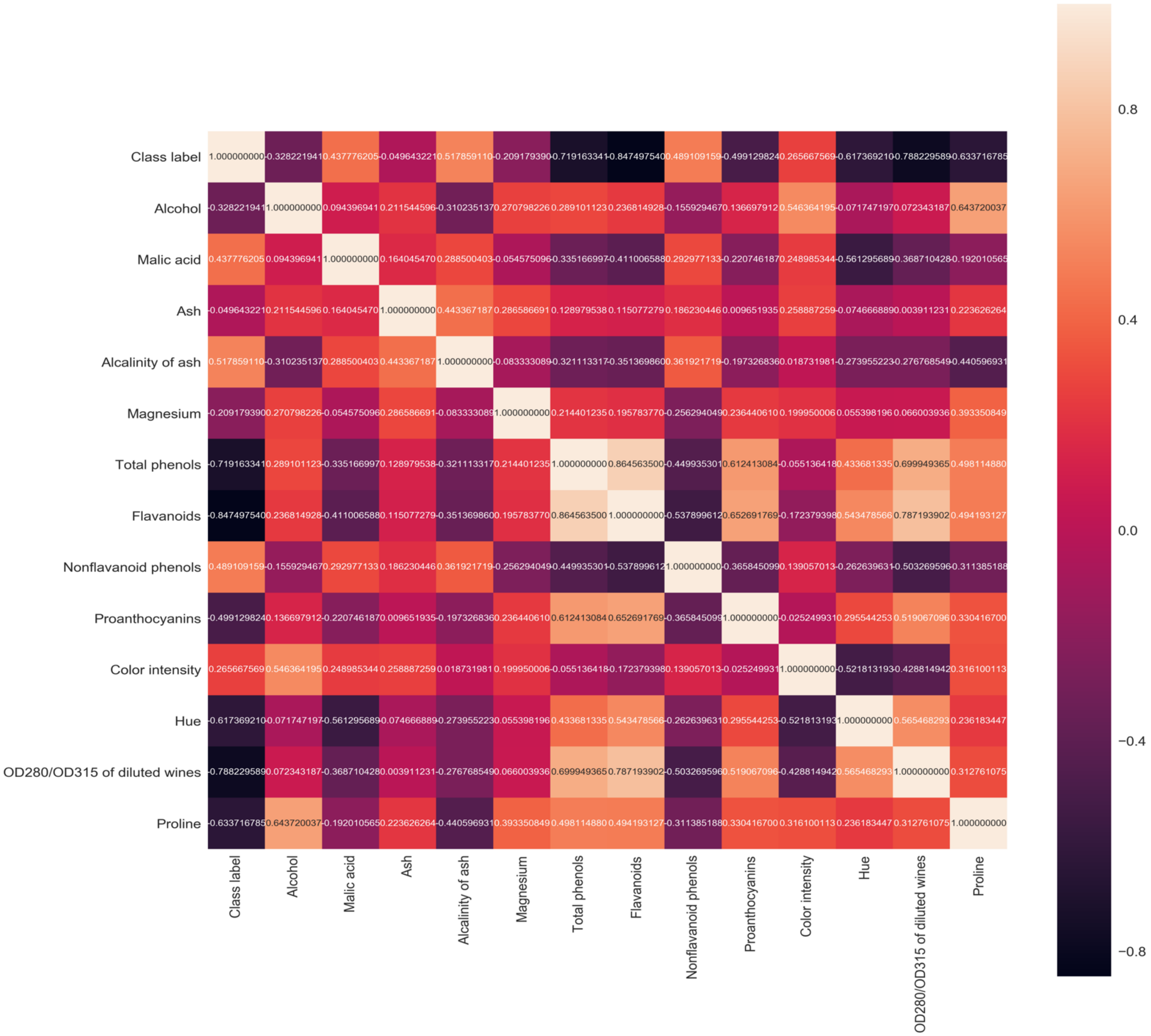
Module 5 Homework (Dimensionality Reduction)

Part 1: Exploratory Data Analysis

Describe the data sets sufficiently using the methods and visualizations that we used previously. Include any output, graphs, tables, heatmaps, box plots, etc. that you think is necessary to represent the data. Label your figures and axes. DO NOT INCLUDE CODE, only output figures!

Split data into training and test sets. Use random_state = 42. Use 80% of the data for the training set. Use the same split for all experiments.





Part 2: Logistic regression classifier v. SVM classifier - baseline

Fit a logistic classifier model to both datasets using SKlearn. Calculate its accuracy score for both in sample and out of sample (train and test sets). (You may use CV accuracy score if you wish).

Fit an SVM classifier model to both datasets using SKlearn. Calculate its accuracy score for both in sample and out of sample (train and test sets). (You may use CV accuracy score if you wish).

```
Logistic regression train/test accuracies 1.000/1.000

SVM train/test accuracies 1.000/0.944
```

Part 3: Perform a PCA

Refit both a logistic and SVM classifier on the PCA transformed datasets. You may choose to use only 2 components, or select a higher appropriate intrinsic dimension. Calculate accuracy scores for both in sample and out of sample (train and test sets) on both datasets.

```
PCA_LR train/test accuracies 0.972/0.944

PCA_SVM train/test accuracies 0.972/0.944
```

Part 4: Perform and LDA

Refit both a logistic and SVM classifier on the LDA transformed datasets. You may choose to use only 2 discriminants, or select a higher appropriate number. Calculate accuracy scores for both in sample and out of sample (train and test sets) on both datasets.

```
LDA_LR train/test accuracies 1.000/0.972

LDA_SVM train/test accuracies 1.000/0.944
```

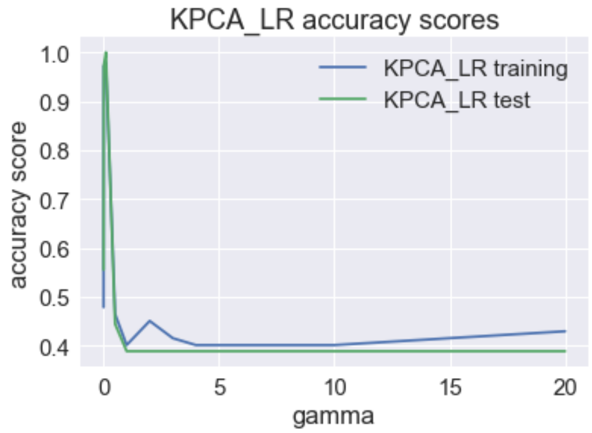
Part 5: Perform a kPCA

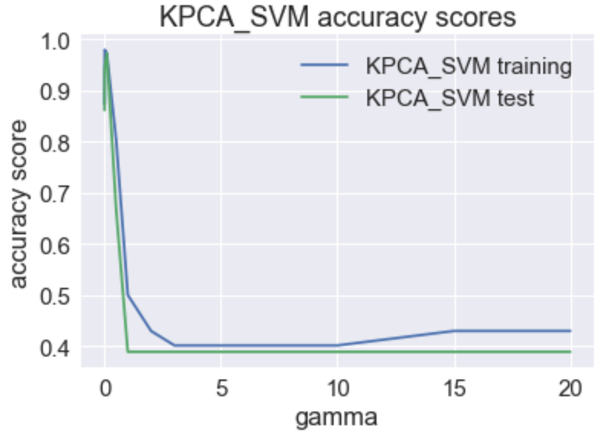
Refit both a logistic and SVM classifier on the kPCA transformed datasets. Use the rbf kernel. Test several different values for Gamma. Calculate accuracy scores for both in sample and out of sample (train and test sets) on both datasets.

```
Gamma:  0.001

KPCA_LR train/test accuracies 0.478873/0.555556

KPCA_SVM train/test accuracies 0.873239/0.861111

Gamma:  0.01

KPCA_LR train/test accuracies 0.971831/0.972222

KPCA_SVM train/test accuracies 0.978873/0.944444

Gamma:  0.1
```

```
KPCA_LR train/test accuracies 0.978873/1.000000
KPCA_SVM train/test accuracies 0.971831/0.972222
Gamma:  0.5
KPCA_LR train/test accuracies 0.464789/0.444444
KPCA_SVM train/test accuracies 0.802817/0.666667
Gamma:  1
KPCA_LR train/test accuracies 0.401408/0.388889
KPCA_SVM train/test accuracies 0.500000/0.388889
Gamma:  2
KPCA_LR train/test accuracies 0.450704/0.388889
KPCA_SVM train/test accuracies 0.429577/0.388889
Gamma:  3
KPCA_LR train/test accuracies 0.415493/0.388889
KPCA_SVM train/test accuracies 0.401408/0.388889
Gamma:  4
KPCA_LR train/test accuracies 0.401408/0.388889
KPCA_SVM train/test accuracies 0.401408/0.388889
Gamma:  5
KPCA_LR train/test accuracies 0.401408/0.388889
KPCA_SVM train/test accuracies 0.401408/0.388889
Gamma:  6
KPCA_LR train/test accuracies 0.401408/0.388889
KPCA_SVM train/test accuracies 0.401408/0.388889
Gamma:  7
KPCA_LR train/test accuracies 0.401408/0.388889
KPCA_SVM train/test accuracies 0.401408/0.388889
Gamma:  8
KPCA_LR train/test accuracies 0.401408/0.388889
KPCA_SVM train/test accuracies 0.401408/0.388889
```

```
Gamma:  9
KPCA_LR train/test accuracies 0.401408/0.388889
KPCA_SVM train/test accuracies 0.401408/0.388889
Gamma:  10
KPCA_LR train/test accuracies 0.401408/0.388889
KPCA_SVM train/test accuracies 0.401408/0.388889
Gamma:  15
KPCA_LR train/test accuracies 0.415493/0.388889
KPCA_SVM train/test accuracies 0.429577/0.388889
Gamma:  20
KPCA_LR train/test accuracies 0.429577/0.388889
KPCA_SVM train/test accuracies 0.429577/0.388889
```



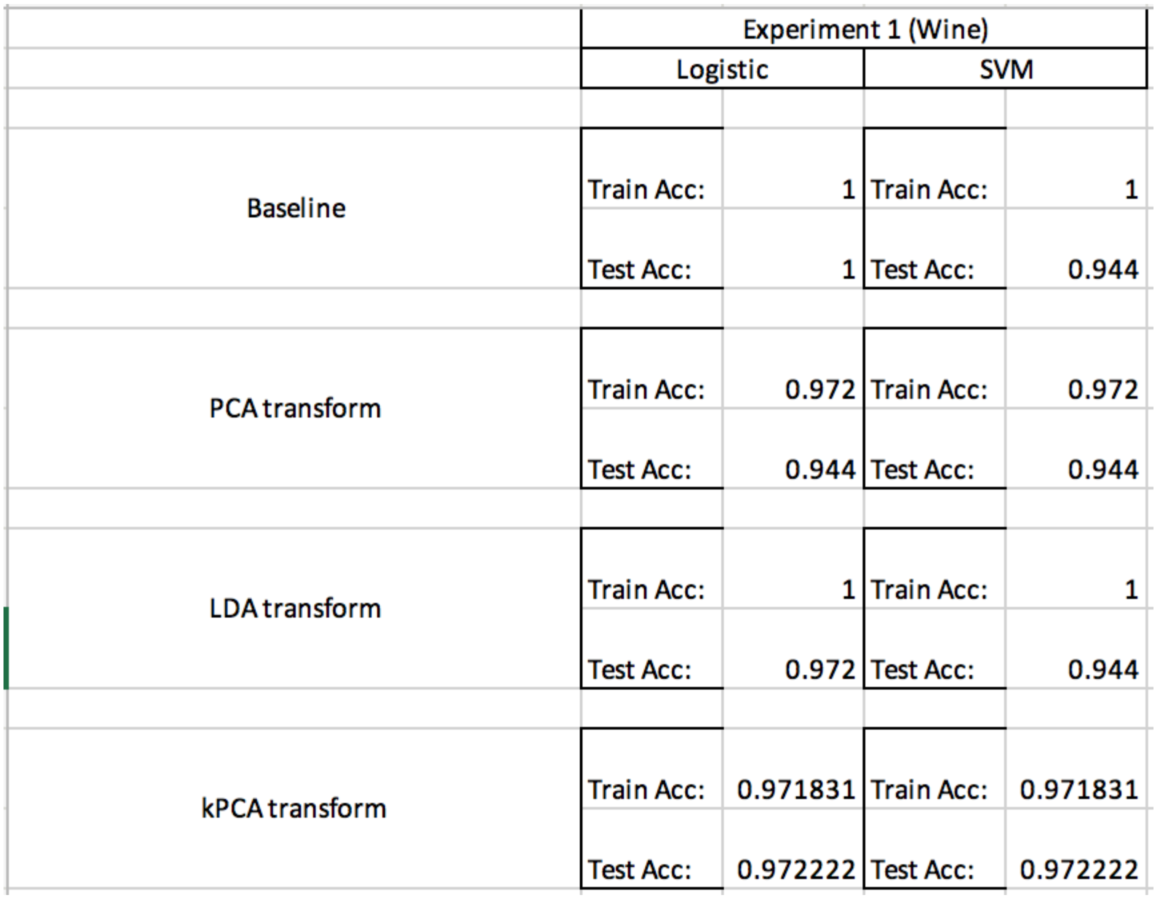


Part 6: Conclusions

Write a short paragraph summarizing your findings. Which model performs best on the untransformed data? Which transformation leads to the best performance increases? Report your results using the Results worksheet format. Embed the completed table in your report.

The wine data set is pretty linear itself originally. So, using transformations will not make the model perform better on this data set. After comparing different gammas on kPCA, the best one I would choose is 0.1 as it gives the highest accuracy score.

Logistic Regression performs best on the untransformed data. Transformations, in this case, do not leads to better performances, or great performance increases. The following sheet includes my results of accuracy scores:



	Experiment 1 (Wine)			
	Logistic		SVM	
Baseline	Train Acc:	1	Train Acc:	1
	Test Acc:	1	Test Acc:	0.944
PCA transform	Train Acc:	0.972	Train Acc:	0.972
	Test Acc:	0.944	Test Acc:	0.944
LDA transform	Train Acc:	1	Train Acc:	1
	Test Acc:	0.972	Test Acc:	0.944
kPCA transform	Train Acc:	0.971831	Train Acc:	0.971831
	Test Acc:	0.972222	Test Acc:	0.972222

Part 7: Appendix

Link to github repo: https://github.com/jzhuuhzj/IE598_F18_HW5.git