Applications of Machine Learning in the analysis of breast cancer

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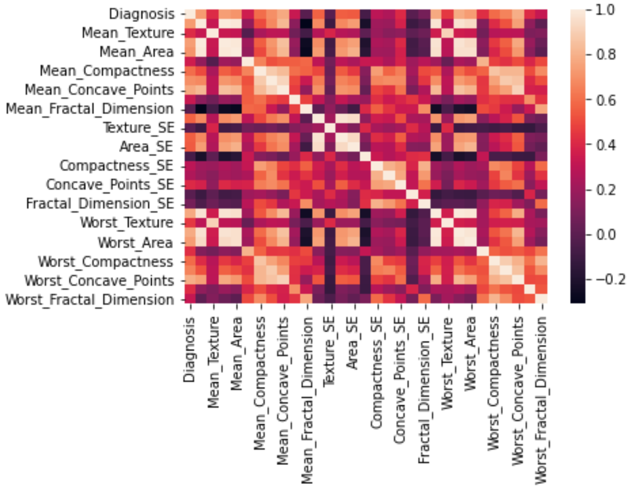
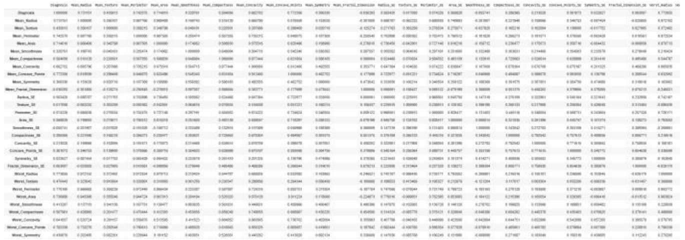
Introduction

- When starting this project we investigated many datasets finally settling on https://archive.ics.uci.edu/ml/machine-learning-databases/breast-cancer-wisconsin/
- This dataset is from the University of Wisconsin – a well-known institute of higher learning in the USA
- The main objective of our project was to use Machine Learning models to accurately predict the presence / absence of breast cancer based on features in the data
- We used a combination of both Supervised and Unsupervised learning in this project to train our models
- Cleaning and analyzing the data was our first task
- We noticed diagnosis had M for malignant and B for benign we decided to replace these with 1 and 0 respectively
- Did this so that we could perform numerical operations easier
- We started by showing a heatmap of our correlations as you can see on the right hand side
- Did this to analyze relations in the data and to see which features were highly correlated with our diagnosis
- We also played around with the training / test set ratios and finally settled on a 70 / 30 split





Models Used

- Linear Regression – to predict and analyze the correlation of 2 features in our dataset
- K Means – This is an unsupervised learning technique creating clusters of data based on a centroid
- KNN – This is a clustering technique which analyzes data nearest to other data to predict a diagnosis
- Naïve Bayes – This is a technique used to predict cancer by taking features of our dataset and using the same weight for each -> Assumes data has same effect on output hence Naïve
- Decision Trees – Which were used to predict diagnosis by making a tree of features in our dataset which will either lead to positive or negative diagnosis based on their values
- Random Forest – Creates multiple trees then merges the best models to predict our diagnois
- PCA (Principle Component Analysis) - unsupervised dimensionality-reduction which reduced features in our dataset by removing similar features which were highly correlated

Analysis of our models

- Linear Regression was used to analyze the strength of the relationship between certain features and our Diagnosis – Also used Craméŕs V
- Had good results we could see which features were positively correlated with a diagnosis value and the strength of this correlation
- K Means – Performed fairly well with 86% accuracy
- KNN – Performed better than KNN with 91% accuracy
- Gaussian Naïve Bayes – without smoothing or scaling had 90% accuracy on testset
- Gaussian Naïve Bayes with scaling had around a 91% accuracy rate – not much improvement
- Decision Tree model had an accuracy of 93%
- Random forest had around the same degree of accuracy
- Entropy Forest had 90% accuracy
- PCA Gini Tree had an accuracy of 0.94%
- PCA Random forest had the best accuracy of all our models at 97%

Final Results Table And Conclusion

- Here we can see our final results table
- Notice which models performed correctly and which didn't
- Trial and error process – it took time finding the right ratio of the training / test sets
- Also it took time to analyze the models and determine how we could get the best performance from them
- From our study we we determined PCA Random Forest had the best accuracy when predicting the diagnosis
- We also learned the limitations of machine learning in healthcare – should be used as an assistant not an expert as even the best trained models can yield false predictions
- We learned the importance of data cleaning and analysis
- We learned which models worked on our dataset and which didn't – it was a fairly small set of only 570 values!

A. Accuracy of Models

Method Description	Accuracy
PCA Gini Random Forest:	0.98%
cross validation gini random forest:	0.96%
Standard trained gini random forest:	0.95%
cross validation entropy random forest:	0.95%
PCA Gini Tree:	0.94%
Standard trained entropy random forest:	0.94%
Standard trained gini decision tree:	0.94%
cross validation entropy decision tree:	0.92%
Navie Bayes - with scaling:	0.91%
Standard trained entropy decision tree:	0.91%
cross validation gini decision tree:	0.91%
K Neighbour:	0.91%
K Means:	0.86%