1. Derive optimal & minimum variance portfolio from stocks of American Express, Twitter Inc, Blackrock, Boeing & Starbucks. Based upon either optimal or minimum variance portfolio use decision tree classification (supervised machine learning) to help predict up or down days for your portfolio returns. You will first need to calculate the daily portfolio returns based on the historical data that you obtained for each of the five assets previously, and the optimal or minimum variance weights chosen from previous calculations. To this end, some useful python code might be: daily\_portfolio\_returns = (returns\*weights).sum(axis=1) Then, using at least two lags of the daily portfolio returns as ‘descriptive features’ in a decision tree (you can use additional descriptive features also), you should;

a) Train your algorithm to predict an up or down day for your portfolio

b) Use 10-fold cross validation to prune your tree and briefly discuss its implications for the model

c) Plot your decision tree and predict whether it’s an up or down day when the one day lagged return is 0% and the two-day lagged return is 9%

d) Test and briefly discuss the accuracy of your algorithm.

2. Ensemble methods in machine learning can have better performance compared to individual Classifiers. Briefly explain this statement. Use an Ensemble method to help predict up or down days for your portfolio returns based on the same data in Question 1. Does it have better performance? Explain.