Homework 5

Introduction to Data Science ¶

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`pulsar.csv` ([source (https://archive.ics.uci.edu/ml/datasets/HTRU2)](https://archive.ics.uci.edu/ml/datasets/HTRU2)) contains statistics from two types of signal from pulsar candidates: integrated profile and dispersion-measure signal-to-noise curve.

In [1]:

```python
import pandas as pd

data = pd.read_csv("pulsar.csv")
display(data)
X = data.iloc[:,:8]
y = data.iloc[:,8]

from sklearn.model_selection import StratifiedShuffleSplit

# Split
split = StratifiedShuffleSplit(n_splits=1, test_size=1/3, random_state=0)
for train_idx, test_idx in split.split(X, y):
    X_train, y_train = X.iloc[train_idx], y.iloc[train_idx]
    X_test, y_test = X.iloc[test_idx], y.iloc[test_idx]
```

	IP_Mean	IP_SD	IP_Kurt	IP_Skew	DMSNR_Mean	DMSNR_SD	DMSNR_Kurt	DI
0	140.562500	55.683782	-0.234571	-0.699648	3.199833	19.110426	7.975532	
1	102.507812	58.882430	0.465318	-0.515088	1.677258	14.860146	10.576487	
2	103.015625	39.341649	0.323328	1.051164	3.121237	21.744669	7.735822	
3	136.750000	57.178449	-0.068415	-0.636238	3.642977	20.959280	6.896499	
4	88.726562	40.672225	0.600866	1.123492	1.178930	11.468720	14.269573	
...	...	...	...	...	...	...	...	
17893	136.429688	59.847421	-0.187846	-0.738123	1.296823	12.166062	15.450260	
17894	122.554688	49.485605	0.127978	0.323061	16.409699	44.626893	2.945244	
17895	119.335938	59.935939	0.159363	-0.743025	21.430602	58.872000	2.499517	
17896	114.507812	53.902400	0.201161	-0.024789	1.946488	13.381731	10.007967	
17897	57.062500	85.797340	1.406391	0.089520	188.306020	64.712562	-1.597527	

17898 rows × 9 columns

Part 1A [3pts] For `max_depth` ranging from 1 to 20, fit decision tree classifiers using to the training data. Use `random_state=0` . Plot training vs. test accuracy.

In [2]:

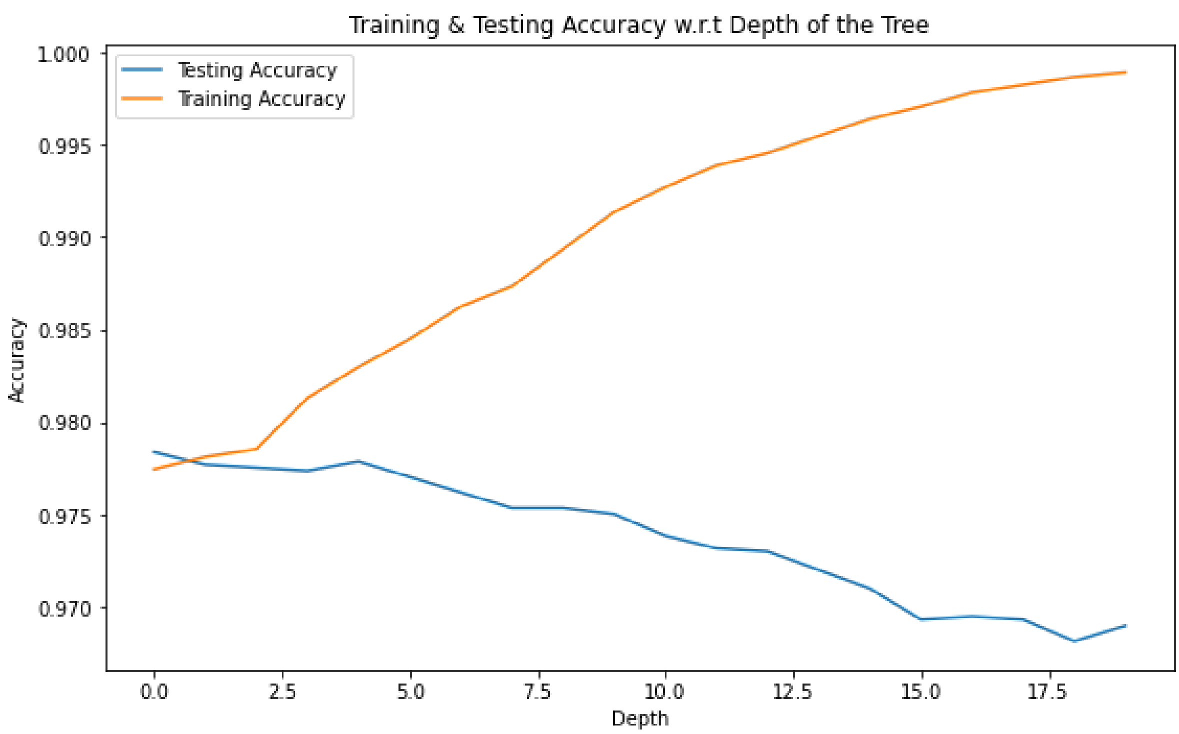
```
import numpy as np
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
import matplotlib.pyplot as plt
```

In [3]:

```
acc = np.zeros((20,2))

# decision-surfaces as fn of max depth
for depth in range(0,20):
    clf = DecisionTreeClassifier(max_depth=depth+1, random_state=0)
    clf.fit(X_train,y_train)
    preds_test = clf.predict(X_test)
    preds_train = clf.predict(X_train)
    acc_test = accuracy_score(y_test,preds_test)
    acc_train = accuracy_score(y_train,preds_train)
    acc[depth,0] = acc_test
    acc[depth,1] = acc_train

# Plot train accuracy vs test accuracy
plt.figure(figsize=(10,6))
plt.plot(acc[:,0])
plt.plot(acc[:,1])
plt.xlabel("Depth")
plt.ylabel("Accuracy")
plt.title("Training & Testing Accuracy w.r.t Depth of the Tree")
plt.legend(["Testing Accuracy","Training Accuracy"])
plt.show()
```



Part 1B [2pts] What trends do you observe in the training and test accuracies as depth increases? Explain these trends.

Part 1B Answer:

I am seeing that as the depth of the tree increases, the testing accuracy decreases and the training accuracy increases. This means that there is an overfitting of our model on this dataset.

Part 2A [3pts] For `n_estimators` ranging from 1 to 101 with step size 10, fit random forest classifiers to the training data. Use `random_state=0` and `max_depth=3`. Plot training vs. test accuracy.

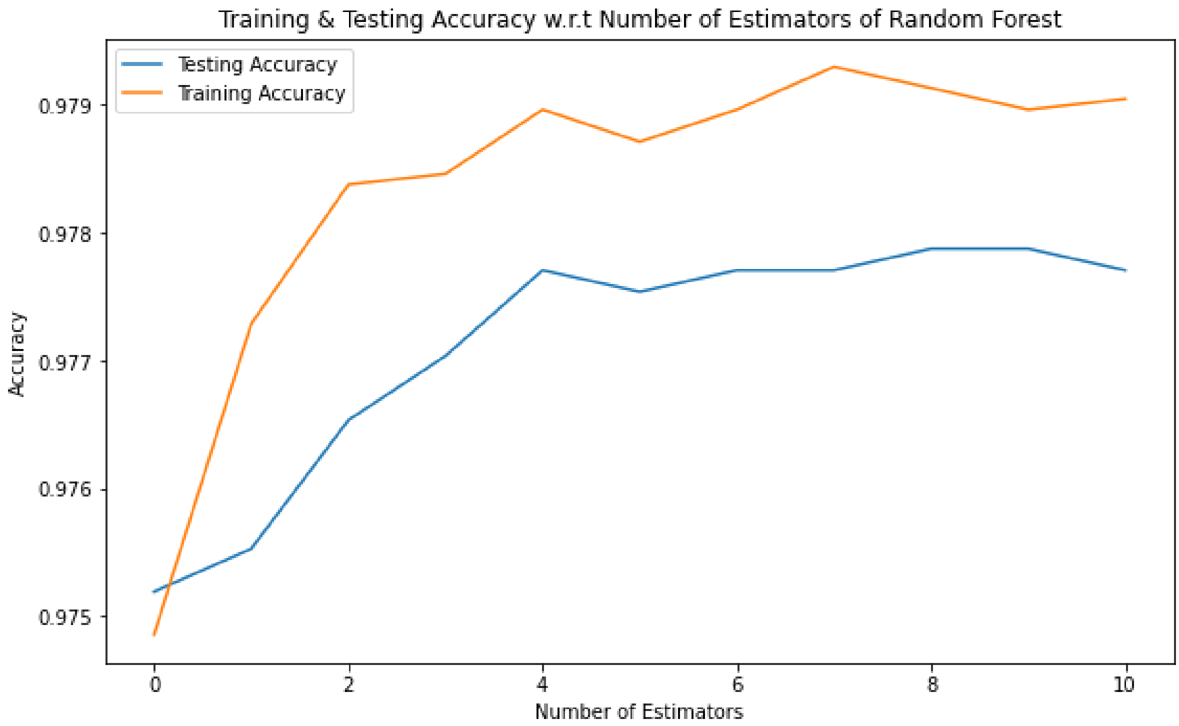
In [4]:

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.ensemble import RandomForestClassifier

acc = np.zeros((11,2))

# decision-surfaces as fn of max depth
for n_est in range(0,101,10):
    clf = RandomForestClassifier(n_estimators=n_est+1, max_depth=3, random_state=0)
    clf.fit(X_train,y_train)
    preds_test = clf.predict(X_test)
    preds_train = clf.predict(X_train)
    acc_test = accuracy_score(y_test,preds_test)
    acc_train = accuracy_score(y_train,preds_train)
    acc[int(n_est/10),0] = acc_test
    acc[int(n_est/10),1] = acc_train

# Plot train accuracy vs test accuracy
plt.figure(figsize=(10,6))
plt.plot(acc[:,0])
plt.plot(acc[:,1])
plt.xlabel("Number of Estimators")
plt.ylabel("Accuracy")
plt.title("Training & Testing Accuracy w.r.t Number of Estimators of Random Forest")
plt.legend(["Testing Accuracy","Training Accuracy"])
plt.show()
```



Part 2B What trends do you observe in the training and test accuracies as `n_estimators` increases? Explain these trends.

Part 2B Answer:

I am seeing that as the number of estimators increase, the train and test accuracy increase together. This

In [ ]:

```

```