A2Q1

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1 CMPT 423/820

1.1 Assignment 2 Question 1

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```
In [3]: import pandas as pd

        # reading iris dataset and adding header
        iris = pd.read_csv('data/iris.csv',
                           header=None,
                           names=['sepal_length', 'sepal_width',
                                  'petal_length', 'petal_width', 'species'])
```

1.1.1 Part 1.

Build the four 1-feature classifiers, and calculate the accuracy of each.

```
In [9]: from sklearn.naive_bayes import GaussianNB
        from sklearn.model_selection import cross_val_score

        KFOLDS = 10

        def nb_classifier(data_in, label_in):
            """
            :purpose: This function creates an NB classifier and calculates
            its cross validated accuracy
            :param data_in: dataset
            :param label_in: true answers for the dataset
            :return: the accuracy of the model with 5 point accuracy
            """
            clf_nb = GaussianNB()

            # fitting the model to the data
            clf_nb.fit(data_in, label_in)
```

```
        result = cross_val_score(clf_nb, data_in,
                        label_in,
                        cv=KFOLDS,
                        scoring='accuracy')

        return round(result.mean(),5)


    # creating answer
    model_info = {'sepal_length':{'acc':0}, 'sepal_width':{'acc':0},
                              'petal_length':{'acc':0}, 'petal_width':{'acc':0},
                             'all_feature':{'acc':0}}

    # separating labels
    labels = iris.values[:, 4]

    # Classifier for sepal length
    split_data = iris.values[:, 0]
    model_info['sepal_length']['acc'] = nb_classifier(split_data.reshape(-1, 1),
                                                      labels)

    # Classifier for sepal width
    split_data = iris.values[:, 1]
    model_info['sepal_width']['acc'] = nb_classifier(split_data.reshape(-1, 1),
                                                    labels)

    # Classifier for petal length
    split_data = iris.values[:, 2]
    model_info['petal_length']['acc'] = nb_classifier(split_data.reshape(-1, 1),
                                                      labels)

    # Classifier for petal width
    split_data = iris.values[:, 3]
    model_info['petal_width']['acc'] = nb_classifier(split_data.reshape(-1, 1),
                                                    labels)

    # printing result in tabular format
    print('\033[1m' + 'Naive Bayes classifier for 1 feature' + '\033[0m')
    print('{:<15} {:<15}'.format('feature','accuracy'))
    for feature, item in model_info.items():
        print('{:<15} {:<15}'.format(feature, item['acc']))
```

```
Naive Bayes classifier for 1 feature
feature         accuracy
sepal_length    0.72667
sepal_width     0.56
petal_length    0.95333
petal_width     0.95333
```

```
all_feature     0
```

1.1.2 Part 2.

Build the 4-feature classifier (as we saw in class), and calculate the accuracy.

```
In [10]: # Classifier for all features
         split_data = iris.values[:, :4]
         model_info['all_feature']['acc'] = nb_classifier(split_data, labels)

         print('\033[1m' + 'Naive Bayes classifier for 4 features' + '\033[0m')

         print('Accuracy {:<15}'.format(model_info['all_feature']['acc']))
```

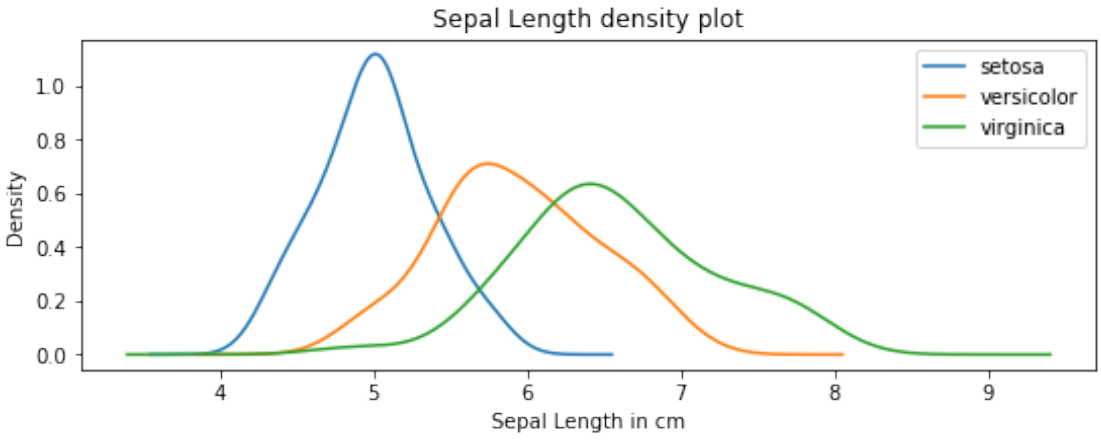
```
Naive Bayes classifier for 4 features
Accuracy 0.95333
```

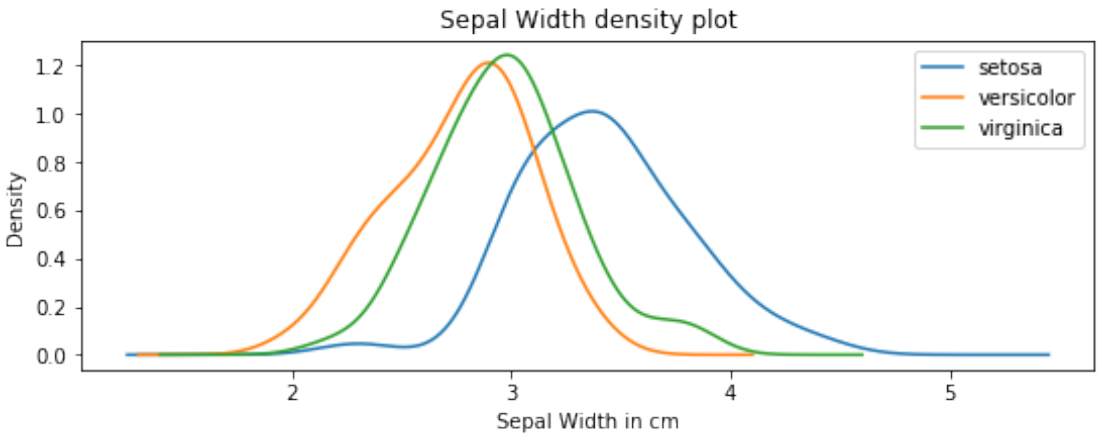
1.1.3 Part 3.

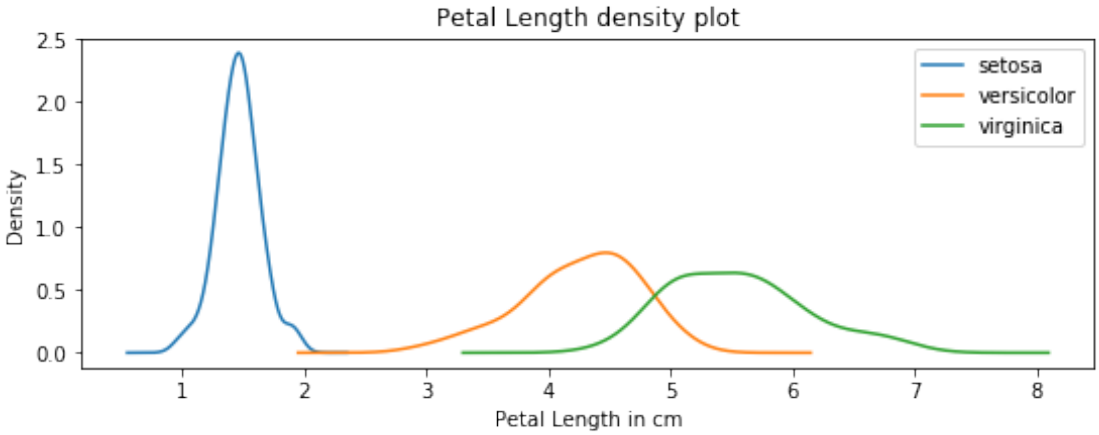
Reproduce the density plots from A1Q7 Task 4 that shows the class density for each feature, and compare the density plots to the accuracy scores you obtained. In a few sentences discuss how the density plot relates to the accuracy score.

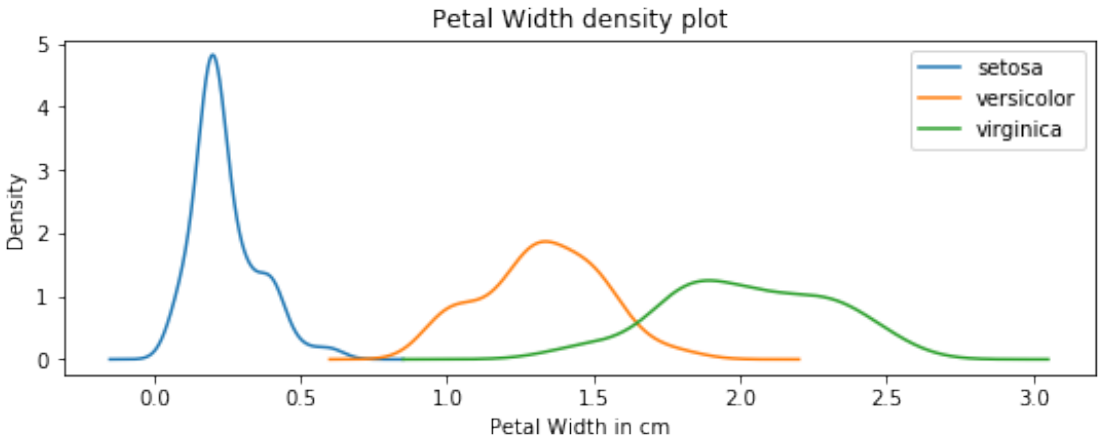
```
In [11]: import matplotlib.pyplot as plt

         # Sepal length
         # select only sepal_length and sepcies columns
         sepal = iris.filter(items=['sepal_length', 'species'])

         # creating plot
         fig, ax = plt.subplots(figsize=(9, 3))

         # adding each group to the plot
         for label, df in sepal.groupby('species'):
             df.sepal_length.plot(kind="kde", ax=ax, label=label)

         # adding plot axis label, title and legend
         plt.title('Sepal Length density plot')
         plt.xlabel('Sepal Length in cm')
         plot = plt.legend()

         # Sepal width
         # select only sepal_width and sepcies columns
         sepal = iris.filter(items=['sepal_width', 'species'])

         fig, ax = plt.subplots(figsize=(9, 3))
         for label, df in sepal.groupby('species'):
```

```
    df.sepal_width.plot(kind="kde", ax=ax, label=label)


plt.title('Sepal Width density plot')
plt.xlabel('Sepal Width in cm')
plot = plt.legend()

# Petal length
# select only petal_length and sepcies columns
sepal = iris.filter(items=['petal_length', 'species'])

fig, ax = plt.subplots(figsize=(9, 3))
for label, df in sepal.groupby('species'):
    df.petal_length.plot(kind="kde", ax=ax, label=label)


plt.title('Petal Length density plot')
plt.xlabel('Petal Length in cm')
plot = plt.legend()

# Petal width
# select only petal_width and sepcies columns
sepal = iris.filter(items=['petal_width', 'species'])

fig, ax = plt.subplots(figsize=(9, 3))
for label, df in sepal.groupby('species'):
    df.petal_width.plot(kind="kde", ax=ax, label=label)


plt.title('Petal Width density plot')
plt.xlabel('Petal Width in cm')
plt.legend()

plt.show()
```




Sepal Width density plot
setosa
versicolor
virginica
Density
Sepal Width in cm


Petal Length density plot
setosa
versicolor
virginica
Density
Petal Length in cm


Petal Width density plot
setosa
versicolor
virginica
Density
Petal Width in cm

```
In [12]: # printing result in tabular format
         print('\033[1m' + 'Naive Bayes classifier for 1 feature' + '\033[0m')
         print('{:<15} {:<15}'.format('feature','accuracy'))
         for feature, item in model_info.items():
             print('{:<15} {:<15}'.format(feature, item['acc']))
```

```
Naive Bayes classifier for 1 feature
feature         accuracy
sepal_length    0.72667
sepal_width     0.56
petal_length    0.95333
petal_width     0.95333
all_feature     0.95333
```

In the plots above, the less the curves for different species in the plots interfere with each other, the better our Naive Bayes classifier gets. We can see that *sepal width* has the worst accuracy, and its curves have the most overlap with each other.

1.1.4 Part 4.

Compare the best 1-feature classifier to the 4-feature classifier, in terms of accuracy. Discuss briefly your results.

```
In [13]: # printing result in tabular format
         print('\033[1m' + 'Naive Bayes classifier' + '\033[0m')
         print('{:<15} {:<15}'.format('feature','accuracy'))
         for feature, item in model_info.items():
             print('{:<15} {:<15}'.format(feature, item['acc']))
```

```
Naive Bayes classifier
feature         accuracy
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petal_width     0.95333
all_feature     0.95333
```

The classifier for *Petal width* has the most accuracy between all features and *Sepat width* has the worst. We can see that 1-feature classifier based on *Petal width* and 4-feature classifier have the same accuracy, so the other features don't enhance our classifier, and we might omit them from our model. However, we should take into account that these are the accuracy on the training set.