Homework2 Report

course: COMP9417

term: 2020T1

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Question 1

part(a). [0.5 mark]

the accuracy has a general tendency to increase with a larger training size

DecisionTreeClassifier

Dataset	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
australian	72.61%	74.63%	75.52%	77.53%	77.97%	79.86%	83.05%	81.29%	80.14%	82.91%
balance-scale	70.10%	72.47%	71.20%	75.69%	73.77%	75.67%	77.74%	75.99%	78.09%	76.98%
hypothyroid	94.94%	96.31%	97.77%	99.18%	99.21%	99.42%	99.42%	99.52%	99.34%	99.20%

BernoulliNB with priors

Dataset	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
australian	73.47%	79.85%	81.72%	80.43%	79.69%	79.84%	80.12%	81.14%	82.16%	81.28%
balance-scale	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%
hypothyroid	91.38%	91.81%	92.23%	92.23%	92.23%	92.26%	92.23%	92.23%	92.23%	92.23%

part(b). [0.5 mark]

(1) none of the 6 models show a learning curve **False**

(2) all of the 6 models show a learning curve **False**

(3) most of the 6 models show a learning curve **True**

(4) All 3 Decision Tree models are generally better than Bernoulli Naive Bayes models **False**

(5) Some Bernoulli Naive Bayes models are better than Decision Tree models **True**

so all true statements are (3) and (5)

part(c). [0.5 mark]

After adding the new line, BNB model results with and without priors are shown below:

BernoulliNB with priors

Dataset	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
australian	73.47%	79.85%	81.72%	80.43%	79.69%	79.84%	80.12%	81.14%	82.16%	81.28%
balance-scale	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%
hypothyroid	91.38%	91.81%	92.23%	92.23%	92.23%	92.26%	92.23%	92.23%	92.23%	92.23%

BernoulliNB without priors(with uniform probabilities)

Dataset	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
australian	73.62%	79.27%	81.44%	78.98%	78.40%	79.69%	78.52%	79.83%	80.41%	80.41%
balance-scale	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%	46.08%
hypothyroid	83.88%	79.59%	77.44%	74.79%	73.12%	65.05%	53.60%	51.30%	51.09%	50.26%

(1) BNB preforms better with priors **True**

(2) BNB preforms better without priors **False**

(3) there is no difference in performance when using BNB with or without priors **False**

so the true statement is (1)

Question 2

part(a). [1 mark]

accuracy score for training data: 0.856682769726248

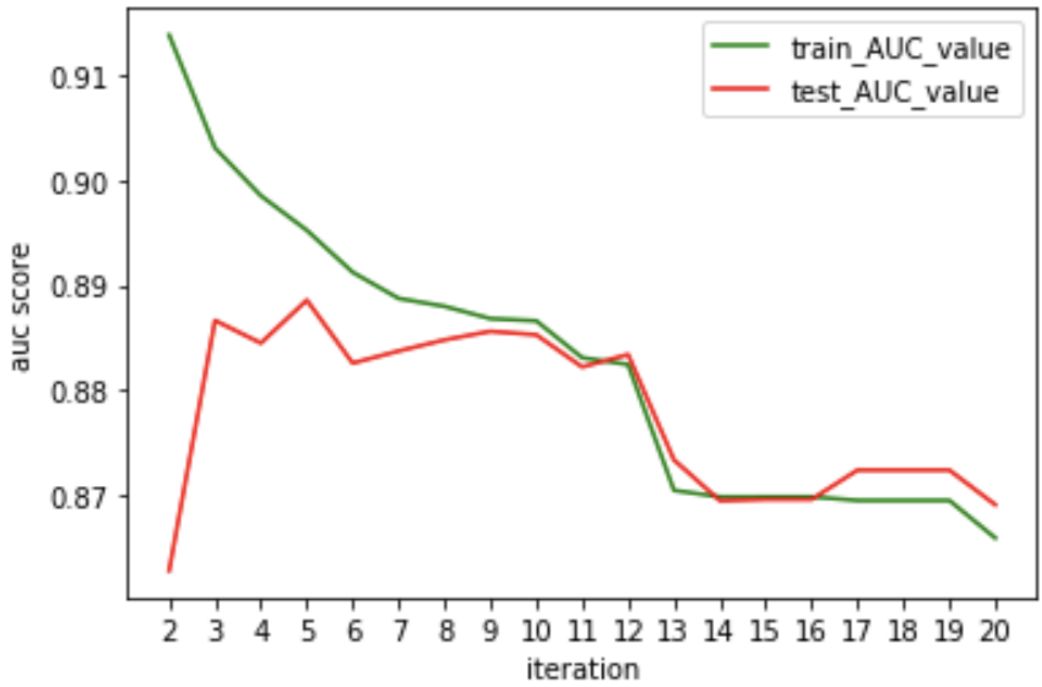
accuracy score for training data: 0.8314606741573034

part(b). [1 mark]

optimal number of min_samples_leaf: 5

part(c). [0.5 mark]

the corresponding plot shown below:



part(d). [1 mark]

posterior probability that part D: 0.36885245901639346

Code below

In [26]:
```
import pandas as pd
import numpy as np
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
import random
import math
import copy
```

In [27]:
```
def pre_processing(dataframe, features):
    for ft in features:
        max_value = dataframe[ft].max()
        min_value = dataframe[ft].min()
        dataframe[ft] = [(x - min_value) / (max_value - min_value) for x in dataframe[ft]]
    return dataframe
```

In [28]:
```
# load data
csv_file = 'titanic.csv'
df = pd.read_csv(csv_file)
feature_vectors = ['Pclass', 'Sex', 'Age', 'Siblings_Spouses_Aboard', 'Parents_Children_Aboard']

df
```

Out[28]:

	Pclass	Sex	Age	Siblings_Spouses_Aboard	Parents_Children_Aboard	Survived
0	3	1	20	1	0	0
1	1	0	30	1	0	1
2	3	0	20	0	0	1
3	1	0	30	1	0	1
4	3	1	30	0	0	0
...	...	...	...	...	...	...
882	2	1	20	0	0	0
883	1	0	10	0	0	1
884	3	0	0	1	2	0
885	1	1	20	0	0	1
886	3	1	30	0	0	0

887 rows × 6 columns

In [29]:
```
# step 1: pre-processing data
df = pre_processing(df, feature_vectors)
df
```

Out[29]:

	Pclass	Sex	Age	Siblings_Spouses_Aboard	Parents_Children_Aboard	Survived
0	1.0	1.0	0.250	0.125	0.000000	0
1	0.0	0.0	0.375	0.125	0.000000	1
2	1.0	0.0	0.250	0.000	0.000000	1
3	0.0	0.0	0.375	0.125	0.000000	1
4	1.0	1.0	0.375	0.000	0.000000	0
...	...	...	...	...	...	...
882	0.5	1.0	0.250	0.000	0.000000	0
883	0.0	0.0	0.125	0.000	0.000000	1
884	1.0	0.0	0.000	0.125	0.333333	0
885	0.0	1.0	0.250	0.000	0.000000	1
886	1.0	1.0	0.375	0.000	0.000000	0

887 rows × 6 columns

In [30]:
```
# split dataset
training_dataset = df.loc[0:620,:]
testing_dataset = df.loc[620:887,:]

# training data and class labels
training_dataset_x = training_dataset.loc[:, feature_vectors]
testing_dataset_x = testing_dataset.loc[:, feature_vectors]
training_dataset_y = training_dataset.loc[:, ['Survived']]
testing_dataset_y = testing_dataset.loc[:, ['Survived']]
```

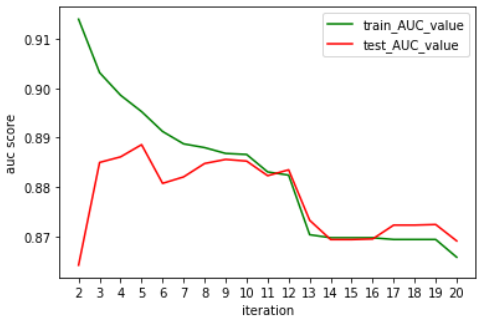
In [31]:
```
clf = DecisionTreeClassifier() # create DT model
clf.fit(training_dataset_x, training_dataset_y) # train model
```

Out[31]:
```
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                       max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort=False,
                       random_state=None, splitter='best')
```

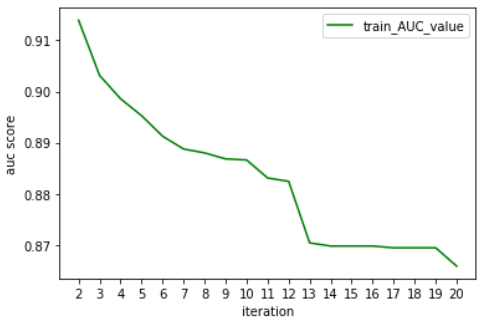
In [32]:
```
from sklearn.metrics import accuracy_score
# for training data
training_predicted = clf.predict(training_dataset_x)
# print("accuracy score for training data: ", accuracy_score(training_dataset_y,training_predicted))

# for testing data
testing_predicted = clf.predict(testing_dataset_x)
# print("accuracy score for testing data: ", accuracy_score(testing_dataset_y,testing_predicted))

print("accuracy score for training data: ", clf.score(training_dataset_x, training_dataset_y))
print("accuracy score for testing data: ", clf.score(testing_dataset_x, testing_dataset_y))
```

```
accuracy score for training data:  0.856682769726248
accuracy score for testing data:  0.8277153558052435
```

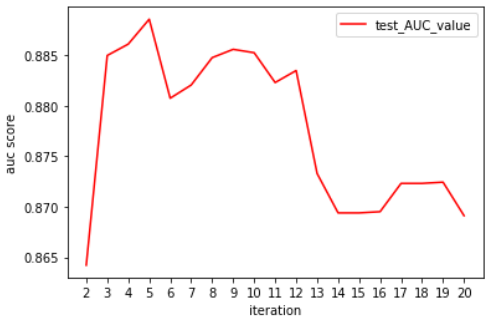
In [33]:
```
import matplotlib.pyplot as plt
from sklearn.metrics import roc_auc_score

iter_list = []
auc_train = [] # store train AUC values
auc_test = []  # store test AUC values
for i in range(2,21,1):
    temp_clf = DecisionTreeClassifier(min_samples_leaf=i)
    temp_clf.fit(training_dataset_x, training_dataset_y)
    temp_train_predicted = temp_clf.predict_proba(training_dataset_x)
    temp_test_predicted = temp_clf.predict_proba(testing_dataset_x)
    auc_train_value = roc_auc_score(training_dataset_y, temp_train_predicted[:,1])
    auc_test_value = roc_auc_score(testing_dataset_y, temp_test_predicted[:,1])
    iter_list.append(int(i))
    auc_test.append(auc_test_value)
    auc_train.append(auc_train_value)
plt.plot(iter_list, auc_train, label="train_AUC_value", color='green')
plt.plot(iter_list, auc_test, label="test_AUC_value", color='red')
plt.xlabel("iteration")
plt.ylabel("auc score")
plt.xticks(iter_list) # show x-coordinate with details
plt.legend() # show label graphic
plt.show()
```



In [34]:
```
# for training data
plt.plot(iter_list, auc_train, label="train_AUC_value", color='green')
plt.xlabel("iteration")
plt.ylabel("auc score")
plt.xticks(iter_list) # show x-coordinate with details
plt.legend() # show label graphic
plt.show()
```



In [35]:
```
# for testing data
plt.plot(iter_list, auc_test, label="test_AUC_value", color='red')
plt.xlabel("iteration")
plt.ylabel("auc score")
plt.xticks(iter_list) # show x-coordinate with details
plt.legend() # show label graphic
plt.show()
```



In [36]:
```
iter_list[auc_test.index(max(auc_test))]
```

Out[36]: 5

In [37]:
```
df
```

Out[37]:

	Pclass	Sex	Age	Siblings_Spouses_Aboard	Parents_Children_Aboard	Survived
0	1.0	1.0	0.250	0.125	0.000000	0
1	0.0	0.0	0.375	0.125	0.000000	1
2	1.0	0.0	0.250	0.000	0.000000	1
3	0.0	0.0	0.375	0.125	0.000000	1
4	1.0	1.0	0.375	0.000	0.000000	0
...	...	...	...	...	...	...
882	0.5	1.0	0.250	0.000	0.000000	0
883	0.0	0.0	0.125	0.000	0.000000	1
884	1.0	0.0	0.000	0.125	0.333333	0
885	0.0	1.0	0.250	0.000	0.000000	1
886	1.0	1.0	0.375	0.000	0.000000	0

887 rows × 6 columns

In [38]:
```
total = df[(df['Sex']==1.0)&(df['Pclass']==0.0)]
survived = total[total['Survived']==1]
len(survived)/len(total)
```

Out[38]:
```
0.36885245901639346
```

In [ ]:
```

```