homework 3

November 14, 2021

[14]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
import warnings

import matplotlib.pyplot as plt
from sklearn.datasets import load_breast_cancer
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from matplotlib.colors import ListedColormap
from sklearn.naive_bayes import GaussianNB
from sklearn.decomposition import PCA
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis as LDA
```

[15]:
```
# Importing and cleaning the data
breast = load_breast_cancer()
breast_data = breast.data
breast_input = pd.DataFrame(breast_data)
breast_labels = breast.target
labels = np.reshape(breast_labels,(569,1))
final_breast_data = np.concatenate([breast_data,labels],axis=1)
final_breast_data.shape
breast_dataset = pd.DataFrame(final_breast_data)
features = breast.feature_names
features_labels = np.append(features,'label')
breast_dataset.columns = features_labels
```

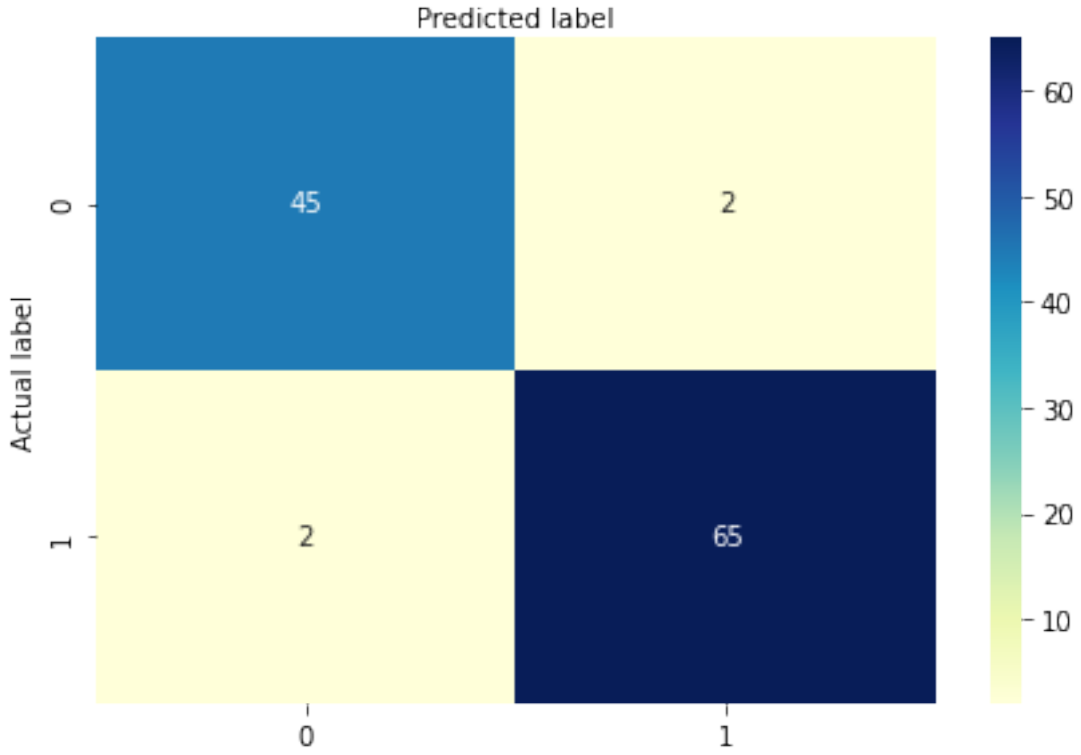
[16]:
```
X = breast_dataset.iloc[:,:30].values
Y = breast_dataset.iloc[:, 30].values

# Scaling the features
sc_X = StandardScaler()
std_X = sc_X.fit_transform(X)
```

[17]:
```
# Problem 1
# Splitting the data
X_train, X_test, Y_train, Y_test = train_test_split(std_X, Y, test_size = 0.20,␣
↪random_state=0)

# Creating the logistic model and fitting it
classifier = LogisticRegression(random_state=42)
classifier.fit(X_train, Y_train)

# Creating predictions with the test data
Y_pred = classifier.predict(X_test)

# Computing the metrics for the model
cnf_matrix = confusion_matrix(Y_test, Y_pred)

print("Accuracy:",metrics.accuracy_score(Y_test, Y_pred))
print("Precision:",metrics.precision_score(Y_test, Y_pred))
print("Recall:",metrics.recall_score(Y_test, Y_pred))
```

```
Accuracy: 0.9649122807017544
Precision: 0.9701492537313433
Recall: 0.9701492537313433
```

[18]:
```
# Confusion matrix
class_names=[0,1] # name  of classes
fig, ax = plt.subplots()
tick_marks = np.arange(len(class_names))
plt.xticks(tick_marks, class_names)
plt.yticks(tick_marks, class_names)
# create heatmap
sns.heatmap(pd.DataFrame(cnf_matrix), annot=True, cmap="YlGnBu" ,fmt='g')
ax.xaxis.set_label_position("top")
plt.tight_layout()
plt.title('Figure 1: Confusion matrix for Logistic Regression', y=1.1)
plt.ylabel('Actual label')
plt.xlabel('Predicted label');
```

Figure 1: Confusion matrix for Logistic Regression



[19]:
```
# Problem 2 - Feature extraction using PCA
# Scaling the features
accuracy = []
precision = []
recall = []

for i in range(29):
    pca = PCA(n_components=i+1)
    principalComponents = pca.fit_transform(std_X)
    principalDf = pd.DataFrame(data = principalComponents)

    # Creating the logistic model and fitting it
    X_train, X_test, Y_train, Y_test = train_test_split(principalDf, Y,␣
 ↪test_size = 0.20, random_state=42)
    classifier = classifier = LogisticRegression(random_state=42)
    classifier.fit(X_train, Y_train)

    # Creating predictions with the test data
    Y_pred = classifier.predict(X_test)
```

```
    accuracy.append(metrics.accuracy_score(Y_test, Y_pred))
    precision.append(metrics.precision_score(Y_test, Y_pred))
    recall.append(metrics.recall_score(Y_test, Y_pred))

# Plotting the accuracy, precision, and recall against the iterations
plt.figure()
plt.plot(range(29),accuracy)
plt.xlabel('Iterations')
plt.ylabel('Accuracy')
plt.title('Figure 2: Accuracy vs the Iterations')
plt.xticks(range(29))
plt.show()

plt.figure()
plt.plot(range(29),precision)
plt.xlabel('Iterations')
plt.ylabel('Precision')
plt.title('Figure 3: Precision vs the Iterations')
plt.show()

plt.figure()
plt.plot(range(29),recall)
plt.xlabel('Iterations')
plt.ylabel('Recall')
plt.title('Figure 4: Recall vs the Iterations')
plt.show()
#Explain that there is no 0 value in here and so the graph starts at iteration␣
 ↪0 and that is why the the graph does not show 0 on the y axis. You can more␣
 ↪easily see the results by not showing iteration 0
```

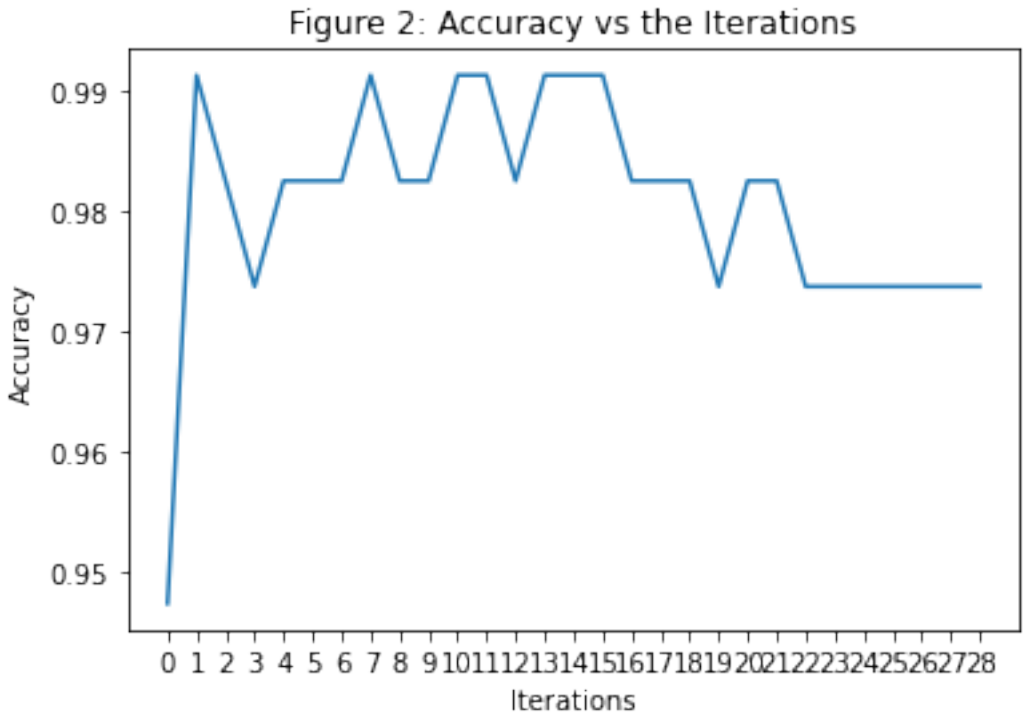


Figure 2: Accuracy vs the Iterations
Accuracy
0.99
0.98
0.97
0.96
0.95
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Iterations

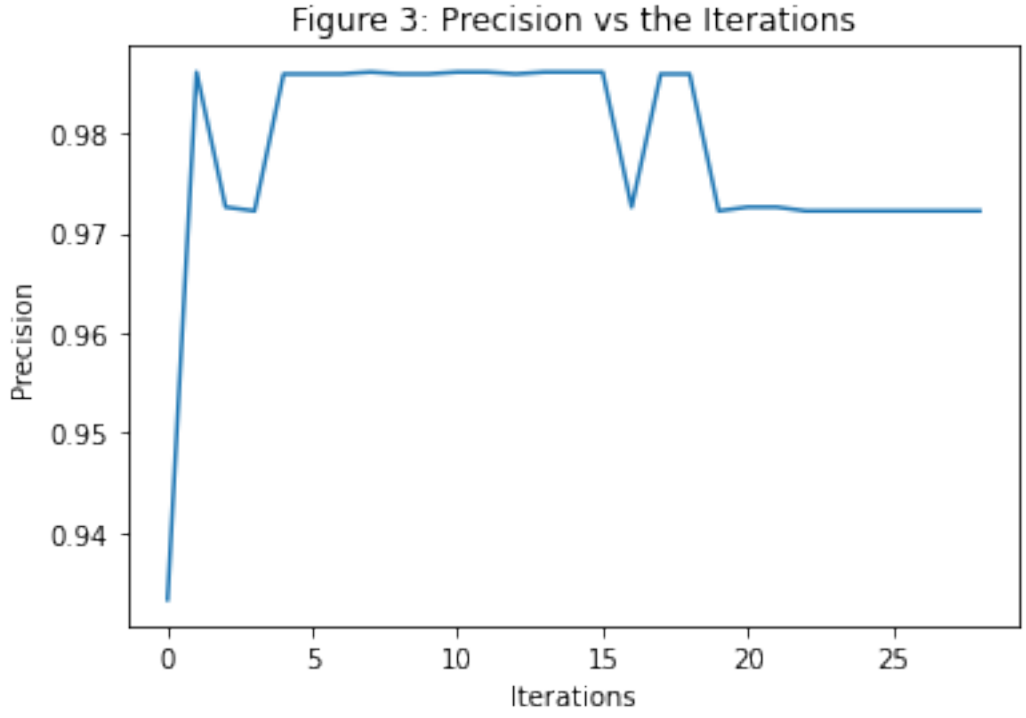
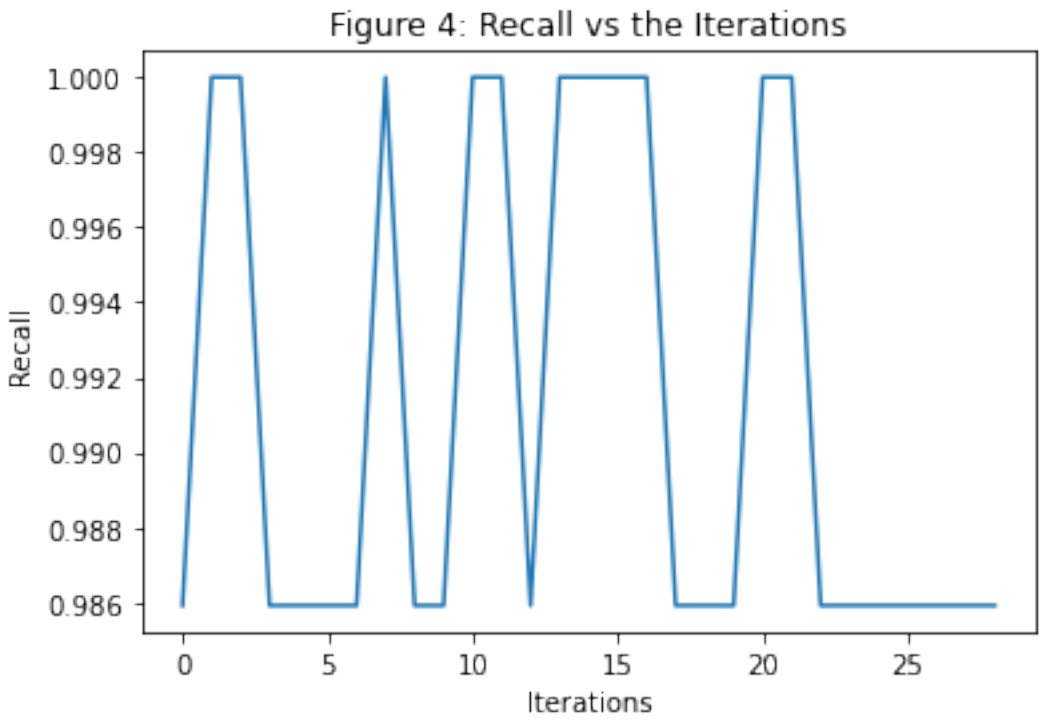


Figure 3: Precision vs the Iterations
Precision
0.98
0.97
0.96
0.95
0.94
0
5
10
15
20
25
Iterations



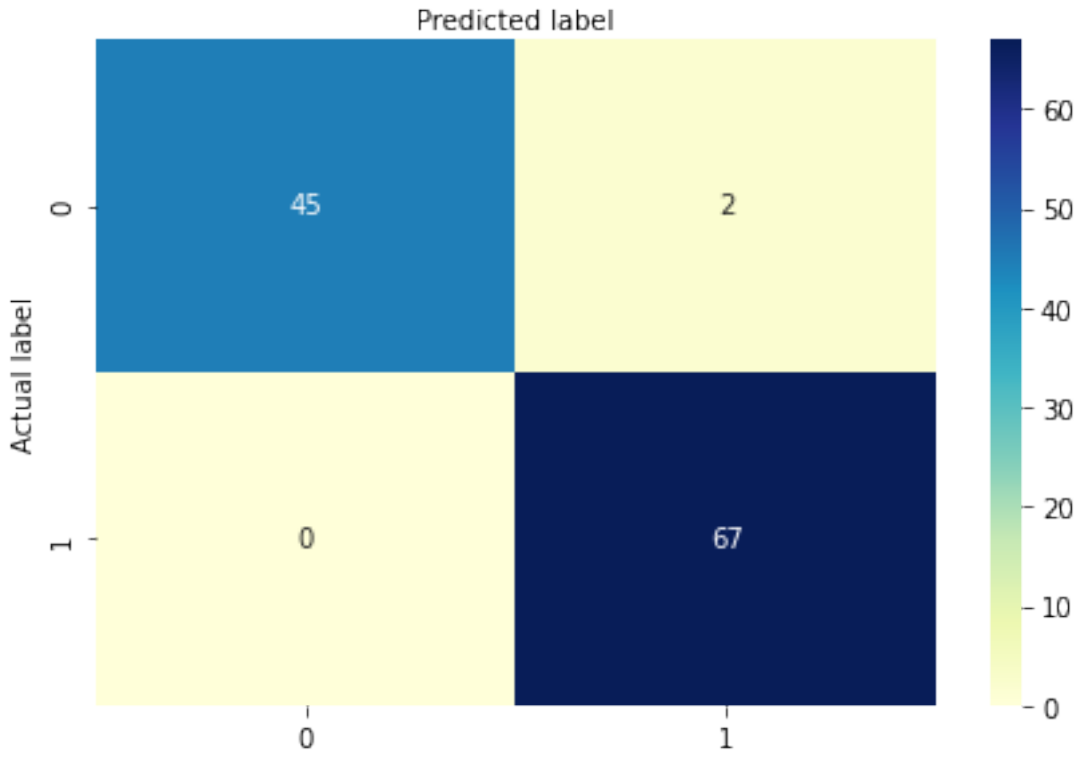
[20]:
```
# Problem 3 - Feature extraction using LDA and Niave Bayes
lda = LDA(n_components=1)
lda_t = lda.fit_transform(X,Y)
```

[21]:
```
# Creating the Naive Bayes model and fitting it
X_train, X_test, Y_train, Y_test = train_test_split(lda_t, Y, test_size = 0.20,␣
 ↪random_state=0)
lda.fit(X_train,Y_train)

#Creating predictions with the test data
Y_pred = lda.predict(X_test)

# Computing the metrics for the model
cnf_matrix = confusion_matrix(Y_test, Y_pred)

print("Accuracy:",metrics.accuracy_score(Y_test, Y_pred))
print("Precision:",metrics.precision_score(Y_test, Y_pred))
print("Recall:",metrics.recall_score(Y_test, Y_pred))
```

```
Accuracy: 0.9824561403508771
Precision: 0.9710144927536232
Recall: 1.0
```

[22]:
```
# Confusion matrix
class_names=[0,1] # name  of classes
fig, ax = plt.subplots()
tick_marks = np.arange(len(class_names))
plt.xticks(tick_marks, class_names)
plt.yticks(tick_marks, class_names)
# create heatmap
sns.heatmap(pd.DataFrame(cnf_matrix), annot=True, cmap="YlGnBu" ,fmt='g')
ax.xaxis.set_label_position("top")
plt.tight_layout()
plt.title('Figure 5: Confusion matrix for Logistic Regression', y=1.1)
plt.ylabel('Actual label')
plt.xlabel('Predicted label');
```

Figure 5: Confusion matrix for Logistic Regression



[23]:
```
# Problem 4 - Feature extraction using LDA and Logistics Regression
lda = LDA(n_components=1)
lda_t = lda.fit_transform(X,Y)
```

[24]:
```
# Splitting the data and fitting the model
```

```
X_train, X_test, Y_train, Y_test = train_test_split(lda_t, Y, test_size = 0.20,␣
↪random_state=0)
classifier = LogisticRegression(random_state=0)
classifier.fit(X_train, Y_train)


#Creating predictions with the test data
Y_pred = classifier.predict(X_test)

# Computing the metrics for the model
cnf_matrix = confusion_matrix(Y_test, Y_pred)

print("Accuracy:",metrics.accuracy_score(Y_test, Y_pred))
print("Precision:",metrics.precision_score(Y_test, Y_pred))
print("Recall:",metrics.recall_score(Y_test, Y_pred))
```

```
Accuracy: 0.9736842105263158
Precision: 0.9705882352941176
Recall: 0.9850746268656716
```

[25]:
```
# Confusion matrix
class_names=[0,1] # name  of classes
fig, ax = plt.subplots()
tick_marks = np.arange(len(class_names))
plt.xticks(tick_marks, class_names)
plt.yticks(tick_marks, class_names)
# create heatmap
sns.heatmap(pd.DataFrame(cnf_matrix), annot=True, cmap="YlGnBu" ,fmt='g')
ax.xaxis.set_label_position("top")
plt.tight_layout()
plt.title('Figure 6: Confusion matrix for Logistic Regression', y=1.1)
plt.ylabel('Actual label')
plt.xlabel('Predicted label');
```

Figure 6: Confusion matrix for Logistic Regression