Python as a Calculator

Blank notebook to be used for class exercises.

Exercise 1

Expand the code below to include CountVectorizer parameters in the GridSearchCV with Pipelines. Include the following CountVectorizer Parameters: stop_words = ['english, None], lowercase=[False, True], and min_df=[1, 5, 10]

- What are the parameters that produce the best micro F1?

Best Params: {'clfC': 0.1, 'veclowercase': True, 'vecmin_df': 1, 'vecngram_range': (1, 1), 'vec__stop_words': None}

In [14]:
```
import csv
from sklearn.svm import LinearSVC
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import accuracy_score, f1_score
from sklearn.pipeline import Pipeline


import numpy as np
np.random.seed(42)
import random
random.seed(42)

X_txt = []
y = []
with open('./sentiment-twitter-data.tsv') as in_file:
    iCSV = csv.reader(in_file, delimiter='\t')
    for row in iCSV:
        X_txt.append(row[-1])
        y.append(row[-2])


X_txt_train, X_txt_test, y_train, y_test = train_test_split(X_txt, y, test_size=0.2, random_state=42)

pipe = Pipeline([('vec', CountVectorizer()),
                 ('clf', LinearSVC(random_state = 42))])
```

```
params = {'clf__C': [0.01, 0.1, 1.],
          'vec__ngram_range': [(1,1), (1,2)],
          'vec__stop_words': ['english', None],
          'vec__lowercase': [False, True],
          'vec__min_df': [1, 5, 10]}

clf = GridSearchCV(pipe, params, cv = 5, scoring = 'f1_micro')

clf.fit(X_txt_train, y_train)

preds = clf.predict(X_txt_test)

print("Best Score:", clf.best_score_)
print("Best Params:", clf.best_params_)
```

```
/opt/anaconda3/lib/python3.8/site-packages/sklearn/svm/_base.py:976: ConvergenceWarning: Liblinear failed to co
nverge, increase the number of iterations.
  warnings.warn("Liblinear failed to converge, increase "
Best Score: 0.4483688280640125
Best Params: {'clf__C': 0.1, 'vec__lowercase': True, 'vec__min_df': 1, 'vec__ngram_range': (1, 1), 'vec__stop_w
ords': None}
```

Exercise 2

Using the same data as Exercise 1, do the following:

- Apply SelectKBest() with chi2 on the training data. What are the most important features with a k=10?
- Add SelectKBest() to the gridsearch pipeline from Exercise 1. Grid-Search over various choices of K. Choose K on your own.
  - What is the best K? **1000**
  - Did the performance improve over the model trained on the entire set of features? **The model did not improve**

In [15]:
```
from sklearn.feature_selection import SelectKBest, chi2
# WRTIE CODE HERE

vec = CountVectorizer()

X_matrix = vec.fit_transform(X_txt)

skb = SelectKBest(chi2, k = 10).fit(X_matrix, y)

features = np.array(vec.get_feature_names())
```

In [18]:
```
X_txt_train, X_txt_test, y_train, y_test = train_test_split(X_txt, y, test_size=0.2, random_state=42)
```

```python
pipe = Pipeline([('vec', CountVectorizer()),
                 ('skb', SelectKBest()),
                 ('clf', LinearSVC(random_state = 42))])

params = {'clf__C': [0.01, 0.1, 1.],
          'skb__k': [10, 1000, 10000],
          'vec__ngram_range': [(1,1), (1,2)]}

clf = GridSearchCV(pipe, params, cv = 5, scoring = 'f1_micro')

clf.fit(X_txt_train, y_train)

preds = clf.predict(X_txt_test)

print("Best Score:", clf.best_score_)
print("Best Params:", clf.best_params_)
```

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nverge, increase the number of iterations.
  warnings.warn("Liblinear failed to converge, increase "
Best Score: 0.44649334016393444
Best Params: {'clf__C': 0.01, 'skb__k': 1000, 'vec__ngram_range': (1, 1)}
```

Exercise 3

Apply PCA with 2 dimensions to the iris dataset, then plot the resulting projections.

In [20]:

```
import csv
import numpy as np
X = []
y = []
with open('./iris.csv') as in_file:
    iCSV = csv.reader(in_file, delimiter=',')
    for row in iCSV:
        y.append(row[-1])
        X.append([float(x) for x in row[:-1]])
X = np.array(X)
y = np.array(y)
```

In [23]:

```
from sklearn.decomposition import PCA
from sklearn.preprocessing import StandardScaler

# Write code here

ss = StandardScaler()
X_scale = ss.fit_transform(X)
pca = PCA(n_components = 2)

X_small = pca.fit_transform(X_scale)# Replace this line/variable with the PCA features
```

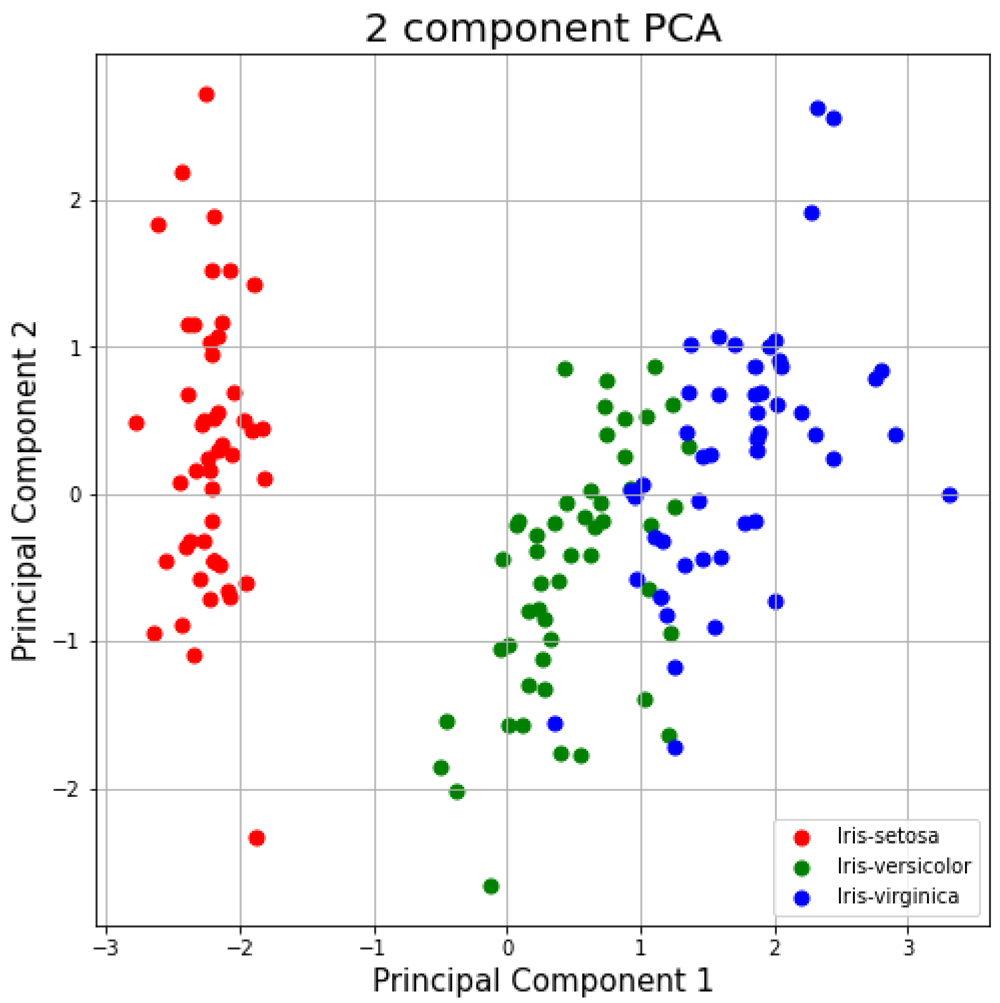
In [24]:

```
%matplotlib inline

# DO NOT Change this cell!!!

import matplotlib
import matplotlib.pyplot as plt

fig = plt.figure(figsize = (8,8))
ax = fig.add_subplot(1,1,1)
ax.set_xlabel('Principal Component 1', fontsize = 15)
ax.set_ylabel('Principal Component 2', fontsize = 15)
ax.set_title('2 component PCA', fontsize = 20)
targets = ['Iris-setosa', 'Iris-versicolor', 'Iris-virginica']
colors = ['r', 'g', 'b']
for target, color in zip(targets,colors):
    indicesToKeep = y == target
    ax.scatter(X_small[indicesToKeep,0]
               , X_small[indicesToKeep,1]
               , c = color
               , s = 50)
ax.legend(targets)
ax.grid()
```



Exercise 4

Using the prima-indians-diabetes.csv'' dataset compare the F1 score of the following missing data strategies:

- Remove all columns with missing values
- Impute using the mean value.
- Impute using the median

What is the best missing data strategy for this dataset?

Note: Missing values are set to 0 in this dataset and only the following columns can have missing values: 2, 3, 4, 5, 6

You will need to convert the 0 values to np.nan.

Here are what the columns represents:

0. Number of times pregnant.
1. Plasma glucose concentration a 2 hours in an oral glucose tolerance test.
2. Diastolic blood pressure (mm Hg).
3. Triceps skinfold thickness (mm).
4. 2-Hour serum insulin (mu U/ml).
5. Body mass index (weight in kg/(height in m)^2).
6. Diabetes pedigree function.
7. Age (years).
8. Class variable (0 or 1).

In [35]:
```
import csv
import numpy as np
X = []
y = []
with open('./prima-indians-diabetes.csv') as in_file:
    iCSV = csv.reader(in_file, delimiter=',')
    for row in iCSV:
        y.append(float(row[-1]))
        X.append([float(x) for x in row[:-1]])
X = np.array(X)
X[X[:,1] == 0,1] = np.nan
X[X[:,2] == 0,2] = np.nan
X[X[:,3] == 0,3] = np.nan
X[X[:,4] == 0,4] = np.nan
X[X[:,5] == 0,5] = np.nan
```

```
print(X[:,3])

y = np.array(y)
```

```
[35. 29. nan 23. 35. nan 32. nan 45. nan nan nan nan 23. 19. nan 47. nan
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 41. nan nan nan 26. 31. nan 48. 27. 23. nan 31.]
```

In [37]:
```
from sklearn.impute import SimpleImputer
```

```
#from sklearn.experimental import enable_iterative_imputer  # noqa
#from sklearn.impute import IterativeImputer # Uncomment this line to use IterativeImputer
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.metrics import f1_score
from sklearn.model_selection import GridSearchCV

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# IMPUTE WITH MEAN
imp_mean = SimpleImputer(missing_values = np.nan,
                        strategy = 'mean')

X_train_mean = imp_mean.fit_transform(X_train)
X_test_mean = imp_mean.transform(X_test)

clf = SVC()
clf.fit(X_train_mean, y_train)

preds = clf.predict(X_test_mean)

f1 = f1_score(y_test, preds)

print("Mean F1 Value:", f1)

# IMPUTE WITH Median
imp_median = SimpleImputer(missing_values = np.nan,
                          strategy = 'median')

X_train_median = imp_median.fit_transform(X_train)
X_test_median = imp_median.transform(X_test)

clf = SVC()
clf.fit(X_train_median, y_train)

preds = clf.predict(X_test_median)

f1 = f1_score(y_test, preds)

print("Median F1 Value:", f1)

# Remove Missing Columns
mask = np.isnan(X).any(axis = 0)

X_train_rem = X_train[:, ~mask]
X_test_rem = X_test[:, ~mask]
```

```
clf = SVC()

clf.fit(X_train_rem, y_train)

preds = clf.predict(X_test_rem)

f1 = f1_score(y_test, preds)

print("Remove Columns Value:", f1)
```

```
Mean F1 Value: 0.6185567010309277
Median F1 Value: 0.6326530612244898
Remove Columns Value: 0.3564356435643564
```

In [ ]:

```
```