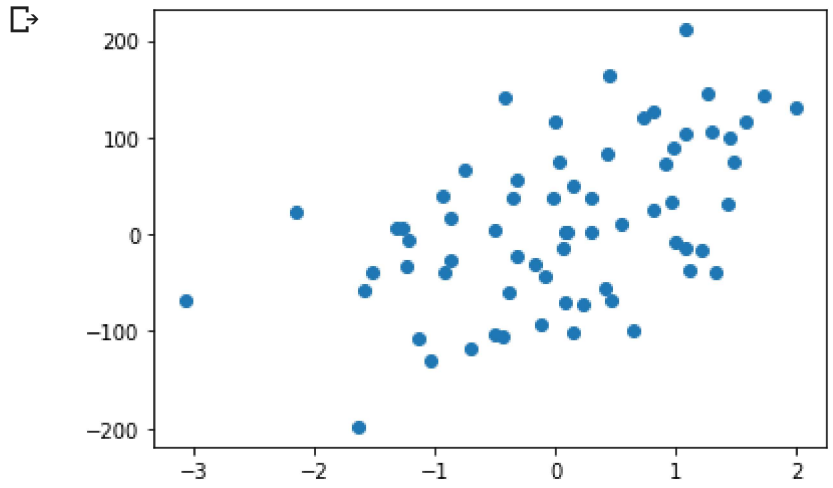
```
import numpy as np
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn.model_selection import train_test_split
```

Ridge regression

Make the train and test sets

```
X, y = datasets.make_regression(n_features=4, noise=0)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)
plt.scatter(X_train[:,0], y_train)
plt.show()
```

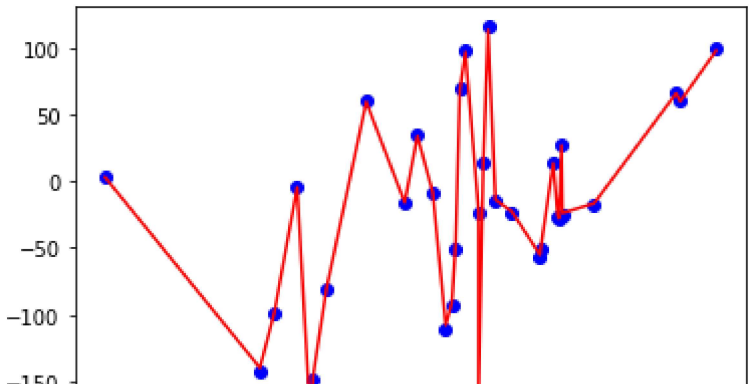


Train the model and do predictions

```
from ridge_regressor import RidgeRegressor

ridge_regressor = RidgeRegressor()
ridge_regressor.fit(X_train, y_train)
y_pred = ridge_regressor.predict(X_test)
sorted_indices = np.argsort(X_test[:,0])

plt.plot(X_test[:,0][sorted_indices], y_pred[sorted_indices], color='r')
plt.scatter(X_test[:,0][sorted_indices], y_test[sorted_indices], color='b')
plt.show()
```



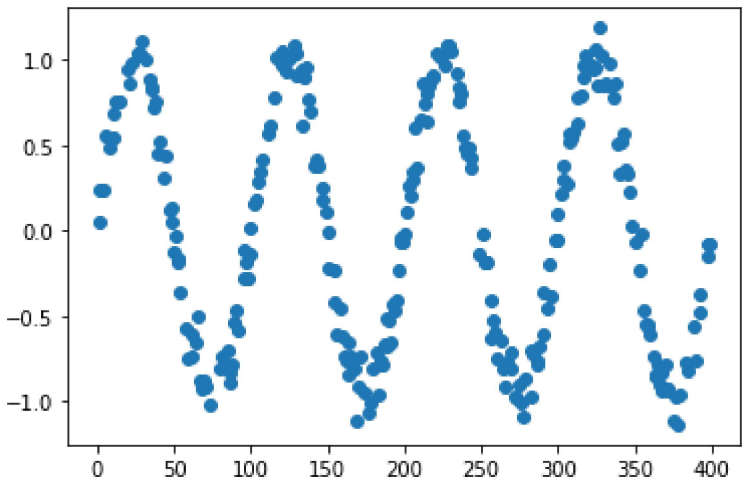
Gaussian process

Make the train and test sets

```
time_step = 400
X = np.arange(time_step).reshape(-1,1)
y = np.sin(2*np.pi*X[:,0]*0.01) + np.random.normal(size=time_step, scale=0.1)

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)

plt.scatter(X_train[:,0], y_train)
plt.show()
```

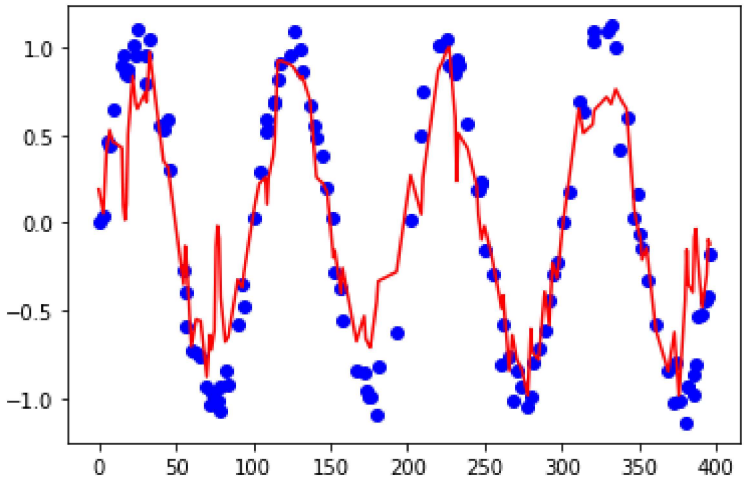


Train the model and do predictions

```
from gaussian_regressor import GaussianRegressor

gaussian_regressor = GaussianRegressor()
gaussian_regressor.fit(X_train, y_train)
y_pred = gaussian_regressor.predict(X_test)
sorted_indices = np.argsort(X_test[:,0])
```

```
plt.plot(X_test[:,0][sorted_indices], y_pred[sorted_indices], color='r')
plt.scatter(X_test[:,0][sorted_indices], y_test[sorted_indices], color='b')
plt.show()
```



SVM

Make the train and test sets

```
dataset = datasets.load_wine()
X = dataset.data
y = dataset.target

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)

# Preprocessing for SVM
y_train = 2*y_train - 1
y_test  = 2*y_test  - 1
```

Train and test the model

```
from svm import SVM

classifier = SVM()
classifier.fit(X_train, y_train)
print('Accuracy:', classifier.eval(X_test, y_test))
```

```
Accuracy: 0.7457627118644068
/usr/local/lib/python3.7/dist-packages/cvxpy/expressions/expression.py:593: UserWarning
This use of ``*`` has resulted in matrix multiplication.
Using ``*`` for matrix multiplication has been deprecated since CVXPY 1.1.
    Use ``*`` for matrix-scalar and vector-scalar multiplication.
```

```
    Use ``@`` for matrix-matrix and matrix-vector multiplication.
    Use ``multiply`` for elementwise multiplication.
This code path has been hit 1 times so far.

  warnings.warn(msg, UserWarning)
```

Decision tree

Make the train and test sets

```
dataset = datasets.load_diabetes()
X = dataset.data[:,:3]
y = dataset.target

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)
```

Train and test the model

```
from decision_tree import DecisionTree

classifier = DecisionTree()
classifier.fit(X_train, y_train)
print('Accuracy:', classifier.eval(X_test, y_test))
```

```
Accuracy: 0.00684931506849315
```

Naive Bayes

Make the train and test sets. The features are the counts of the words in a document.

```
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.datasets import fetch_20newsgroups

data = fetch_20newsgroups(categories=['comp.graphics', 'sci.med'])
X = CountVectorizer().fit_transform(data.data)[:,1000]
y = data.target

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=43)
```

Train and test the model

```
from naive_bayes import NaiveBayes

classifier = NaiveBayes()
classifier.fit(X_train, y_train)
print('Accuracy:', classifier.eval(X_test, y_test))
```

```
Accuracy: 0.5089974293059126
```

Gaussian Bayes

Make the train and test sets

```
dataset = datasets.load_wine()
X = dataset.data
y = dataset.target

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)
```

Train and test the model

```
from gaussian_bayes import GaussianBayes

classifier = GaussianBayes()
classifier.fit(X_train, y_train)
print('Accuracy:', classifier.eval(X_test, y_test))
```

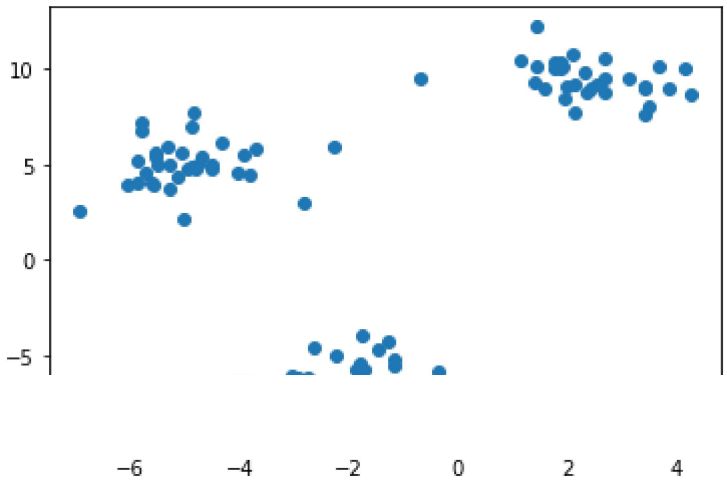
```
Accuracy: 0.9830508474576272
```

K-mean

Make the blobs

```
X, y = datasets.make_blobs()

plt.scatter(X[:,0], X[:,1])
plt.show()
```

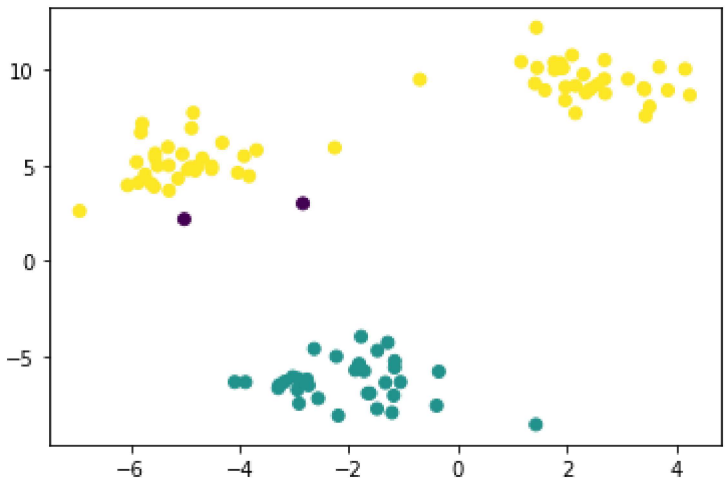


Run k-mean

```
from k_mean import KMEAN

k_mean = KMEAN()
k_mean.fit(X, cluster_num=3)
membership = k_mean.get_membership()

plt.scatter(X[:,0], X[:,1], c=list(membership))
plt.show()
```

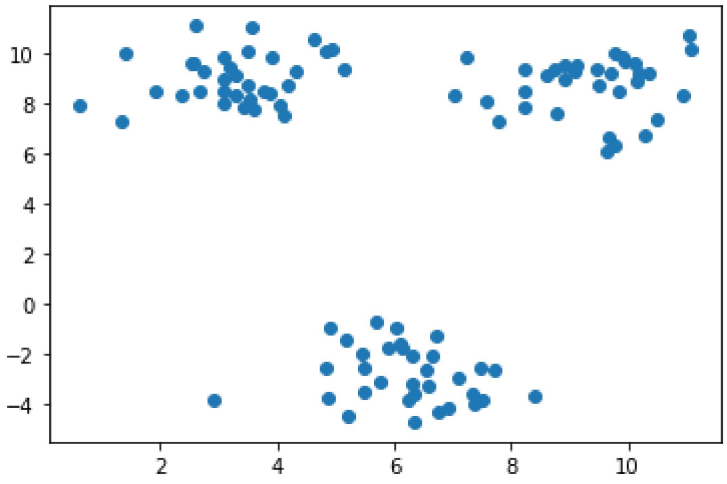


Gaussian mixture model

Make the blobs

```
X, y = datasets.make_blobs()

plt.scatter(X[:,0], X[:,1])
plt.show()
```

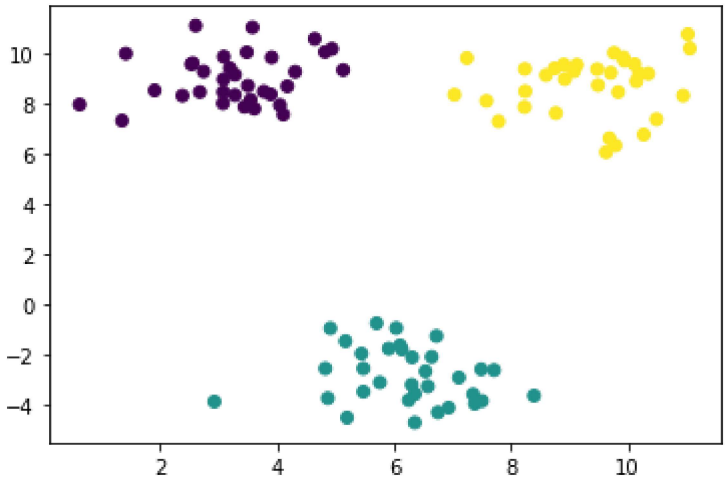


Run GMM

```
from gmm import GMM

gmm = GMM()
gmm.fit(X, cluster_num=3)
membership = gmm.get_membership()

plt.scatter(X[:,0], X[:,1], c=list(membership))
plt.show()
```



Neural Network for dataset load_diabetes

```
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
dataset = datasets.load_diabetes()
X = dataset.data
```

```
y = dataset.target

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)

mlp = MLPClassifier(hidden_layer_sizes=(8,8,8), activation='relu', solver='adam', max_iter=50
mlp.fit(X_train,y_train)

predict_train = mlp.predict(X_train)
predict_test = mlp.predict(X_test)

train_result = accuracy_score(predict_train, y_train)
print("training output:", train_result)
test_result = accuracy_score(predict_test, y_test)
print("test output:", test_result)
```

```
training output: 0.05067567567567568
test output: 0.00684931506849315
/usr/local/lib/python3.7/dist-packages/sklearn/neural_network/_multilayer_perceptron.py
  ConvergenceWarning,
```

```
from sklearn.metrics import classification_report,confusion_matrix
print(confusion_matrix(y_train,predict_train))
print(classification_report(y_train,predict_train))
```

```
[[0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]
 ...
 [0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]]
              precision    recall  f1-score   support

        25.0       0.00      0.00      0.00         1
        31.0       0.00      0.00      0.00         1
        39.0       0.00      0.00      0.00         2
        40.0       0.00      0.00      0.00         1
        42.0       0.00      0.00      0.00         2
        43.0       0.00      0.00      0.00         1
        44.0       0.00      0.00      0.00         1
        45.0       0.00      0.00      0.00         1
        47.0       0.00      0.00      0.00         2
        48.0       0.00      0.00      0.00         1
        49.0       0.00      0.00      0.00         3
        50.0       0.00      0.00      0.00         1
        51.0       0.00      0.00      0.00         2
        52.0       0.00      0.00      0.00         1
        53.0       0.00      0.00      0.00         3
        54.0       0.00      0.00      0.00         1
        55.0       0.00      0.00      0.00         4
        57.0       0.00      0.00      0.00         1
        58.0       0.00      0.00      0.00         1
```

59.0	0.00	0.00	0.00	3
60.0	0.00	0.00	0.00	1
63.0	0.00	0.00	0.00	1
64.0	0.00	0.00	0.00	2
65.0	0.00	0.00	0.00	3
66.0	0.00	0.00	0.00	2
67.0	0.00	0.00	0.00	1
68.0	0.00	0.00	0.00	2
69.0	0.00	0.00	0.00	1
70.0	0.00	0.00	0.00	1
71.0	0.00	0.00	0.00	3
72.0	0.00	0.00	0.00	2
73.0	0.00	0.00	0.00	1
74.0	0.00	0.00	0.00	2
75.0	0.00	0.00	0.00	2
77.0	0.08	1.00	0.15	3
78.0	0.00	0.00	0.00	3
79.0	0.00	0.00	0.00	1
80.0	0.00	0.00	0.00	1
81.0	0.00	0.00	0.00	2
83.0	0.00	0.00	0.00	3
84.0	0.00	0.00	0.00	2
85.0	0.00	0.00	0.00	4
86.0	0.00	0.00	0.00	1
87.0	0.00	0.00	0.00	1
88.0	0.00	0.00	0.00	3
89.0	0.00	0.00	0.00	1
90.0	0.00	0.00	0.00	1

Task 1: Execute the code properly and solve any issues that may arise in the code (10%)

Task 2: Understand and explain what did you analyze in the code. Make a detailed analysis (30%)

Task 3: Use any other dataset to run the tasks above again (40%)

Task 4: Use basic Artificial Neural Network on the dataset used in Task#3 (20%)