```
# Import modules
from sklearn import datasets
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
from sklearn.model_selection import cross_val_score
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.naive_bayes import GaussianNB
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import LogisticRegression

import seaborn as sns
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd


# Load dataset
digits = datasets.load_digits()

# Create data and label arrays
X = digits.data
y = digits.target

# Split into training and test set
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size =
0.4)

df = pd.DataFrame(columns = 'train test'.split())
for i in range(1,8):
    kNN = KNeighborsClassifier(n_neighbors=i)
    kNN.fit(X_train, y_train)
    tr = kNN.score(X_train,y_train)
    te = kNN.score(X_test,y_test)
    df.loc[i] = [tr, te]
df
```

```
/Users/saikatduttatanu/Desktop/ANACONDA/anaconda3/lib/python3.9/site-
packages/sklearn/neighbors/_classification.py:228: FutureWarning:
Unlike other reduction functions (e.g. `skew`, `kurtosis`), the
default behavior of `mode` typically preserves the axis it acts along.
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`keepdims` will become False, the `axis` over which the statistic is
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taken will be eliminated, and the value None will no longer be
accepted. Set `keepdims` to True or False to avoid this warning.
  mode, _ = stats.mode(_y[neigh_ind, k], axis=1)
```
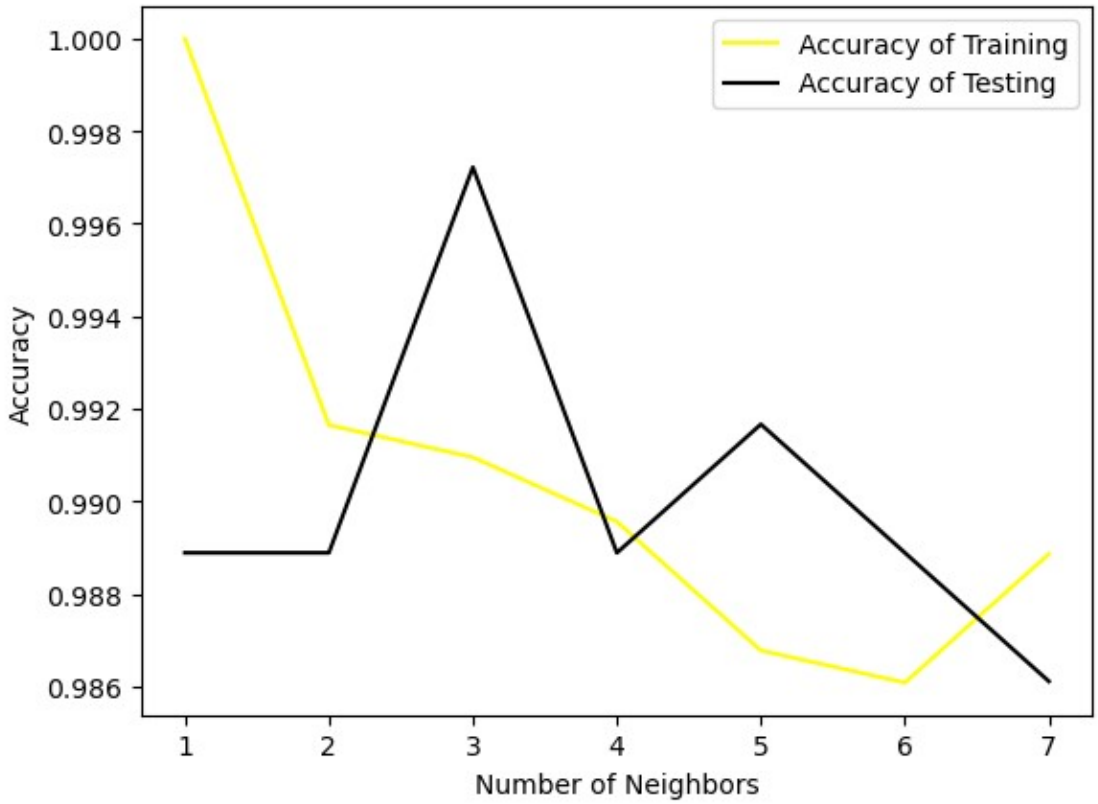

	train	test
1	1.000000	0.988889
2	0.991649	0.988889
3	0.990953	0.997222
4	0.989562	0.988889
5	0.986778	0.991667
6	0.986082	0.988889
7	0.988866	0.986111

```
#plot graph of train and test
plt.plot(df['train'],color = 'yellow', label = 'Accuracy of Training')
plt.plot(df['test'],color = 'black', label = 'Accuracy of Testing')
plt.xlabel('Number of Neighbors')
plt.ylabel('Accuracy')
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7ff2db64b7f0>
```




```
svm = SVC(kernel='linear')
svm.fit(X_train,y_train)
y_pred = svm.predict(X_test)
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      0.99      0.99        75
           1       0.97      0.97      0.97        78
           2       0.99      1.00      0.99        71
           3       1.00      0.99      0.99        70
           4       0.93      1.00      0.96        65
           5       0.99      0.97      0.98        71
           6       1.00      0.97      0.99        79
           7       1.00      0.98      0.99        82
           8       0.97      0.94      0.95        63
           9       0.93      0.97      0.95        65

    accuracy                           0.98       719
   macro avg       0.98      0.98      0.98       719
weighted avg       0.98      0.98      0.98       719
```

```
svm = SVC(kernel='poly')
svm.fit(X_train,y_train)
```

```
y_pred = svm.predict(X_test)
print(classification_report(y_test, y_pred))
```

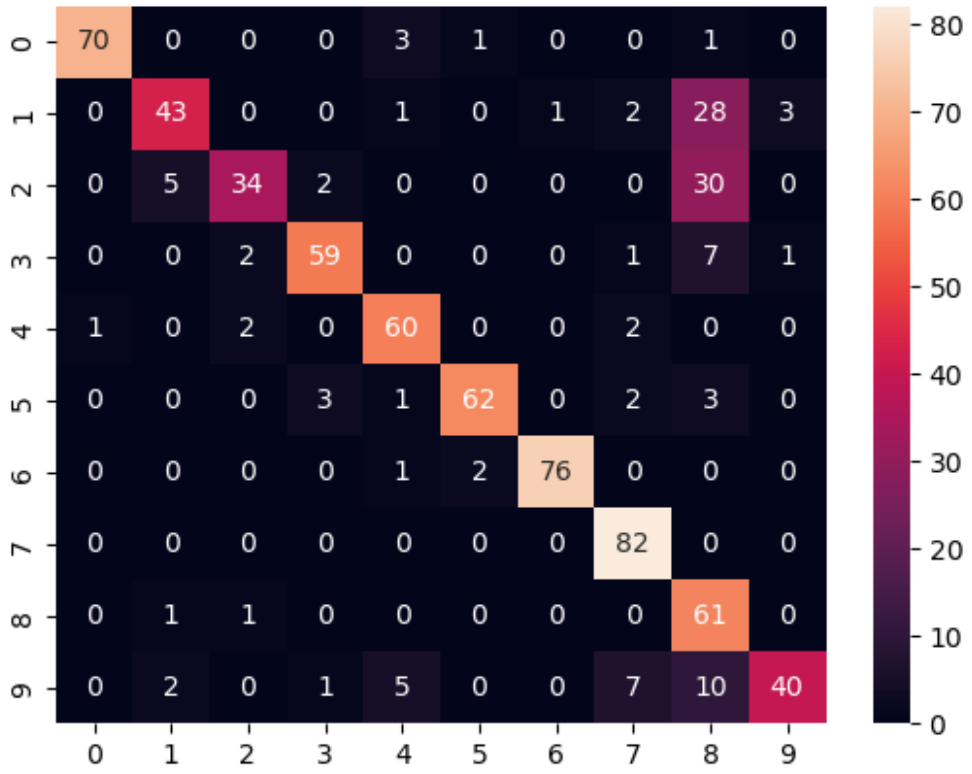
```
              precision    recall  f1-score   support

           0       1.00      0.99      0.99        75
           1       0.99      1.00      0.99        78
           2       0.99      1.00      0.99        71
           3       1.00      0.99      0.99        70
           4       0.98      1.00      0.99        65
           5       0.99      0.97      0.98        71
           6       1.00      0.99      0.99        79
           7       1.00      0.99      0.99        82
           8       0.98      1.00      0.99        63
           9       0.95      0.97      0.96        65

    accuracy                           0.99       719
   macro avg       0.99      0.99      0.99       719
weighted avg       0.99      0.99      0.99       719
```

```
svm = SVC(kernel='rbf')
svm.fit(X_train,y_train)
y_pred = svm.predict(X_test)
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      0.99      0.99        75
           1       0.96      1.00      0.98        78
           2       0.99      1.00      0.99        71
           3       1.00      0.99      0.99        70
           4       0.98      1.00      0.99        65
           5       0.99      0.97      0.98        71
           6       1.00      1.00      1.00        79
           7       0.99      0.99      0.99        82
           8       1.00      0.97      0.98        63
           9       0.95      0.95      0.95        65

    accuracy                           0.99       719
   macro avg       0.99      0.99      0.99       719
weighted avg       0.99      0.99      0.99       719
```

```
bayes = GaussianNB()
bayes.fit(X_train, y_train)
y_pred = bayes.predict(X_test)
conf_matrix = confusion_matrix(y_test,y_pred)
sns.heatmap(conf_matrix, annot= True)
```

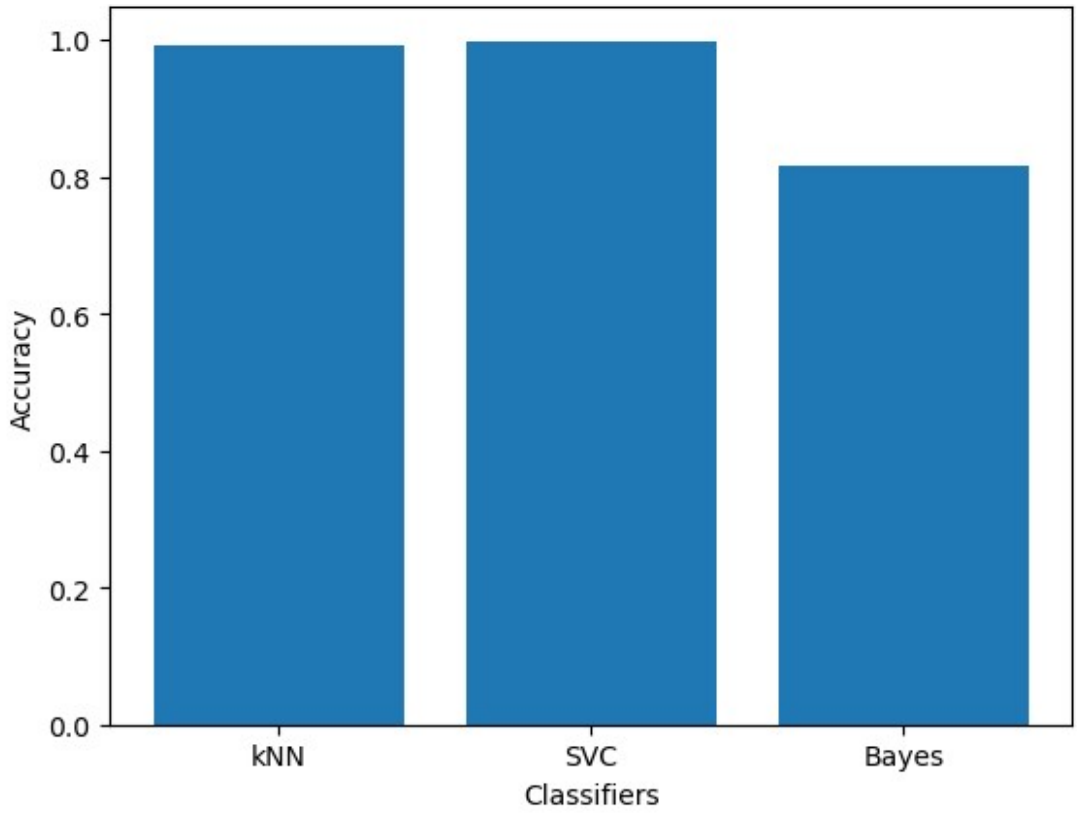
```
<AxesSubplot:>
```




```
kNN = KNeighborsClassifier(n_neighbors=3)
kNN.fit(X_train, y_train)
a = kNN.score(X_train,y_train)

svm = SVC(kernel='poly')
svm.fit(X_train,y_train)
b = svm.score(X_train,y_train)

bayes = GaussianNB()
bayes.fit(X_train, y_train)
c = bayes.score(X_train,y_train)

d = np.array(["kNN", "SVC", "Bayes"])
e = np.array([a,b,c])

plt.bar(d,e)
plt.xlabel("Classifiers")
plt.ylabel("Accuracy")
plt.show()
```

```
/Users/saikatduttatanu/Desktop/ANACONDA/anaconda3/lib/python3.9/site-
packages/sklearn/neighbors/_classification.py:228: FutureWarning:
Unlike other reduction functions (e.g. `skew`, `kurtosis`), the
default behavior of `mode` typically preserves the axis it acts along.
In SciPy 1.11.0, this behavior will change: the default value of
`keepdims` will become False, the `axis` over which the statistic is
```

```
taken will be eliminated, and the value None will no longer be
accepted. Set `keepdims` to True or False to avoid this warning.
  mode, _ = stats.mode(_y[neigh_ind, k], axis=1)
```



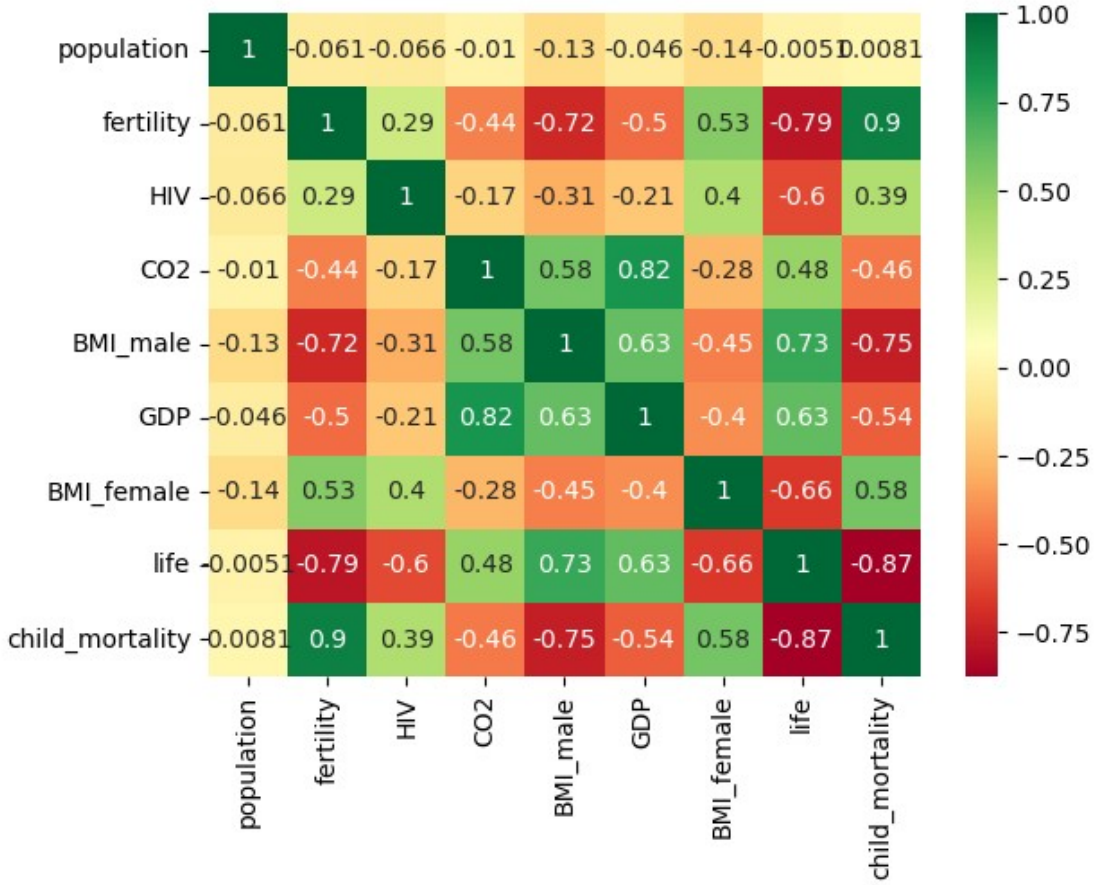

```
df = pd.read_csv("/Users/saikatduttatanu/Desktop/TRIMESTER 1,
2023/Data Analytics/gapminder.csv")
df.head()
```

```
   population  fertility  HIV        CO2  BMI_male    GDP  BMI_female
life  \
0    34811059       2.73  0.1   3.328945  24.59620  12314    129.9049
75.3
1    19842251       6.43  2.0   1.474353  22.25083   7103    130.1247
58.3
2    40381860       2.24  0.5   4.785170  27.50170  14646    118.8915
75.5
3     2975029       1.40  0.1   1.804106  25.35542   7383    132.8108
72.5
4    21370348       1.96  0.1  18.016313  27.56373  41312    117.3755
81.5

   child_mortality                       Region
0             29.5  Middle East & North Africa
1            192.0          Sub-Saharan Africa
2             15.4                     America
```

```
3              20.0       Europe & Central Asia
4               5.2         East Asia & Pacific
```

```
sns.heatmap(df.corr(), cmap = "RdYlGn", annot=True)
```

```
<AxesSubplot:>
```

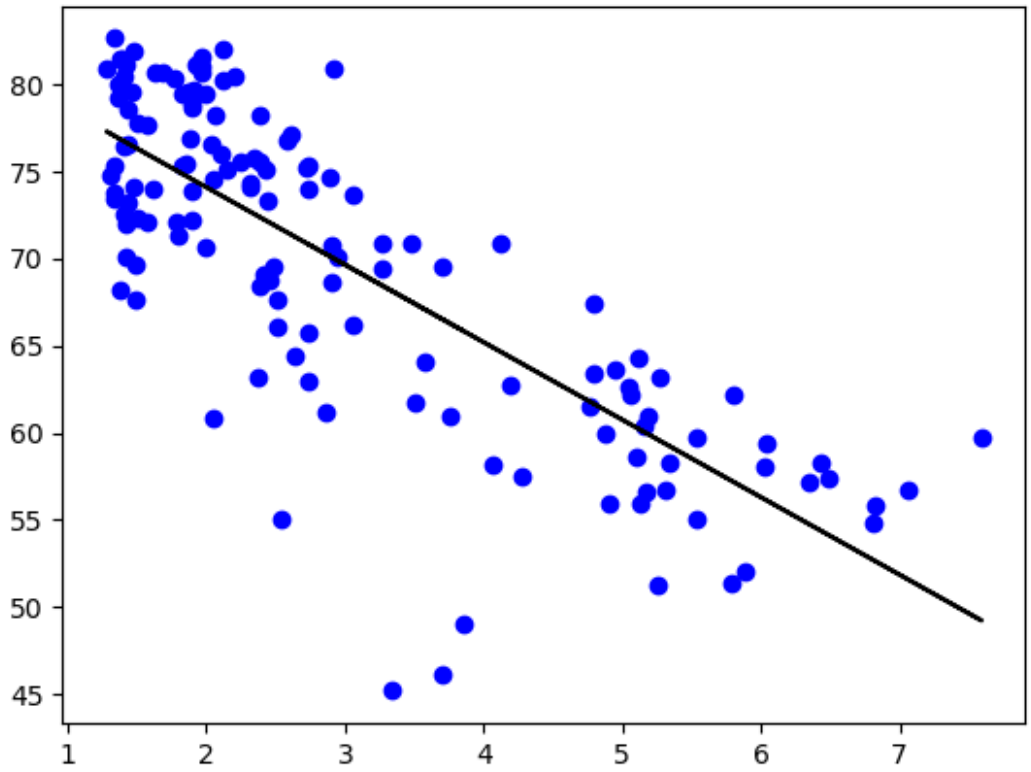



```
# Linear Regression
x = df["fertility"]
y = df["life"]

regression = LinearRegression()
regression.fit(x[:, None], y)
print(regression.score(x[:, None], y))

fig, ax = plt.plot(x, y, 'bo', x, regression.predict(x[:, None]), '-
k')
```

```
0.6192442167740035
```

```
/var/folders/sl/4pwtl8ws3psb02vg3snwbjd40000gn/T/
ipykernel_89987/4038681955.py:6: FutureWarning: Support for multi-
dimensional indexing (e.g. `obj[:, None]`) is deprecated and will be
removed in a future version.  Convert to a numpy array before indexing
```

```
instead.
  regression.fit(x[:, None], y)
/var/folders/sl/4pwtl8ws3psb02vg3snwbjd40000gn/T/ipykernel_89987/40386
81955.py:7: FutureWarning: Support for multi-dimensional indexing
(e.g. `obj[:, None]`) is deprecated and will be removed in a future
version.  Convert to a numpy array before indexing instead.
  print(regression.score(x[:, None], y))
/var/folders/sl/4pwtl8ws3psb02vg3snwbjd40000gn/T/ipykernel_89987/40386
81955.py:9: FutureWarning: Support for multi-dimensional indexing
(e.g. `obj[:, None]`) is deprecated and will be removed in a future
version.  Convert to a numpy array before indexing instead.
  fig, ax = plt.plot(x, y, 'bo', x, regression.predict(x[:, None]), '-
k')
```

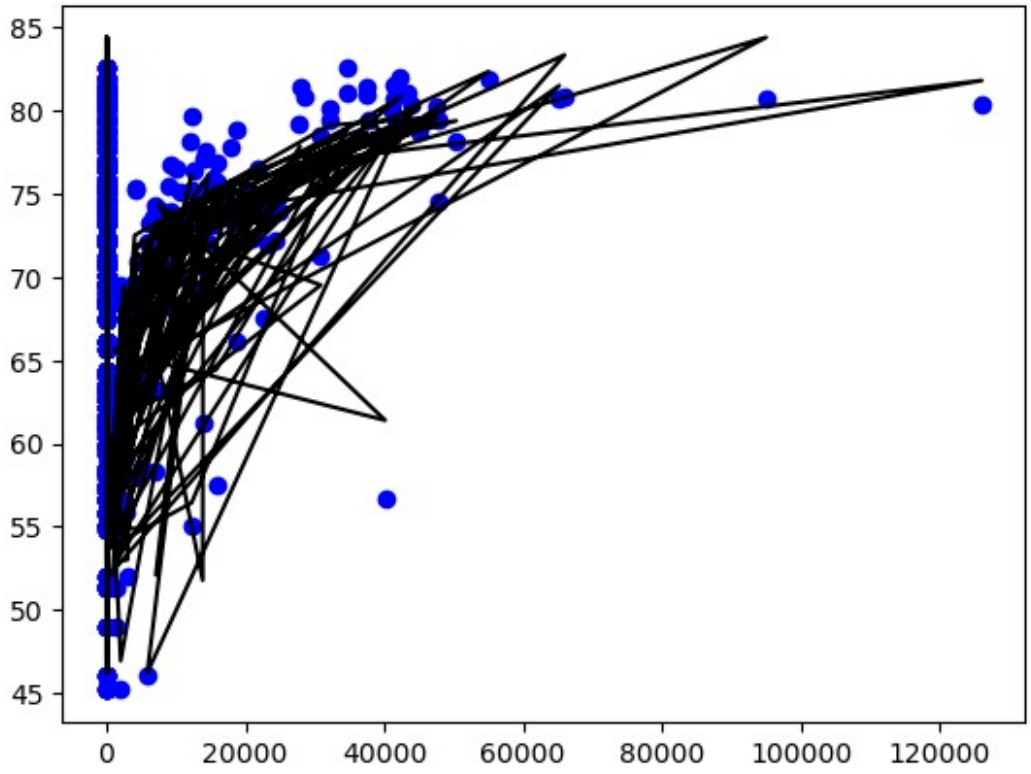



```
#5 fold cross-validation
cross_val_score(regression, x[:,None], y, cv=5)
```

```
/var/folders/sl/4pwtl8ws3psb02vg3snwbjd40000gn/T/
ipykernel_89987/3833724394.py:2: FutureWarning: Support for multi-
dimensional indexing (e.g. `obj[:, None]`) is deprecated and will be
removed in a future version.  Convert to a numpy array before indexing
instead.
  cross_val_score(regression, x[:,None], y, cv=5)

array([0.71001079, 0.75007717, 0.55271526, 0.547501  , 0.52410561])
```

```
# Linear Regression with all features
x =
df[["fertility","HIV","CO2","BMI_male","GDP","BMI_female","child_morta
lity"]]
y = df["life"]

regression1 = LinearRegression()
regression1.fit(x, y)
print(regression1.score(x, y))

plt.plot(x, y, 'bo', x, regression1.predict(x),'-k')
plt.show()
```

```
0.8974995317332959
```




```
#5 fold cross-validation

cross_val_score(regression1, x, y, cv=5)
```

```
array([0.81621881, 0.8322471 , 0.90868335, 0.81325568, 0.94404223])
```

```
#Compare the above linear regressions.
# II 2. Credit card
df1 = pd.read_csv("/Users/saikatduttatanu/Desktop/TRIMESTER 1,
2023/Data Analytics/creditcard.csv")
print(df1.shape)
df1.head()
```

```
(284807, 31)
```

```
   Time        V1        V2        V3        V4        V5        V6
V7  \
0   0.0 -1.359807 -0.072781  2.536347  1.378155 -0.338321  0.462388
0.239599
1   0.0  1.191857  0.266151  0.166480  0.448154  0.060018 -0.082361 -
0.078803
2   1.0 -1.358354 -1.340163  1.773209  0.379780 -0.503198  1.800499
0.791461
3   1.0 -0.966272 -0.185226  1.792993 -0.863291 -0.010309  1.247203
0.237609
4   2.0 -1.158233  0.877737  1.548718  0.403034 -0.407193  0.095921
0.592941

         V8        V9  ...       V21       V22       V23       V24
V25  \
0  0.098698  0.363787  ... -0.018307  0.277838 -0.110474  0.066928
0.128539
1  0.085102 -0.255425  ... -0.225775 -0.638672  0.101288 -0.339846
0.167170
2  0.247676 -1.514654  ...  0.247998  0.771679  0.909412 -0.689281 -
0.327642
3  0.377436 -1.387024  ... -0.108300  0.005274 -0.190321 -1.175575
0.647376
4 -0.270533  0.817739  ... -0.009431  0.798278 -0.137458  0.141267 -
0.206010

        V26       V27       V28  Amount  Class
0 -0.189115  0.133558 -0.021053  149.62      0
1  0.125895 -0.008983  0.014724    2.69      0
2 -0.139097 -0.055353 -0.059752  378.66      0
3 -0.221929  0.062723  0.061458  123.50      0
4  0.502292  0.219422  0.215153   69.99      0

[5 rows x 31 columns]
```

```
# Logistic Regression
X = df1.drop("Class",axis = 1)
y = df1.Class

log_regression = LogisticRegression()
log_regression.fit(X, y)
y_pred = log_regression.predict(X)
conf_matrix = confusion_matrix(y, y_pred)

sns.heatmap(conf_matrix, annot=True)
```

```
/Users/saikatduttatanu/Desktop/ANACONDA/anaconda3/lib/python3.9/site-
packages/sklearn/linear_model/_logistic.py:814: ConvergenceWarning:
```

```
lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as
shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  n_iter_i = _check_optimize_result(

<AxesSubplot:>
```