Supervised Learning with scikit-learn

1). Classification

a). k-Nearest Neighbors: Fit

```
# Import KNeighborsClassifier from sklearn.neighbors
from sklearn.neighbors import KNeighborsClassifier

# Create arrays for the features and the response variable
y = df['party'].values
X = df.drop('party', axis=1).values

# Create a k-NN classifier with 6 neighbors
knn = KNeighborsClassifier(6)

# Fit the classifier to the data
knn.fit(X,y)
```

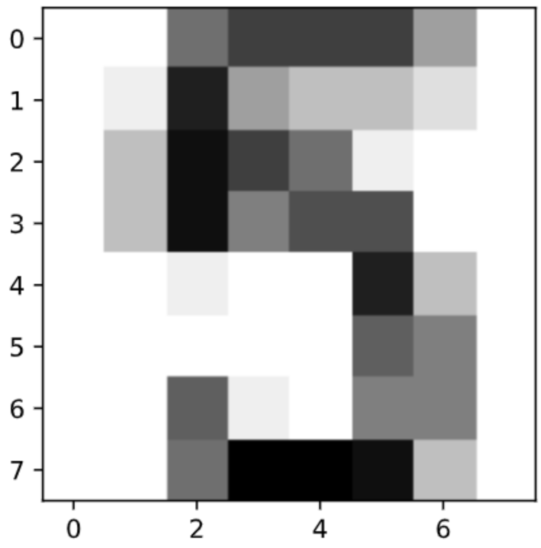
b). k-Nearest Neighbors: Predict

```
# Import KNeighborsClassifier from sklearn.neighbors
from sklearn.neighbors import KNeighborsClassifier

# Create arrays for the features and the response variable
y = df['party'].values
X = df.drop('party',axis=1).values

# Create a k-NN classifier with 6 neighbors: knn
knn = KNeighborsClassifier(6)

# Fit the classifier to the data
knn.fit(X,y)

# Predict the labels for the training data X
y_pred = knn.predict(X)

# Predict and print the label for the new data point X_new
new_prediction = knn.predict(X_new)
print("Prediction: {}".format(new_prediction))
```

```
<script.py> output:
    Prediction: ['democrat']
```

c). <u>The digits recognition dataset</u>

```
# Import necessary modules
from sklearn import datasets
import matplotlib.pyplot as plt

# Load the digits dataset: digits
digits = datasets.load_digits()

# Print the keys and DESCR of the dataset
print(digits.keys())
print(digits.DESCR)

# Print the shape of the images and data keys
print(digits.images.shape)
print(digits.data.shape)

# Display digit 1010
plt.imshow(digits.images[1010], cmap=plt.cm.gray_r, interpolation='nearest')
plt.show()
```



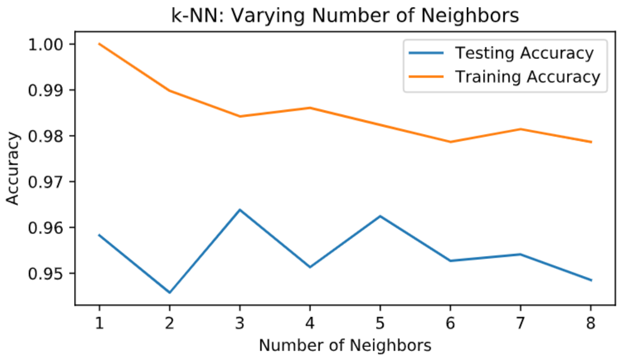
d). Train/Test Split + Fit/Predict/Accuracy

```
# Import necessary modules
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split

# Create feature and target 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 = 0.2, random_state=42, stratify=y)

# Create a k-NN classifier with 7 neighbors: knn
knn = KNeighborsClassifier(n_neighbors=7)

# Fit the classifier to the training data
knn.fit(X_train, y_train)

# Print the accuracy
print(knn.score(X_test, y_test))
```

```
<script.py> output:
    0.983333333333
```

e). **Overfitting & Underfitting**

```
# Setup arrays to store train and test accuracies
neighbors = np.arange(1, 9)
train_accuracy = np.empty(len(neighbors))
test_accuracy = np.empty(len(neighbors))
# Loop over different values of k
for i, k in enumerate(neighbors):
    # Setup a k-NN Classifier with k neighbors: knn
    knn = KNeighborsClassifier(n_neighbors=k)

    # Fit the classifier to the training data
    knn.fit(X_train, y_train)
    #Compute accuracy on the training set
    train_accuracy[i] = knn.score(X_train, y_train)
    #Compute accuracy on the testing set
    test_accuracy[i] = knn.score(X_test, y_test)
# Generate plot
plt.title('k-NN: Varying Number of Neighbors')
plt.plot(neighbors, test_accuracy, label = 'Testing Accuracy')
plt.plot(neighbors, train_accuracy, label = 'Training Accuracy')
plt.legend()
plt.xlabel('Number of Neighbors')
plt.ylabel('Accuracy')
plt.show()
```


k-NN: Varying Number of Neighbors
Testing Accuracy
Training Accuracy
Accuracy
Number of Neighbors