Support-Vector-Machine

January 14, 2025

[ ]:
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'''
    Support Vector Machine -->

    Support Vector Machine (SVM) is a supervised machine learning algorithm␣
 ↪used for
    classification, regression, and outlier detection tasks. Its primary goal␣
 ↪is to
    find the optimal hyperplane that best separates the classes in the feature␣
 ↪space.
    For datasets that are not linearly separable, SVM employs kernel functions␣
 ↪to project
    the data into a higher-dimensional space, making it easier to find a␣
 ↪decision boundary.
'''
```

[ ]:
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'''
    How SVM Works -->

    Hyperplane :

    A hyperplane is a decision boundary that separates the data points of␣
 ↪different classes.
    In 2D, it's a line; in 3D, it's a plane, and in higher dimensions, it's a␣
 ↪hyperplane.

    Support Vectors :

    The data points closest to the hyperplane are called support vectors.
    These points are critical as they influence the position and orientation of␣
 ↪the hyperplane.

    Maximizing the Margin :

    SVM tries to find the hyperplane that maximizes the margin (distance)␣
 ↪between the nearest points of the classes.

    Kernels for Nonlinear Data :
```

```
    If data is not linearly separable, SVM uses a kernel function to transform the data into
    a higher-dimensional space where a linear hyperplane can be applied.

    Common kernel types :

    Linear Kernel
    Polynomial Kernel
    Radial Basis Function (RBF) or Gaussian Kernel
    Sigmoid Kernel
'''
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[ ]:

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'''
    Advantages of SVM -->

    Works well in high-dimensional spaces.
    Effective for linearly separable and non-linearly separable data.
    Robust to overfitting, especially for smaller datasets.

    Disadvantages of SVM -->

    Computationally expensive for large datasets.
    Choice of kernel and hyperparameters can significantly affect performance.
    Does not work well with noisy data or overlapping classes.

    Applications of SVM -->

    Image classification
    Text classification (e.g., spam detection)
    Bioinformatics (e.g., cancer detection)
    Handwriting recognition
'''
```

[11]:

```
#   Importing Libraries -->

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix
```

[2]:

```
#   Importing Dataset -->
```

```
data = pd.read_csv('Data/Social_Network_Ads.csv')
data.head(10)
```

[2]:

```
   Age  EstimatedSalary  Purchased
0   19            19000          0
1   35            20000          0
2   26            43000          0
3   27            57000          0
4   19            76000          0
5   27            58000          0
6   27            84000          0
7   32           150000          1
8   25            33000          0
9   35            65000          0
```

[3]:

```
x_data = data.iloc[:, :-1].values
y_data = data.iloc[:, -1].values
```

[4]:

```
#   Splitting The Dataset -->


x_train, x_test, y_train, y_test = train_test_split(x_data, y_data, test_size=0.
 ↪25, random_state=42)
```

[5]:

```
x_train
```

[5]:

```
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```

[6]:

```
y_train
```

[6]:

```
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       0, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0], dtype=int64)
```

[7]:

```
#   Feature Scaling -->

sc = StandardScaler()
x_train = sc.fit_transform(x_train)
x_test = sc.transform(x_test)
```

[12]:

```
x_train
```

[12]:

```
array([[ 1.8925893 ,  1.52189404],
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       [-0.75873781,  1.08372877],
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```

[13]:
```
x_test
```

[13]:
```
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```

```
[8]: #   Building The Model -->

     model = SVC(kernel='linear', random_state=42)
     model.fit(x_train, y_train)
```

```
[8]: SVC(kernel='linear', random_state=42)
```

```
[ ]: #   Predicting Results -->

     y_pred = model.predict(x_test)
     y_pred
```

```
[ ]: array([0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0,
            0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0,
            0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0,
            1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1,
            0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0], dtype=int64)
```

```
[14]: #   Accuracy Score, Confusion Matrix and Classification Report -->

      acc_score = accuracy_score(y_test, y_pred)
      conf_matrix = confusion_matrix(y_test, y_pred)
      class_report = classification_report(y_test, y_pred)
```

```
[16]: print("Accuracy Score --> ",acc_score)
```

```
Accuracy Score -->  0.86
```

```
[18]: print("Confusion Matrix -->\n\n", conf_matrix)
```

```
Confusion Matrix -->

 [[61  2]
 [12 25]]
```

```
[19]: print("Classification Report -->\n\n", class_report)
```

```
Classification Report -->

               precision    recall  f1-score   support

           0       0.84      0.97      0.90        63
           1       0.93      0.68      0.78        37

    accuracy                           0.86       100
```

```
   macro avg       0.88      0.82      0.84       100
weighted avg       0.87      0.86      0.85       100
```