Kernel-Support-Vector-Machine

January 14, 2025

[ ]:
```
'''
   Kernel SVM -->

   A Kernel Support Vector Machine (SVM) is an extension of the traditional␣
↪Support Vector Machine
   that allows it to handle data that is not linearly separable. By using␣
↪kernel functions,
   the SVM maps the input data into a higher-dimensional space where a linear␣
↪separator (hyperplane) can be found.

   Kernel -->

   In Support Vector Machines (SVM), the kernel is a mathematical function␣
↪that transforms the input data
   into a higher-dimensional space, making it easier to find a hyperplane that␣
↪separates the data into different classes.

   Why is a kernel needed ?

   SVMs aim to find the optimal hyperplane that separates data points of␣
↪different classes.
   However, not all datasets are linearly separable in their original feature␣
↪space.
   The kernel trick helps SVMs tackle such datasets by projecting them into a␣
↪higher-dimensional space
   where they can be separated linearly.
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[ ]:
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'''
   Key Concepts -->

   Support Vectors :
   Data points that lie closest to the decision boundary (margin) and␣
↪influence its position and orientation.

   Kernel Trick :
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    Instead of explicitly transforming data to a higher-dimensional space, the␣
 ↪SVM uses a kernel
    function to compute the dot product of data points in that space, saving␣
 ↪computational resources.

    Objective :
    Maximize the margin (distance between the hyperplane and the nearest data␣
 ↪points) while correctly
    classifying the data.

    Hyperparameters :
    C (Regularization Parameter): Controls the trade-off between maximizing the␣
 ↪margin and minimizing
    classification error.

    Kernel Type :
    Defines the transformation applied to the input data.
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'''
    Advantages of Kernel SVM -->

    Handles both linearly and non-linearly separable data.
    Versatile with various kernels for different datasets.
    High performance in small to medium-sized datasets.

    Disadvantages of Kernel SVM -->

    Computationally intensive for large datasets.
    Requires careful selection of kernel and hyperparameters (C, ).
    Sensitive to noise and outliers.
'''
```

[1]:
```
#   Import 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.
↪2, random_state=42)
```

[5]:
```
x_train
```

[5]:
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```

[ ]:
```
y_train
```

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

[ ]:
```
#   Applying Feature Scaling -->

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

[8]:
```
x_train
```

[8]:
```
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```

```
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```

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[ 1.38625693,  1.27175481],
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[-0.4780302 , -0.85177573],
```

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       [-1.16487283, -1.02631249],
       [ 0.50317355,  1.82445454],
       [ 0.11069205,  0.19544481],
       [-0.57615058,  0.45724994]])
```

[9]:
```
x_test
```

[9]:
```
array([[ 0.79753468, -1.40447546],
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       [ 0.99377543,  0.74814454],
       [-0.87051171, -1.22993871],
       [-0.77239133, -0.24089709],
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       [-0.87051171,  0.36998156],
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       [ 0.40505317, -0.15362871],
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```

```
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[ 0.01257167, -0.4445233 ],
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[ 2.17121993,  0.92268129],
[-1.16487283,  1.38811264],
```

```
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       [-0.28178945, -0.38634438],
       [ 1.38625693,  0.57360778],
       [-0.96863208,  0.4863394 ],
       [-0.96863208, -0.32816546],
       [-1.06675246,  1.94081237],
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       [ 0.89565505,  2.14443859],
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       [-0.28178945, -0.67723898],
       [-0.0855487 ,  0.22453427]])
```

[10]:
```
#   Building The Model -->

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

[10]:
```
SVC(random_state=42)
```

[12]:
```
y_pred = model.predict(x_test)
y_pred
```

[12]:
```
array([1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0,
       1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1,
       1, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 0], dtype=int64)
```

[13]:
```
#   Accuracy -->

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

[14]:
```
print("Accuracy Score --> ", acc_score)
```

```
Accuracy Score -->  0.925
```

[15]:
```
print("Confusion Matrix -->\n\n", conf_matrix)
```

```
Confusion Matrix -->

 [[47  5]
 [ 1 27]]
```

[16]:
```
print("Classification Report -->\n\n", class_report)
```

```
Classification Report -->

              precision    recall  f1-score   support

           0       0.98      0.90      0.94        52
           1       0.84      0.96      0.90        28

    accuracy                           0.93        80
   macro avg       0.91      0.93      0.92        80
weighted avg       0.93      0.93      0.93        80
```