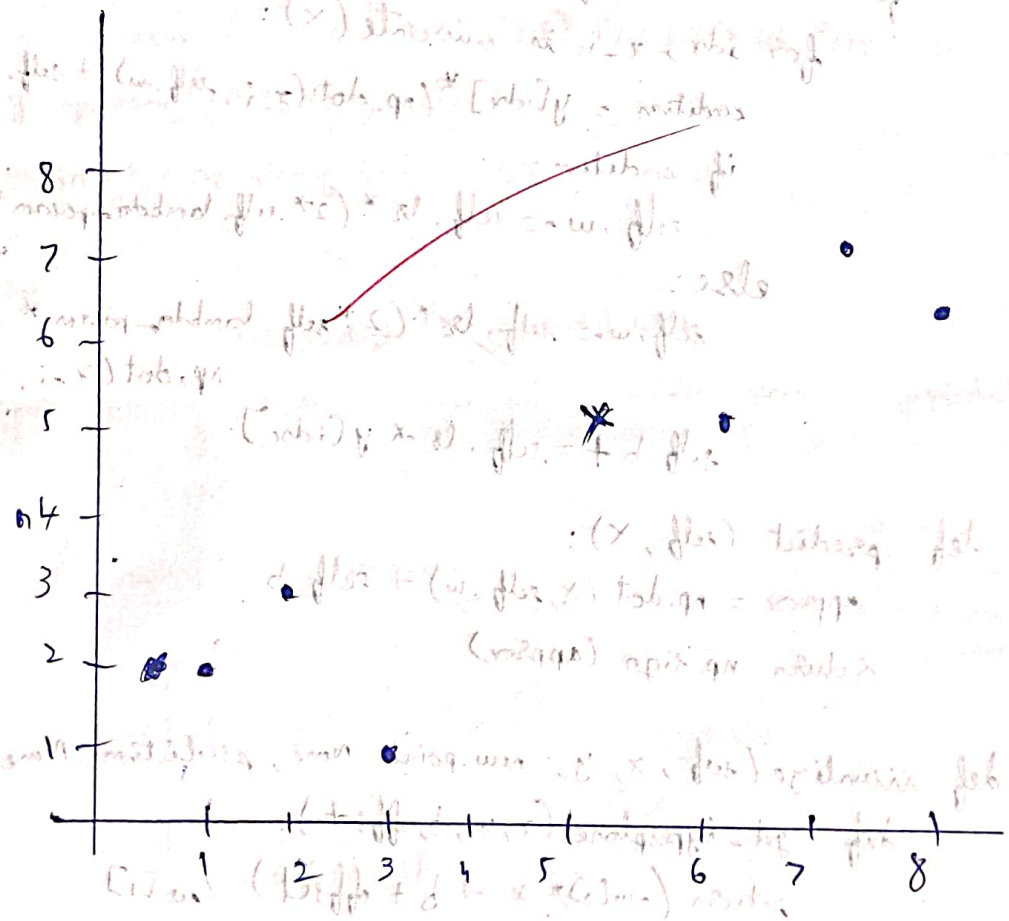
Lab-4

Implement KNN and SVM algorithms

① KNN

```
import numpy as np
import matplotlib.pyplot as plt
from collections import Counter

def euclidean_distance(x1, x2):
    return np.sqrt(np.sum((x1 - x2) ** 2))

class KNN:
    def __init__(self, k=3):
        self.k = k

    def fit(self, X, y):
        self.X_train = np.array(X)
        self.y_train = np.array(y)

    def predict(self, X):
        return [self._predict(x) for x in X]

    def _predict(self, x):
        distances = [euclidean_distance(x, x_train) for x_train in self.X_train]
        k_indices = np.argsort(distances)[:self.k]
        k_nearest_labels = [self.y_train[i] for i in k_indices]
        most_common = Counter(k_nearest_labels).most_common(1)
        return most_common[0][0]

    def score(self, X, y):
        predictions = self.predict(X)
        return np.mean(predictions == y)

X_train = np.array([[1, 2], [2, 3], [3, 1], [6, 5], [7, 7], [8, 6]])
y_train = np.array([0, 0, 0, 1, 1, 1])
X_test = np.array([[5, 5]])

knn = KNN(k=3)
knn.fit(X_train, y_train)
prediction = knn.predict(X_test)
```

```
plt.figure(figsize = (8, 6))

for i in range(len(X_train)):
    plt.scatter(X_train[i][0], X_train[i][1],
                color = 'red' if y_train[i] == 0 else 'blue',
                label = f"class {y_train[i]}" if f"class {y_train[i]}" not in
                plt.gca().get_legend_handles_labels()[1] else "")

plt.scatter(X_test[0][0], X_test[0][1], color = 'green', s=200, marker = 'x', label=
                                                        'Test Point')
plt.title(f"KNN classification( Predicted class : {prediction[0]})")
plt.xlabel("Feature 1")
plt.ylabel("Feature 2")
plt.legend()
plt.grid(True)
plt.show()
```



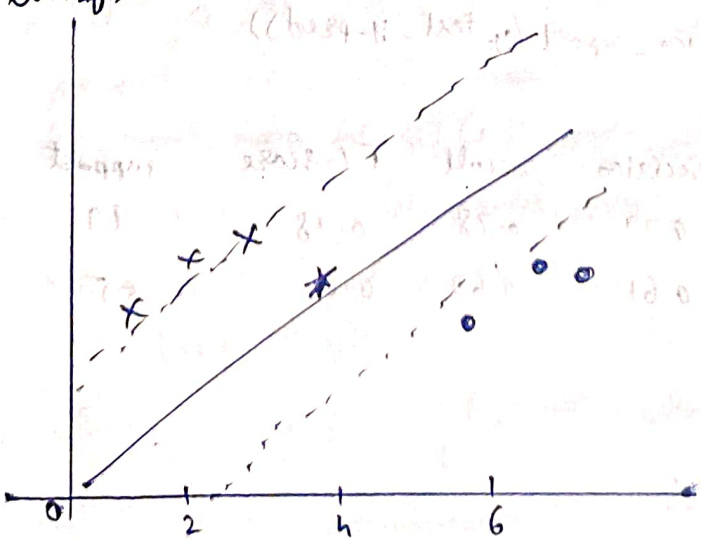
② SVM

```
import numpy as np
import matplotlib.pyplot as plt

class SVM:
    def __init__(self, learning_rate=0.001, lambda_param=0.01, n_iters=1000):
        self.lr = learning_rate
        self.lambda_param = lambda_param
        self.n_iters = n_iters
        self.w = None
        self.b = None

    def fit(self, X, y):
        y = np.where(y <= 0, -1, 1)
        n_samples, n_features = X.shape
        self.w = np.zeros(n_features)
        self.b = 0

        for _ in range(self.n_iters):
            for idx, x_i in enumerate(X):
                condition = y[idx] * (np.dot(x_i, self.w) + self.b) >= 1
                if condition:
                    self.w -= self.lr * (2 * self.lambda_param * self.w)
                else:
                    self.w -= self.lr * (2 * self.lambda_param * self.w -
                                         np.dot(x_i, y[idx]))

                    self.b += self.lr * y[idx]

    def predict(self, X):
        approx = np.dot(X, self.w) + self.b
        return np.sign(approx)

    def visualize(self, X, y, new_point=None, prediction=None):
        def get_hyperplane(x, w, b, offset):
            return (-w[0] * x + b + offset) / w[1]

        fig = plt.figure()
        ax = fig.add_subplot(1, 1, 1)
```

```
    for i, sample in enumerate(X):
        if y[i] == 1:
            plt.scatter(sample[0], sample[1], marker='o', color='blue',
                        label='Class +1', if i == 0 else "")
        else:

x0 = np.linspace(np.min(X[:,0])-1, np.max(X[:,0])+1, 100)

if new_point is not None:
    color = 'green' if prediction == 1 else 'orange'
ax.legend()
plt.xlabel()
plt.ylabel()
plt.title()
plt.grid(True)
plt.show()

if __name__ == "__main__":
    X = np.array([[1,7], [2,8], [3,8], [8,1], [9,2], [10,2]])
    y = np.array([0,0,0,1,1,1])
    new_point = np.array([[5,5]])
    svm = SVM()
    svm.fit()
    prediction = svm.predict(new_point)[0]
    svm.visualize(X, y, new_point=new_point[0], prediction=prediction)
```

Output :-

New point [5 5] classified as class 0



7/4/25