M11-L1-P2

November 26, 2023

0.1 M10-L1 Problem 2: Solution

In this problem you will use the `sklearn` implementation of the K-Means algorithm to cluster the same two datasets from problem 1.

[ ]:
```
import numpy as np
import matplotlib.pyplot as plt

from sklearn.datasets import make_blobs, make_moons
from sklearn.cluster import KMeans

## DO NOT MODIFY
def plotter(x, y, labels = None, centers = None):
    fig = plt.figure(dpi = 200)
    for i in range(len(np.unique(y))):
        if labels is not None:
            plt.scatter(x[labels == i, 0], x[labels == i, 1], alpha = 0.5)
        else:
            plt.scatter(x[y == i, 0], x[y == i, 1], alpha = 0.5)
    if labels is not None:
        if (labels != y).any():
            plt.scatter(x[labels != y, 0], x[labels != y, 1], s = 100, c =␣
 ↪'None', edgecolors = 'black', label = 'Misclassified Points')
    if centers is not None:
        plt.scatter(centers[:,0], centers[:,1], c = 'red', label = 'Cluster␣
 ↪Centers')
    plt.xlabel('$x_0$')
    plt.ylabel('$x_1$')
    if labels is not None or centers is not None:
        plt.legend()
    plt.show()
```

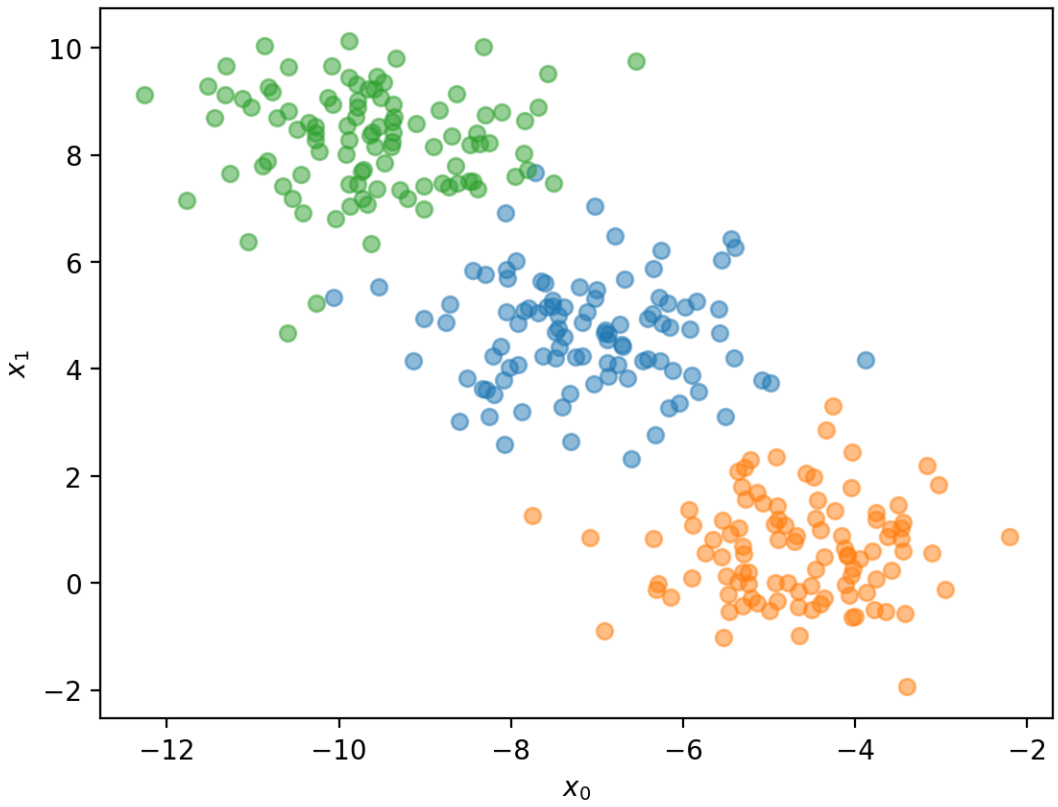
We will use `sklearn.datasets.make_blobs()` to generate the dataset. The `random_state = 12` argument is used to ensure all students have the same data.

[ ]:
```
## DO NOT MODIFY
x, y = make_blobs(n_samples = 300, n_features = 2, random_state = 12)
```

Visualize the data using the `plotter(x,y)` function. You do not need to pass the `labels` or

`centers` arguments

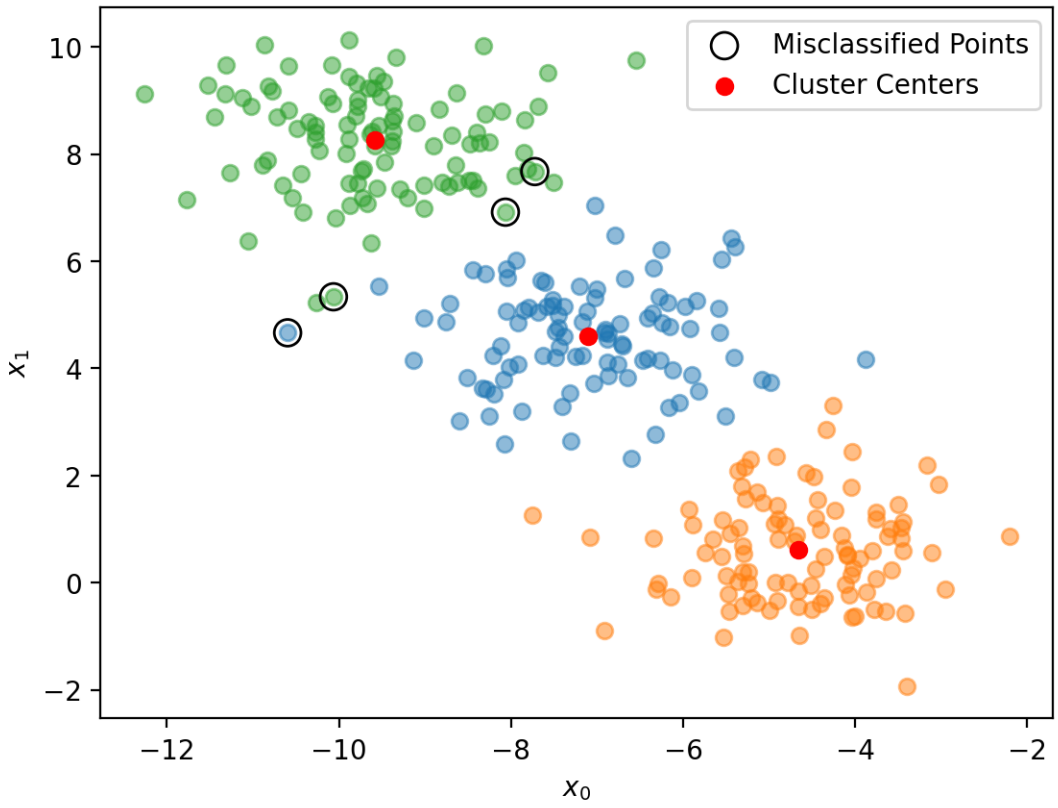
[ ]:
```
plotter(x,y)
```



Now you will use `sklearn.cluster.KMeans()` to cluster the provided data points `x`. For the `KMeans()` function to perform identically to our implementation, we need to provide the same initial clusters with the `init` argument. The cluster centers should be initialized as `np.array([[-5,5],[0,0],[-10,10]])`, and you can additionally pass in the `n_init = 1` argument to silence a runtime warning that comes from passing explicit initial cluster centers. Then plot the results using the provided `plotter(x,y,labels,centers)` function.

[ ]:
```
model = KMeans(n_clusters=3, init=np.array([[-5,5],[0,0],[-10,10]]), n_init=1).
  ↪fit(x)
centers = model.cluster_centers_
labels = model.labels_

plotter(x, y, labels, centers)
```



0.2 Moon Dataset

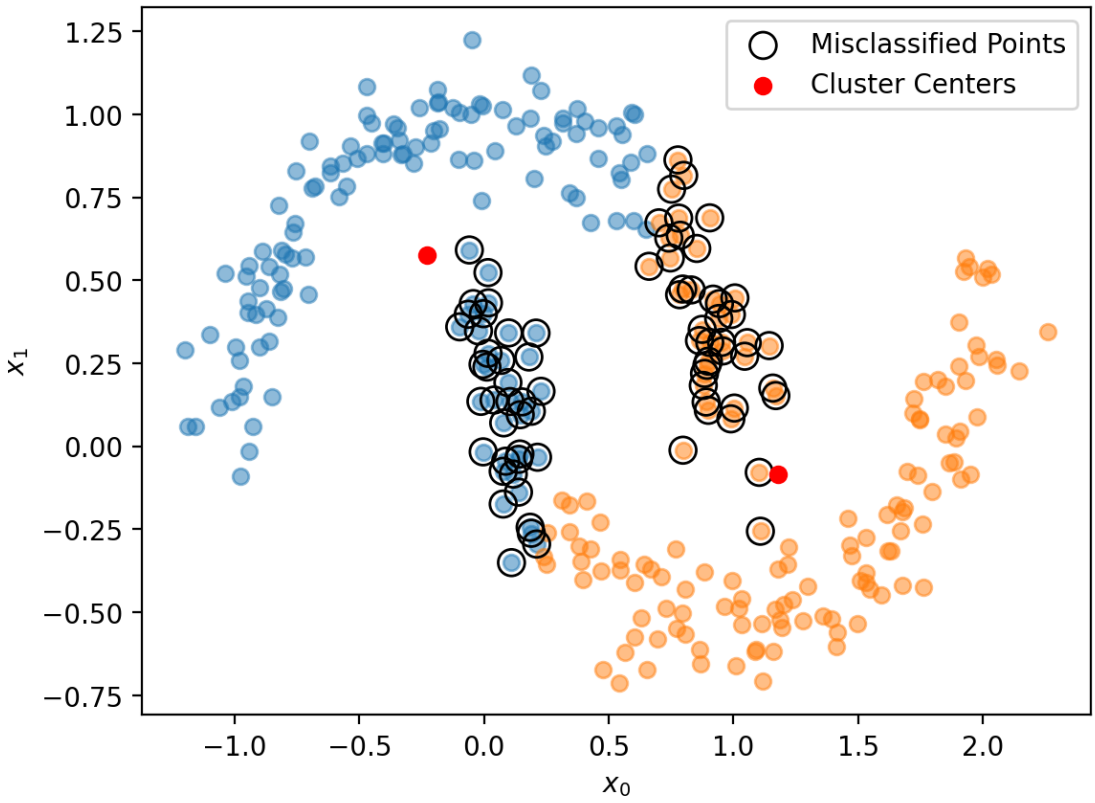
Now we will try using the `sklearn.cluster.KMeans()` function on the moons dataset from problem 1.

[ ]:
```
## DO NOT MODIFY
x,y = make_moons(n_samples = 300, noise = 0.1, random_state = 0)
```

Using the same initial cluster centers from problem 1, namely, `np.array([[0,1],[1,-0.5]])`, cluster the moons datasets and plot the results using the provided `plotter(x,y,labels,centers)` function.

[ ]:
```
model = KMeans(n_clusters=2, init=np.array([[0,1],[1,-0.5]]), n_init=1).fit(x)
centers = model.cluster_centers_
labels = model.labels_

plotter(x, y, labels, centers)
```



0.3 Discussion

How do the results of your hand coded implementation of the K-Means algorithm compare to the `sklearn` implementation? If there is any discrepancy between the results, provide your reasoning why.

My hand coded implementation exactl matches the sklearn algorithm. This is because using the same initial conditions wil result in the same outcome from an optimization standpoint. Since both are following the same general algorithm and all the input parameters are the same, it isn't a surprise that the results are the same.