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.

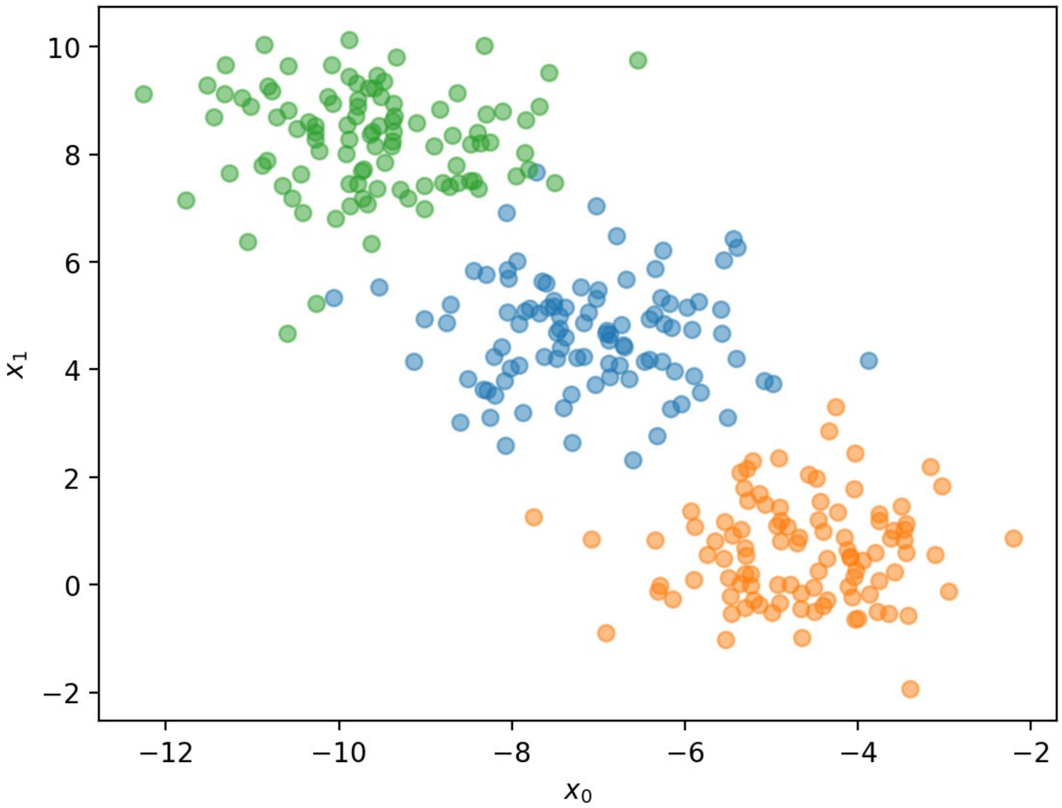
```
import numpy as np
import matplotlib.pyplot as plt

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)
```

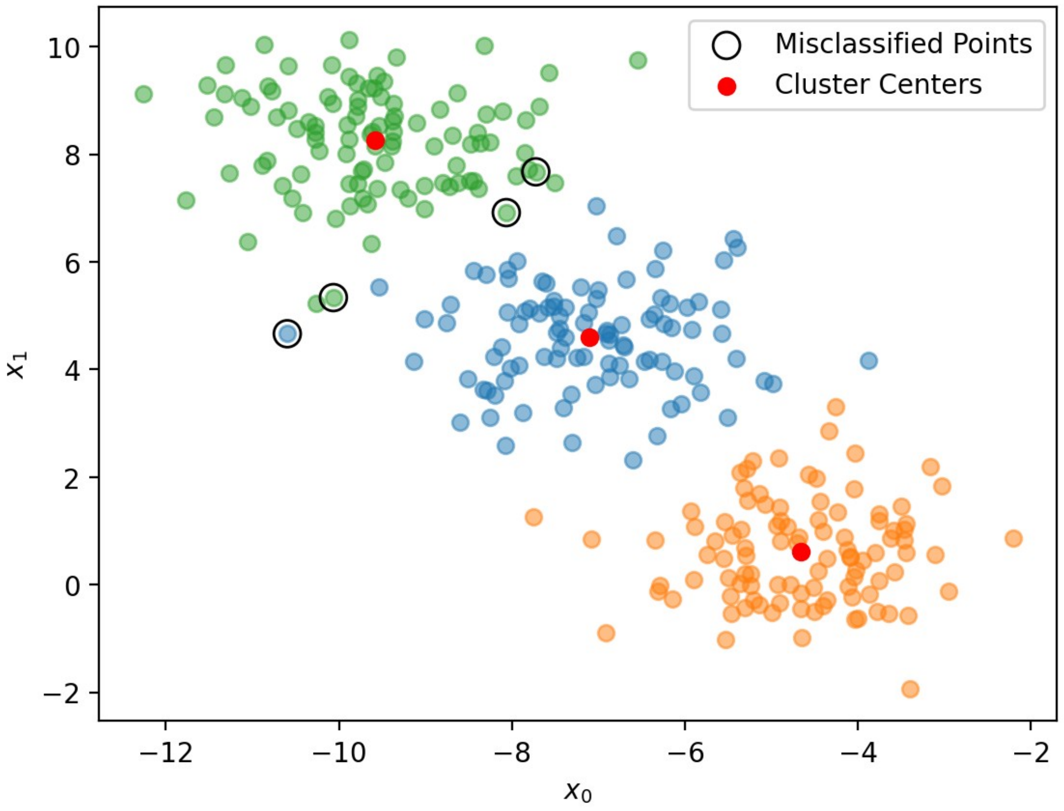
Visualize the data using the `plotter(x,y)` function. You do not need to pass the `labels` or `centers` arguments

```
## YOUR CODE GOES HERE
# visualize the data
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.

```
## YOUR CODE GOES HERE
# visualize the model's clustering
init_center = np.array([[-5, 5], [0, 0], [-10, 10]])
kmeans = KMeans(n_clusters = 3, init = init_center, random_state = 12)
kmeans.fit(x)
plotter(x, y, kmeans.labels_, kmeans.cluster_centers_)
```



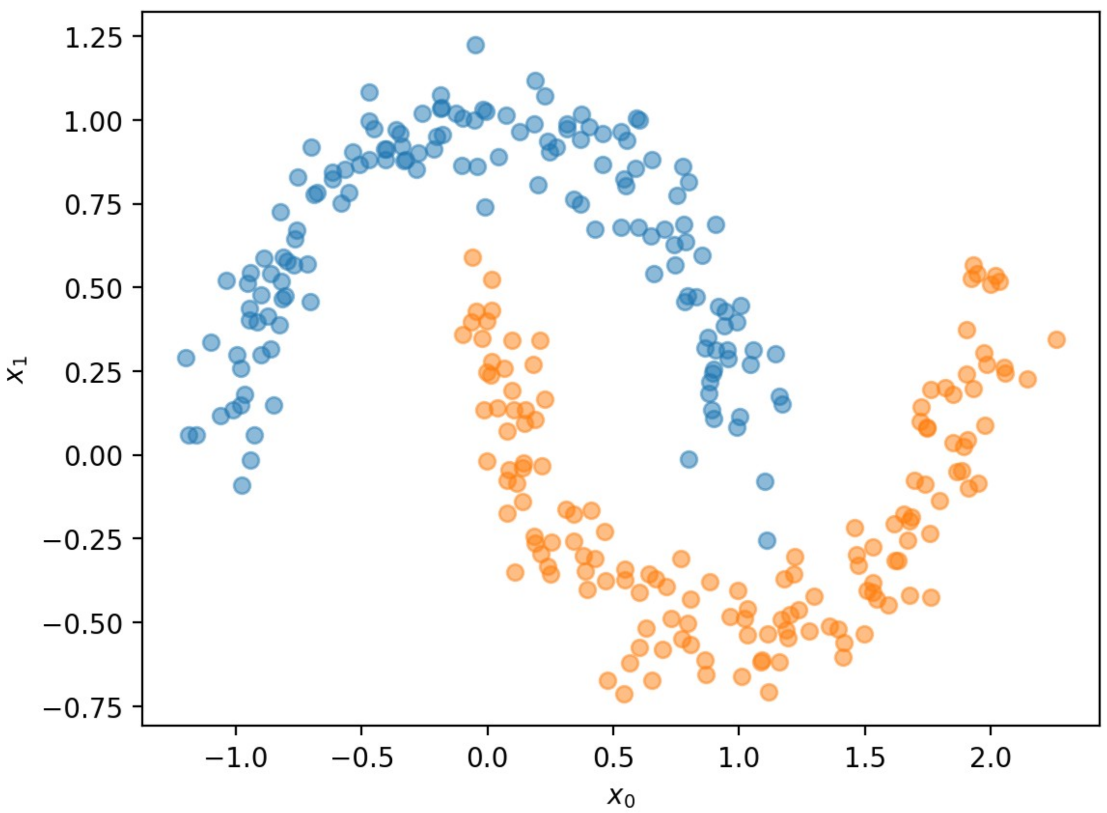
Moon Dataset

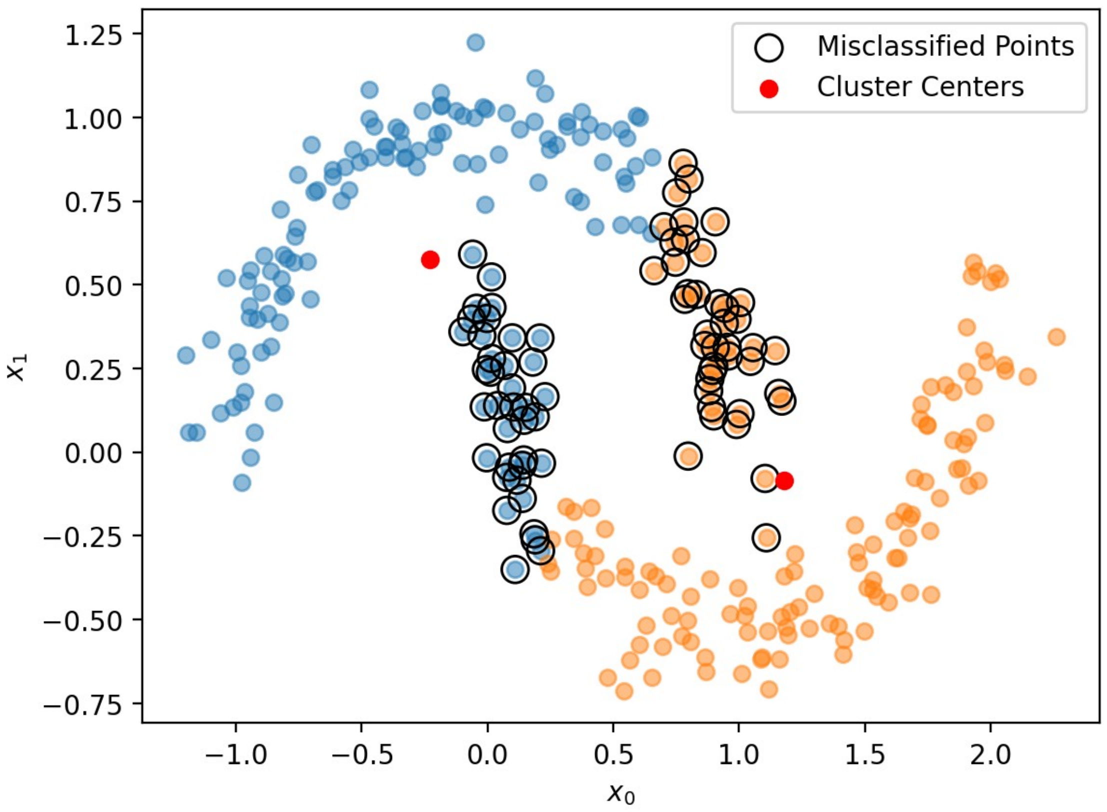
Now we will try using the `sklearn.cluster.KMeans()` function on the moons dataset from problem 1.

```
## 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.

```
## YOUR CODE GOES HERE
# visualize the orginal data
plotter(x, y)

# visualize the model's clustering
init_center = np.array([[0, 1], [1, -0.5]])
kmeans = KMeans(n_clusters = 2, init = init_center, random_state = 12)
kmeans.fit(x)
plotter(x, y, kmeans.labels_, kmeans.cluster_centers_)
```


1.25
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
x_1
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
x_0


Misclassified Points
Cluster Centers
1.25
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
x_1
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
x_0

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.

From the results, my hand-coded implementation and the sklearn implementation have no discrepancy between the results.