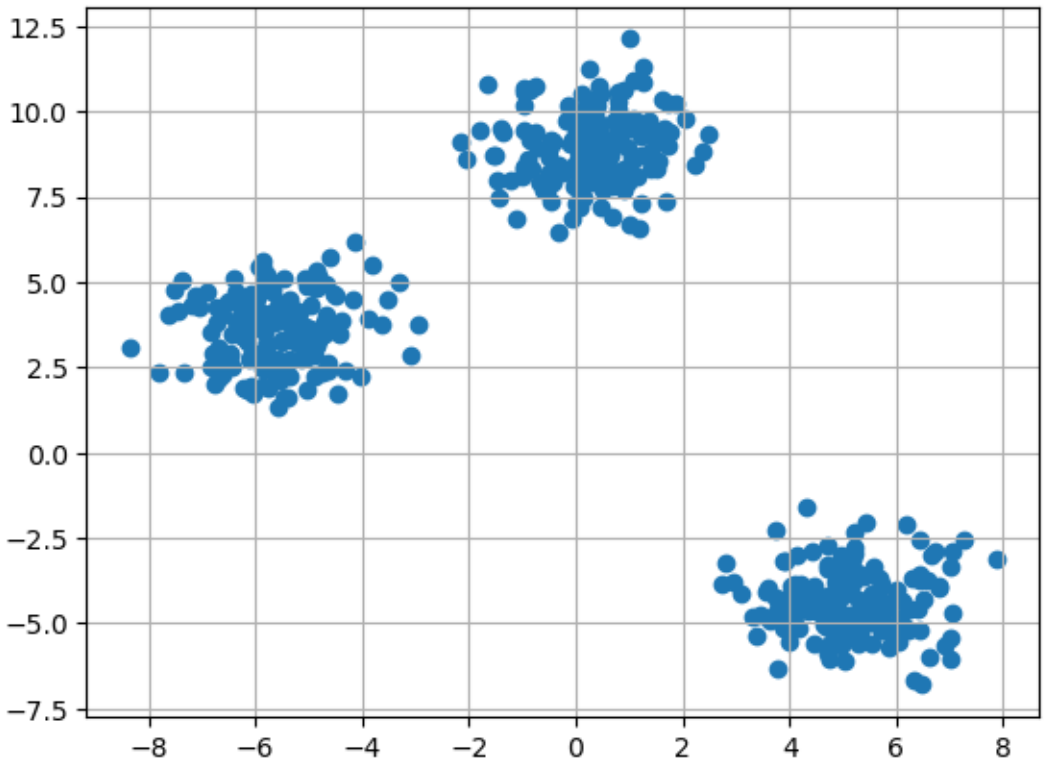
K_Means_Clustering

January 12, 2026

[3]:
```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.datasets import make_blobs
```

[4]:
```
X,y = make_blobs(n_samples = 500,n_features = 2,centers = 3,random_state = 23)

fig = plt.figure(0)
plt.grid(True)
plt.scatter(X[:,0],X[:,1])
plt.show()
```



[5]:
```python
from scipy.spatial.distance import cdist
import numpy as np

distortions = []
inertias = []
mapping1 = {}
mapping2 = {}
K = range(1, 10)

for k in K:
    kmeanModel = KMeans(n_clusters=k, random_state=42).fit(X)

    distortions.append(sum(np.min(cdist(X, kmeanModel.cluster_centers_,
 ↪'euclidean'), axis=1)**2) / X.shape[0])

    inertias.append(kmeanModel.inertia_)

    mapping1[k] = distortions[-1]
    mapping2[k] = inertias[-1]
```

```
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```
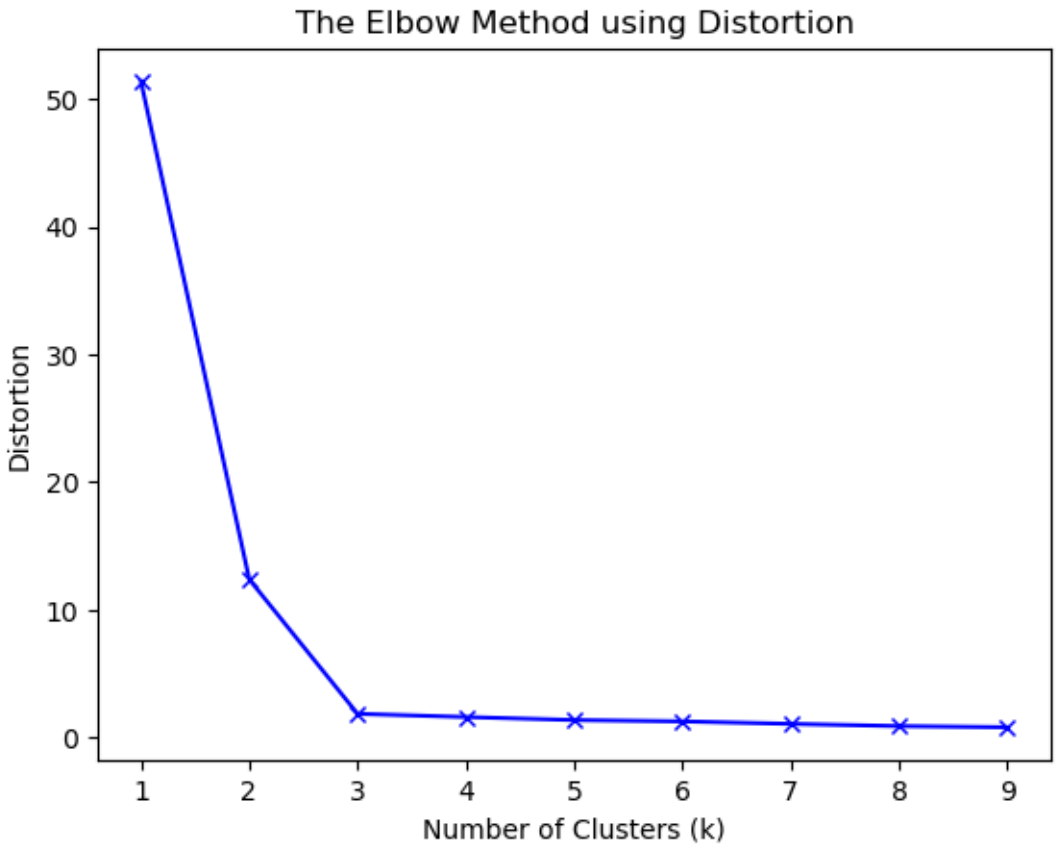

[6]:

```python
print("Distortion values:")
for key, val in mapping1.items():
    print(f'{key} : {val}')

plt.plot(K, distortions, 'bx-')
plt.xlabel('Number of Clusters (k)')
plt.ylabel('Distortion')
plt.title('The Elbow Method using Distortion')
plt.show()
```

```
Distortion values:
1 : 51.38030861339299
2 : 12.391523013559503
3 : 1.8656904088995896
4 : 1.6131499386161376
5 : 1.377915442066909
6 : 1.2704967895753339
7 : 1.078503673485082
8 : 0.9032621968822933
9 : 0.8130888790517962
```



[7]:
```
k_range = range(1, 5)

for k in k_range:
    kmeans = KMeans(n_clusters=k, init='k-means++', random_state=42)
    y_kmeans = kmeans.fit_predict(X)

    plt.scatter(X[:, 0], X[:, 1], c=y_kmeans, cmap='viridis', marker='o',␣
 ↪edgecolor='k', s=100)
    plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1],
                s=300, c='red', label='Centroids', edgecolor='k')
    plt.title(f'K-means Clustering (k={k})')
    plt.xlabel('Feature 1')
    plt.ylabel('Feature 2')
    plt.legend()
    plt.grid()
    plt.show()
```

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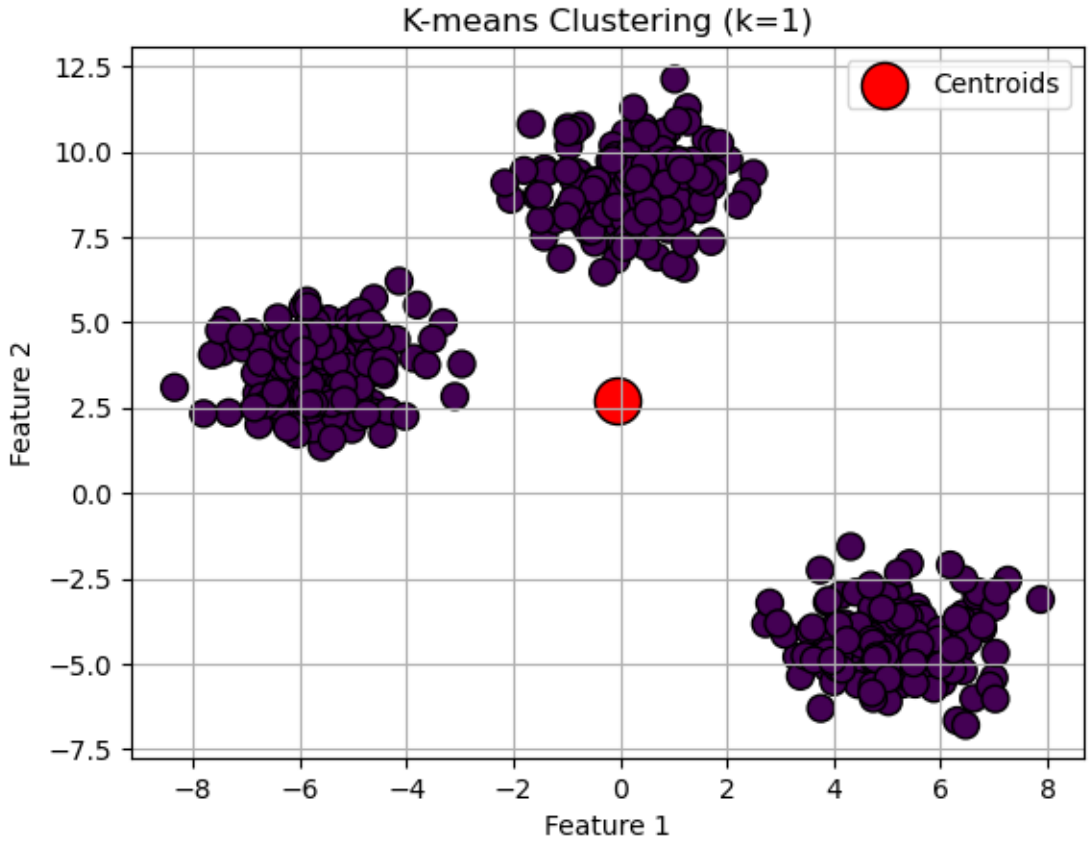


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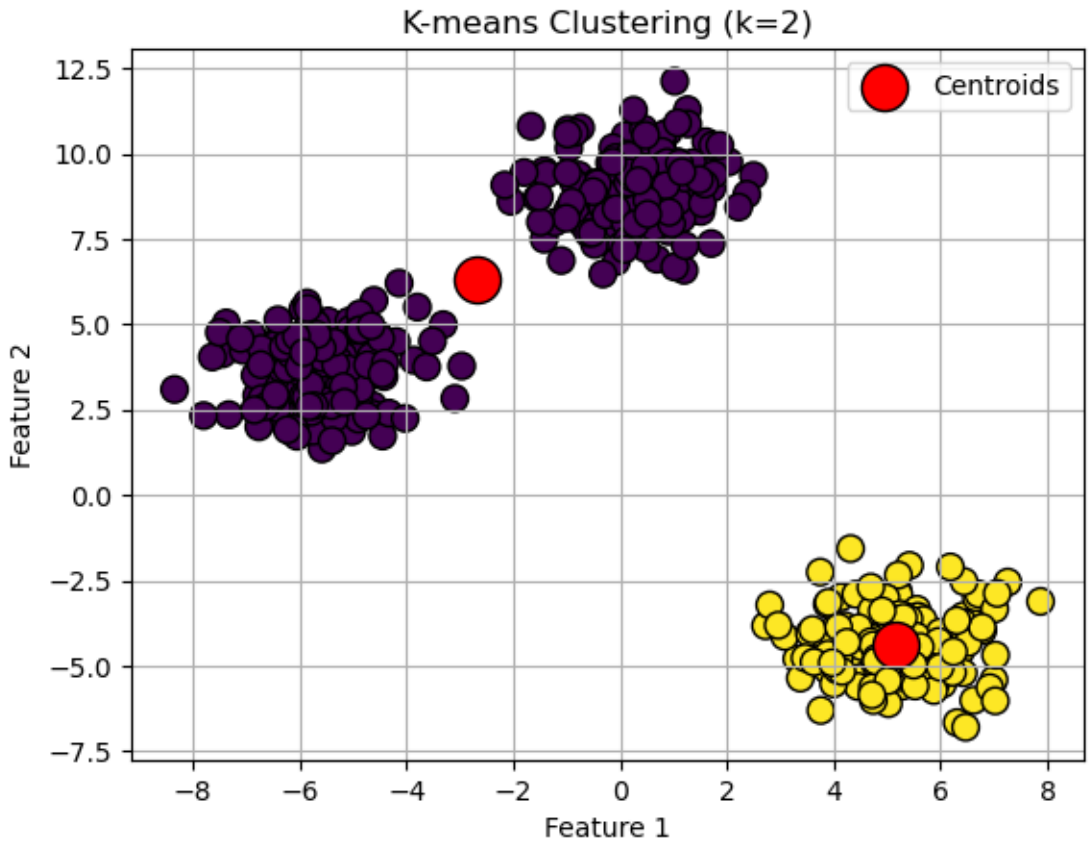


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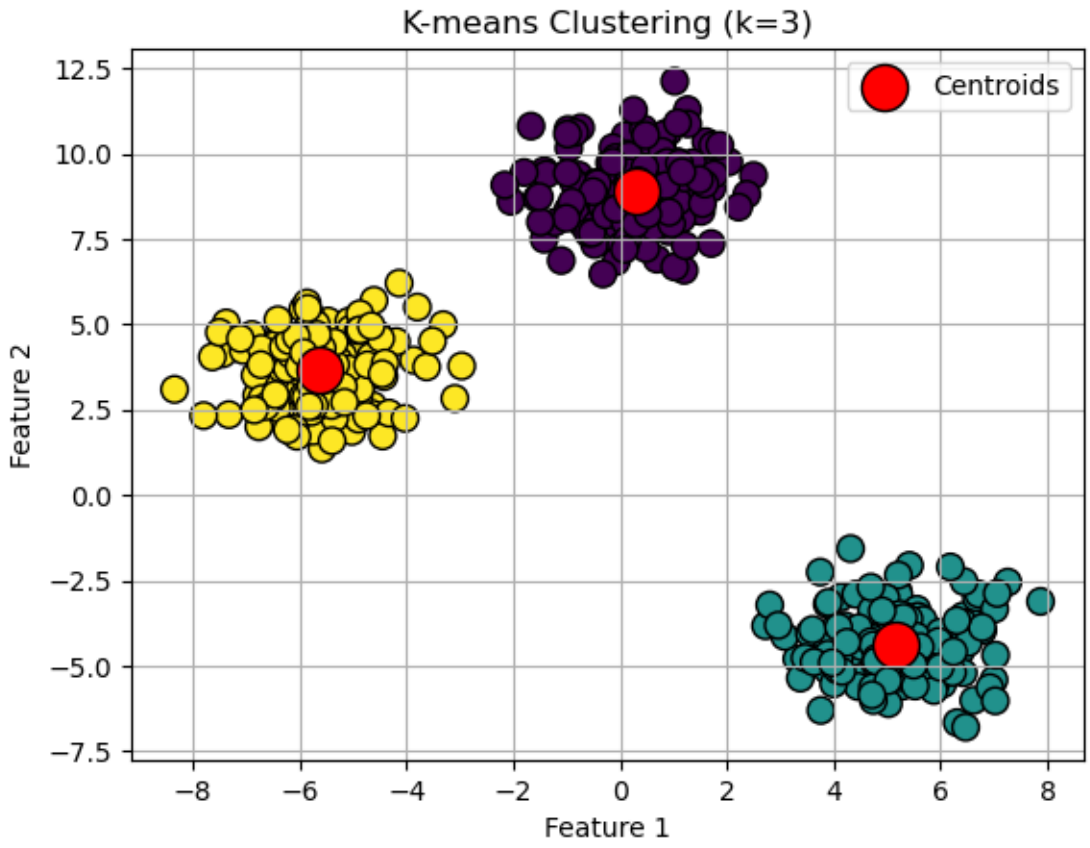


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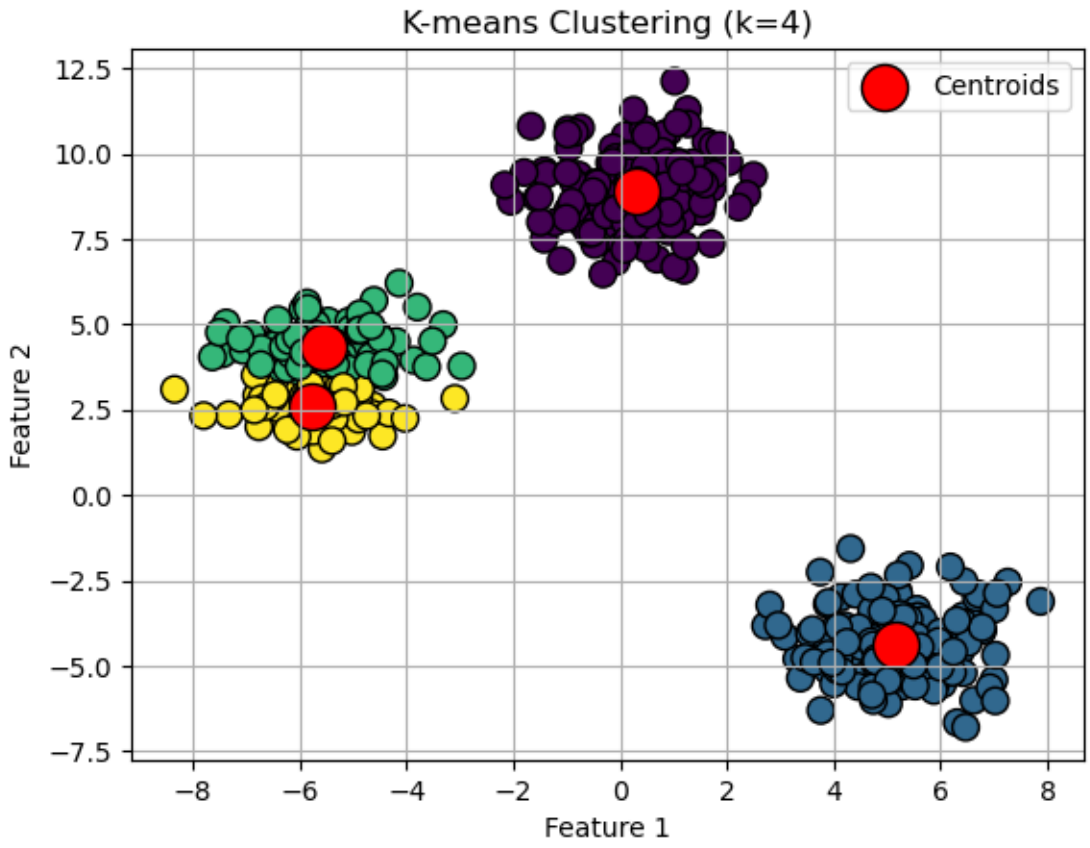
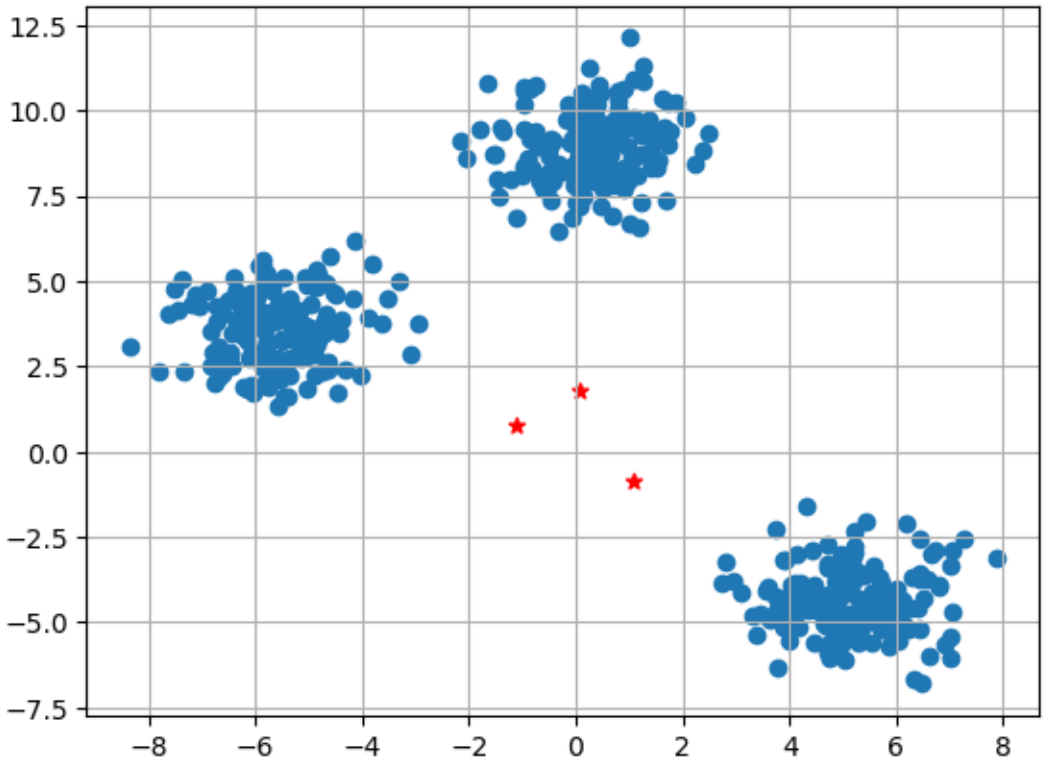


[8]:
```
k = 3

clusters = {}
np.random.seed(23)

for idx in range(k):
    center = 2*(2*np.random.random((X.shape[1],))-1)
    points = []
    cluster = {
        'center' : center,
        'points' : []
    }

    clusters[idx] = cluster

clusters
```

[8]:
```
{0: {'center': array([0.06919154, 1.78785042]), 'points': []},
 1: {'center': array([ 1.06183904, -0.87041662]), 'points': []},
 2: {'center': array([-1.11581855,  0.74488834]), 'points': []}}
```

[9]:
```
plt.scatter(X[:,0],X[:,1])
plt.grid(True)
for i in clusters:
    center = clusters[i]['center']
    plt.scatter(center[0],center[1],marker = '*',c = 'red')
plt.show()
```



[10]:
```
def distance(p1,p2):
    return np.sqrt(np.sum((p1-p2)**2))
```

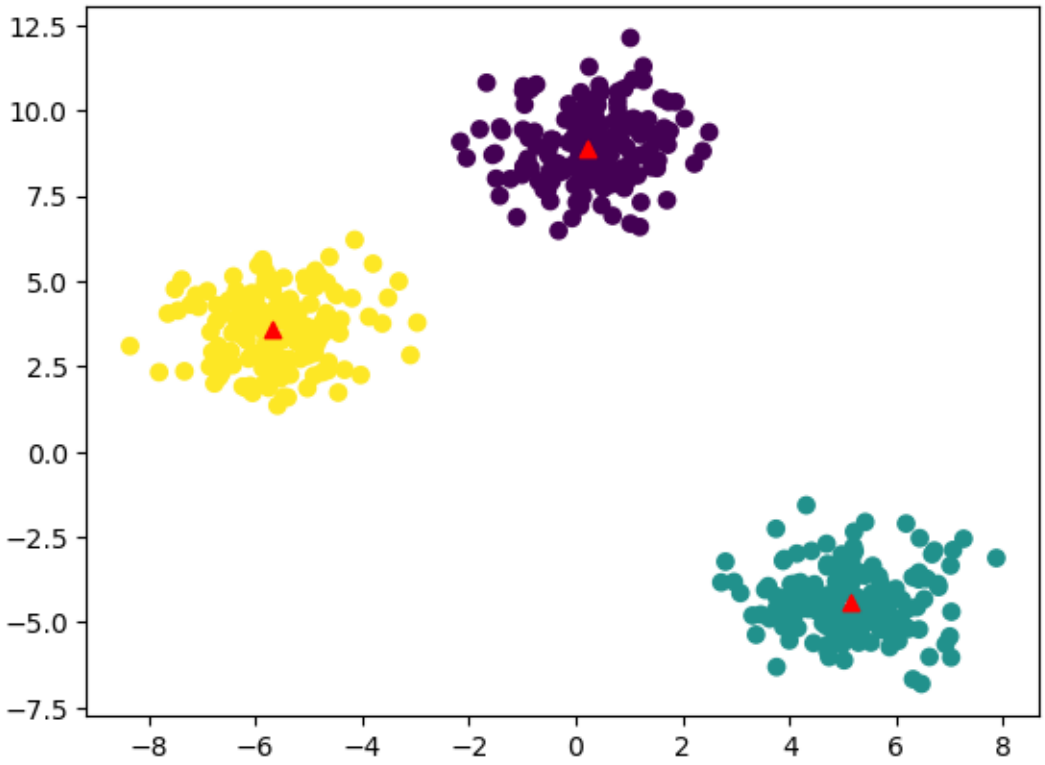
[11]:
```
def assign_clusters(X, clusters):
    for idx in range(X.shape[0]):
        dist = []

        curr_x = X[idx]

        for i in range(k):
            dis = distance(curr_x,clusters[i]['center'])
            dist.append(dis)
        curr_cluster = np.argmin(dist)
        clusters[curr_cluster]['points'].append(curr_x)
    return clusters
```

```
def update_clusters(X, clusters):
    for i in range(k):
        points = np.array(clusters[i]['points'])
        if points.shape[0] > 0:
            new_center = points.mean(axis =0)
            clusters[i]['center'] = new_center

            clusters[i]['points'] = []
    return clusters
```

[12]:
```
def pred_cluster(X, clusters):
    pred = []
    for i in range(X.shape[0]):
        dist = []
        for j in range(k):
            dist.append(distance(X[i],clusters[j]['center']))
        pred.append(np.argmin(dist))
    return pred
```

[13]:
```
clusters = assign_clusters(X,clusters)
clusters = update_clusters(X,clusters)
pred = pred_cluster(X,clusters)
```

[14]:
```
plt.scatter(X[:,0],X[:,1],c = pred)
for i in clusters:
    center = clusters[i]['center']
    plt.scatter(center[0],center[1],marker = '^',c = 'red')
plt.show()
```


12.5
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−8
−6
−4
−2
0
2
4
6
8

[ ]: