# Project 3 Task 2: K-Means

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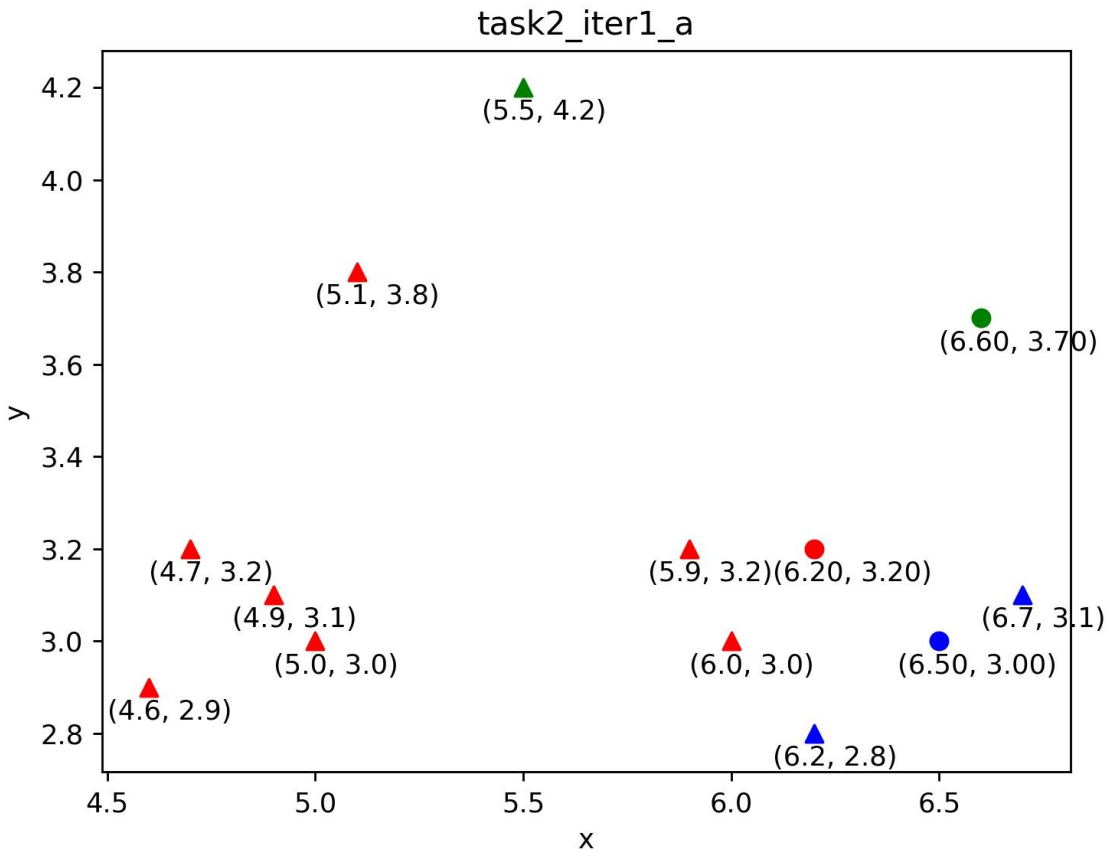
## 1. K-Means Clustering

In the implementation of our K-Means clustering algorithm, during each interaction, there are two steps.

The first step is a classification step, which is implemented in the classify() function. In this step, for each point in the collection, we calculate the Euclidean distance between the point and each center, then we assign the point to its nearest cluster (the cluster whose center is closest to the point in Euclidean distance).

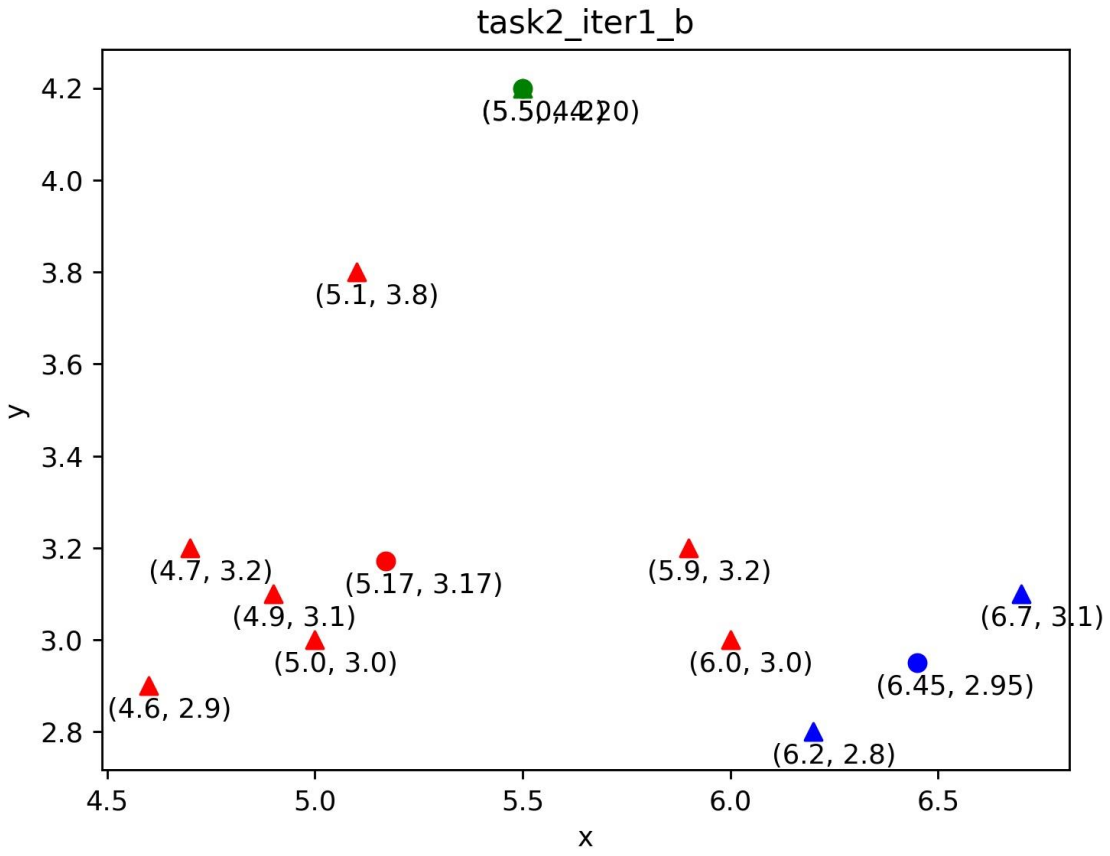
The second step is the update step, which is implemented in the update_center() function. In this step, we re-compute the center of each cluster. Noted that the clusters are updated in the first step, i.e., the classification step.

The first iteration results are shown below,




The classification vectors are

| | |
|---|---|
| [5.9 3.2] | 0 |
| [4.6 2.9] | 0 |
| [4.7 3.2] | 0 |
| [5.0 3.0] | 0 |
| [4.9 3.1] | 0 |
| [5.1 3.8] | 0 |
| [6.0 3.0] | 0 |
| [5.5 4.2] | 1 |
| [6.2 2.8] | 2 |
| [6.7 3.1] | 2 |



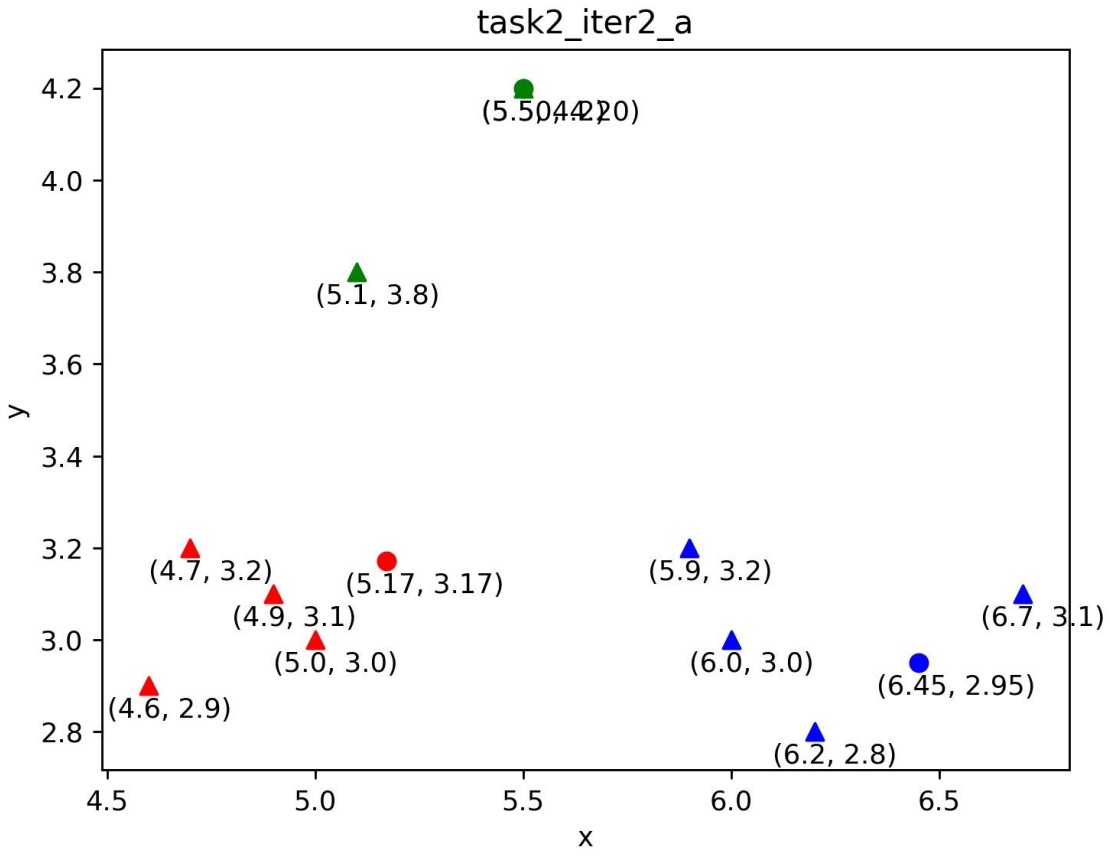

The update centers are:

[5.17142857143, 3.17142857143]

[5.5, 4.2]

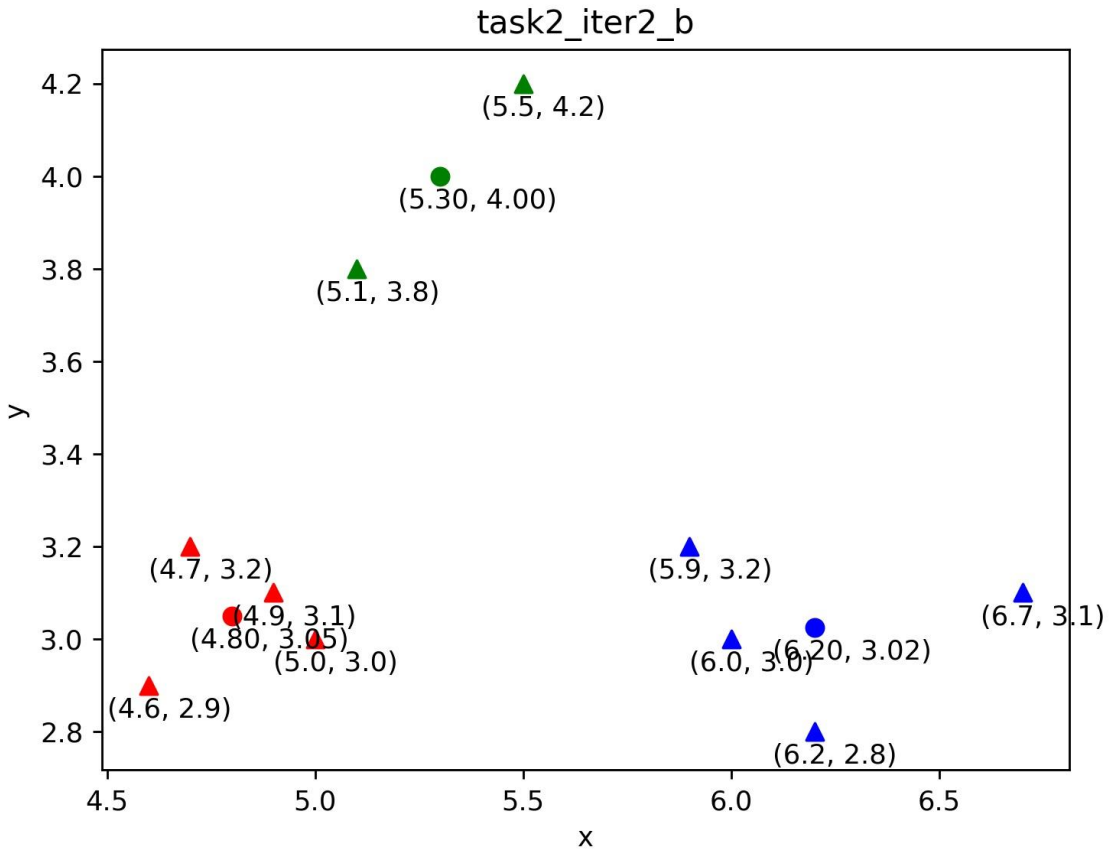
[6.45, 2.95]

The second iteration results are shown below:




The classification vectors are:

| | |
|---|---|
| [4.6 2.9] | 0 |
| [4.7 3.2] | 0 |
| [5.0 3.0] | 0 |
| [4.9 3.1] | 0 |
| [5.5 4.2] | 1 |
| [5.1 3.8] | 1 |
| [5.9 3.2] | 2 |
| [6.2 2.8] | 2 |
| [6.7 3.1] | 2 |
| [6.0 3.0] | 2 |




The updated centers are:

[4.8, 3.05]
[5.3, 4.0]
[6.2, 3.025]

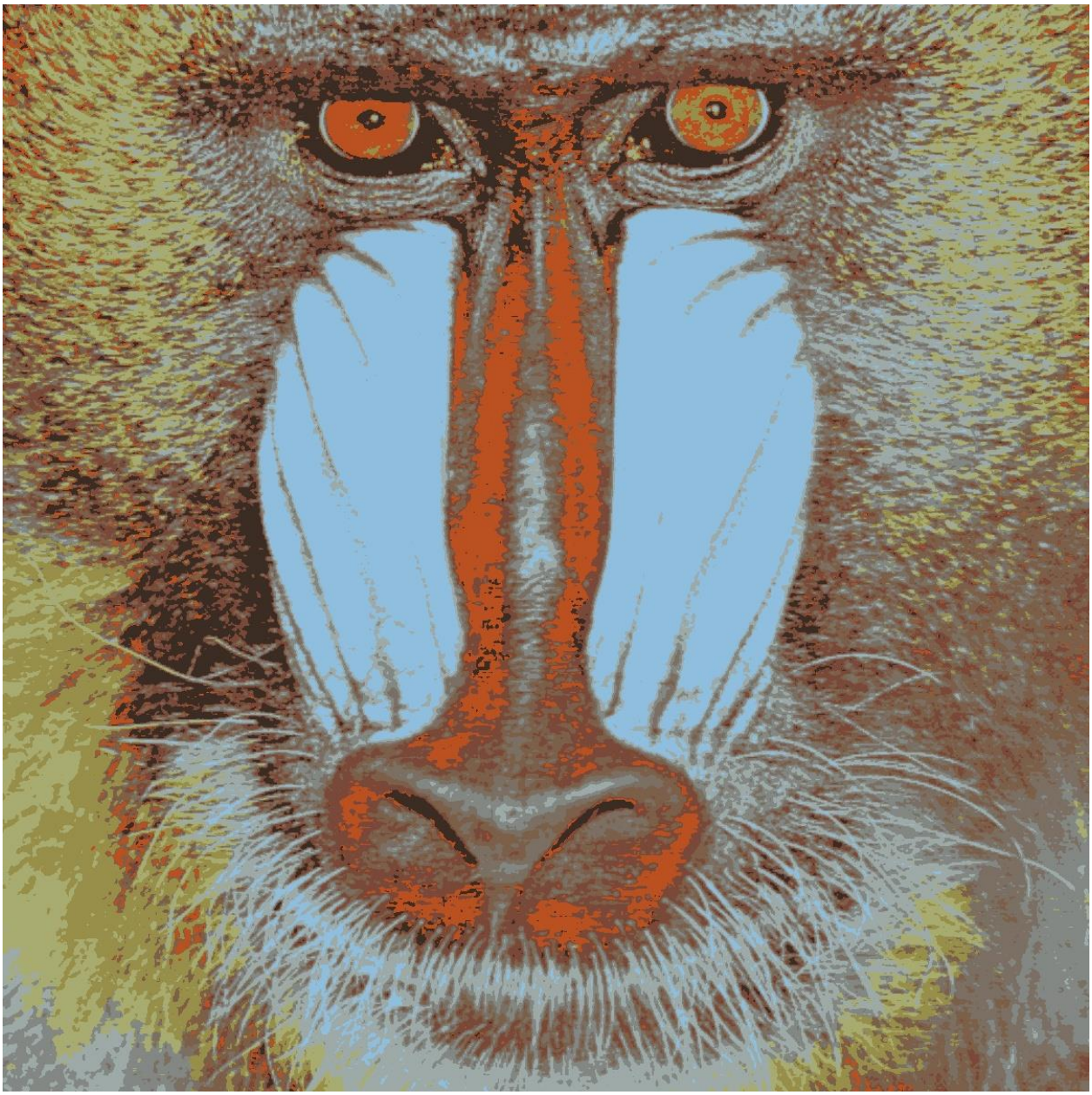
# 2. Color Quantization

The color of each pixel is clustered into K groups using the K-Means algorithm. Then we replaced the color of each pixel with the center of the cluster where the pixel is classified.

When K is set to 3, we have

When K is set to 5, we have

When K is set to 10, we have



When K is set to 20, we have