Assignment 06

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In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
import random
import copy
import math
```

In [2]:
```
# Make x and y domain matrix
def make_domain_matrix() :
    x_matrix = np.zeros((M, N), dtype="int")
    y_matrix = np.zeros((M, N), dtype="int")

    for i in range(M) :
        x_matrix[i, :] = i

    for j in range(N) :
        y_matrix[:, j] = j

    return (x_matrix, y_matrix)

# Distance function between two vectors x and y by L1 Norm
def distance_L1(x, y, c) :
    dx = abs(x - c[0])
    dy = abs(y - c[1])
    s = dx + dy

    return (s)

# Distance function between two vectors x and y by L2 Norm
def distance_L2(x, y, c):

    dx = (x - c[0]) ** 2
    dy = (y - c[1]) ** 2
    s = dx + dy

    return(s)
```

```
        # Plot image
        def plot_image(label, k) :

            plt.imshow(label, cmap=plt.cm.get_cmap('gist_ncar', k))
            plt.colorbar(ticks=range(k), format='color: %d')
            plt.axis('off')


In [3]: class KMeans() :
            def __init__ (self, k) :
                self.k = k
                self.centroid_xy    = np.zeros((self.k, 2), dtype="float")
                self.centroid_count = np.zeros(self.k, dtype="int")

            def init_centroid(self) :
                for i in range(M) :
                    for j in range(N) :
                        rand_label = random.randint(0, self.k-1)
                        self.cur_label[i][j] = rand_label


            def update_centroid(self) :
                self.centroid_xy    = np.zeros((self.k, 2), dtype="float")
                self.centroid_count = np.zeros(self.k, dtype="int")

                # Sum all x and y by label
                for i in range (M) :
                    for j in range (N) :
                        label = self.cur_label[i][j]
                        self.centroid_xy[label, 0] += i
                        self.centroid_xy[label, 1] += j
                        self.centroid_count[label] += 1


                # Divide sum of centroid by count
                for i in range (self.k) :
                    if (self.centroid_count[i] != 0) :
                        self.centroid_xy[i , :] /= self.centroid_count[i]


            def labeling(self, norm) :
                # Label for each entry
                for i in range (M) :
                    for j in range (N) :

                        # Calculate distance between each centroid and entry
                        dist_sum = []
```

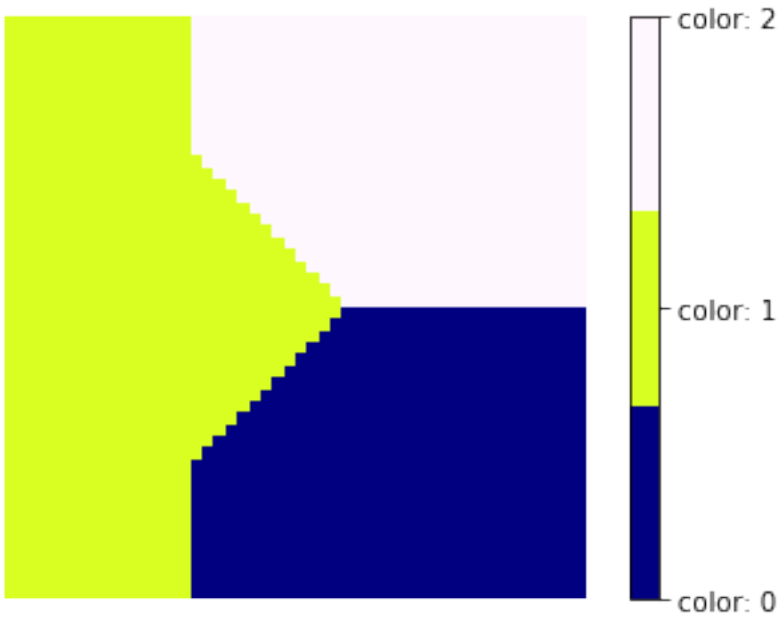
```
                    for t in range (self.k) :
                        if (norm == 1) :
                            dist_sum.append(distance_L1(i, j, self.centroid_xy[t, :]))
                        elif (norm == 2) :
                            dist_sum.append(distance_L2(i, j, self.centroid_xy[t, :]))

                    # Find minimum distance and its index
                    min_dist  = min(dist_sum)
                    min_index = dist_sum.index(min_dist)

                    # Put index in the label
                    self.cur_label[i][j] = min_index


        def train(self, norm) :
            self.cur_label  = np.zeros((M, N), dtype="int")
            self.prev_label = np.zeros((M, N), dtype="int")

            self.init_centroid()

            while not (np.array_equal(self.cur_label, self.prev_label)) :

                self.update_centroid()

                self.prev_label = copy.deepcopy(self.cur_label)

                self.labeling(norm)

            return (self.cur_label)
```

In [4]:
```
# Number of rows(M) and columns(N)
M = 50
N = 50

# Make x and y domain matrix
x_matrix, y_matrix = make_domain_matrix()
```

1.1 K = 3

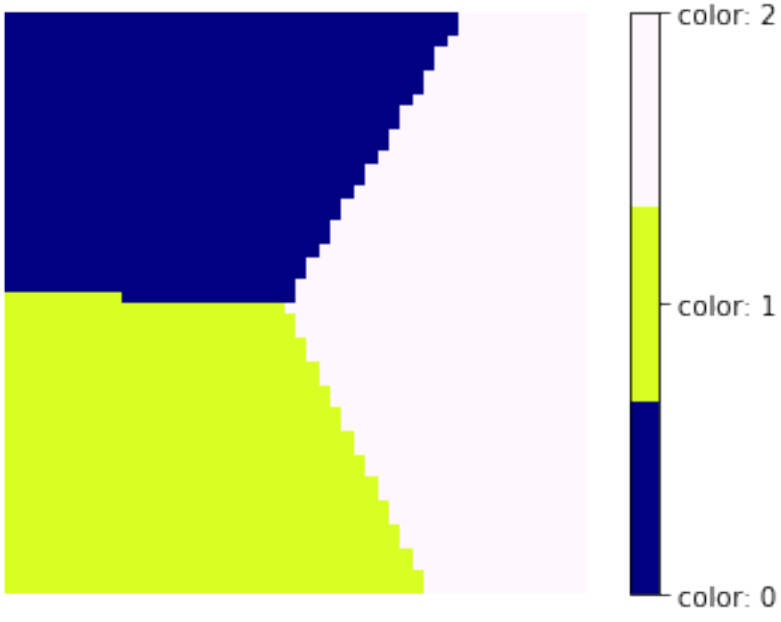
1.1.1 L1 Norm

In [5]:
```
k_num = 3
k_means= KMeans(k_num)
k_num_label = k_means.train(1)

plot_image(k_num_label, k_num)
```



1.1.2 L2 Norm

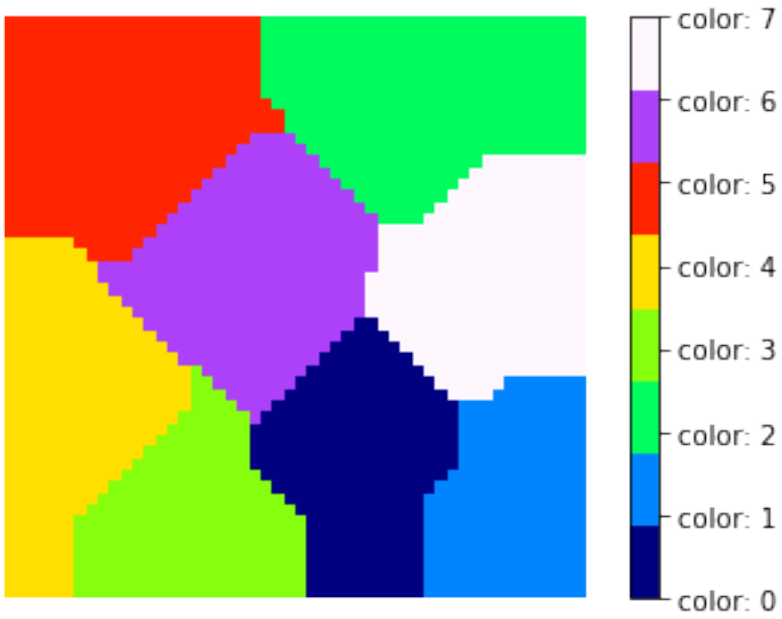
```
In [6]: k_means= KMeans(k_num)
        k_num_label = k_means.train(2)

        plot_image(k_num_label, k_num)
```



1.2 K = 8

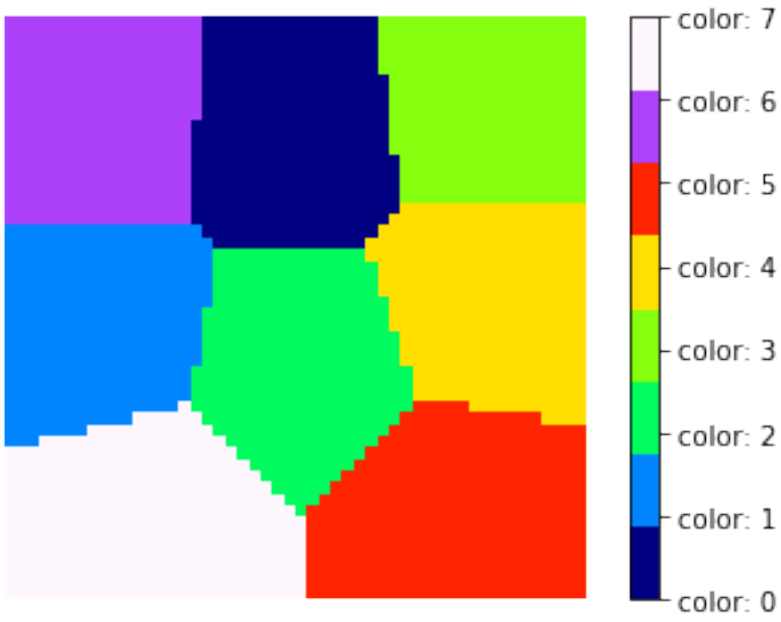
1.2.1 L1 Norm

```
In [7]: k_num = 8
        k_means= KMeans(k_num)
        k_num_label = k_means.train(1)

        plot_image(k_num_label, k_num)
```



1.2.2 L2 Norm

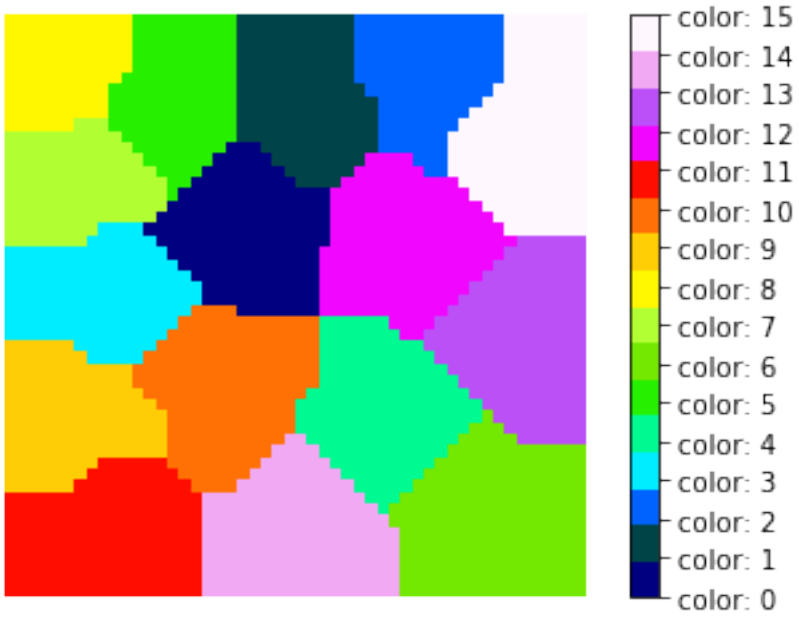
```
In [8]: k_means= KMeans(k_num)
        k_num_label = k_means.train(2)

        plot_image(k_num_label, k_num)
```



1.3 K = 16

1.3.1 L1 Norm

```
In [9]: k_num = 16
        k_means= KMeans(k_num)
        k_num_label = k_means.train(1)

        plot_image(k_num_label, k_num)
```



1.3.2 L2 Norm

```
In [10]: k_means= KMeans(k_num)
         k_num_label = k_means.train(2)

         plot_image(k_num_label, k_num)
```