Project Report 6

K-Means Clustering: Image Segmentation

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Question:

Take a bright colorful image (Eg: image having fruits in it) and implement image segmentation using K-Means. You can first try to implement K-Means on iris dataset to understand its working and then extend the same logic, using the image pixels as the data points. Hint: All the K centroids will represent a color and therefore, you can initialize all the pixels to belong to a cluster randomly and then start the training of the centroids.

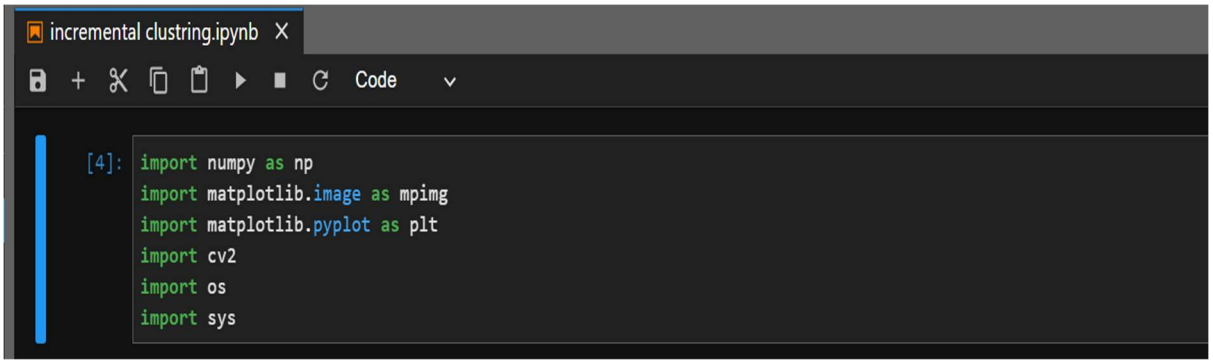
Prerequisites

What things you need to install the software and how to install them:

Python 3.6 This setup requires that your machine has latest version of python. The following url https://www.python.org/downloads/ can be referred to download python. Once you have python downloaded and installed, you will need to setup PATH variables (if you want to run python program directly, detail instructions are below in how to run software section). To do that check this: https://www.pythoncentral.io/add-python-to-path-python-is-not-recognized-asan-internal-or-externalcommand/ . Setting up PATH variable is optional as you can also run program without it and more instruction are given below on this topic.

Second and easier option is to download anaconda and use its anaconda prompt to run the commands. To install anaconda check this url https://www.anaconda.com/download/ You will also need to download and install below 3 packages after you install either python or anaconda from the steps above Sklearn (scikit-learn) numpy scipy if you have chosen to install python 3.6

Importing the libraries and loading dataset.

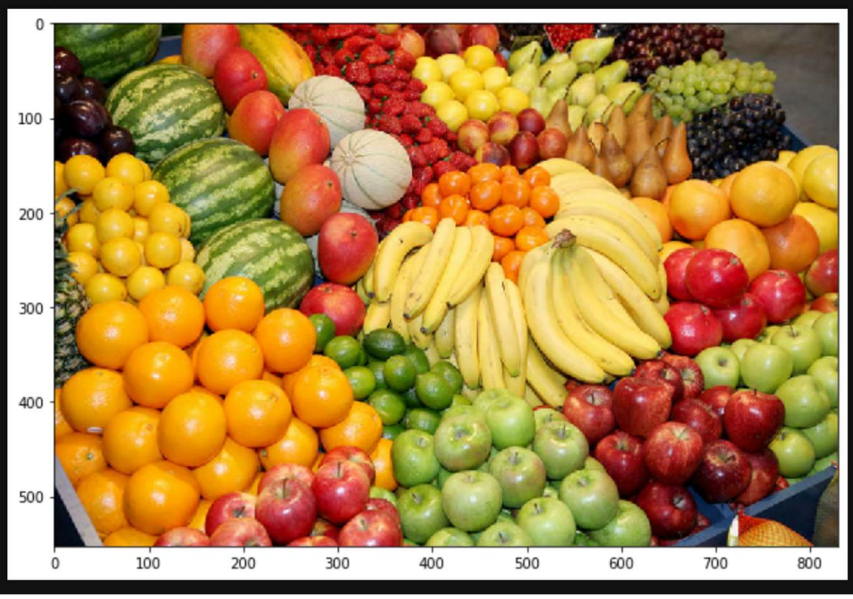


func to initialize mean and variance images

```
[5]: # func to initialize mean and variance images
     def initBackground(initImage):
         img_arr = mpimg.imread(initImage)
         mean = img_arr
         variance = 9*np.ones(img_arr.shape)
         return (mean, variance)
```

Reading the image

```
[19]: # Reading the image
      img = cv2.imread("fruits.jpg")
      img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)

[18]: plt.figure(figsize=(10,10))
      plt.imshow(img)

[18]: <matplotlib.image.AxesImage at 0x1608b43c288>
```



Classify images into foreground and background pixels using chebyshev inequality

```
[6]: # classify images into foreground and background pixels using chebyshev inequality
     def ForegroundDetection(img_file, mean, variance, lmda):
         img = cv2.imread(img_file)
         d = img-mean
         y = variance*(lmda**2)
         d_2 = np.square(d)
         I = d_2-y

         mask = np.all(I>0, axis = 2)
         rI = 255*mask.astype(int)
         rI = rI.astype(np.uint8)
         return (rI)
```

Reduce the image noise using voting scheme

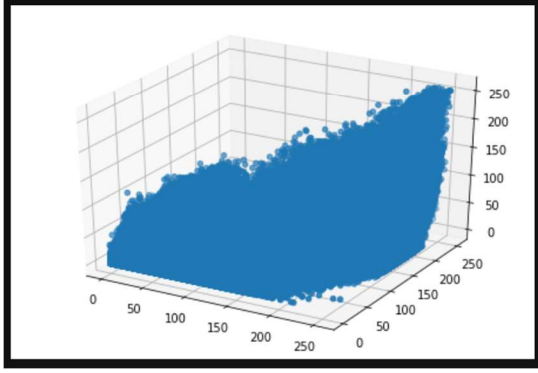
```
]: # reduce the image noise using voting scheme
def voting(rI, eta, m, n):
    r, c = rI.shape
    cI = np.zeros((rI.shape[0], rI.shape[1]))

    for i in range(m, r-1-m):
        for j in range(n, c-1-n):
            img_patch = rI[i-m:i, j-n:j]
            y_unq, counts = np.unique(img_patch, return_counts = True)
            if len(coubts) == 1 & y_unq[0] == 1:
                cI[i, j] = 255
            if len(counts)>1:
                if counts[1]>eta*m*n:
                    cI[i, j] = 255
    cI = cI.astype(np.uint8)
    return cI
```

Update mean and variance images using weighted average scheme

```
[5]: # update mean and variance images using weighted average scheme
def MeanVarUpdate(cI, img_path, M, V, alpha):
    img = mpimg.imread(img_path)
    mean_upd = np.zeros(img.shape)
    var_upd = np.zeros(img.shape)
    d = img-M
    d_2 = np.square(d)

    for i in range(cI.shape[0]):
        for j in range(cI.shape[1]):
            if cI[i, j] == 0:
                mean_upd[i, j, :] = (1-alpha)*M[i, j, :]+ alpha*img[i, j, :]
                var_upd[i, j, :] = (1-alpha)*(V[i, j, :] + alpha*d_2[i, j, :])
                var_upd[i, j, :] = np.clip(var_upd[i, j, :], a_min = 9, a_max = None)
    return (mean_upd, var_upd)
```

```
def Background_substraction(img_dir, lmda, eta, m, n, alpha):
    img_file_name = os.listdir(img_dir)
    initImage = os.path.join(img_dir, img_file_name[0])
    mean, variance = initBackground(initImage)

    for i in range(1, 19):
        img_path = os.path.join(img_dir, img_file_name[i])
        fig, ax = plt.subplots(1, 3, figsize=(10,10))

        rI = ForegroundDetection(img_path, mean, variance, lmda)
        ax[0].imshow(rI, cmap = "gray")

        cI = voting(rI, eta, m, n)
        mean, variance = MeanVarUpdate(cI, img_path, mean, variance, alpha)
        ax[1].imshow(cI, cmap = "gray")

        img = cv2.imread(img_path)
        ax[2].imshow(img, cmap = "gray")

        plt.show()
    return (mean, variance)
```

```
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
import cv2
img = cv2.imread("fruits.jpg")
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
r, g, b = cv2.split(img)
r = r.flatten()
g = g.flatten()
b = b.flatten()#plotting
fig = plt.figure()
ax = Axes3D(fig)
ax.scatter(r, g, b)
plt.show()
```



Output: Segmented image

[12]:
```
vectorized = img.reshape((-1,3))
vectorized = np.float32(vectorized)
```

[13]:
```
criteria = (cv2.TERM_CRITERIA_EPS + cv2.TERM_CRITERIA_MAX_ITER, 10, 1.0)
```

[14]:
```
K = 7
attempts=10
ret,label,center=cv2.kmeans(vectorized,K,None,criteria,attempts,cv2.KMEANS_PP_CENTERS)
```

[15]:
```
center = np.uint8(center)
```

[16]:
```
res = center[label.flatten()]
result_image = res.reshape((img.shape))
```

[17]:
```
figure_size = 15
plt.figure(figsize=(figure_size,figure_size))
plt.subplot(1,2,1),plt.imshow(img)
plt.title('Original Image'), plt.xticks([]), plt.yticks([])
plt.subplot(1,2,2),plt.imshow(result_image)
plt.title('Segmented Image when K = %i' % K), plt.xticks([]), plt.yticks([])
plt.show()
```