# 读取数据，图片类型

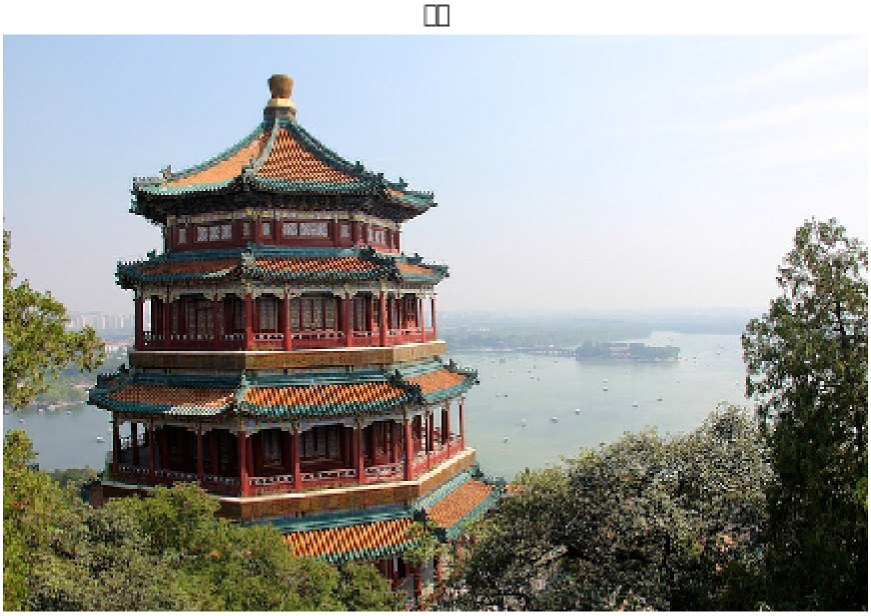
```python
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.metrics import pairwise_distances_argmin
from sklearn.datasets import load_sample_image
from sklearn.utils import shuffle
from time import time
from numpy import *
import time
import matplotlib.pyplot as plt

n_colors = 64
n_clusters=n_colors
# Load the Summer Palace photo
china = load_sample_image("china.jpg")
print(china.shape)

china = np.array(china, dtype=np.float64) / 255
w, h, d = original_shape = tuple(china.shape)
image_array = np.reshape(china, (w * h, d))
image_array_sample = shuffle(image_array, random_state=0)[:1000]
```

```
(427, 640, 3)
```

```
C:\Users\Magneto_Wang\Anaconda3\lib\site-packages\sklearn\datasets\base.py:762: DeprecationWarning: `imread` is deprecated!
`imread` is deprecated in SciPy 1.0.0, and will be removed in 1.2.0.
Use ``imageio.imread`` instead.
  images = [imread(filename) for filename in filenames]
C:\Users\Magneto_Wang\Anaconda3\lib\site-packages\sklearn\datasets\base.py:762: DeprecationWarning: `imread` is deprecated!
`imread` is deprecated in SciPy 1.0.0, and will be removed in 1.2.0.
Use ``imageio.imread`` instead.
  images = [imread(filename) for filename in filenames]
```

```python
plt.figure(4)
plt.clf()
ax = plt.axes([0, 0, 1, 1])
plt.axis('off')
plt.title('原图')
plt.imshow(china)
```

```
<matplotlib.image.AxesImage at 0x20b8fff59b0>
```



# 基本函数的构造

# kmeans

```python
# k-means cluster
#dataSet为一个矩阵
#k为将dataSet矩阵中的样本分成k个类
def kmeans(dataSet, k):
    numSamples = dataSet.shape[0]  #读取矩阵dataSet的第一维度的长度,即获得有多少个样本数据
    # first column stores which cluster this sample belongs to,
    # second column stores the error between this sample and its centroid
    clusterAssment = mat(zeros((numSamples, 2)))  #得到一个N*2的零矩阵
    clusterChanged = True

    ## step 1: init centroids
    centroids = initCentroids(dataSet, k)  #在样本集中随机选取k个样本点作为初始质心

    while clusterChanged:
        clusterChanged = False
        ## for each sample
        for i in range(numSamples):  #range
            minDist  = 100000.0
            minIndex = 0

            ## for each centroid
            ## step 2: find the centroid who is closest
            #计算每个样本点与质点之间的距离，将其归内到距离最小的那一簇
            for j in range(k):
                distance = euclDistance(centroids[j, :], dataSet[i, :])
                if distance < minDist:
                    minDist  = distance
                    minIndex = j

            ## step 3: update its cluster
            #k个簇里面与第i个样本距离最小的的标号和距离保存在clusterAssment中
            #若所有的样本不在变化，则退出while循环
            if clusterAssment[i, 0] != minIndex:
                clusterChanged = True
                clusterAssment[i, :] = minIndex, minDist**2  #两个**表示的是minDist的平方

        ## step 4: update centroids
        for j in range(k):
            #clusterAssment[:,0].A==j是找出矩阵clusterAssment中第一列元素中等于j的行的下标，返回的是一个以array的列表，第一个array为等于j的下标
            pointsInCluster = dataSet[nonzero(clusterAssment[:, 0].A == j)[0]] #将dataSet矩阵中相对应的样本提取出来
            centroids[j, :] = mean(pointsInCluster, axis = 0)  #计算标注为j的所有样本的平均值

    print ('Congratulations, cluster complete!')
    return centroids, clusterAssment

# calculate Euclidean distance
def euclDistance(vector1, vector2):
    return sqrt(sum(power(vector2 - vector1, 2)))  #求这两个矩阵的距离，vector1、2均为矩阵

def initCentroids(dataSet, k):
    numSamples, dim = dataSet.shape   #矩阵的行数、列数
    centroids = zeros((k, dim))         #感觉要不要你都可以
    for i in range(k):
        index = int(random.uniform(0, numSamples))  #随机产生一个浮点数，然后将其转化为int型
        centroids[i, :] = dataSet[index, :]
    return centroids

```

# 原图各个像素的分类

```
def predict_data(dataSet, k,centroids, clusterAssment):
    numSamples = dataSet.shape[0]
    label=[]
    predict_Assment = mat(zeros((numSamples, 2)))

    clusterChanged = True
    for i in range(numSamples):
        minDist  = 100000.0
        minIndex = 0

        for j in range(k):
            distance = euclDistance(centroids[j, :], dataSet[i, :])
            if distance < minDist:
                minDist  = distance
                minIndex = j
            if predict_Assment[i, 0] != minIndex:
                clusterChanged = True
                predict_Assment[i, :] = minIndex, minDist**2


    return predict_Assment
```

# 重构图片

```
def recreate_image(codebook, labels, w, h):
    """Recreate the (compressed) image from the code book & labels"""
    d = codebook.shape[1]
    image = np.zeros((w, h, d))
    label_idx = 0
    for i in range(w):
        for j in range(h):
            #labelIndex,dist= labels[i, :]
            image[i][j] = codebook[int(label[label_idx, :][0,:1])]
            label_idx += 1
    return image

```

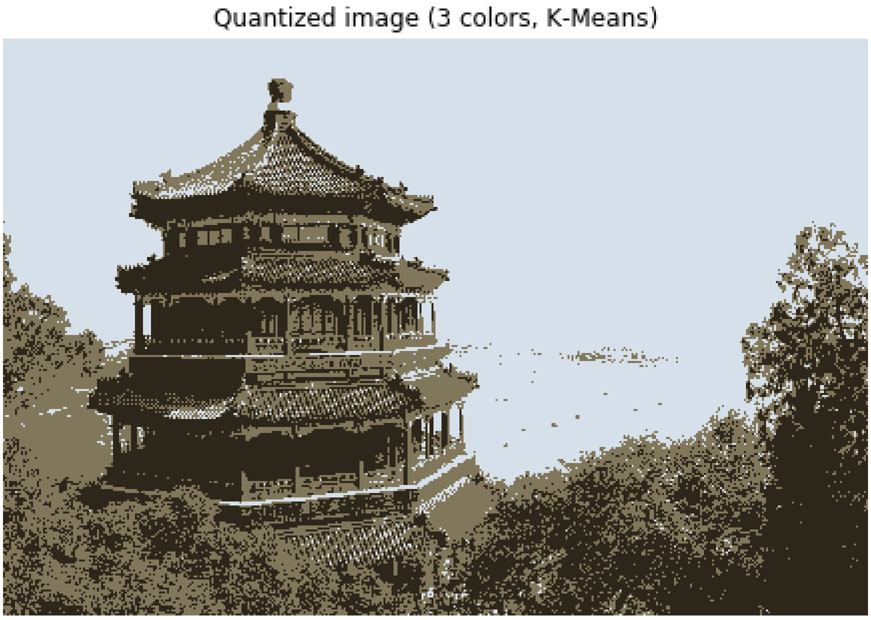
# 图片数据量非常大。为了更快计算。我是抽样其中部分数据。虽然图像有损失，但是效果依然不错

## 聚类的点数是自定义。这里选择3，30，60

```
centroids, clusterAssment=kmeans(image_array_sample, 3)
```

```
label=predict_data(image_array,3,centroids, clusterAssment)
image=recreate_image(centroids,label,w,h)
```

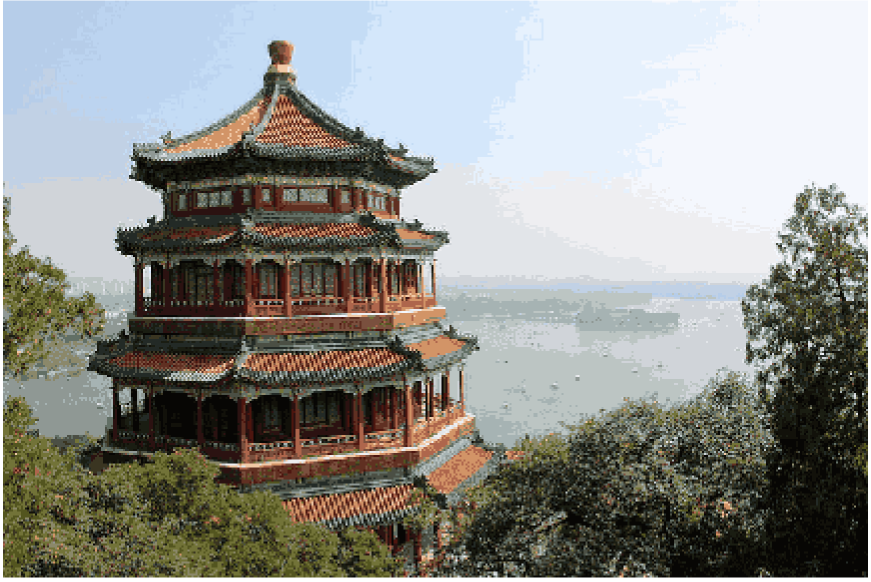
```
plt.figure(1)
plt.clf()
ax = plt.axes([0, 0, 1, 1])
plt.axis('off')
plt.title('Quantized image (3 colors, K-Means)')
plt.imshow(image)
```



```python
centroids, clusterAssment=kmeans(image_array_sample, 30)
```

```python
label=predict_data(image_array,30,centroids, clusterAssment)
image=recreate_image(centroids,label,w,h)
```

```python
plt.figure(2)
plt.clf()
ax = plt.axes([0, 0, 1, 1])
plt.axis('off')
plt.title('Quantized image (30 colors, K-Means)')
plt.imshow(image)
```



Quantized image (30 colors, K-Means)

```python
n_color=60
centroids, clusterAssment=kmeans(image_array_sample, n_color)
label=predict_data(image_array,n_color,centroids, clusterAssment)
image=recreate_image(centroids,label,w,h)
plt.figure(3)
plt.clf()
ax = plt.axes([0, 0, 1, 1])
plt.axis('off')
plt.title('Quantized image (60 colors, K-Means)')
plt.imshow(image)
```

```
Congratulations, cluster complete!
```

Quantized image (60 colors, K-Means)