4 附录

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import random
import copy
import warnings
warnings.filterwarnings('ignore')
%matplotlib inline
```

In [2]:
```
sns.set_style("darkgrid", {"grid.color": ".6", "grid.linestyle": ":"})
sns.set_theme(font='Times New Roman', font_scale=1.2)
plt.rc("figure", autolayout=True)
# plot settings
plt.rcParams["figure.figsize"] = (10, 7)
plt.rcParams['figure.dpi'] = 150
plt.rcParams['axes.grid'] = False
# Chinese support
plt.rcParams['font.sans-serif'] = ['SimHei']
plt.rcParams['axes.unicode_minus'] = False
```

In [3]:
```
df = pd.read_csv('./waveform.data', header=None)
print(df[21].value_counts())
df.head()
```

```
2    1696
0    1657
1    1647
Name: 21, dtype: int64
```

Out[3]:

	0	1	2	3	4	5	6	7	8	9	...	12	\
0	-1.23	-1.56	-1.75	-0.28	0.60	2.22	0.85	0.21	-0.20	0.89	...	2.89	
1	-0.69	2.43	0.61	2.08	2.30	3.25	5.52	4.55	2.97	2.22	...	1.24	
2	-0.12	-0.94	1.29	2.59	2.42	3.55	4.94	3.25	1.90	2.07	...	2.50	
3	0.86	0.29	2.19	-0.02	1.13	2.51	2.37	5.45	5.45	4.84	...	2.58	
4	1.16	0.37	0.40	-0.59	2.66	1.00	2.69	4.06	5.34	3.53	...	4.30	

```
     13    14    15    16    17    18    19    20  21
0  7.75  4.59  3.15  5.12  3.32  1.20  0.24 -0.56   2
1  1.89  1.88 -1.34  0.83  1.41  1.78  0.60  2.42   1
2  0.12  1.41  2.78  0.64  0.62 -0.01 -0.79 -0.12   0
3  1.40  1.24  1.41  1.07 -1.43  2.84 -1.18  1.12   1
4  1.84  1.73  0.21 -0.18  0.13 -0.21 -0.80 -0.68   1

[5 rows x 22 columns]
```

4.1 PAM 算法聚类

```
In [4]: def add_noise(data): # 20% 加高斯噪声
            numSamples, dim = data.shape
            sample = set((numSamples *
                          np.random.rand(int(numSamples * 0.2))).astype(int))
            for i in sample:
                for j in range(dim):
                    data[i, j] += random.gauss(mu=0, sigma=1)
            return data

In [5]: data = df.iloc[:, 0:21].to_numpy()
        data = add_noise(data)

In [6]: def calDist(vec1, vec2):
            distance = np.sqrt(np.sum(np.square(vec2 - vec1)))
            return distance

In [7]: def PAM(dataSet, k):
            numSamples, dim = dataSet.shape
            newdata = copy.deepcopy(dataSet)
            nowdata = copy.deepcopy(dataSet)
            cid = np.random.choice(numSamples, k, replace=False)
            centroids = newdata[cid, :dim-1]
            dist = [[] for  i in range(k)]
            newdist = [[] for i in range(k)]
            lost = np.ones([numSamples, k]) * float('inf')
            for i in range(k):
                dist[i] = np.sqrt(np.sum(np.square(newdata[:, :dim-1]
```

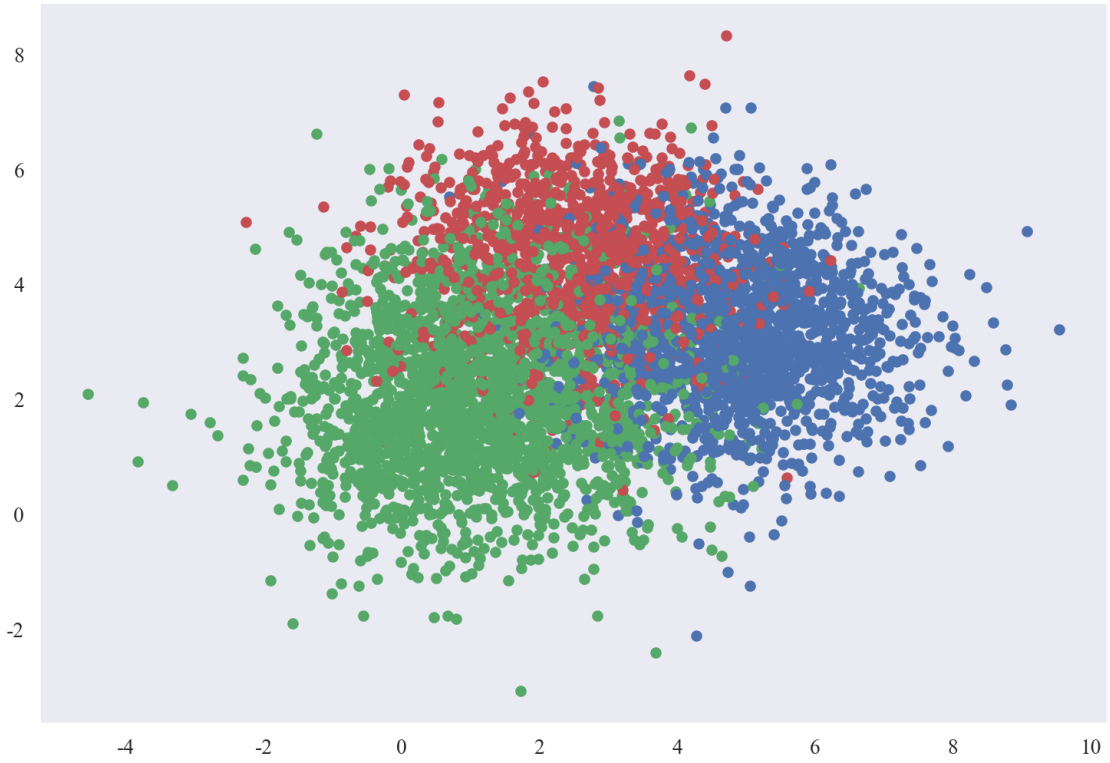
```
                                - np.array(centroids[i])), axis=1))
        newdata[:, dim-1] = np.argmin(np.array(dist), axis=0)
        iter = 0
        while iter <= 10:
            iter += 1
            for i in range(k):
                for j in range(numSamples):
                    center = copy.deepcopy(centroids)
                    center[i] = nowdata[j, :dim-1]
                    for l in range(k):
                        newdist[l] = np.sqrt(np.sum(np.square(nowdata[:, :(dim-1)]
                                        - np.array(center[l])), axis=1))
                    nowdata[:, dim-1] = np.argmin(np.array(newdist), axis=0)
                    lost[j, i] = (calDist(nowdata[:, :dim-1],
                                    center[nowdata[:, dim-1].astype(int)])
                                    - calDist(nowdata[:, :dim-1],
                                    centroids[newdata[:, dim-1].astype(int)])).sum()
            if np.min(lost) < 0:
                index = np.where(np.min(lost) == lost)
                index_j = index[0][0]
                index_i = index[1][0]
            centroids[index_i] = nowdata[index_j, :dim-1]
            for i in range(k):
                dist[i] = np.sqrt(np.sum(np.square(nowdata[:, :(dim-1)]
                                - np.array(centroids[i])), axis=1))
            newdata[:, (dim-1)] = np.argmin(np.array(dist), axis=0)
            return centroids, newdata

In [8]: centroids, newdata = PAM(data, 3)

In [9]: centroids

Out[46]: array([[-0.86,  0.01, -1.22,  0.53,  0.94,  1.06,  1.78,  3.37,  4.69,
                  3.26,  7.43,  5.51,  3.11,  1.74,  1.54,  2.26, -0.04, -1.36,
                 -0.54,  0.73],
                [-0.28,  1.74,  1.95,  1.79,  3.9 ,  5.12,  5.66,  5.58,  3.93,
                  5.02,  1.32,  1.7 ,  0.92, -0.22, -0.11,  0.97,  0.92,  0.09,
                  0.52,  2.37],
```

```
       [ 1.47, -0.95,  1.05,  0.2 ,  0.16,  0.24,  0.83,  1.11,  2.11,
         2.27,  2.73,  2.68,  4.52,  3.79,  4.5 ,  3.15,  3.18,  1.61,
         1.31,  0.61]])
```

In [10]:
```
# newdata # 太长不显示
```

In [11]:
```
def clusterplot(dataSet):
    numSamples, dim = dataSet.shape
    mark =  ['or', 'ob', 'og', 'ok', '^r', '+r', 'sr', 'dr', '<r', 'pr',
             'xr', 'sb', 'sg', 'sk', '2r', '<b', '<g', '+b', '+g', 'pb']
    for i in range(numSamples):
        label = dataSet[i, dim-1].astype(int)
        plt.plot(dataSet[i, 6], dataSet[i, 9], mark[label])
    plt.savefig('./document/figure/plot1.pdf')
    plt.show()
```

In [12]:
```
clusterplot(newdata)
```



4.2 噪声图像分割

```
In [13]: from PIL import Image
         import pylab

In [14]: def image_add_noise(image):
             img = image.astype(np.int16)
             for i in range(img.shape[0]):
                 for j in range(img.shape[1]):
                     for k in range(3):
                         img[i, j, k] += random.gauss(mu=0, sigma=50)
             img[img > 255] = 255
             img[img < 0] = 0
             img = img.astype(np.uint8)
             return img

In [15]: img = Image.open('image-1080x1350.jpg')
         # img = img.convert('L')
         imgdata = image_add_noise(np.array(img))
         noiseimg = Image.fromarray(imgdata)
         noiseimg.save('noise_image.jpg')

In [16]: def getImageRGB(file):
             image = Image.open(file)
             image = np.array(image)
             width, height, x = image.shape
             rgb = np.zeros((width, height, x))
             for i in range(width):
                 for j in range(height):
                     rgb[i][j] = image[i, j]
             return rgb

In [17]: def initCentroids(imageRGB, k):
             center = []
             for i in range(k):
                 x, y = random.randint(0, imageRGB.shape[0]), \
                         random.randint(0, imageRGB.shape[1])
                 center += [[x, y]]
             return center
```

```
In [18]: def chooseOneNoCenterSample(imageRGB, centers):
             x, y = 0, 0
             isChooseACenterSampleFlag = True
             while(isChooseACenterSampleFlag):
                 isExist = False
                 x, y = random.randint(0, imageRGB.shape[0]), \
                         random.randint(0, imageRGB.shape[1])
                 for k in range(len(centers)):
                     if(x==centers[k][0] and y==centers[k][1]):
                         isExist = True
                         break;
                 if(isExist == False):
                     break;
             return [x, y]

In [19]: def caclEucDistance(imageRGB, centers):
             region = []
             for i in range(imageRGB.shape[0]):
                 x = []
                 for j in range(imageRGB.shape[1]):
                     temp = []
                     for k in range(len(centers)):
                         dist = np.sqrt(np.sum(np.square(imageRGB[i, j]
                             - imageRGB[centers[k][0], centers[k][1]])))
                         temp += [dist]
                     x.append(np.argmin(temp))
                 region.append(x)
             return region

In [20]: def calcCost(imageRGB, features, centers):
             cost = 0.0
             for i in range(imageRGB.shape[0]):
                 for j in range(imageRGB.shape[1]):
                     dist = np.sqrt(np.sum(np.square(imageRGB[i, j]
                                     - imageRGB[centers[features[i][j]][0],
                                     centers[features[i][j]][1]])))
                     cost = cost + dist
             return cost
```

```
In [21]: def showImage(imageRGB, centercolor, features, k, iteration):
             NewImage = np.empty((len(features), len(features[0]), 3))
             for i in range(len(features)):
                 for j in range(len(features[i])):
                     NewImage[i, j] = centercolor[features[i][j]]
             fig = plt.figure(figsize=(10, 4), facecolor='white')
             fig.suptitle('knum='+str(k)+', iternum='+str(iteration),
                          fontsize=12, color='k')
             fig.gca().xaxis.set_major_locator(plt.NullLocator())
             fig.gca().yaxis.set_major_locator(plt.NullLocator())

             ax1 = fig.add_subplot(1, 2, 1)
             ax1.axis('off')
             ax1.imshow(imageRGB / 255)
             ax1.set_title('Original image', fontsize=10, color='k')

             ax2 = fig.add_subplot(1, 2, 2)
             ax2.axis('off')
             ax2.imshow(NewImage / 255)
             ax2.set_title('Split image', fontsize=10, color='k')

             pylab.show()
             plt.savefig('cluster' + str(k) + '.pdf')
             plt.show()

In [22]: def PAM(imageRGB, features, centers):
             cost0 = calcCost(imageRGB, features, centers)
             aNoCenterSample = chooseOneNoCenterSample(imageRGB, centers)

             belongsK = features[aNoCenterSample[0]][aNoCenterSample[1]]
             TempCenters = centers
             TempCenters[belongsK][0] = aNoCenterSample[0]
             TempCenters[belongsK][1] = aNoCenterSample[1]
             TempFeatures = caclEucDistance(imageRGB, TempCenters)
             Tempcost = calcCost(imageRGB, TempFeatures, TempCenters)
             if (Tempcost < cost0):
                 centers = TempCenters
```

```
                features = TempFeatures
                cost0 = Tempcost
            return features, centers
```

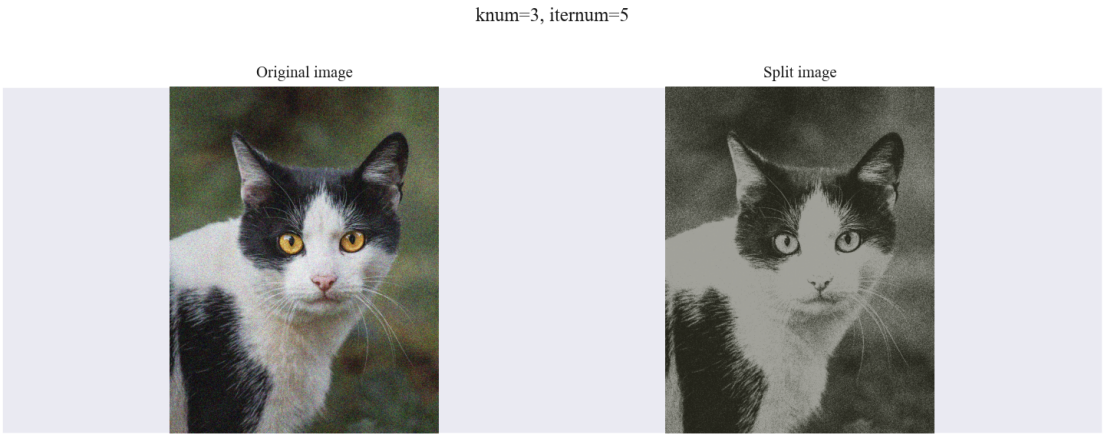
In [23]:
```
def calNewCenter(features, imageRGB, k):
    temp = []
    for i in features:
        for j in i:
            temp.append(j)
    centercolor = [0] * k
    for i in range(len(features)): #Rows
        for j in range(len(features[i])): #Columns
            centercolor[features[i][j]] += imageRGB[i, j]

    for i in range(len(centercolor)):
        centercolor[i] /= temp.count(i)
        for j in range(len(centercolor[i])):
            centercolor[i][j] = int(centercolor[i][j])
    return centercolor
```

In [24]:
```
def main(knum, iternum):
    imageRGB = getImageRGB('noise_image.jpg')
    k = knum
    iteration = iternum

    centers = initCentroids(imageRGB, k)
    features = caclEucDistance(imageRGB, centers)
    print('PAM start...\n')
    for i in range(iteration, 0, -1):
        print('iteration = ', i)
        features, centers = PAM(imageRGB, features, centers)
        print('\n' + 'Centers = ', centers, '\n')

    centercolor = calNewCenter(features, imageRGB, k)
    showImage(imageRGB, centercolor, features, k, iteration)
```

In [25]:
```
main(3, 5)
```

```
PAM start...
```

```
iteration =  5

Centers =  [[1268, 303], [961, 597], [535, 984]]

iteration =  4

Centers =  [[1268, 303], [575, 982], [535, 984]]

iteration =  3

Centers =  [[1268, 303], [471, 892], [535, 984]]

iteration =  2

Centers =  [[1268, 303], [860, 681], [535, 984]]

iteration =  1

Centers =  [[1268, 303], [860, 681], [1320, 457]]
```




```
<Figure size 1500x1050 with 0 Axes>
```

```
In [26]: main(6, 5)

PAM start...

iteration =  5

Centers =  [[45, 206], [453, 973], [217, 489], [1041, 446], [887, 151], [504, 764]]

iteration =  4

Centers =  [[45, 206], [453, 973], [217, 489], [1041, 446], [1116, 507], [504, 764]]

iteration =  3

Centers =  [[45, 206], [1130, 1031], [217, 489], [1041, 446], [1116, 507], [504, 764]]

iteration =  2

Centers =  [[45, 206], [1130, 1031], [217, 489], [781, 510], [1116, 507], [504, 764]]

iteration =  1

Centers =  [[45, 206], [1247, 610], [217, 489], [781, 510], [1116, 507], [504, 764]]
```