Методы кластеризации в Python ¶

1. Метод k-means

In [1]:

```
from sklearn.datasets.samples_generator import make_blobs
```

In [2]:

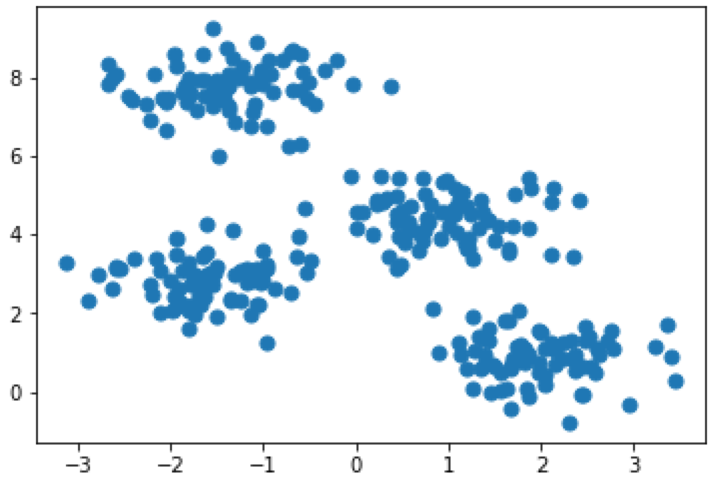
```
import numpy as np                                    # Массивы
import matplotlib.pyplot as plt                       # Графики
%matplotlib inline
```

In [3]:

```
X, y_true = make_blobs(n_samples = 300, centers = 4, cluster_std = 0.6, random_state = 0)
plt.scatter(X[:, 0], X[:, 1], s = 50)
```

Out[3]:

```
<matplotlib.collections.PathCollection at 0x1f268c61f28>
```

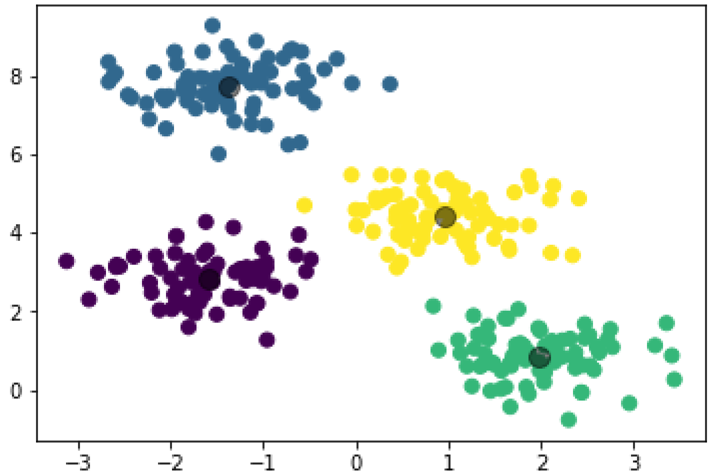


In [4]:

```
from sklearn.cluster import KMeans
kmeans = KMeans(n_clusters = 4)
kmeans.fit(X)
y_kmeans = kmeans.predict(X)
plt.scatter(X[:, 0], X[:, 1], c = y_kmeans, s = 50, cmap = 'viridis')
centers = kmeans.cluster_centers_
plt.scatter(centers[:, 0], centers[:, 1], c = 'black', s = 100, alpha = 0.5)
```

Out[4]:

```
<matplotlib.collections.PathCollection at 0x1f26a341908>
```



1.1. Распознавание рукописных цифр методом k-means

In [5]:

```
from sklearn.datasets import load_digits
digits = load_digits()
digits.data.shape
```

Out[5]:

```
(1797, 64)
```

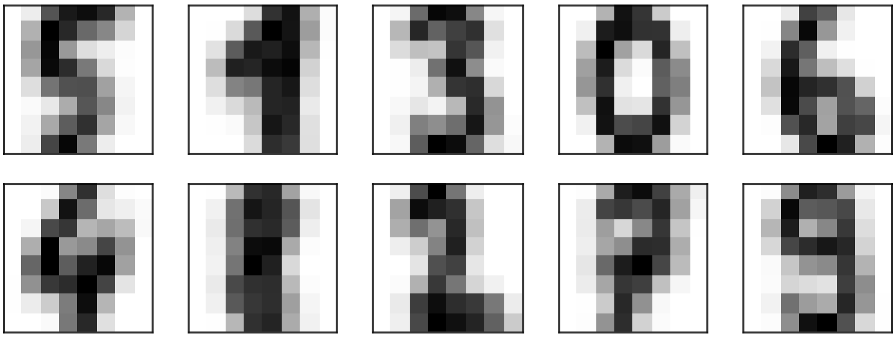
In [6]:

```
kmeans = KMeans(n_clusters = 10)
clusters = kmeans.fit_predict(digits.data)
centers = kmeans.cluster_centers_.reshape(10, 8, 8)
```

Центры кластеров

In [7]:

```
fig, ax = plt.subplots(2, 5, figsize = (8, 3))
for axi, center in zip(ax.flat, centers):
    axi.set(xticks = [], yticks = [])
    axi.imshow(center, interpolation = 'nearest', cmap = plt.cm.binary)
```



Ошибка

In [8]:

```
from scipy.stats import mode
labels = np.zeros_like(clusters)
for i in range(10):
    mask = (clusters == i)
    labels[mask] = mode(digits.target[mask])[0]

from sklearn.metrics import accuracy_score
print(accuracy_score(digits.target, labels))
```

```
0.7946577629382304
```

Пример

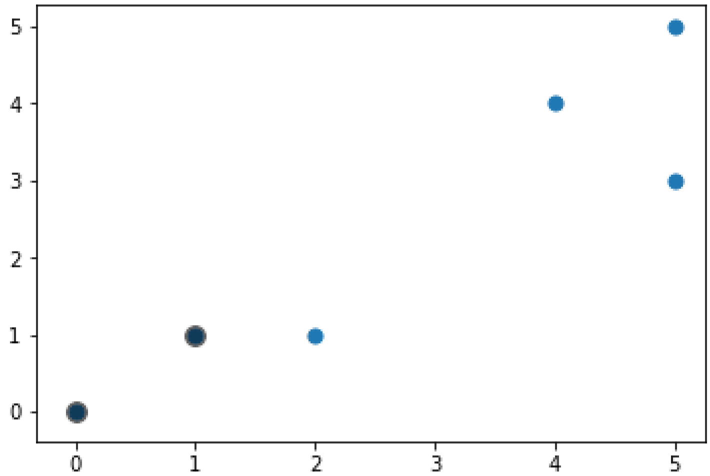
Пусть задана выборка $\mathrm{x}_1 = (1,1)^T$, $\mathrm{x}_2 = (0,0)^T$, $\mathrm{x}_3 = (2,1)^T$, $\mathrm{x}_4 = (4,4)^T$, $\mathrm{x}_5 = (5,5)^T$, $\mathrm{x}_6 = (5,3)^T$. Найти кластеризацию этих образов по двум классам методом k-means.

In [9]:

```
X = np.array([[1, 1], [0, 0], [2, 1], [4, 4], [5, 5], [5, 3]])
centers = np.array([[1, 1], [0, 0]])
plt.scatter(X[:, 0], X[:, 1], s = 50)
plt.scatter(centers[:, 0], centers[:, 1], c = 'black', s = 100, alpha = 0.5)
```

Out[9]:

```
<matplotlib.collections.PathCollection at 0x1f26a57b860>
```

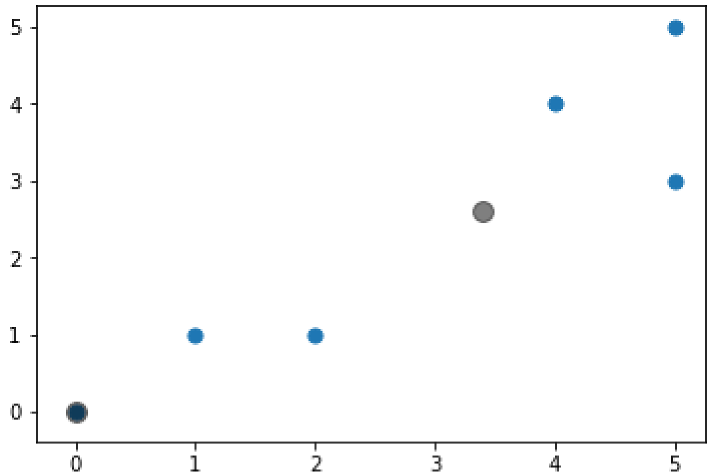


In [10]:

```
centers = np.array([[17./5., 13./5.], [0, 0]])
plt.scatter(X[:, 0], X[:, 1], s = 50)
plt.scatter(centers[:, 0], centers[:, 1], c = 'black', s = 100, alpha = 0.5)
```

Out[10]:

```
<matplotlib.collections.PathCollection at 0x1f26a616b38>
```

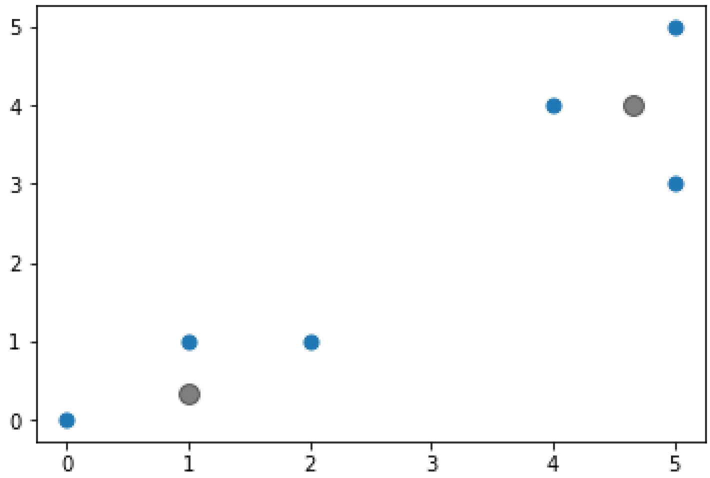


In [11]:

```
centers = np.array([[14./3., 4], [1, 1./3.]])
plt.scatter(X[:, 0], X[:, 1], s = 50)
plt.scatter(centers[:, 0], centers[:, 1], c = 'black', s = 100, alpha = 0.5)
```

Out[11]:

```
<matplotlib.collections.PathCollection at 0x1f26a67d160>
```



1.2. ЕМ-алгоритм

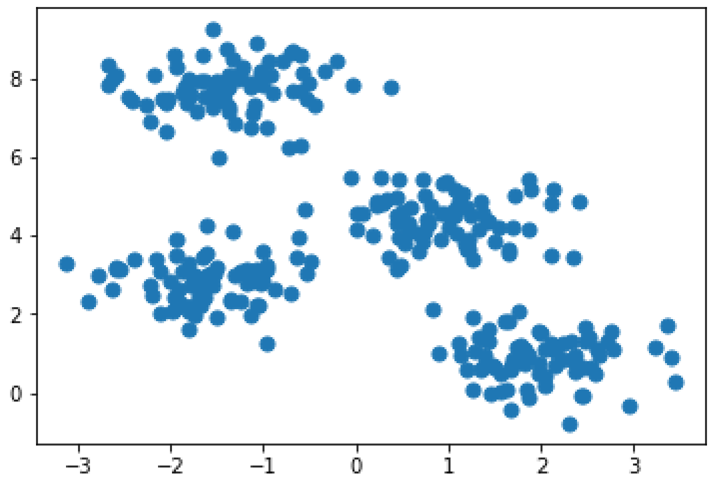
In [3]:

```
from sklearn.datasets.samples_generator import make_blobs
import numpy as np                                 # Массивы
import matplotlib.pyplot as plt                    # Графики
%matplotlib inline

X, y_true = make_blobs(n_samples = 300, centers = 4, cluster_std = 0.6, random_state = 0)
plt.scatter(X[:, 0], X[:, 1], s = 50)
```

Out[3]:

```
<matplotlib.collections.PathCollection at 0x19b7c491860>
```



In [13]:

```
rnd = np.random.RandomState(13)
X_stretched = np.dot(X, rnd.randn(2, 2))
```

In [16]:

```
rnd.randn(2, 2)
```

Out[16]:

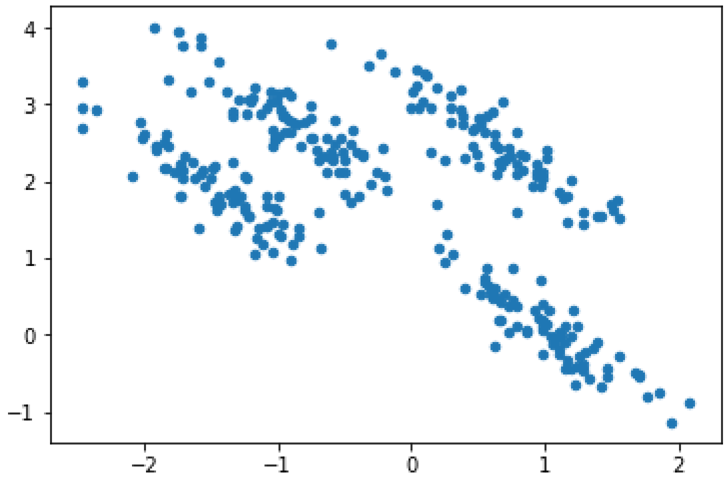
```
array([[1.34510171, 0.53233789],
       [1.3501879 , 0.86121137]])
```

In [35]:

```
plt.scatter(X_stretched[:, 0], X_stretched[:, 1], s = 20)
```

Out[35]:

```
<matplotlib.collections.PathCollection at 0xcb3d2e8>
```

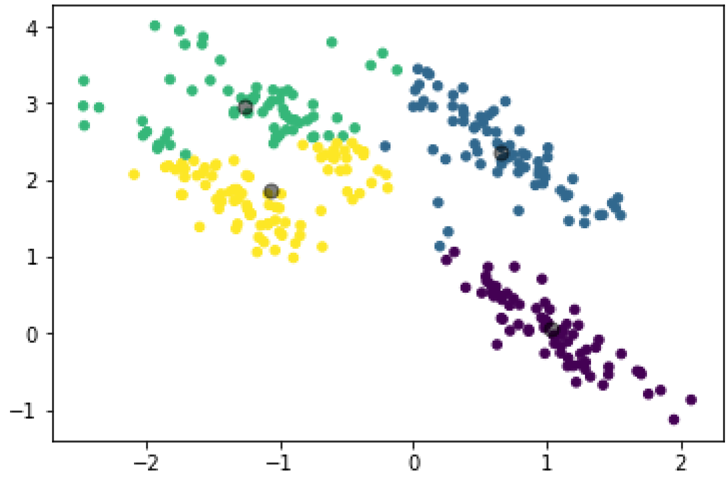


In [34]:

```
from sklearn.cluster import KMeans # Для сравнения методом к-средних
kmeans = KMeans(n_clusters = 4)
kmeans.fit(X_stretched)
y_kmeans = kmeans.predict(X_stretched)
plt.scatter(X_stretched[:, 0], X_stretched[:, 1], c = y_kmeans, s = 20, cmap = 'viridis')
centers = kmeans.cluster_centers_
plt.scatter(centers[:, 0], centers[:, 1], c = 'black', s = 50, alpha = 0.5)
```

Out[34]:

```
<matplotlib.collections.PathCollection at 0xcaf8b70>
```



In [17]:

```
y_kmeans
```

Out[17]:

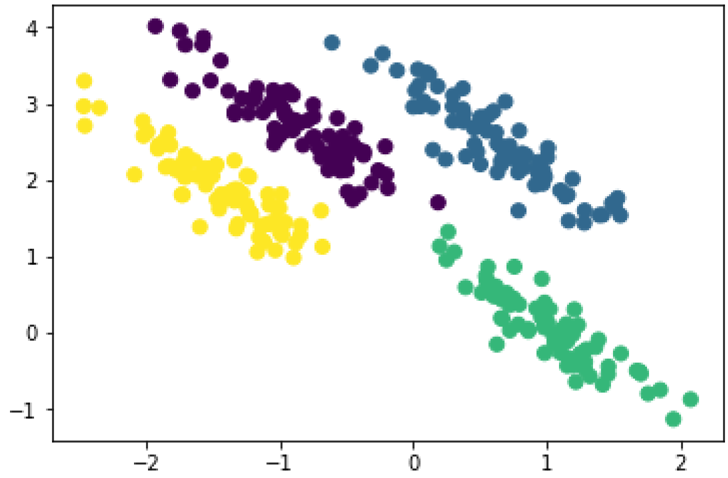
```
array([2, 1, 3, 1, 2, 2, 0, 3, 1, 1, 0, 1, 3, 1, 2, 3, 3, 2, 0, 0, 2, 2,
       3, 0, 0, 3, 2, 3, 0, 3, 1, 1, 3, 1, 1, 1, 1, 1, 0, 2, 3, 0, 3, 3,
       0, 0, 1, 0, 1, 2, 0, 2, 1, 2, 2, 0, 1, 0, 1, 2, 1, 3, 1, 0, 0, 0,
       1, 2, 1, 0, 3, 0, 1, 0, 0, 1, 0, 3, 2, 1, 2, 3, 2, 2, 1, 3, 2, 3,
       1, 1, 3, 2, 1, 0, 0, 3, 2, 2, 3, 0, 1, 2, 1, 2, 3, 2, 2, 3, 1, 3,
       0, 0, 2, 1, 2, 3, 1, 2, 2, 3, 0, 2, 0, 2, 2, 2, 2, 0, 2, 0, 1, 0,
       0, 2, 1, 0, 0, 1, 3, 1, 1, 0, 3, 0, 3, 0, 1, 3, 1, 1, 1, 3, 1, 3,
       2, 0, 1, 0, 2, 3, 1, 3, 3, 2, 3, 0, 0, 3, 2, 3, 3, 1, 2, 3, 0, 1,
       2, 2, 3, 0, 2, 3, 0, 0, 3, 3, 3, 3, 2, 1, 3, 0, 3, 3, 0, 0, 0, 3,
       0, 1, 3, 0, 2, 0, 3, 1, 0, 1, 3, 1, 3, 0, 3, 3, 1, 0, 0, 2, 2, 3,
       1, 2, 2, 0, 2, 0, 3, 1, 1, 3, 3, 1, 3, 2, 0, 3, 2, 0, 1, 0, 2, 3,
       2, 1, 1, 1, 1, 0, 0, 1, 3, 0, 2, 3, 0, 0, 0, 2, 2, 1, 3, 3, 0, 2,
       1, 0, 3, 1, 3, 2, 2, 0, 0, 3, 2, 2, 2, 3, 1, 1, 2, 2, 3, 2, 2, 2,
       1, 0, 1, 3, 2, 2, 1, 1, 1, 2, 2, 3, 1, 0])
```

In [33]:

```
from sklearn.mixture import gaussian_mixture
gmm = gaussian_mixture.GaussianMixture(n_components = 4) # EM-алгоритм
gmm.fit(X_stretched)
labels = gmm.predict(X_stretched)
plt.scatter(X_stretched[:, 0], X_stretched[:, 1], c = labels, s = 50, cmap = 'viridis')
```

Out[33]:

<matplotlib.collections.PathCollection at 0xca9eba8>



Сегментация изображений. Задание.

Пусть дано цветное изображение. В качестве вектор-признака пикселя примем вектор (r, g, b). Используя методы кластеризации, разбить полученное множество векторов на кластеры -- сегменты.

In [1]:

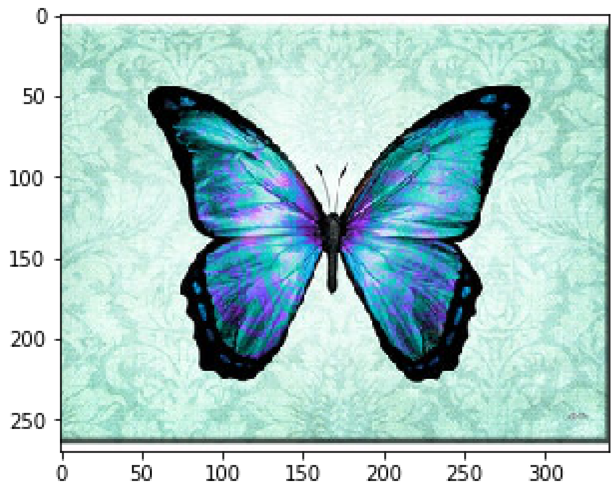
```
from PIL import Image                 # для работы с изображениями
```

In [23]:

```
# открываем картинку и преобразуем в монохромное
im = np.array(Image.open('segment.jpg'))
fig = plt.figure()
plt.imshow(im)
```

Out[23]:

```
<matplotlib.image.AxesImage at 0x19b00130e48>
```



In [24]:

```
m, n, s = im.shape
```

In [25]:

```
im = im.reshape((m * n, s)) # Здесь векторы-признаки пикселей
im.shape
```

Out[25]:

```
(91800, 3)
```

In [12]:

```
im = im.reshape((m * n, s))
im.shape
```

Out[12]:

```
(91800, 3)
```

In [26]:

```
from sklearn.cluster import KMeans
n_clusters = 3
'''
метод к-средних...
'''
```

In [27]:

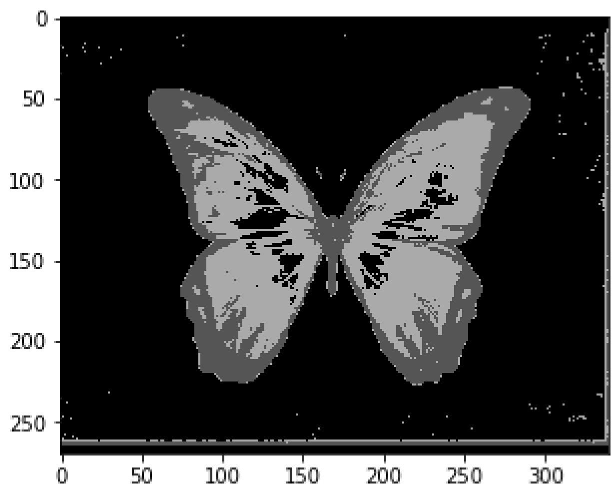
```
im[:, 0] = (y_kmeans[:] / n_clusters) * 255
im[:, 1] = (y_kmeans[:] / n_clusters) * 255
im[:, 2] = (y_kmeans[:] / n_clusters) * 255
```

In [28]:

```
''' Сегментация методом к-средних '''
im = im.reshape((m, n, s))
fig = plt.figure()
plt.imshow(im)
```

Out[28]:

<matplotlib.image.AxesImage at 0x19b001980f0>



In [21]:

```
'''
EM-алгоритм
'''
```

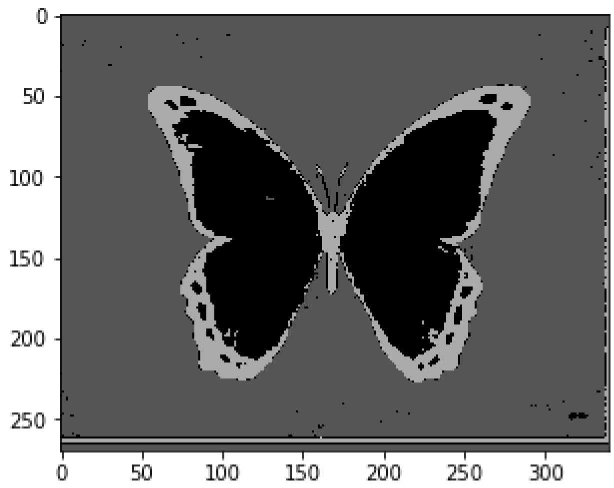
In [22]:

```
''' Сегментация с помощью EM-алгоритма'''

im = im.reshape((m, n, s))
fig = plt.figure()
plt.imshow(im)
```

Out[22]:

```
<matplotlib.image.AxesImage at 0x19b000d3cf8>
```



In [ ]:

```
```