RK_2

June 3, 2019

0.1 Mironov S.V. IU5-62 Var 2(clustering)

```
In [1]: #!pip install seaborn
```

```
DEPRECATION: Python 2.7 will reach the end of its life on January 1st, 2020. Please upgrade you
Requirement already satisfied: seaborn in /usr/local/lib/python2.7/dist-packages (0.9.0)
Requirement already satisfied: matplotlib>=1.4.3 in /usr/lib/python2.7/dist-packages (from seal
Requirement already satisfied: numpy>=1.9.3 in /usr/local/lib/python2.7/dist-packages (from sea
Requirement already satisfied: pandas>=0.15.2 in /usr/local/lib/python2.7/dist-packages (from s
Requirement already satisfied: scipy>=0.14.0 in /usr/local/lib/python2.7/dist-packages (from se
Requirement already satisfied: pytz>=2011k in /usr/lib/python2.7/dist-packages (from pandas>=0
Requirement already satisfied: python-dateutil>=2.5.0 in /usr/lib/python2.7/dist-packages (fror
```

```
In [17]: import numpy as np
         import pandas as pd
         from sklearn import datasets
         import matplotlib.pyplot as plt
         import seaborn as sns


         from sklearn.metrics import accuracy_score, balanced_accuracy_score
         from sklearn.metrics import precision_score, recall_score, f1_score, classification_re
         from sklearn.metrics import confusion_matrix
         from sklearn.metrics import mean_absolute_error, mean_squared_error, mean_squared_log_
         from sklearn.metrics import roc_curve, roc_auc_score
         from sklearn.model_selection import train_test_split, GridSearchCV
         from sklearn.neighbors import KNeighborsRegressor, KNeighborsClassifier
         from sklearn.model_selection import learning_curve, validation_curve

         from typing import Dict, Tuple
         from scipy import stats
         from IPython.display import Image
         from sklearn import cluster, datasets, mixture
         from sklearn.neighbors import kneighbors_graph
         from sklearn.preprocessing import StandardScaler
         from sklearn.metrics import adjusted_rand_score
         from sklearn.metrics import adjusted_mutual_info_score
         from sklearn.metrics import homogeneity_completeness_v_measure
         from sklearn.metrics import silhouette_score
         from itertools import cycle, islice


         %matplotlib inline

In [11]: df = pd.read_csv('s1.txt', sep="    ", header=None)

/usr/local/lib/python3.6/dist-packages/ipykernel/__main__.py:1: ParserWarning: Falling back to
  if __name__ == '__main__':


In [33]: df.head()

Out[33]:         0       1
         0  664159  550946
         1  665845  557965
         2  597173  575538
         3  618600  551446
         4  635690  608046

In [0]: df.head()

In [55]: cluster_n_samples = 1500

         datasets_names = ['circles', 'moons', 'blobs', 'aniso', 'varied', 'no_structure']


         def generate_datasets(n_samples):
             """
                 1500
             """
             noisy_circles, noisy_circles_y = datasets.make_circles(
                 n_samples=n_samples, factor=0.9, noise=.01)
             noisy_moons, noisy_moons_y = datasets.make_moons(n_samples=n_samples, noise=.2)
             blobs, blobs_y = datasets.make_blobs(n_samples=n_samples, random_state=32)
             no_structure = np.random.rand(n_samples, 7)

             X_aniso, y_aniso = datasets.make_blobs(n_samples=n_samples, random_state=320)
             transformation = [[-0.6, 0.3], [-0.7, 0.1]]
             aniso = np.dot(X_aniso, transformation)

             varied, varied_y = datasets.make_blobs(
                 n_samples=n_samples,
                 cluster_std=[3.5, 0.5, 2.5],
                 random_state=370)

             result_y = [noisy_circles_y, noisy_moons_y, varied_y, y_aniso, blobs_y]
```

```
        result_not_scaled = [noisy_circles, noisy_moons,
                             varied, aniso, blobs, no_structure]

        #
        result = []
        for data in result_not_scaled:
            data_res = StandardScaler().fit_transform(data)
            result.append(data_res)

        return result, result_y
```

```
In [56]: def visualize_clusters(cluster_datasets, cluster_results):
             """

             """
             plt.subplots(figsize=(10,7))
             plot_num = 0
             for X, y_pred in zip(cluster_datasets, cluster_results):
                 plot_num += 1
                 plt.subplot(2, 3, plot_num)
                 #
                 colors = np.array(list(islice(cycle(['#377eb8', '#ff7f00', '#4daf4a',
                                                      '#f781bf', '#a65628', '#984ea3',
                                                      '#999999', '#e41a1c', '#dede00']),
                                               int(max(y_pred) + 1))))
                 #
                 colors = np.append(colors, ["#000000"])
                 plt.scatter(X[:, 0], X[:, 1], s=3, color=colors[y_pred])
                 plt.xlim(-2.5, 2.5)
                 plt.ylim(-2.5, 2.5)
                 plt.xticks(())
                 plt.yticks(())
                 plt.title(datasets_names[plot_num-1])

             plt.show()
```

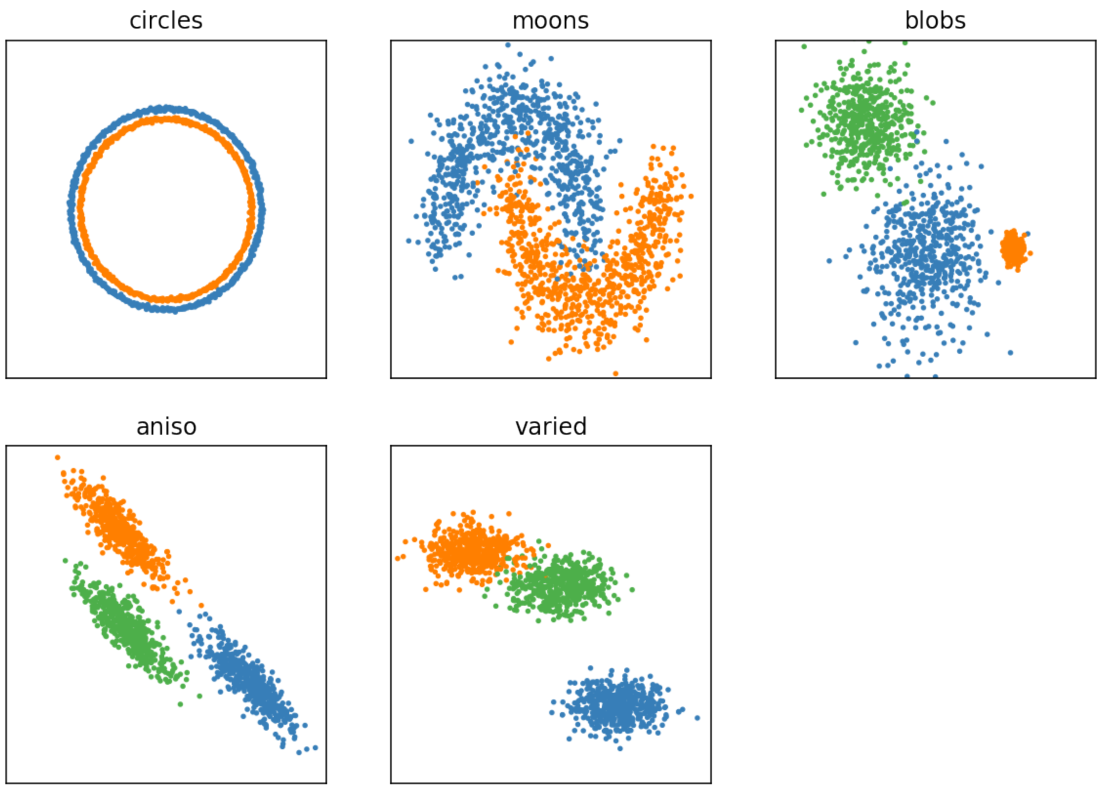
```
In [57]: def do_clustering(cluster_datasets, method):
             """

             """
             cluster_results = []
             for X in cluster_datasets:
                 temp_cluster = method.fit_predict(X)
                 cluster_results.append(temp_cluster)
             return cluster_results
```

```
In [58]: from sklearn.cluster import KMeans, MiniBatchKMeans
In [59]: cluster_datasets, cluster_true_y = generate_datasets(cluster_n_samples)
```

```
In [60]: visualize_clusters(cluster_datasets, cluster_true_y)
```

Out[60]:

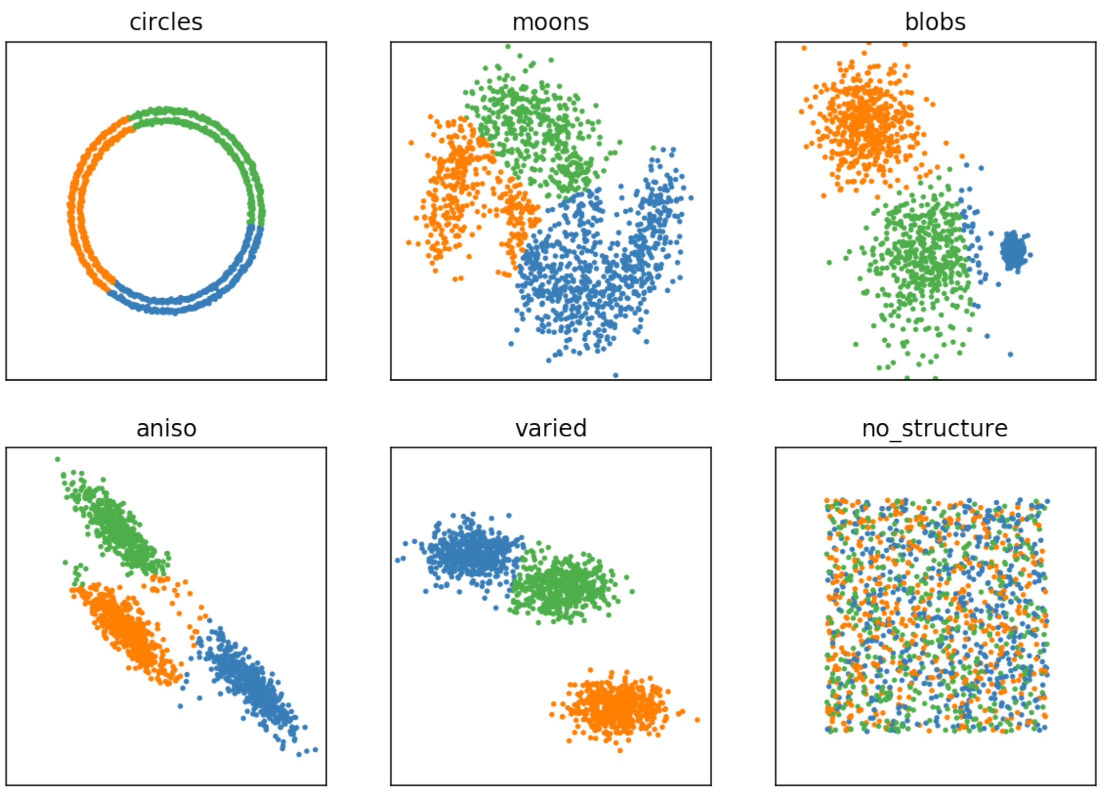


```
In [63]: %time result_KMeans_3 = do_clustering(cluster_datasets, KMeans(n_clusters=3))
```

```
CPU times: user 303 ms, sys: 208 ms, total: 511 ms
Wall time: 505 ms
```

```
In [65]: visualize_clusters(cluster_datasets, result_KMeans_3)
```

Out[65]:



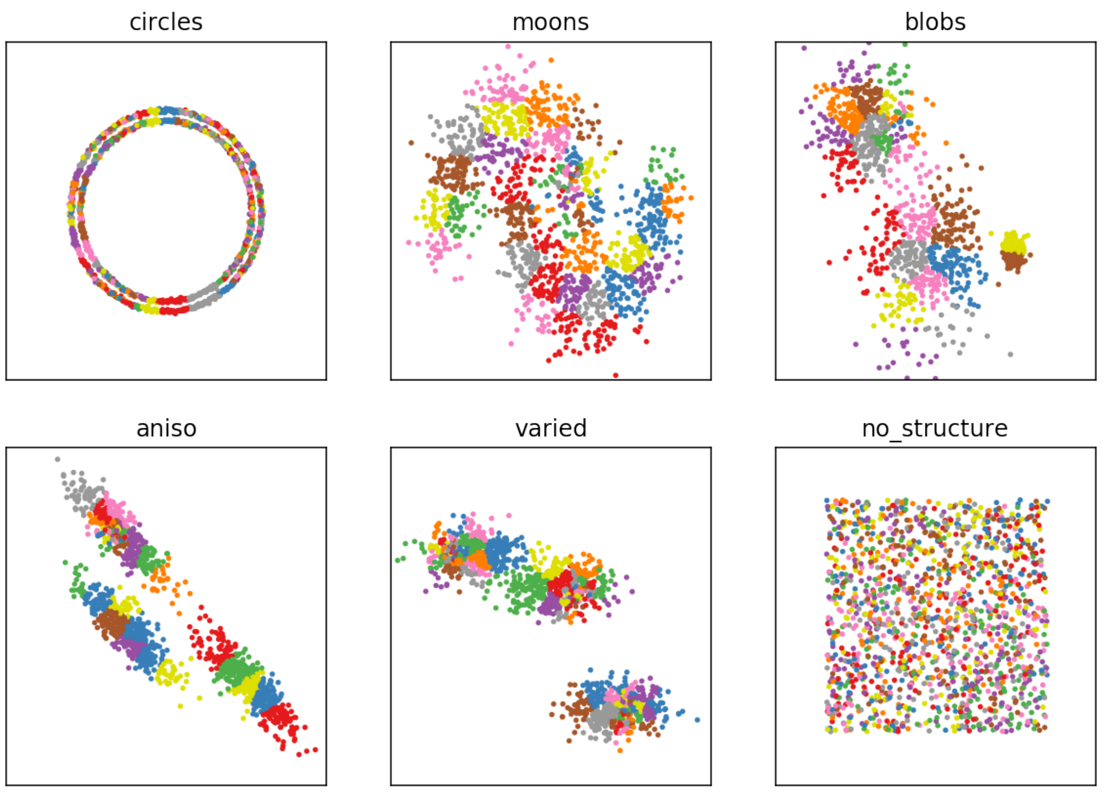
```
In [67]: from sklearn.cluster import AffinityPropagation

In [68]: %time result_AffinityPropagation = do_clustering(cluster_datasets, AffinityPropagatio
```

```
CPU times: user 55.2 s, sys: 1.15 s, total: 56.4 s
Wall time: 59 s
```

```
In [69]: visualize_clusters(cluster_datasets, result_AffinityPropagation)
```

Out[69]:



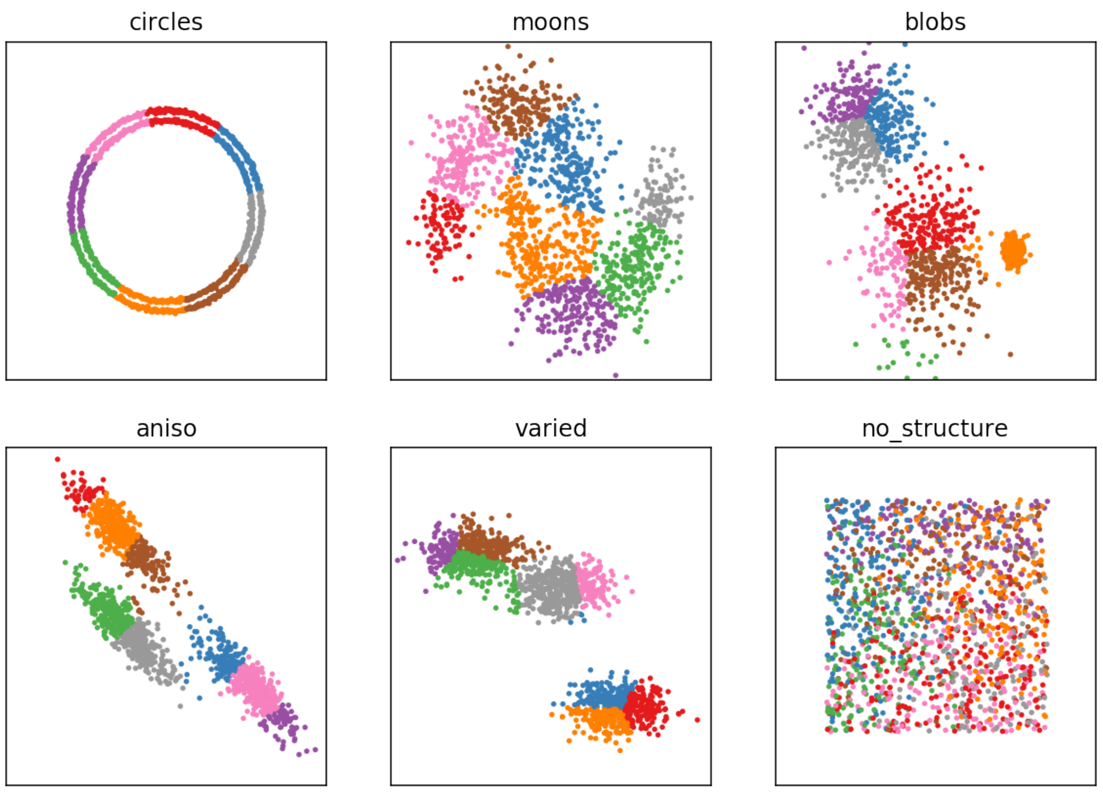
```
In [71]: from sklearn.cluster import SpectralClustering

In [72]: %time result_SpectralClustering = do_clustering(cluster_datasets, SpectralClustering()

CPU times: user 5.94 s, sys: 4.59 s, total: 10.5 s
Wall time: 10.6 s


In [73]: visualize_clusters(cluster_datasets, result_SpectralClustering)

Out[73]:
```



```
In [74]: import warnings
         warnings.simplefilter(action='ignore', category=FutureWarning)

         def claster_metrics(method, cluster_datasets, cluster_true_y, datasets_names):
             """

             """
             ari = []
             ami = []
             hl = []
             cl = []
             vl = []
             sl = []
             for X, true_y in zip(cluster_datasets, cluster_true_y):
                 temp_cluster = method.fit_predict(X)
                 ari.append(adjusted_rand_score(true_y, temp_cluster))
                 ami.append(adjusted_mutual_info_score(true_y, temp_cluster))

                 h, c, v = homogeneity_completeness_v_measure(true_y, temp_cluster)
                 hl.append(h)
                 cl.append(c)
                 vl.append(v)
```

```
        sl.append(silhouette_score(X, temp_cluster))

    result = pd.DataFrame({'Datasets':datasets_names[0:5],
                           'ARI':ari, 'AMI':ami,
                           'Homogeneity':hl,
                           'Completeness':cl,
                           'V-measure':vl, 'Silhouette':sl})
    return result
```

0.2 Metrics for k near

```
In [75]: claster_metrics(KMeans(n_clusters=3), cluster_datasets, cluster_true_y, datasets_names

Out[75]:   Datasets       ARI       AMI  Homogeneity  Completeness  V-measure  \
         0  circles -0.000888 -0.000607     0.000002      0.000001   0.000001
         1    moons  0.395917  0.293977     0.447369      0.294425   0.355130
         2    blobs  0.893052  0.866318     0.866481      0.868750   0.867614
         3    aniso  0.914260  0.875655     0.875806      0.876036   0.875921
         4   varied  0.949284  0.926801     0.926890      0.926895   0.926892

            Silhouette
         0    0.470246
         1    0.418815
         2    0.646185
         3    0.623058
         4    0.669755
```

0.3 Metrics for Spectral Clustering

```
In [76]: claster_metrics(SpectralClustering(), cluster_datasets, cluster_true_y, datasets_names

Out[76]:   Datasets       ARI       AMI  Homogeneity  Completeness  V-measure  \
         0  circles -0.001135 -0.001094     0.000097      0.000032   0.000049
         1    moons  0.205532  0.253531     0.740636      0.254397   0.378712
         2    blobs  0.604992  0.559580     0.935321      0.560714   0.701117
         3    aniso  0.521903  0.541265     0.964589      0.542367   0.694328
         4   varied  0.455050  0.491318     0.902213      0.492503   0.637180

            Silhouette
         0    0.488973
         1    0.368644
         2    0.505368
         3    0.440729
         4    0.307920
```

0.4 Metrics for Affinity Propagation

```
In [77]: claster_metrics( AffinityPropagation(), cluster_datasets, cluster_true_y, datasets_nan
Out[77]:   Datasets       ARI       AMI  Homogeneity  Completeness  V-measure  \
         0  circles  0.004507  0.025733     0.817080      0.094764   0.169831
         1    moons  0.055369  0.159887     0.867517      0.165458   0.277911
         2    blobs  0.299367  0.353782     0.967304      0.359323   0.523997
         3    aniso  0.167097  0.299909     0.991408      0.314595   0.477628
         4   varied  0.085877  0.220834     0.957495      0.245806   0.391187

            Silhouette
         0    0.097319
         1    0.267576
         2    0.278822
         3    0.265528
         4    0.149381
```