DecisionTreeAgosto

July 29, 2018

1 Decision Tree en agosto

En este notebook vamos a ver cómo se comportan los DecisionTree con el dataset de digits. Vamos a probar Decision Tree usando el dataset normal, usando los RFF que vienen por defecto, usando la tangente en vez del coseno, también vamos a probar el Nßstroem

Lectura del dataset

```
In [1]: %matplotlib inline
        import matplotlib.pyplot as plt
        import numpy as np
        from time import time
        import math

        # Import datasets, classifiers and performance metrics
        from sklearn import datasets, pipeline
        #from sklearn import sum
        from sklearn.kernel_approximation import (RBFSampler,
                                                  Nystroem)
        #from sklearn.decomposition import PCA

        from sklearn.tree import DecisionTreeClassifier
        from sklearn.linear_model import LogisticRegression
        #from sklearn.neural_network import MLPClassifier

In [2]: from ribes_tan_RFFSampler import ribes_tan_RFFSampler

In [3]: # The digits dataset
        digits = datasets.load_digits()

In [4]: data = digits.data
        target = digits.target
        N = data.shape[0]
        prop_train = 1 / 2
        N_train = math.ceil(N * prop_train)
        N_test = N - N_train
```

```
In [5]: data /= 16
        data -= data.mean(axis = 0)

In [6]: data_train = data[:N_train]
        data_test = data[N_train:]

        target_train = target[:N_train]
        target_test = target[N_train:]
```

2 Decision Tree normal

```
In [7]: dtc = DecisionTreeClassifier()

In [8]: dtc.fit(data_train, target_train)

Out[8]: DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                    max_features=None, max_leaf_nodes=None,
                    min_impurity_decrease=0.0, min_impurity_split=None,
                    min_samples_leaf=1, min_samples_split=2,
                    min_weight_fraction_leaf=0.0, presort=False, random_state=None,
                    splitter='best')

In [9]: train_score_normal_dt = dtc.score(data_train, target_train)
        test_score_nomal_dt = dtc.score(data_test, target_test)

In [10]: train_score_normal_dt, test_score_nomal_dt

Out[10]: (1.0, 0.7594654788418709)
```

3 Decision Tree con RBFSampler

```
In [11]: feature_map_fourier = RBFSampler(gamma=.2, random_state=1)
         feature_map_nystroem = Nystroem(gamma=.2, random_state=1)

In [12]: dtc_rbf = pipeline.Pipeline([("feature_map", feature_map_fourier),
                                       ("ctf", DecisionTreeClassifier())])

In [13]: D = 500

In [14]: dtc_rbf.set_params(feature_map__n_components=D)

Out[14]: Pipeline(memory=None,
              steps=[('feature_map', RBFSampler(gamma=0.2, n_components=500, random_state=1)),
                     max_features=None, max_leaf_nodes=None,
                     min_impurity_decrease=0.0, min_impurity_split=None,
                     min_samples_leaf=1, min_samples_split=2,
                     min_weight_fraction_leaf=0.0, presort=False, random_state=None,
                     splitter='best'))])
```

```
In [15]: dtc_rbf.fit(data_train, target_train)

Out[15]: Pipeline(memory=None,
              steps=[('feature_map', RBFSampler(gamma=0.2, n_components=500, random_state=1)),
                     max_features=None, max_leaf_nodes=None,
                     min_impurity_decrease=0.0, min_impurity_split=None,
                     min_samples_leaf=1, min_samples_split=2,
                     min_weight_fraction_leaf=0.0, presort=False, random_state=None,
                     splitter='best'))])

In [16]: train_score = dtc_rbf.score(data_train, target_train)
         test_score = dtc_rbf.score(data_test, target_test)

In [17]: train_score, test_score

Out[17]: (1.0, 0.6458797327394209)
```

4 Decision Tree con Nystroem

```
In [18]: dtc_nys = pipeline.Pipeline([("feature_map", feature_map_nystroem),
                                      ("ctf", DecisionTreeClassifier())])

In [19]: dtc_nys.set_params(feature_map__n_components=D)

Out[19]: Pipeline(memory=None,
              steps=[('feature_map', Nystroem(coef0=None, degree=None, gamma=0.2, kernel='rbf'
              n_components=500, random_state=1)), ('ctf', DecisionTreeClassifier(class_weight=
                     max_features=None, max_leaf_nodes=None,
                     min_impur...      min_weight_fraction_leaf=0.0, presort=False, random_sta
                     splitter='best'))])

In [20]: dtc_nys.fit(data_train, target_train)

Out[20]: Pipeline(memory=None,
              steps=[('feature_map', Nystroem(coef0=None, degree=None, gamma=0.2, kernel='rbf'
              n_components=500, random_state=1)), ('ctf', DecisionTreeClassifier(class_weight=
                     max_features=None, max_leaf_nodes=None,
                     min_impur...      min_weight_fraction_leaf=0.0, presort=False, random_sta
                     splitter='best'))])

In [21]: train_score = dtc_nys.score(data_train, target_train)
         test_score = dtc_nys.score(data_test, target_test)

In [22]: train_score, test_score

Out[22]: (1.0, 0.6904231625835189)
```

5 Regresión Logística

```
In [23]: logit = LogisticRegression( C = 1e30, multi_class = 'multinomial',
                                     solver = 'lbfgs')

In [24]: logit.fit(data_train, target_train)

Out[24]: LogisticRegression(C=1e+30, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, max_iter=100, multi_class='multinomial',
                   n_jobs=1, penalty='l2', random_state=None, solver='lbfgs',
                   tol=0.0001, verbose=0, warm_start=False)

In [25]: train_score_logit = logit.score(data_train, target_train)
         test_score_logit = logit.score(data_test, target_test)

In [26]: train_score_logit, test_score_logit

Out[26]: (1.0, 0.920935412026726)
```

6 Decision Tree con RFF usando la tangente

```
In [27]: feature_map_tan = ribes_tan_RFFSampler(gamma=.2, random_state=1)

In [28]: dtc_rbf_tan = pipeline.Pipeline([("feature_map", feature_map_tan),
                                           ("ctf", DecisionTreeClassifier())])

In [29]: dtc_rbf_tan.set_params(feature_map__n_components=D)

Out[29]: Pipeline(memory=None,
              steps=[('feature_map', ribes_tan_RFFSampler(gamma=0.2, n_components=500, random_s
                     max_features=None, max_leaf_nodes=None,
                     min_impurity_decrease=0.0, min_impurity_split=None,
                     min_samples_leaf=1, min_samples_split=2,
                     min_weight_fraction_leaf=0.0, presort=False, random_state=None,
                     splitter='best'))])

In [30]: dtc_rbf_tan.fit(data_train, target_train)

Out[30]: Pipeline(memory=None,
              steps=[('feature_map', ribes_tan_RFFSampler(gamma=0.2, n_components=500, random_s
                     max_features=None, max_leaf_nodes=None,
                     min_impurity_decrease=0.0, min_impurity_split=None,
                     min_samples_leaf=1, min_samples_split=2,
                     min_weight_fraction_leaf=0.0, presort=False, random_state=None,
                     splitter='best'))])

In [31]: train_score = dtc_rbf_tan.score(data_train, target_train)
         test_score = dtc_rbf_tan.score(data_test, target_test)

In [32]: train_score, test_score

Out[32]: (1.0, 0.30957683741648107)
```

7 Incrementando la cantidad de features

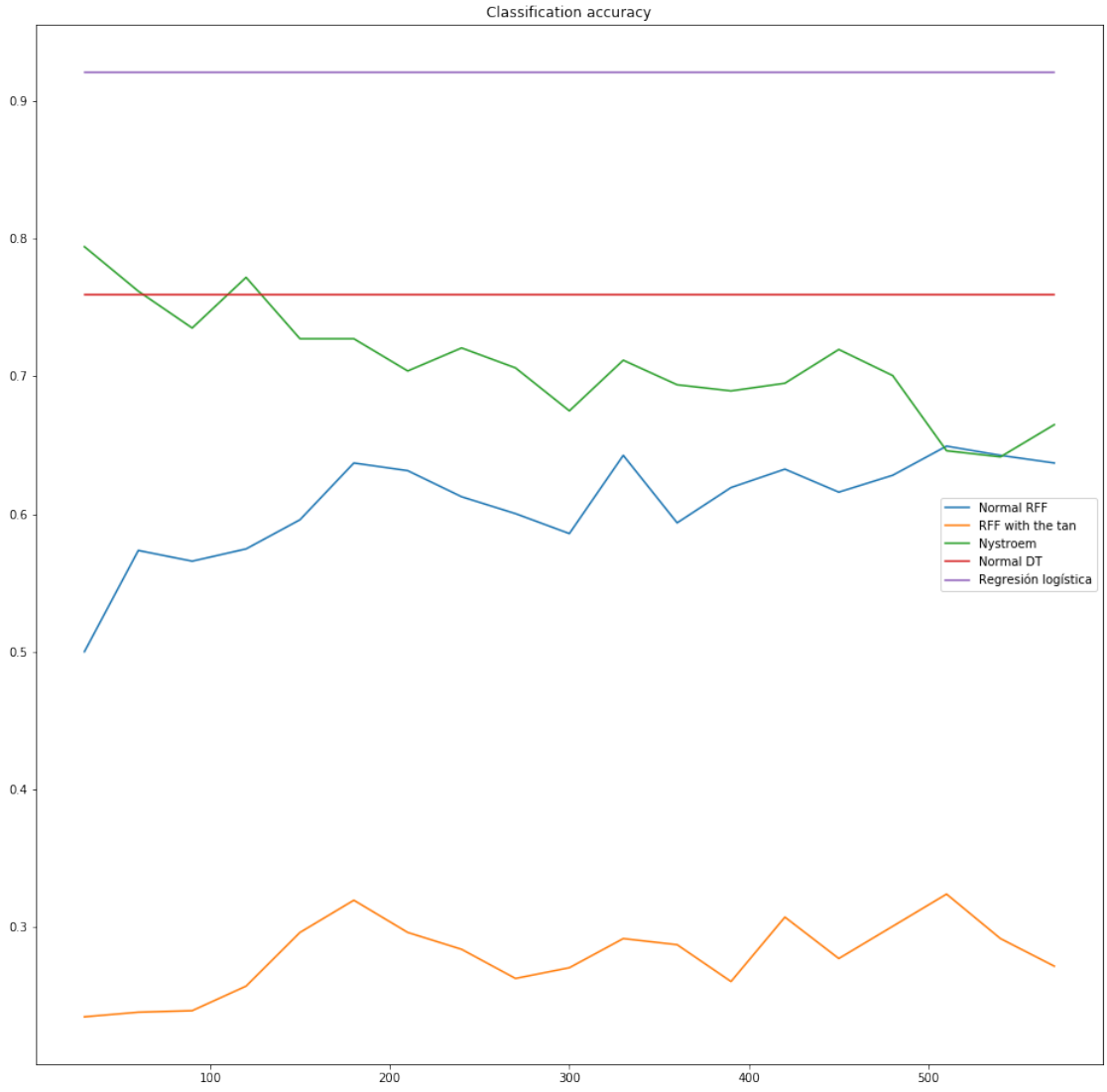
```
In [33]: sample_sizes = 30 * np.arange(1, 20)
```

```
In [34]: normal_fourier_scores = []
         tan_fourier_scores = []
         nystroem_scores = []
```

```
In [35]: for D in sample_sizes:
             dtc_rbf.set_params(feature_map__n_components=D)
             dtc_rbf_tan.set_params(feature_map__n_components=D)
             dtc_nys.set_params(feature_map__n_components=D)

             dtc_rbf.fit(data_train, target_train)
             dtc_rbf_tan.fit(data_train, target_train)
             dtc_nys.fit(data_train, target_train)

             normal_fourier_score = dtc_rbf.score(data_test, target_test)
             tan_fourier_score = dtc_rbf_tan.score(data_test, target_test)
             nystroem_score = dtc_nys.score(data_test, target_test)

             normal_fourier_scores.append(normal_fourier_score)
             tan_fourier_scores.append(tan_fourier_score)
             nystroem_scores.append(nystroem_score)
```

```
In [36]: plt.figure(figsize=(16, 16))
         accuracy = plt.subplot(111)
         accuracy.plot(sample_sizes, normal_fourier_scores, label = "Normal RFF")
         accuracy.plot(sample_sizes, tan_fourier_scores, label = "RFF with the tan")
         accuracy.plot(sample_sizes, nystroem_scores, label = "Nystroem")

         accuracy.plot([sample_sizes[0], sample_sizes[-1]],
                       [test_score_nomal_dt, test_score_nomal_dt], label="Normal DT")
         accuracy.plot([sample_sizes[0], sample_sizes[-1]],
                       [test_score_logit, test_score_logit], label="Regresión logística")

         accuracy.set_title("Classification accuracy")
         accuracy.legend(loc='best')
```

```
Out[36]: <matplotlib.legend.Legend at 0x7f5e58e37160>
```



8 Conclusiones y observaciones

- Parece que regresión logística va mucho mejor que Decision Tree. Se supone que esto no debería ser así. Creo que esto es lo primero que hay que investigar, pues es el caso más simple y el que parece más contradictorio
- El tema de la tangente es un fracaso absoluto. Es totalmente aleatorio, y no generaliza nada, aunque sí que es capaz de memorizar
- Entre Nystroem y RFF parece que Nystroem es mejor, aunque tampoco despunta demasiado. Da la impresión que al incrementear la cantidad de features Nystroem va empeorando, y en cambio RFF va mejorando, pero no conozco los detalles de Nystroem y no sé si es lo normal
- La primera impresión es que no parece salir a cuenta hacer ningún tipo de resampling de los datos, con ninguno de los métodos