ML computer_image_classification

May 28, 2019

0.0.1 Computer vision for image classification

Problem Statement

After cleaning the dataset, work on the classification

The instances were drawn randomly from a database of 7 outdoor images. The images were hand-segmented to create a classification for every pixel. Each instance is a 3 pixel x 3 pixel region (9 pixels).

Your task is to predict the probability that each 3x3 image region belongs to each of the seven classes (window, foliage, brickface, sky, grass, path, cement).

For each unique 3x3 region you should provide 7 probabilities with value between 0 and 1.

0.0.2 import packages

```
In [1]: %matplotlib inline
        import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        import scipy as sc
        import sklearn as skl
        import seaborn as sns
```

```
In [2]: # Input data files are available in the "../input/" directory.
        # For example, running this (by clicking run or pressing Shift+Enter) will list the fi

        import os
        print(os.listdir("../cmu_data"))
```

```
['.ipynb_checkpoints', 'train.csv', 'clean_image.csv', 'sample_submission_fixed.csv', 'test.cs
```

0.0.3 import dataset

```
In [3]: #import csv data and read it as a dataframe
        image_test_df=pd.read_csv('../cmu_data/test.csv', sep=',')
        image_train_df=pd.read_csv('../cmu_data/train.csv', sep=',')
```

0.1 EDA

```
In [4]: image_test_df.head(2)
```

```
Out[4]:    id  REGION-CENTROID-COL  REGION-CENTROID-ROW  REGION-PIXEL-COUNT  \
        0   0                  105                  110                   9
        1   1                   36                  189                   9

           SHORT-LINE-DENSITY-5  SHORT-LINE-DENSITY-2  VEDGE-MEAN  VEDGE-SD  \
        0                   0.0                   0.0    0.500000  0.122222
        1                   0.0                   0.0    1.944444  2.462961

           HEDGE-MEAN   HEDGE-SD  INTENSITY-MEAN  RAWRED-MEAN  RAWBLUE-MEAN  \
        0    1.944444   2.374073        4.222222     4.333334      6.333334
        1    5.833334  21.588884       31.370370    28.444445     38.000000

           RAWGREEN-MEAN  EXRED-MEAN  EXBLUE-MEAN  EXGREEN-MEAN  VALUE-MEAN  \
        0       2.000000    0.333333     6.333334     -6.666666    6.333334
        1      27.666666   -8.777778    19.888890    -11.111111   38.000000

           SATURATION-MEAN  HUE-MEAN
        0         0.708333 -1.539762
        1         0.266302 -2.020345
```

```
In [5]: image_train_df.head(2)
```

```
Out[5]:    REGION-CENTROID-COL  REGION-CENTROID-ROW  REGION-PIXEL-COUNT  \
        0                123.0                152.0                   9
        1                226.0                110.0                   9

           SHORT-LINE-DENSITY-5  SHORT-LINE-DENSITY-2  VEDGE-MEAN  VEDGE-SD  \
        0                   0.0                   0.0    0.000000  0.000000
        1                   0.0                   0.0    0.333333  0.088889

           HEDGE-MEAN  HEDGE-SD  INTENSITY-MEAN  RAWRED-MEAN  RAWBLUE-MEAN  \
        0         0.0  0.000000        0.000000     0.000000      0.000000
        1         0.5  0.211111        1.666667     0.111111      4.444445

           RAWGREEN-MEAN  EXRED-MEAN  EXBLUE-MEAN  EXGREEN-MEAN  VALUE-MEAN  \
        0       0.000000    0.000000     0.000000      0.000000    0.000000
        1       0.444444   -4.666666     8.333333     -3.666667    4.444445

           SATURATION-MEAN  HUE-MEAN  CLASS
        0         0.000000  0.000000      0
        1         0.977778 -2.155984      1
```

```
In [6]: image_train_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 210 entries, 0 to 209
```

```
Data columns (total 20 columns):
REGION-CENTROID-COL     210 non-null float64
REGION-CENTROID-ROW     210 non-null float64
REGION-PIXEL-COUNT      210 non-null int64
SHORT-LINE-DENSITY-5    210 non-null float64
SHORT-LINE-DENSITY-2    210 non-null float64
VEDGE-MEAN              210 non-null float64
VEDGE-SD                210 non-null float64
HEDGE-MEAN              210 non-null float64
HEDGE-SD                210 non-null float64
INTENSITY-MEAN          210 non-null float64
RAWRED-MEAN             210 non-null float64
RAWBLUE-MEAN            210 non-null float64
RAWGREEN-MEAN           210 non-null float64
EXRED-MEAN              210 non-null float64
EXBLUE-MEAN             210 non-null float64
EXGREEN-MEAN            210 non-null float64
VALUE-MEAN              210 non-null float64
SATURATION-MEAN         210 non-null float64
HUE-MEAN                210 non-null float64
CLASS                   210 non-null int64
dtypes: float64(18), int64(2)
memory usage: 32.9 KB
```

```
In [7]: image_train_df.shape
```

```
Out[7]: (210, 20)
```

```
In [8]: # to change dtype use .astype()
        image_train_df['REGION-PIXEL-COUNT'] = image_train_df['REGION-PIXEL-COUNT'].astype(floa
```

0.1.1 Clean datasets

```
In [9]: image_train_df.isnull().values.any()
```

```
Out[9]: False
```

```
In [10]: image_test_df[image_test_df.isnull().values.any(axis=1)]
```

```
Out[10]: Empty DataFrame
         Columns: [id, REGION-CENTROID-COL, REGION-CENTROID-ROW, REGION-PIXEL-COUNT, SHORT-LINE
         Index: []
```

0.1.2 check for outliers on train dataframe

0.1.3 IQR method

```
In [11]: import numpy as np
```

```
        def outliers_iqr(image_train_df):
            quartile_1, quartile_3 = np.percentile(image_class_df, [25, 75])
            iqr = quartile_3 - quartile_1
            lower_bound = quartile_1 - (iqr * 1.5)
            upper_bound = quartile_3 + (iqr * 1.5)
            return np.where((image_train_df > upper_bound) | (image_train_df < lower_bound))
```

0.1.4 z-score method

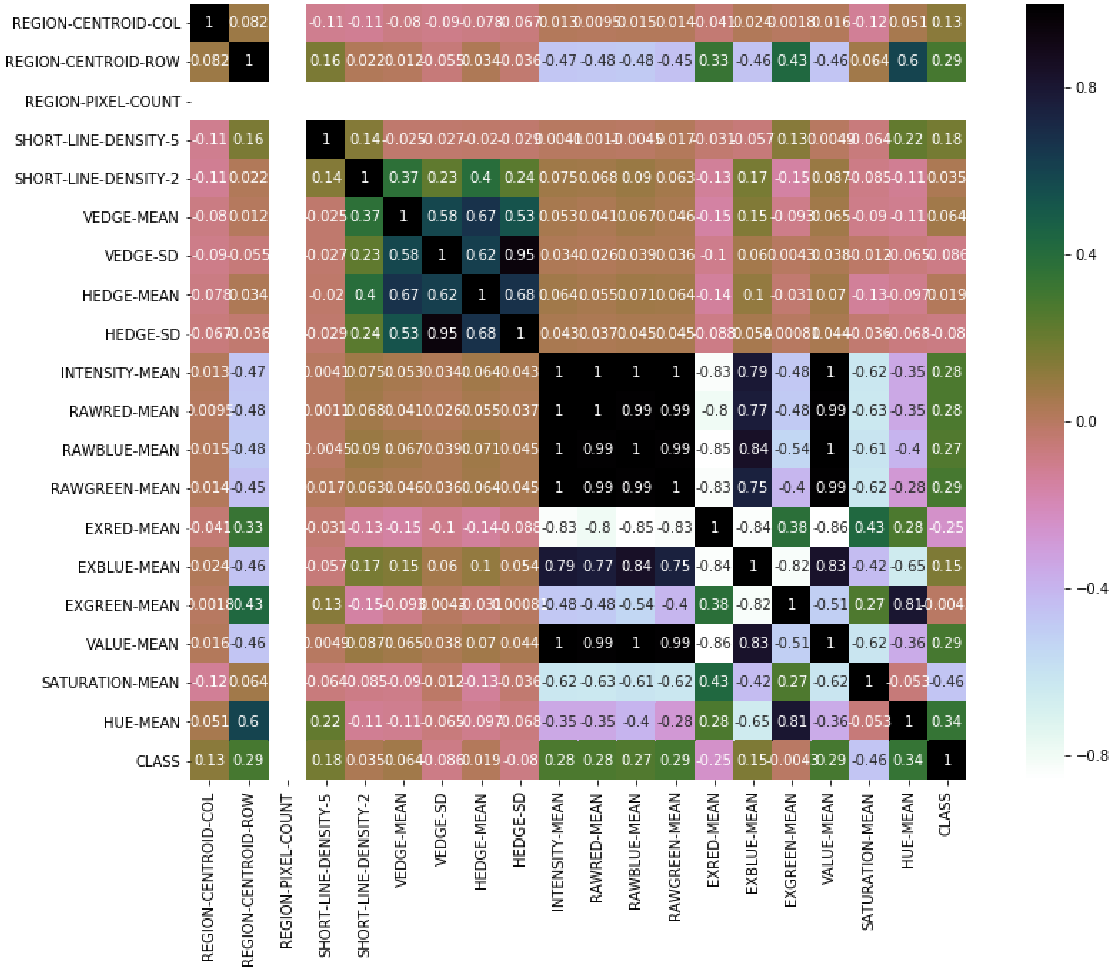
```
In [12]: import numpy as np

         def outliers_z_score(image_train_df):
             threshold = 3

             mean_y = np.mean(image_train_df)
             stdev_y = np.std(image_train_df)
             z_scores = [(y - mean_y) / stdev_y for y in image_train_df]
             return np.where(np.abs(z_scores) > threshold)
```

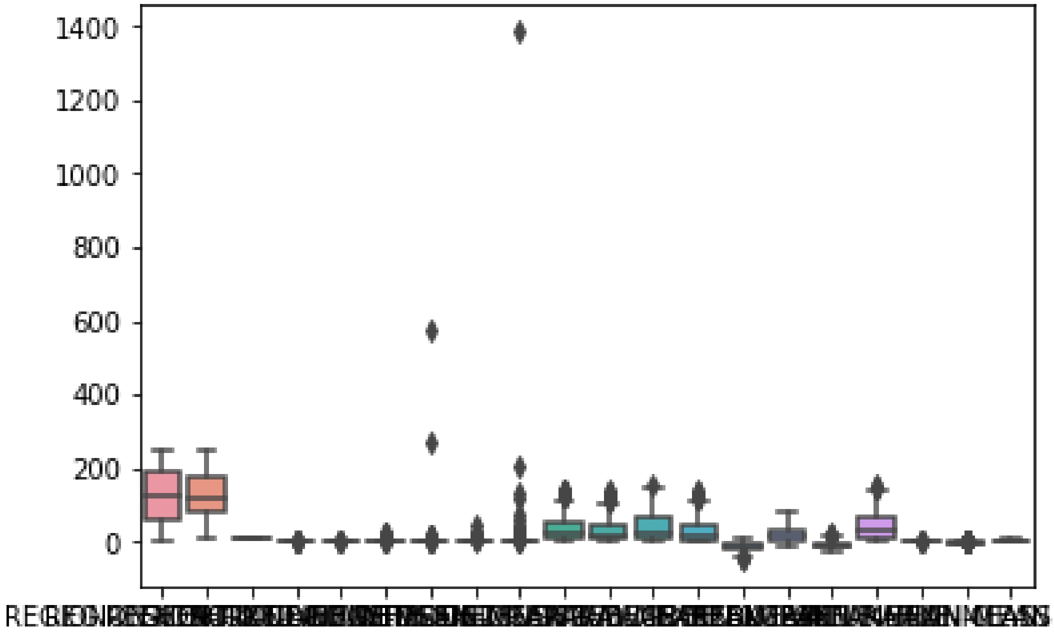
```
In [13]: plt.figure(figsize=(15, 10))
         sns.heatmap(image_train_df.corr(), vmax=1, annot=True, square=True, cmap='cubehelix_r
```

```
Out[13]: <matplotlib.axes._subplots.AxesSubplot at 0x7f07c8c0dba8>
```



0.2 Boxplot

```
In [14]: sns.boxplot(data=image_train_df)
         plt.rcParams['figure.figsize'] = (30, 20)
```



0.2.1 Plot Data

0.3 Train and test

0.3.1 train and test split

```
In [15]: image_train_df.keys()
```

```
Out[15]: Index(['REGION-CENTROID-COL', 'REGION-CENTROID-ROW', 'REGION-PIXEL-COUNT',
                'SHORT-LINE-DENSITY-5', 'SHORT-LINE-DENSITY-2', 'VEDGE-MEAN',
                'VEDGE-SD', 'HEDGE-MEAN', 'HEDGE-SD', 'INTENSITY-MEAN', 'RAWRED-MEAN',
                'RAWBLUE-MEAN', 'RAWGREEN-MEAN', 'EXRED-MEAN', 'EXBLUE-MEAN',
                'EXGREEN-MEAN', 'VALUE-MEAN', 'SATURATION-MEAN', 'HUE-MEAN', 'CLASS'],
               dtype='object')
```

```
In [16]: image_test_df.keys()
```

```
Out[16]: Index(['id', 'REGION-CENTROID-COL', 'REGION-CENTROID-ROW',
                'REGION-PIXEL-COUNT', 'SHORT-LINE-DENSITY-5', 'SHORT-LINE-DENSITY-2',
                'VEDGE-MEAN', 'VEDGE-SD', 'HEDGE-MEAN', 'HEDGE-SD', 'INTENSITY-MEAN',
                'RAWRED-MEAN', 'RAWBLUE-MEAN', 'RAWGREEN-MEAN', 'EXRED-MEAN',
                'EXBLUE-MEAN', 'EXGREEN-MEAN', 'VALUE-MEAN', 'SATURATION-MEAN',
                'HUE-MEAN'],
               dtype='object')
```

```
In [17]: # the classes
         image_train_df['CLASS'].unique()
```

```
Out[17]: array([0, 1, 2, 3, 4, 5, 6])
```

0.4 Train-Test Data Splitting

```
In [ ]: import pandas as pd
        from sklearn import datasets, linear_model
        from sklearn.model_selection import train_test_split
        from matplotlib import pyplot as plt

        columns = ['REGION-CENTROID-COL', 'REGION-CENTROID-ROW', 'REGION-PIXEL-COUNT',
                   'SHORT-LINE-DENSITY-5', 'SHORT-LINE-DENSITY-2', 'VEDGE-MEAN',
                   'VEDGE-SD', 'HEDGE-MEAN', 'HEDGE-SD', 'INTENSITY-MEAN', 'RAWRED-MEAN',
               'RAWBLUE-MEAN', 'RAWGREEN-MEAN', 'EXRED-MEAN', 'EXBLUE-MEAN',
               'EXGREEN-MEAN', 'VALUE-MEAN', 'SATURATION-MEAN', 'HUE-MEAN']

        holdout = image_test_df # from now on we will refer to this
                       # dataframe as the holdout data
        X = image_train_df[columns]
        y = image_train_df['CLASS']

        X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.20,random_state=
```

0.4.1 Prediction of the instances with a given 3*3 pixel region

0.5 Random Forests

```
In [ ]: from sklearn.ensemble import RandomForestClassifier
        rf = RandomForestClassifier(random_state = 42)
        from pprint import pprint
         #Look at parameters used by our current forest
        print('Parameters currently in use:\n')
        pprint(rf.get_params())
```

```
In [ ]: from sklearn.model_selection import RandomizedSearchCV
        # Number of trees in random forest
        n_estimators = [int(x) for x in np.linspace(start = 100, stop = 1000, num = 10)]
        # Number of features to consider at every split
        max_features = ['auto', 'sqrt']
        # Maximum number of levels in tree
        max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
        max_depth.append(None)
        # Minimum number of samples required to split a node
        min_samples_split = [2, 5, 10]
        # Minimum number of samples required at each leaf node
        min_samples_leaf = [1, 2, 4]
        # Method of selecting samples for training each tree
        bootstrap = [True, False]
        # Create the random grid
        random_grid = {'n_estimators': n_estimators,
                       'max_features': max_features,
                       'max_depth': max_depth,
                       'min_samples_split': min_samples_split,
                       'min_samples_leaf': min_samples_leaf,
                       'bootstrap': bootstrap}
        pprint(random_grid)
```

```
In [ ]: from sklearn.ensemble import RandomForestClassifier
        rfc = RandomForestClassifier(n_estimators=800, max_depth=10, min_samples_split=2,
                                     min_samples_leaf=4,max_features='sqrt', bootstrap=True,ra
        rfc.fit(X_train, y_train)
```

```
In [ ]: from sklearn.preprocessing import LabelEncoder

        labels = LabelEncoder()
        y_train_labels_fit = labels.fit(y_train)
        y_train_lables_trf = labels.transform(y_train)

        x_test = holdout.drop(['id'], axis=1)
        holdout_predictions = rfc.predict_proba(x_test)

        # model accuracy for X_test
        accuracy = rfc.score(X_test, y_test)
        print (accuracy)
```

```
In [ ]: test_pred = pd.DataFrame(rfc.predict_proba(x_test)*1, columns=labels.classes_)
        q = {'id': test_data["id"], 'no_financial_services': test_pred[0], 'other_only': test_
            'mm_only': test_pred[2], 'mm_plus': test_pred[3]}
        df_pred = pd.DataFrame(data=q)
        df_pred = df_pred[['ID','no_financial_services', 'other_only', 'mm_only', 'mm_plus'  ]]
```

```
In [ ]: rfc.score(X_train, y_train)
```

0.6 XG BOOST

```
In [ ]: #Applying XGBoost
        import xgboost as xgb

        xgb_clf = xgb.XGBClassifier()
        xgb_clf = xgb_clf.fit(train_X, train_y)

        print('The accuracy of the XGBoost classifier on training data is {:.2f}'.format(xgb_c
        print('The accuracy of the XGBoost classifier on test data is {:.2f}'.format(xgb_clf.s
```

```
In [ ]: xgb = xgb.XGBClassifier()
        model.fit(X, y)
        holdout_predictions = model.predict(holdout[columns])
```

```
In [ ]: holdout_ids = holdout["id"]
        submission_df = {"id": holdout_ids,
                         "CLASS": holdout_predictions}
        submission = pd.DataFrame(submission_df)
        submission.to_csv("submission2.csv",index=False)
```

```
In [ ]:
```