5-rank1-error-confusion-analysis

February 6, 2020

1 Determine NN of all samples used in pairs list of the Balance Faces in the Wild (BFW) dataset.

Uses the data in `data/bfw-datatable.pkl` to determine the NN. Saves the summary to `results/bfw-stats.csv`.

[1]:
```
import pathlib
path_package=f'../'
import sys
if path_package not in sys.path:
    sys.path.append(path_package)
```

[2]:
```
%matplotlib inline
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd
import numpy as np
import glob
from sklearn.metrics.pairwise import cosine_similarity
import matplotlib.colors as colors

from facebias.io import load_bfw_datatable, save_bfw_datatable,␣
↪load_features_from_image_list

import pathlib
sns.set_style('whitegrid',
              {'font.family': 'serif', 'font.serif': 'Times New Roman',
               'fontsize'   : 12})

# Load out custom tool for loading and processing the data
# from facebias.iotools import load_bfw_feature_lut
from facebias.preprocessing import encode_filepaths_to_labels,␣
↪encode_filepaths_to_ethnicity_labels, encode_filepaths_to_gender_labels
```

1.1 Load the data

Get all feature paths and store as dictionary with keys set as the relative file paths.

[3]:
```
# f_features = pathlib.Path('/Users/jrobby/bfw-data/features/resnet50/
 ↪allfeatures.pkl')
dir_features = '../../data/bfw-data/features/senet50/'
files_features = glob.glob(f'{str(dir_features)}/*males/n*/*.npy')
files_features.sort()
data = pd.DataFrame(files_features, columns=['path'])
```

[4]:
```
features = {f.replace(dir_features, ''): np.load(f) for f in files_features}
data.path = data.path.str.replace(dir_features, '')
print(f"{len(features)} features loaded")
```

```
20000 features loaded
```

[5]:
```
data = pd.DataFrame(list(features.keys()), columns=['path'])
data.head()

data['att'] = data.path.apply(lambda x: x.split('/')[0]).astype('category')

data['id'] = data.path.apply(lambda x: "/".join(x.split('/')[:-1])).
 ↪astype('category')

data['e'] = data.att.apply(lambda x: x.split('_')[0][0].upper())

data['g'] = data.att.apply(lambda x: x.split('_')[1][0].upper())

data['a'] = (data['e'] + data['g']).astype('category')

data['e'] = data['e'].astype('category')
data['g'] = data['g'].astype('category')

print(f"No. of Identities: {data.id.unique().shape[0]}\n"
      f"No. of Subgroups: {data.a.unique().shape[0]}\n"
      f"No. of Genders: {data.g.unique().shape[0]}\n"
      f"o. of Ethnics: {data.e.unique().shape[0]}\n")

data.head()
```

```
No. of Identities: 800
No. of Subgroups: 8
No. of Genders: 2
o. of Ethnics: 4
```

[5]:

	path	att	id	e	\
0	asian_females/n000009/0010_01.npy	asian_females	asian_females/n000009	A	
1	asian_females/n000009/0011_01.npy	asian_females	asian_females/n000009	A	
2	asian_females/n000009/0012_01.npy	asian_females	asian_females/n000009	A	

```
3  asian_females/n000009/0013_01.npy  asian_females  asian_females/n000009  A
4  asian_females/n000009/0017_01.npy  asian_females  asian_females/n000009  A

   g   a
0  F  AF
1  F  AF
2  F  AF
3  F  AF
4  F  AF
```

1.2 Calculate similarity matrix.

Pass N features to cosine_similarity; returns an NxN matrix of scores between ith row and jth column.

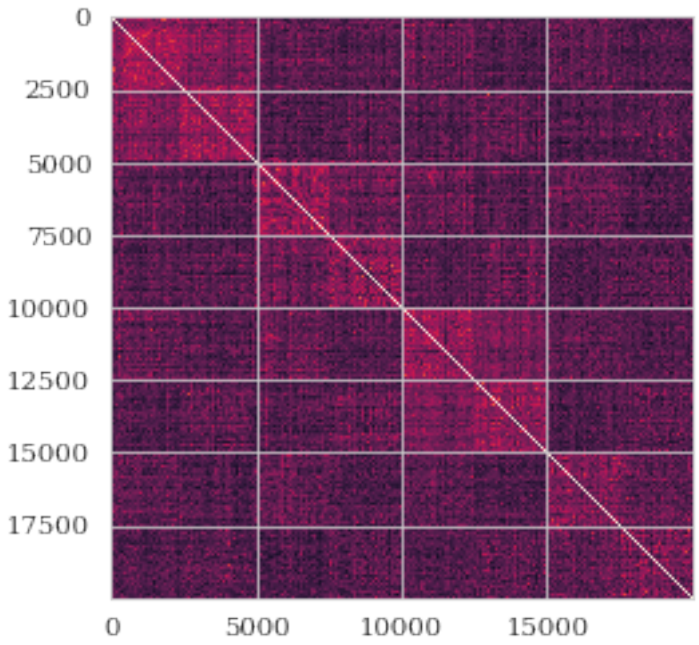
[6]:
```
tup_features = tuple(features.items())
print(tup_features[0])
```

```
('asian_females/n000009/0010_01.npy', array([[7.9472065 , 0.01692374, 1.3884583
, …, 0.04910585, 1.5160486 ,
        0.03306211]], dtype=float32))
```

[7]:
```
score_matrix = cosine_similarity([feature for sublist in
                                  data.path.apply(lambda x: features[x]).
 ↪to_list()
                                  for feature in sublist])
```

[8]:
```
# score_matrix = cosine_similarity([f[1][0] for f in tup_features])

plt.imshow(score_matrix)
```

[8]:
```
<matplotlib.image.AxesImage at 0x1a24127f60>
```



[9]:
```
score_matrix[np.eye(len(score_matrix))==1]=0
```

[10]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
le.fit(data['id'].unique())
data['tag'] = le.transform(data['id'])
data['nn_ids'] = np.argmax(score_matrix, axis=1)
data.head()
```

[10]:

	path	att	id	e	\
0	asian_females/n000009/0010_01.npy	asian_females	asian_females/n000009	A	
1	asian_females/n000009/0011_01.npy	asian_females	asian_females/n000009	A	
2	asian_females/n000009/0012_01.npy	asian_females	asian_females/n000009	A	
3	asian_females/n000009/0013_01.npy	asian_females	asian_females/n000009	A	
4	asian_females/n000009/0017_01.npy	asian_females	asian_females/n000009	A	

	g	a	tag	nn_ids
0	F	AF	0	1432
1	F	AF	0	0
2	F	AF	0	24
3	F	AF	0	1
4	F	AF	0	12

[11]:
```
data['nn']=data.loc[data.nn_ids]['tag'].to_list()
data['nn_type']=data.loc[data.nn_ids]['a'].to_list()
```

```
data['tp'] = (data['tag'] == data['nn']).astype(int)
data['fn'] = (data['tag'] != data['nn']).astype(int)
data.head()
```

[11]:

	path	att	id	e	\
0	asian_females/n000009/0010_01.npy	asian_females	asian_females/n000009	A	
1	asian_females/n000009/0011_01.npy	asian_females	asian_females/n000009	A	
2	asian_females/n000009/0012_01.npy	asian_females	asian_females/n000009	A	
3	asian_females/n000009/0013_01.npy	asian_females	asian_females/n000009	A	
4	asian_females/n000009/0017_01.npy	asian_females	asian_females/n000009	A	

	g	a	tag	nn_ids	nn	nn_type	tp	fn
0	F	AF	0	1432	57	AF	0	1
1	F	AF	0	0	0	AF	1	0
2	F	AF	0	24	0	AF	1	0
3	F	AF	0	1	0	AF	1	0
4	F	AF	0	12	0	AF	1	0

[13]:
```
conf = data.groupby(by=['a','nn_type']).sum()['fn']
# /data.groupby(by=['a','nn_type']).count()['tp']
conf.head()
# data.groupby(by=['a','nn']).count().head()
```

[13]:
```
a   nn_type
AF  AF         290.0
    AM          21.0
    BF           2.0
    BM           NaN
    IF           2.0
Name: fn, dtype: float64
```

[14]:
```
# conf.head(20)
confusion_npy = conf.values.reshape(1,-1)
confusion_npy[np.isnan(confusion_npy)] = 0
confusion_npy=confusion_npy.reshape((8, -1))

print(confusion_npy)
```

```
[[290.  21.   2.   0.   2.   0.   0.   0.]
 [ 23. 168.   0.   0.   0.   3.   1.   2.]
 [  2.   0. 106.   8.   8.   0.   5.   0.]
 [  0.   0.  13. 100.   0.   3.   1.   3.]
 [  3.   0.   0.   0. 130.   4.   2.   0.]
 [  0.   6.   0.   1.   7. 110.   0.   3.]
 [  1.   1.   4.   0.   2.   0.  72.   4.]
 [  0.   2.   1.   1.   0.   6.   0.  19.]]
```

[15]:
```
df_conf = pd.DataFrame(confusion_npy, index=data.a.unique(),
                       columns=data.a.unique())
print(f"\t\t\tNumber of FN\n{df_conf}")
```

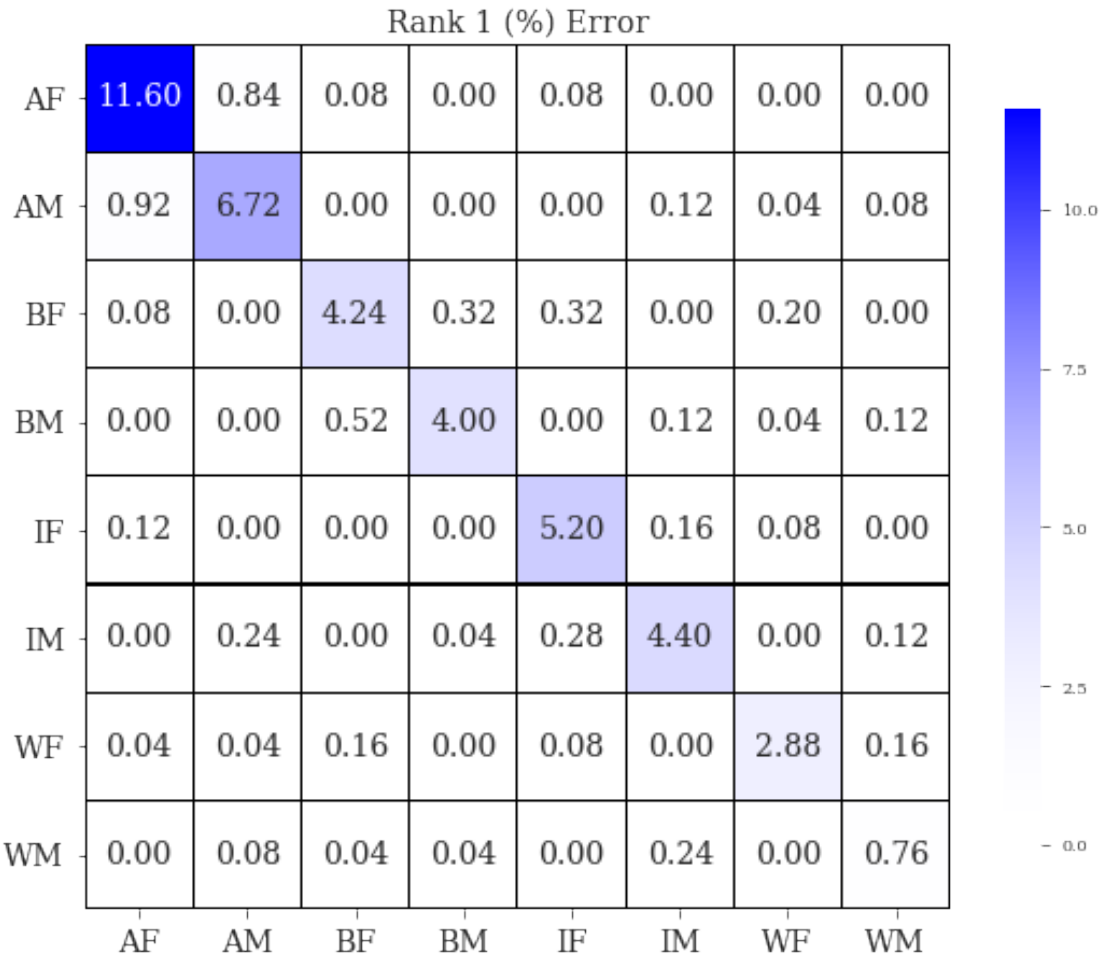
```
                        Number of FN
       AF     AM     BF     BM     IF     IM    WF    WM
AF  290.0   21.0    2.0    0.0    2.0    0.0   0.0   0.0
AM   23.0  168.0    0.0    0.0    0.0    3.0   1.0   2.0
BF    2.0    0.0  106.0    8.0    8.0    0.0   5.0   0.0
BM    0.0    0.0   13.0  100.0    0.0    3.0   1.0   3.0
IF    3.0    0.0    0.0    0.0  130.0    4.0   2.0   0.0
IM    0.0    6.0    0.0    1.0    7.0  110.0   0.0   3.0
WF    1.0    1.0    4.0    0.0    2.0    0.0  72.0   4.0
WM    0.0    2.0    1.0    1.0    0.0    6.0   0.0  19.0
```

[16]:
```
n_samples_per_subgroup=data.a.count()/data.a.nunique()
df_conf_percent_error = (df_conf/n_samples_per_subgroup)*100
colormap = sns.palplot(sns.color_palette("coolwarm",9))
sns.set_style({'xtick.bottom': True}, {'ytick.left': True})
```

[19]:
```
import matplotlib.style as style
style.available
style.use('seaborn-paper') #sets the size of the charts
# style.use('ggplot')
import matplotlib
font = {'family' : 'serif',
        'weight' : 'normal',
        'size'   : 14}

matplotlib.rc('font', **font)
```

[22]:
```
cmap = colors.LinearSegmentedColormap.
 ↪from_list('nameofcolormap',['w','b'],gamma=2.0)
fig, ax = plt.subplots(figsize=(9,9))


ax=sns.heatmap(df_conf_percent_error, annot=True, linewidths=.1, square=True,␣
 ↪cmap=cmap,
            cbar_kws={'shrink': .7, 'ticks': [0.0, 2.5, 5.0, 7.5, 10.0, 12.5]},
```

```
            linecolor='black', ax=ax, fmt='.2f', annot_kws={'size':␣
↪14},cbar=True)


# add the column names as labels
ax.set_yticklabels(df_conf_percent_error.columns, rotation=0, fontsize=14)
ax.set_xticklabels(df_conf_percent_error.columns, fontsize=14)
ax.set_xlabel(ax.get_xlabel(), size=14)
ax.axhline(y=0, color='k', linewidth=2)
ax.axhline(y=df_conf_percent_error.shape[1], color='k', linewidth=2)
ax.axvline(x=0, color='k', linewidth=2)
ax.axvline(x=df_conf_percent_error.shape[0], color='k', linewidth=2)
ax.set_title('Rank 1 (%) Error', fontsize=14)
plt.savefig('confusion.pdf', transparent=True)
```



[ ]: