project

July 29, 2018

```
In [1]: import networkx as nx
        train_graph = nx.Graph()
        valid_graph = nx.Graph()
        graph = nx.Graph()
        f = open("u.data","r")
        for line in f:
            line_splited = line.split()
            train_graph.add_node('a' + line_splited[0], bipartite=0)
            train_graph.add_node('b' + line_splited[1], bipartite=1)
            valid_graph.add_node('a' + line_splited[0], bipartite=0)
            valid_graph.add_node('b' + line_splited[1], bipartite=1)
            graph.add_node('a' + line_splited[0], bipartite=0)
            graph.add_node('b' + line_splited[1], bipartite=1)
            graph.add_edge('a' + line_splited[0], 'b' + line_splited[1])
```

/home/ubuntu/.local/share/virtualenvs/ComplexNetwork-rchcUDBE/lib/python3.5/importlib/_bootstrap
  return f(*args, **kwds)
/home/ubuntu/.local/share/virtualenvs/ComplexNetwork-rchcUDBE/lib/python3.5/importlib/_bootstrap
  return f(*args, **kwds)

```
In [2]: import random
        valid_edges = random.sample(graph.edges(), int(len(graph.edges()) * 0.7))
        for edge in valid_edges:
            valid_graph.add_edge( edge[0], edge[1])

In [3]: train_edges = random.sample(valid_graph.edges(), int(len(valid_graph.edges()) * 0.7))
        for edge in train_edges:
            train_graph.add_edge( edge[0], edge[1])

In [4]: print(nx.info(graph))
        print(nx.info(valid_graph))
        print(nx.info(train_graph))
```

```
Name:
Type: Graph
Number of nodes: 2625
Number of edges: 100000
```

```
Average degree:   76.1905
Name:
Type: Graph
Number of nodes: 2625
Number of edges: 70000
Average degree:   53.3333
Name:
Type: Graph
Number of nodes: 2625
Number of edges: 49000
Average degree:   37.3333
```

In [5]: from networkx.algorithms import bipartite
        bottom_nodes, top_nodes = bipartite.sets(graph)

In [6]: len(bottom_nodes)

Out[6]: 1682

In [7]: len(top_nodes)

Out[7]: 943

In [8]: R_train = nx.algorithms.bipartite.matrix.biadjacency_matrix(train_graph, top_nodes, bott
        R_valid = nx.algorithms.bipartite.matrix.biadjacency_matrix(valid_graph, top_nodes, bott
        R_test = nx.algorithms.bipartite.matrix.biadjacency_matrix(graph, top_nodes, bottom_node

In [9]: R_train = R_train.toarray()
        R_valid = R_valid.toarray()
        R_test = R_test.toarray()

In [10]: print(type(R_train))
         print(R_train.shape)

```
<class 'numpy.ndarray'>
(943, 1682)
```

In [11]: import numpy as np
         #R_train = R_train.asfptype()
         u_train, s_train, vt_train = np.linalg.svd(R_train)

In [12]: print(u_train.shape)
         print(s_train.shape)
         print(vt_train.shape)

```
(943, 943)
(943,)
(1682, 1682)
```

```
In [13]: temp = np.dot(np.transpose(u_train), R_valid)

In [14]: print(temp.shape)

(943, 1682)


In [15]: B = np.dot(temp, np.transpose(vt_train))

In [16]: B.shape

Out[16]: (943, 1682)

In [17]: for i in range(0, 943):
            print("{}\t{}".format(s_train[i], B[i][i]))
```

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30.034411940485114	39.78694687411855
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1.1293058375761331	1.0922257232933827
1.1195092530871462	1.1359776701933355
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1.0967947251776649	1.1074466497144564
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0.7362248998788645	0.753919609117425
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0.710317139743306	0.7091498387063748
0.7093326693536646	0.6830317127680596
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0.6927237950084738	0.6037736233641532
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0.6780129648815791	0.7097429866771602
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0.6237906496821273	0.6086164301375087
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0.6043566477593598	0.6144326413658763
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0.5531546007955116	0.6023522063414148
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0.5026711370237884	0.502577293606989
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0.3736579561452371   0.3927013298941765
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0.2997513673562652   0.34362830113169
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0.22734991799588716   0.22235026971745314
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0.14893090541723208   0.19355239736431215
0.14244547406549687   0.16694065818002943
0.13144034321107614   0.11636767629254144
0.12670175683150717   0.14931913644396444
0.1117288199187424   0.08287797964816752
0.10505279838874085   0.049018698570232916
0.0931627378143935   0.08166627728861792
0.09076368101323738   0.04465632296783615

```
In [18]: x = []
         y = []
         for i in range (0,943):
             x.append(s_train[i])
             y.append(B[i][i])

In [19]: X = np.array(x)
         Y = np.array(y)
         from sklearn import linear_model
         reg_linear_regression = linear_model.LinearRegression()
         X = X.reshape(-1, 1)
         reg_linear_regression.fit (X,Y)
```

/home/ubuntu/.local/share/virtualenvs/ComplexNetwork-rchcUDBE/lib/python3.5/importlib/_bootstrap
  return f(*args, **kwds)
/home/ubuntu/.local/share/virtualenvs/ComplexNetwork-rchcUDBE/lib/python3.5/importlib/_bootstrap
  return f(*args, **kwds)

```
Out[19]: LinearRegression(copy_X=True, fit_intercept=True, n_jobs=1, normalize=False)

In [20]: u_valid, s_valid, vt_valid = np.linalg.svd(R_valid)

In [21]: print(u_valid.shape)
         print(vt_valid.shape)
```

(943, 943)
(1682, 1682)

```
In [22]: g_valid_linear_regression = np.zeros(shape=(943,1682))

In [23]: for i in range (0, len(s_valid)):
             g_valid_linear_regression[i][i] = reg_linear_regression.predict(s_valid[i])

In [24]: u_valid.shape

Out[24]: (943, 943)

In [25]: result_on_valid_linear_regression = u_valid @ g_valid_linear_regression @ vt_valid
```

0.1 MAP Evaluation of Linear Regression

```
In [26]: def MAP (A, B):
             arg_sorted_A = np.argsort(-A, axis=1)
             sum_of_ap = 0
             for i in range(0, arg_sorted_A.shape[0]):
                 soorat = 0
                 makhraj = 0
                 sum_of_relavant = 0
```

```
            number_of_relavant = 0
            for j in range(0, arg_sorted_A.shape[1]):
                makhraj = makhraj + 1
                if(B[i][arg_sorted_A[i][j]] == 1):
                    soorat = soorat +1
                    sum_of_relavant = sum_of_relavant + (soorat/makhraj)
                    number_of_relavant = number_of_relavant + 1
            sum_of_ap = sum_of_ap + (sum_of_relavant/number_of_relavant)
        print("Map is {}".format(sum_of_ap / arg_sorted_A.shape[0]))
        return (sum_of_ap / arg_sorted_A.shape[0])
```

In [27]: MAP(result_on_valid_linear_regression , R_test)

Map is 0.8246037943796815

Out[27]: 0.8246037943796815

0.2 eˆax regression

```
In [28]: import numpy as np
        x_data = X.flatten()
        y_data = Y.flatten()
        from scipy import optimize

        def test_func(x, a):
            return np.sin(a * x)

        params, params_covariance = optimize.curve_fit(test_func, x_data, y_data)
        print(params)
```

[0.1608665]

In [29]: g_valid_sinh_regression = np.zeros(shape=(943,1682))

In [30]: for i in range (0, len(s_valid)):
            g_valid_sinh_regression[i][i] = test_func(s_valid[i], params[0])

In [31]: result_on_valid_sinh_regression = u_valid @ g_valid_sinh_regression @ vt_valid

In [32]: MAP(result_on_valid_sinh_regression , R_test)

Map is 0.6988955406220082

Out[32]: 0.6988955406220082

0.3 Neumann graph kernel

```
In [38]: import numpy as np
         x_data = X.flatten()
         y_data = Y.flatten()
         from scipy import optimize

         def test_func(x, a):
             return np.divide(a * x , 1 - a * a * np.power(x, 2))

         params, params_covariance = optimize.curve_fit(test_func, x_data, y_data, p0=[0])
         print(params)
```

```
[0.02848727]
```

```
In [39]: g_valid_Neumann = np.zeros(shape=(943,1682))
```

```
In [40]: for i in range (0, len(s_valid)):
             g_valid_Neumann[i][i] = test_func(s_valid[i], params[0])
```

```
In [41]: result_on_valid_Neumann = u_valid @ g_valid_Neumann @ vt_valid
```

```
In [42]: MAP(result_on_valid_Neumann , R_test)
```

```
Map is 0.7191786425165047
```

```
Out[42]: 0.7191786425165047
```