4-3_MS

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Problem 4-3
Assignment 3

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[ ]:
```
# Install a pip package in the current Jupyter kernel
! pip install numpy pandas networkx matplotlib powerlaw
```

```
Requirement already satisfied: numpy in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (1.21.3)
Requirement already satisfied: pandas in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (1.3.4)
Requirement already satisfied: networkx in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (2.6.3)
Requirement already satisfied: matplotlib in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (3.4.3)
Requirement already satisfied: powerlaw in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (1.5)
Requirement already satisfied: python-dateutil>=2.7.3 in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
pandas) (2.8.2)
Requirement already satisfied: pytz>=2017.3 in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
pandas) (2021.3)
Requirement already satisfied: cycler>=0.10 in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
matplotlib) (0.10.0)
Requirement already satisfied: pyparsing>=2.2.1 in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
matplotlib) (3.0.3)
Requirement already satisfied: pillow>=6.2.0 in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
matplotlib) (8.3.2)
Requirement already satisfied: kiwisolver>=1.0.1 in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
matplotlib) (1.3.2)
```

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Requirement already satisfied: mpmath in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
powerlaw) (1.2.1)
Requirement already satisfied: scipy in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
powerlaw) (1.7.1)
Requirement already satisfied: six in
/workplace/anaconda3/envs/complex_network/lib/python3.9/site-packages (from
cycler>=0.10->matplotlib) (1.16.0)
```

[ ]:
```python
import pandas as pd
import networkx as nx
import numpy as np

path = '/workplace/CNA/Complex-Network-Analysis-Exercises/assignment-4/
 ↪facebook-links.txt.anon'
data = pd.read_csv(path, delimiter='\t')
data= data[['1', '2']]
#remove time stamp
print(data.head())
```

```
   1  2
0  1  3
1  1  4
2  1  5
3  1  6
4  1  7
```

[ ]:
```python
def generate_plot_graph2(data, plot=True):
    g=nx.from_pandas_edgelist(data,source='1', target='2', create_using=nx.
 ↪DiGraph())
    print(len(g.edges))
    g=g.to_undirected(reciprocal=False, as_view=False)

    #control to not having multiple edges
    for node in g.nodes():
        # We look for adjacent nodes
        for adj_node in g[node]:
            # If our graph has several edges from the first to the adjacent node
            if len(g[node][adj_node]) > 1:
                print(node, adj_node)

    if plot==True:
        pos = nx.spring_layout(g, seed=1)
        nx.draw_networkx_edges(g, pos=pos)

    return g
```

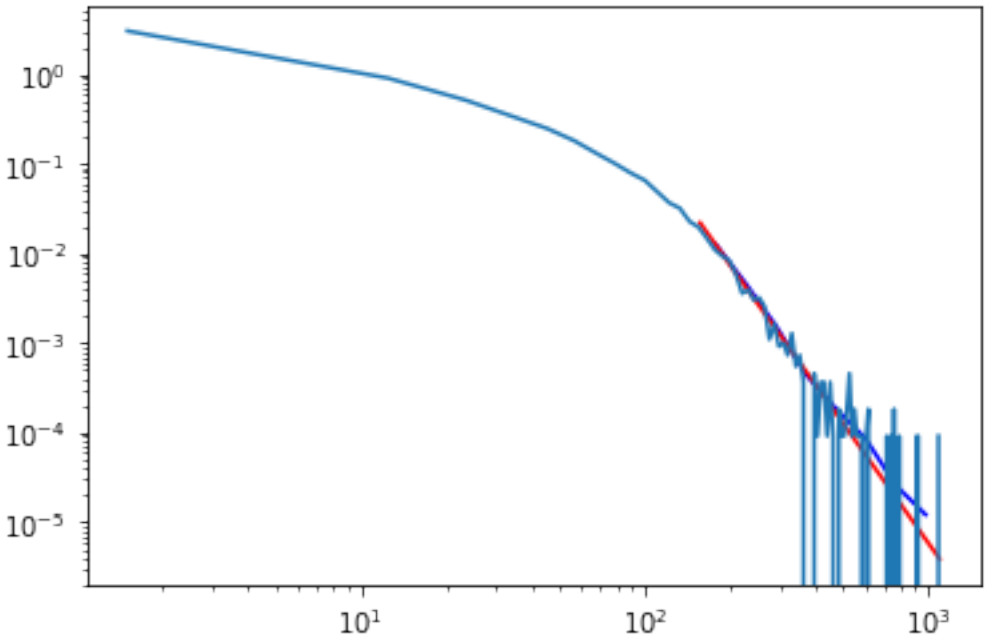
[ ]:
```
g = generate_plot_graph2(data, plot=False)
```

```
1545685
```

[ ]:
```
import powerlaw

max_diameter = len(max(nx.connected_components(g)))

print(f'1. max_diameter {max_diameter}')

current_max=0
current_id=0
degrees=[]
for id, node in enumerate(g.nodes):
    degrees.append(g.degree(node))
    if g.degree(node)>current_max:
        current_max =g.degree(node)
        current_id=id
print(f'2. ID highest degree {current_id} with value {current_max}')


triangle = nx.triangles(g)
amount_triangles=sum(triangle.values())/3
print(f'3. number of triangles is {amount_triangles}')

average_clustering=nx.average_clustering(g)
print(f'4. average clustering is {average_clustering}')


fit = powerlaw.Fit(degrees)
print(f'5. power-law exponent is {fit.alpha}')
fig1=fit.plot_pdf(color='b')
fit.power_law.plot_pdf(color='r', ax=fig1)
hist, bin_edges = np.histogram(degrees, bins=100, density=True)
bin_edges
#normalization factor was estiamted
factor = 8**2
fig1.plot(bin_edges[:-1]+0.5, factor*hist)
```

```
1. max_diameter 63392
2. ID highest degree 2331 with value 1098
3. number of triangles is 3501542.0
4. average clustering is 0.22099367691190397
Calculating best minimal value for power law fit
5. power-law exponent is 4.438180320754116
```

[ ]:
```
[<matplotlib.lines.Line2D at 0x7f8af34d2c10>]
```


10^{0}
10^{-1}
10^{-2}
10^{-3}
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