Report

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1 Algorithmic Methods of Data Mining

1.1 Homework 4

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```
In [3]: import itertools
        import json
        import matplotlib.pyplot as plt
        import networkx as nx
        import numpy as np
        import pandas as pd
        import pprint
```

1.2 Exercise 1

```
In [4]: import Modules as hw4
```

```
In [5]: G=hw4.create_graph('full_dblp.json')
```

```
In [6]: print('Our Graph have this info: ', nx.info(G))
```

```
Our Graph have this info:  Name: Data Scientist Network
Type: Graph
Number of nodes: 904664
Number of edges: 3679473
Average degree:   8.1345
```

1.3 Exercise 2

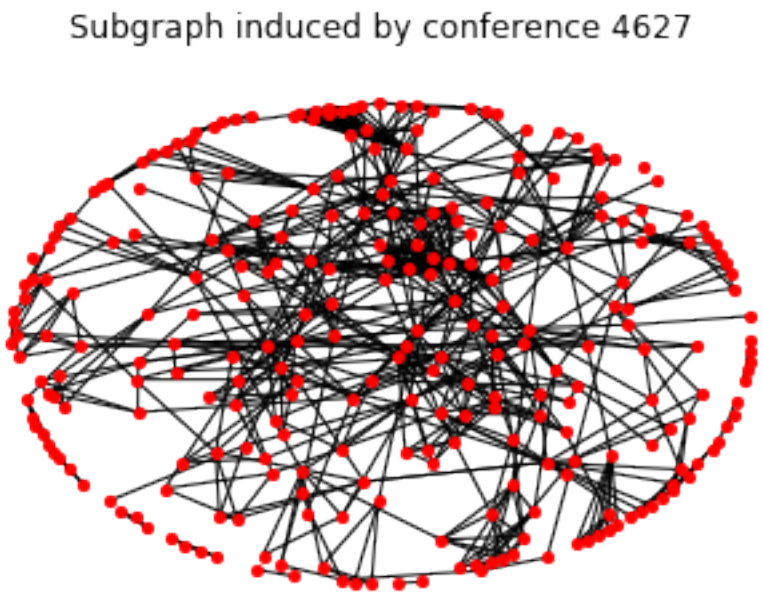
```
In [7]: conf=int(input('Insert a conference id '))
        subgraph=hw4.inducted_subgraph(G,conf)
```

```
Insert a conference id 4627
```

The new subgraph have this info

```
In [8]: print(nx.info(subgraph))

Name: Data Scientist Network
Type: Graph
Number of nodes: 275
Number of edges: 742
Average degree:   5.3964
```

```
In [9]: nx.draw_networkx(subgraph, with_labels = False, node_size=15)
        limits = plt.axis('off')
        plt.title('Subgraph induced by conference %s'%conf)
        plt.show()
```



After having calculated the centrality measurements (degree, closeness, betweeness) for all the nodes, we show a table with the first 20

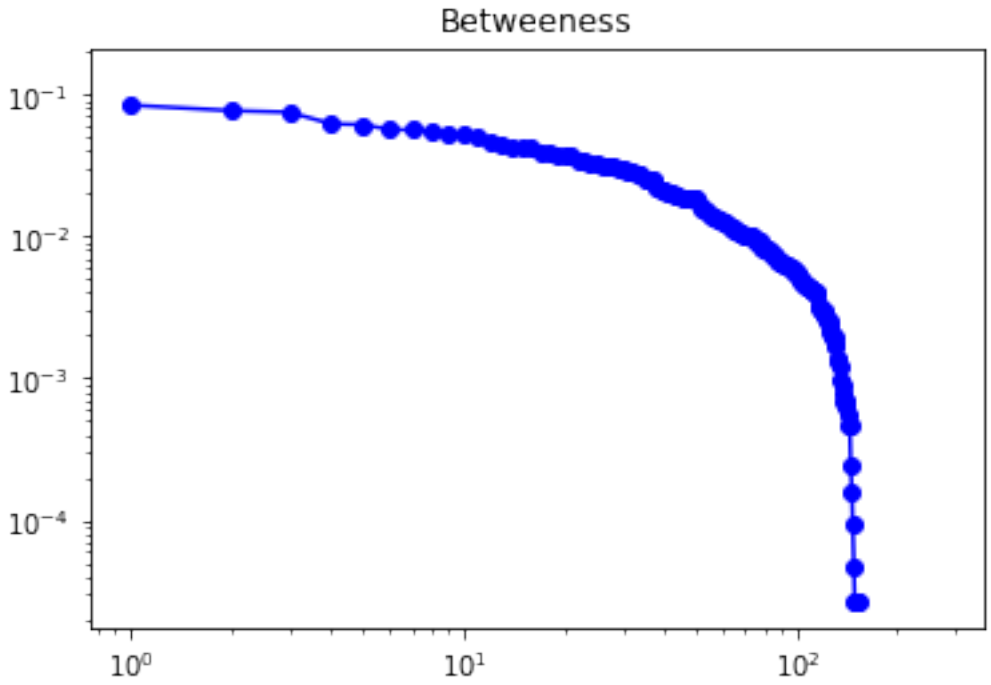
```
In [10]: centr=hw4.centralities(subgraph)
```

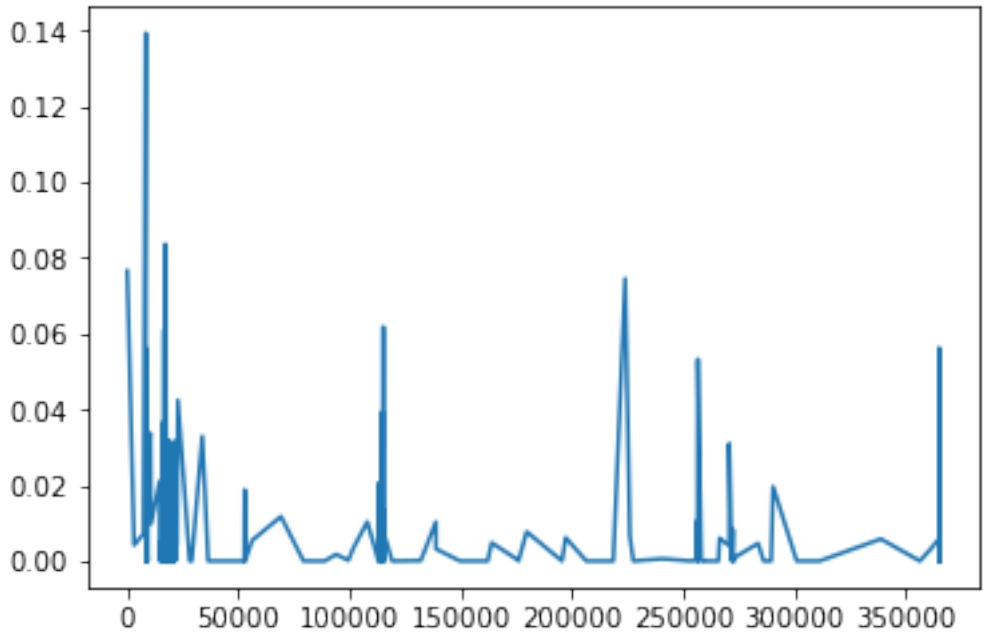
```
In [11]: nodes={'degree':list(centr['degree'].values()),
                'closeness':list(centr['closeness'].values()),
                'betweeness':list(centr['betweeness'].values())}

         summary_data = pd.DataFrame(nodes, index=list(centr['closeness'].keys()))
         summary_data.head(20)
```

Out[11]:

	betweeness	closeness	degree
206361	0.000000	0.000000	0
240513	0.000561	0.191594	4
20752	0.004182	0.212904	6
3330	0.004182	0.212904	6
364796	0.005864	0.183597	5
158503	0.000000	0.167800	3
21484	0.020522	0.188622	6
15952	0.015604	0.185408	6
21688	0.000000	0.106727	2
114923	0.000000	0.106727	2
114661	0.012620	0.121534	3
8861	0.038918	0.277863	12
8862	0.042887	0.267093	13
8860	0.000000	0.222051	3
8864	0.006480	0.251803	12
364806	0.001408	0.237894	8
94086	0.001747	0.232804	7
364807	0.010497	0.251803	10
8557	0.139403	0.298743	23
266235	0.006029	0.253968	12

In [12]:
```
db=sorted(centr['betweeness'].values(), reverse=True)
plt.loglog(db, 'b-', marker='o')
plt.title('Betweeness')
plt.show()
lists = sorted(centr['betweeness'].items())
x, y = zip(*lists)
plt.plot(x, y)
plt.show()
```

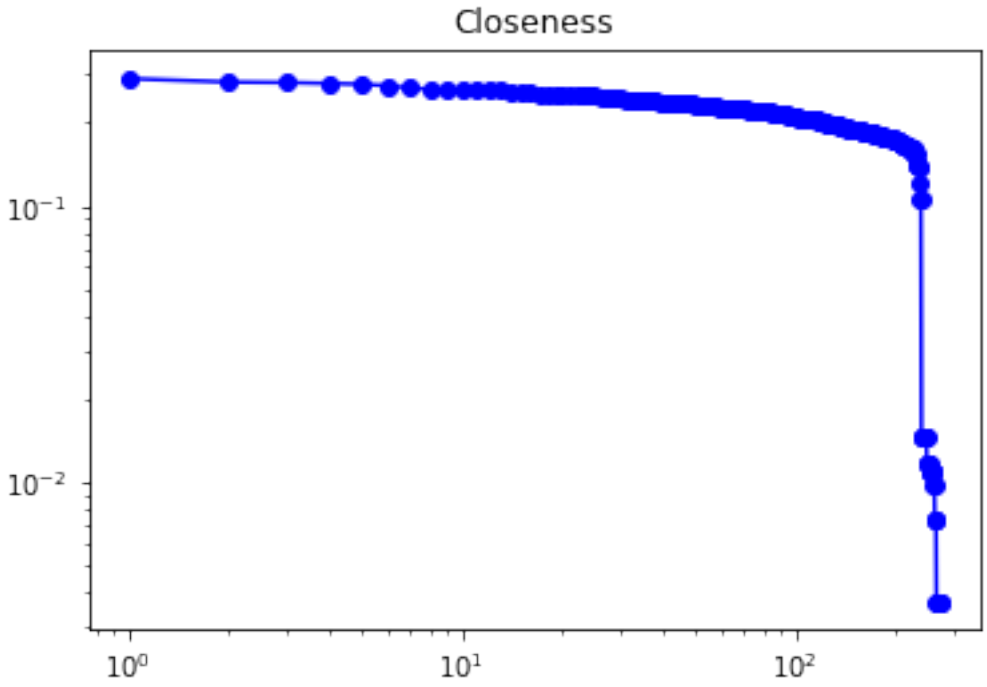


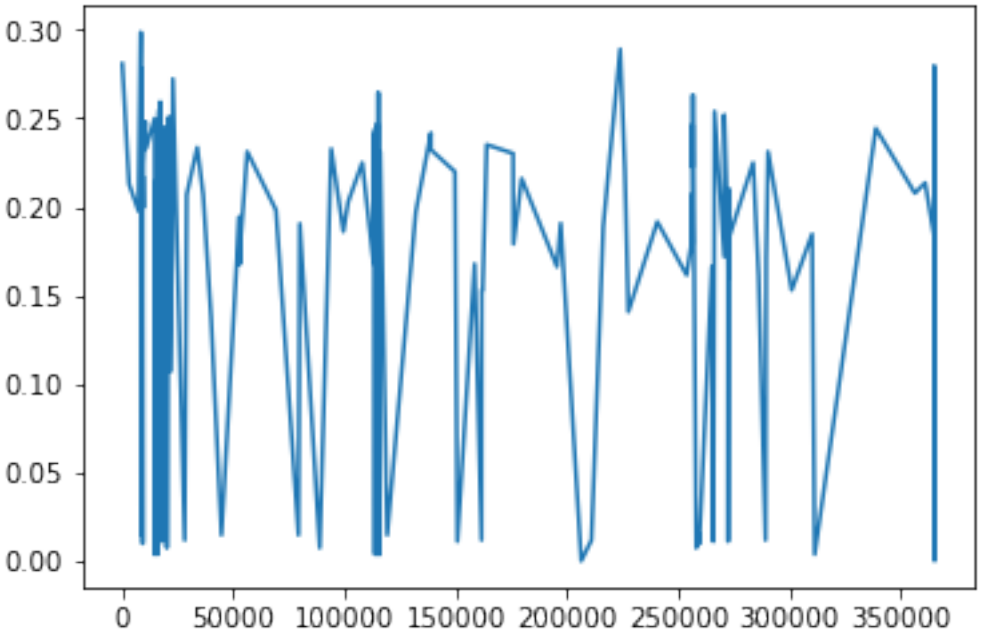


Betweenness Centrality is an analytic that determines vertex influence in a graph, but the fastest known algorithm for computing betweenness centrality has O(mn) time complexity for

graphs with n vertices and m edges; betweenness centrality determines the importance of vertices in a network by measuring the ratio of shortest paths passing through a particular vertex to the total number of shortest paths between all pairs of vertices. Intuitively, this ratio determines how well a vertex connects pairs of vertices in the network. in this case we have the distribution grouped more in the first 35.000 values.

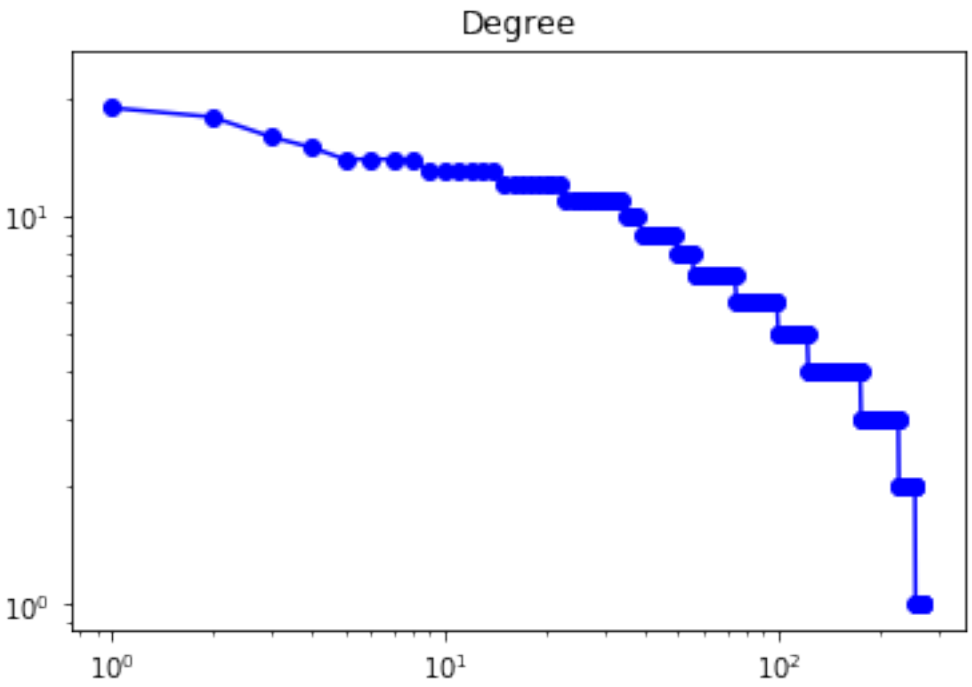
```
In [13]: dc=sorted(centr['closeness'].values(), reverse=True)
         plt.loglog(dc, 'b-', marker='o')
         plt.title('Closeness')
         plt.show()
         lists = sorted(centr['closeness'].items())
         x, y = zip(*lists)
         plt.plot(x, y)
         plt.show()
```

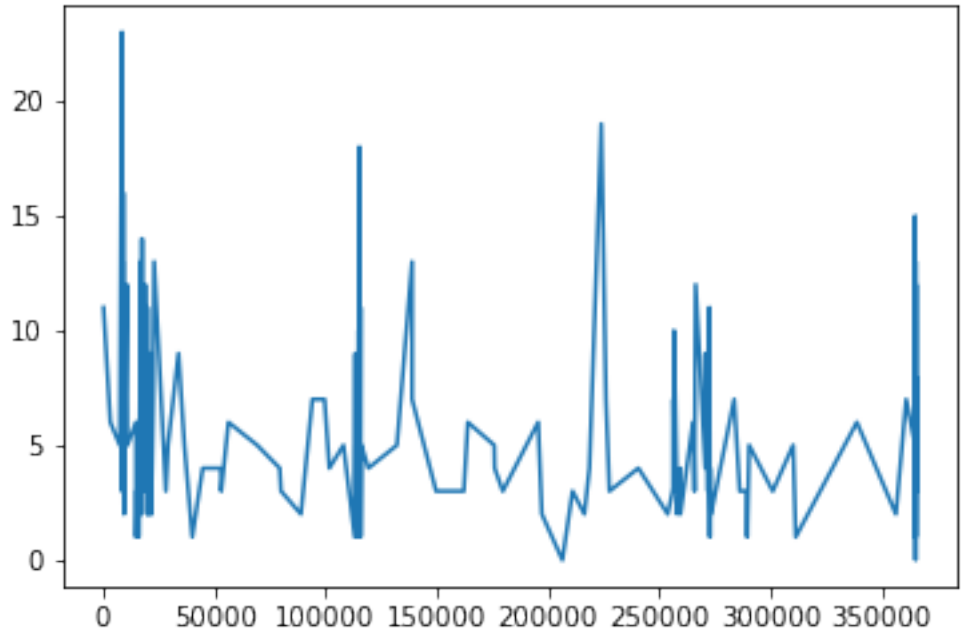




Closeness centrality measures the mean distance from a vertex to other vertices: more central a node is, the closer it is to all other nodes (The bigger the number the LESS central they are (because they are farther away from everyone)). When a node has a low closeness score (i.e., is highly central), it tends to receive anything flowing through the network very quickly. This is because the speed with which something spreads in a network is a function of the number of links in the paths traversed. Since nodes with low closeness scores are close to all nodes, they receive things quickly. Although being numerically more grouped in the first terms we notice a constantly fluctuating trend

```
In [14]: dg=sorted(centr['degree'].values(), reverse=True)
         plt.loglog(dg, 'b-', marker='o')
         plt.title('Degree')
         plt.show()
         lists = sorted(centr['degree'].items())
         x, y = zip(*lists)
         plt.plot(x, y)
         plt.show()
```





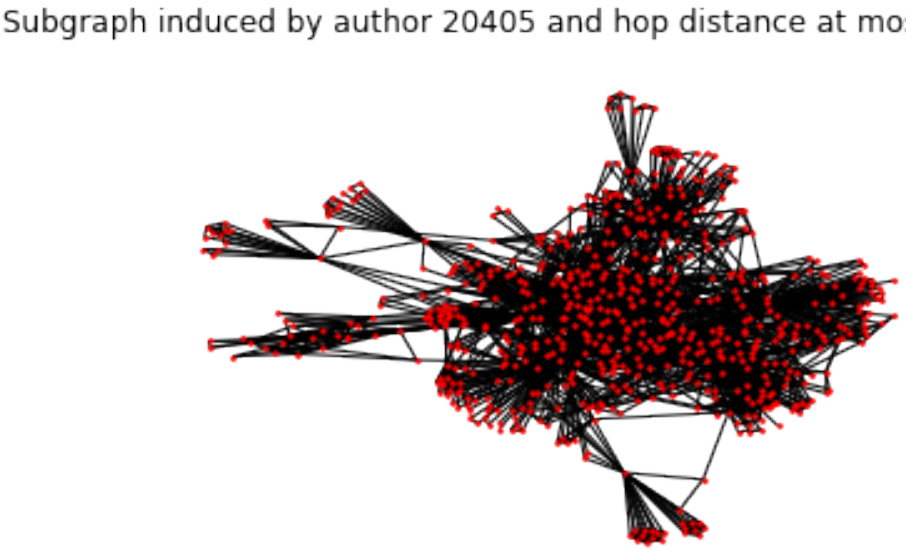
Degree centrality of a node refers to the number of edges attached to the node, it can also be interpreted in terms of the immediate risk of a node for catching whatever is flowing through the network Also in this case although being numerically more grouped in the first terms we notice

a constantly fluctuating trend; furthermore, in the loglog plot we see a trend like a power law distribution.

```
In [15]: aut=int(input('Insert an author id '))
         hop=int(input('Insert an integer d '))
         ego=hw4.subgraph_inducted_by_author(G,aut,hop)

Insert an author id 20405
Insert an integer d 2
```

```
In [16]: print(nx.info(ego))

Name: Data Scientist Network
Type: Graph
Number of nodes: 644
Number of edges: 2846
Average degree:   8.8385
```

```
In [17]: nx.draw_networkx(ego, with_labels = False, node_size=2)
         limits = plt.axis('off')
         plt.title('Subgraph induced by author %s and hop distance at most equal to %s' %(aut,
         plt.show()
```



1.4 Exercise 3

Since Aris is our mentor, let's calculate the 'Aris Number' to describe the "collaborative distance" between Aris (id 256176) and other people, let's start with Stefano Leonardi (id 365188)

```
In [18]: original_id = int(input("Please tell me the id of the author you want to connect with
         print("Computing the distance between Aris and ", hw4.tell_me_the_name(original_id),
         destination_id = hw4.tell_me_the_id("aris anagnostopoulos")
         sol = hw4.my_dijkstra(G,256176,original_id)
         if type(sol) == float:
             print("The shortest path has weight ", sol)
         else:
             print("They are not connected, so sorry.")
```

```
Please tell me the id of the author you want to connect with Aris: 365188
Computing the distance between Aris and  stefano leonardi  ...
The shortest path has weight  0.7777777777777778
```

And repeat for Adriano Fazzone (id 272067)

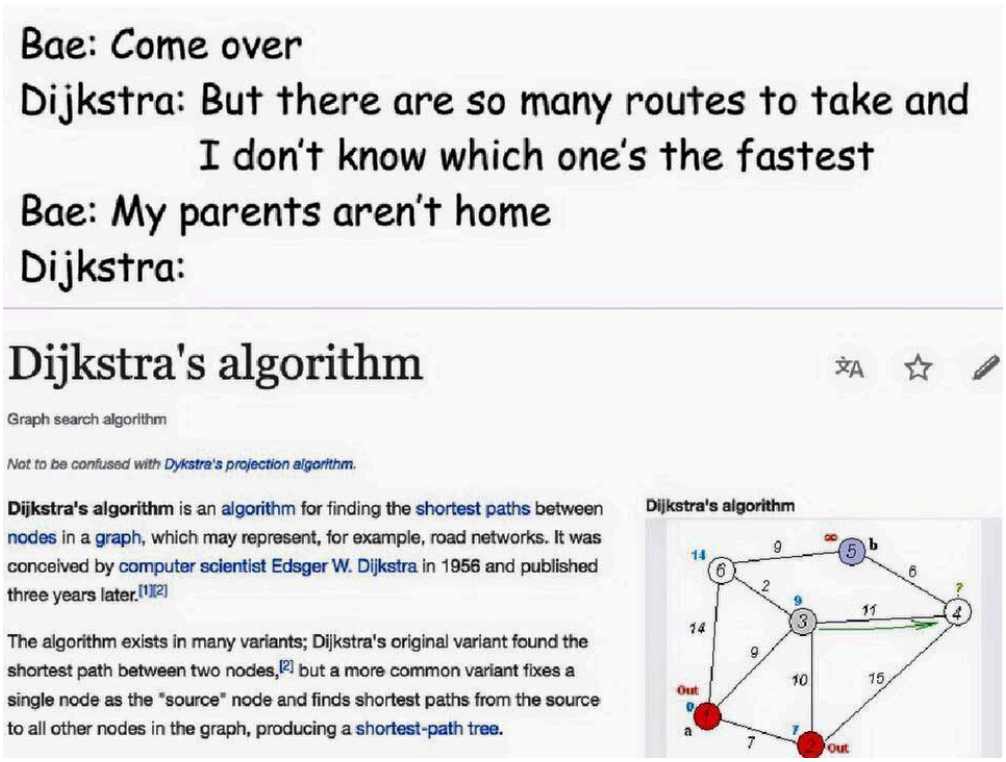
```
In [19]: original_id = int(input("Please tell me the id of the author you want to connect with
         print("Computing the distance between Aris and ", hw4.tell_me_the_name(original_id),
         destination_id = hw4.tell_me_the_id("aris anagnostopoulos")
         sol = hw4.my_dijkstra(G,256176,original_id)
         if type(sol) == float:
             print("The shortest path has weight ", sol)
         else:
             print("They are not connected, so sorry.")
```

```
Please tell me the id of the author you want to connect with Aris: 272067
Computing the distance between Aris and  adriano fazzone  ...
The shortest path has weight  0.9473684210526316
```

And for Mario Frank (id 9451)

```
In [20]: original_id = int(input("Please tell me the id of the author you want to connect with
         print("Computing the distance between Aris and ", hw4.tell_me_the_name(original_id),
         destination_id = hw4.tell_me_the_id("aris anagnostopoulos")
         sol = hw4.my_dijkstra(G,256176,original_id)
         if type(sol) == float:
             print("The shortest path has weight ", sol)
         else:
             print("They are not connected, so sorry.")
```

```
Please tell me the id of the author you want to connect with Aris: 9451
Computing the distance between Aris and  mario frank  ...
They are not connected, so sorry.
```



title

We note therefore that both Stefano Leonardi and Adriano Fazzone are closely related to aris (in particular Adriano Fazzone) while there is no connection with Mario Frank

```
In [21]: n= int(input("Please tell me the number of authors you are going to give me: "))
         l = []
         for i in range(n):
             l.append(int(input("Tell me an identifier: ")))

         group_number = hw4.my_dijkstra_group(G,l)
         print("The group number for all the nodes is: ")
         pp = pprint.PrettyPrinter(indent=4)
         ele={k: v for k, v in group_number.items() if v != None}
         first25 = {k: ele[k] for k in list(ele)[:25]}
         pp.pprint(first25)

Please tell me the number of authors you are going to give me: 2
Tell me an identifier: 365188
Tell me an identifier: 272067
Computing the distance between  stefano leonardi  and all the other authors...
Computing the distance between  adriano fazzone  and all the other authors...
The group number for all the nodes is:
{   248: 365188,
    287: 365188,
    1304: 365188,
```

```
2730: 365188,
2979: 365188,
2980: 365188,
2981: 365188,
3079: 365188,
3981: 365188,
4017: 365188,
4689: 365188,
5364: 365188,
5587: 365188,
5619: 365188,
5620: 365188,
5661: 365188,
5799: 365188,
6958: 365188,
7132: 365188,
7179: 365188,
7180: 365188,
7181: 365188,
7182: 365188,
7224: 365188,
7424: 365188}
```