PSG COLLEGE OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

19OH01 – SOCIAL AND ECONOMIC NETWORK ANALYSIS

TOPIC: GITHUB RECOMMENDER SYSTEM

TEAM MEMBERS:

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Problem Statement:

By using this recommending system, we analyze user similarity and recommend repositories to users using the concept of bipartite graphs. In our project, there are two sets of nodes(Projects or Repositories and Users). By finding similar projects and similarity score between given users, we recommend repositories to users.

Dataset Description:

Our data set is in the form of adjacency list, whereas the first word is the head node and the following nodes are the neighbours of first node. The word begins with ‘u’ is considered as users in our project and word begin with ‘p’ is considered as projects or repositories in our project. Total number of nodes in the dataset is 22353 and edges are 20052. In that nodes 10721 are users and 11632 nodes are projects.

Tools Used:

1. API Used:

→ **Google Colaboratory** - Anybody to write and execute arbitrary python code through the browser, and is especially well suited to machine learning, data analysis and education.

2. Library:

→ **Networkx -** NetworkX is a Python library for studying graphs and networks.

Challenges faced:

1. Dataset is in the format of adjacency list. It is hard to modify the dataset to convert for our convenience.

2. We are new to this Google colab API and networkx. It takes time to understand colab environment and some functions in networkx package.

3. Initially, we have faced difficulties in loading the dataset with our concept in Gephi. So, we moved to Google Colab API because of easy implementation.

Contribution of Team Members:

1) Naveen P - 18Z335
   [Dataset Modification, Coding]
2) Gopisankar G - 19Z433
   [Code Part, Documentation]
3) Rahul R - 19Z461
   [Project Ideas, Documentation]
4) Mouleeswaran S - 19Z464
   [Graph Visualization, Coding]

Annexure I:

```
→ import networkx as nx
→ G=nx.Graph()
→ G=nx.read_adjlist("dataset.txt")
→ type(G)
→ len(G.nodes())
→ len(G.edges())

→ for n in G.nodes():
  if(n[:1]=='p'):
   G.nodes[n]['bipartite'] = 'projects'
  else:
   G.nodes[n]['bipartite'] = 'users'

→ #To count number of users and projects in our dataset
   def get_nodes_from_partition(G,partition):
     nodes = []
     for n in G.nodes():
       if G.nodes[n]['bipartite'] == partition:
         #if the node belogs to given partition, then the node is added to nodes list
         nodes.append(n)
     return nodes
   print(len(get_nodes_from_partition(G, 'users')))
   print(len(get_nodes_from_partition(G, 'projects')))

→ def shared_partition_nodes(G, n1, n2):
     #Checking whether passed nodes belong to users partition or not
     assert G.nodes[n1]['bipartite'] =='users'
     assert G.nodes[n2]['bipartite'] =='users'

     # Getting neighbors of node1
     nbr1 = G.neighbors(n1)
     # Getting neighors of node2
     nbr2 = G.neighbors(n2)

     # To get shared projects between users
     common = set(nbr1).intersection(nbr2)
     return common

→ def user_similarity(G, u1, u2, proj_nodes):
     #Checking whether passed nodes belong to users partition or not
     assert G.nodes[u1]['bipartite'] == 'users'
     assert G.nodes[u2]['bipartite'] == 'users'

     # To get shared projects between given users
     shared_nodes = shared_partition_nodes(G, u1, u2)
     # return similarity score
     return len(shared_nodes) / len(proj_nodes)

→ from collections import defaultdict
   def most_similar_users(G, user, user_nodes, proj_nodes):
      #Checking whether passed nodes belong to users partition or not
     assert G.nodes[user]['bipartite'] == 'users'

     # Getting other user nodes
     user_nodes = set(user_nodes)
     user_nodes.remove(user)

     # Creating dictionary
     similarities = defaultdict(list)
     for n in user_nodes:
       similarity = user_similarity(G, user, n, proj_nodes)
       similarities[similarity].append(n)

     # computing maximum similarity
     max_similarity = max(similarities.keys())

     #  returing maximum similarity users
     return similarities[max_similarity]
   user_nodes = get_nodes_from_partition(G, 'users')
   project_nodes = get_nodes_from_partition(G, 'projects')

→ def recommend_repositories(G, from_user, to_user):
   # repositiores of user1
   from_repos = set(G.neighbors(from_user))
   #repositiories of user2
   to_repos = set(G.neighbors(to_user))

   print("Suggesting repositiories to user1")
   print(to_repos.difference(from_repos))
```

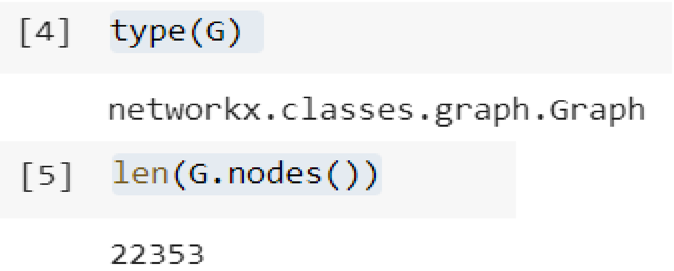
```
     print("Suggesting repositiories to user2")
     print(from_repos.difference(to_repos))

→ G1=nx.Graph()

→def draw_graph(user1,user2):
    G1.add_node(user1)
    G1.add_node(user2)
    repos1=G.neighbors(user1)
    repos2=G.neighbors(user2)
    for n in repos1:
      G1.add_node(n)
      G1.add_edge(user1,n)
    for n in repos2:
      G1.add_node(n)
      G1.add_edge(user2,n)
    #nx.draw(G1,with_labels=True)
    nx.draw(G1,node_color="red",with_labels=True,node_size=1000)

→user1='u21'
   user2='u2509'
   print("Number of Shared repositiories")
   print(len(shared_partition_nodes(G,user1,user2)))
   print("Similarity Score")
   project_nodes = get_nodes_from_partition(G, 'projects')
   similarity_score = user_similarity(G,user1,user2, project_nodes)
   print(similarity_score)
   print("Recommending repositories")
   recommend_repositories(G,user1,user2)
   draw_graph(user1,user2)
```

Annexure II:

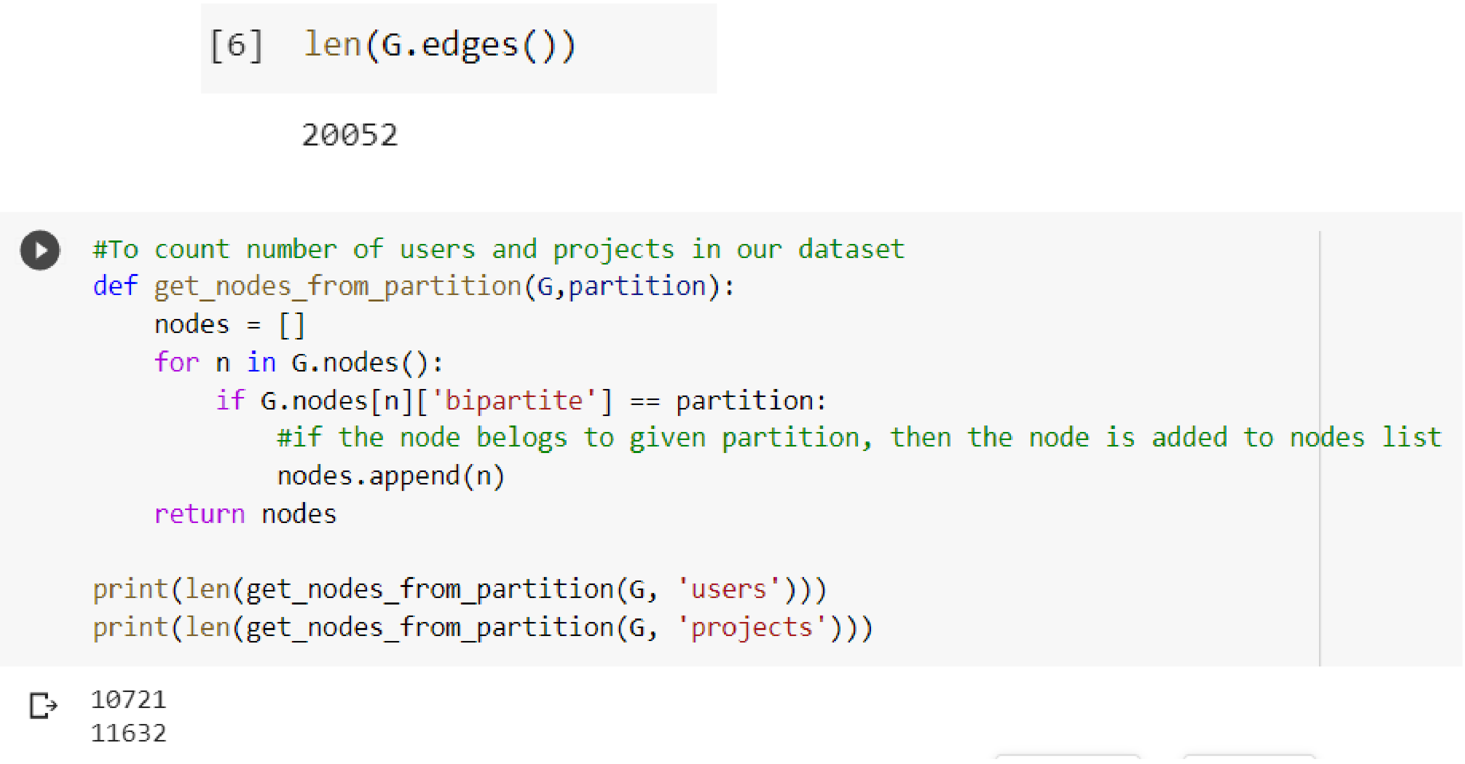


```
[4]  type(G)

     networkx.classes.graph.Graph

[5]  len(G.nodes())

     22353
```



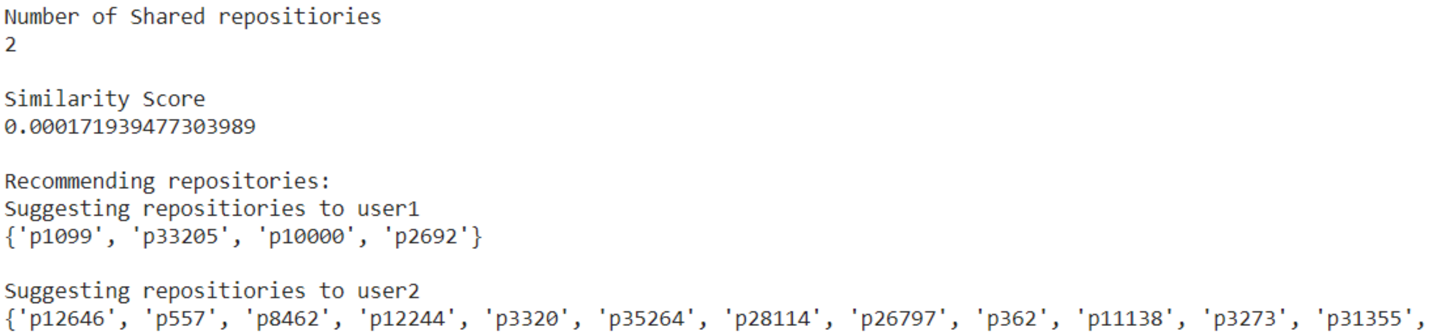
```
[6]  len(G.edges())

     20052
```

```
#To count number of users and projects in our dataset
def get_nodes_from_partition(G,partition):
    nodes = []
    for n in G.nodes():
        if G.nodes[n]['bipartite'] == partition:
            #if the node belogs to given partition, then the node is added to nodes list
            nodes.append(n)
    return nodes

print(len(get_nodes_from_partition(G, 'users')))
print(len(get_nodes_from_partition(G, 'projects')))
```

```
10721
11632
```

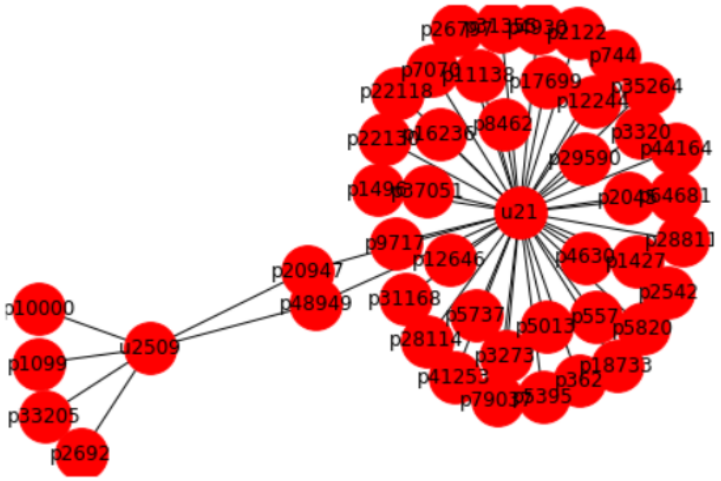


```
Number of Shared repositiories
2

Similarity Score
0.000171939477303989

Recommending repositories:
Suggesting repositiories to user1
{'p1099', 'p33205', 'p10000', 'p2692'}

Suggesting repositiories to user2
{'p12646', 'p557', 'p8462', 'p12244', 'p3320', 'p35264', 'p28114', 'p26797', 'p362', 'p11138', 'p3273', 'p31355',
```



References:

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2. https://networkx.org/documentation/stable/tutorial.html

3. https://networkx.org/documentation/latest/_modules/networkx/algorithms/operators/product.html

4. https://campus.datacamp.com/courses/intermediate-network-analysis-in-python/bipartite-graphs-product-recommendation-systems?ex=12

5. https://campus.datacamp.com/courses/intermediate-network-analysis-in-python/bipartite-graphs-product-recommendation-systems?ex=9

6. https://towardsdatascience.com/customizing-networkx-graphs-f80b4e69bedf#:~:text=Altering%20node%20size%20globally%20is,()%20method%20%E2%80%94%20just%20specify%20node_size!