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Social Network Analysis for Community Detection and Recommendations: A Graph-based Approach

Social Network Analysis

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Report submitted for the

Final Project Review of

THEORY DA [PROJECT]

Course Code: BCSE302L

Data Base Management System

Slot A1+ TA1

Professor: Dr Govinda K

AIM

The aim of the project is to develop a social network analysis system using Spring Boot. The project aims to analyse and understand social relationships and connections among users in a network and providing appropriate friend recommendations to users. The main objectives of the project include:

1. User Management: Implement a system to manage user data, including attributes like name, username, password, date of birth, and phone number.

2. Friend Connections: Allow users to create and manage connections with other users, representing friendship relationships in the social network.

3. Graph Representation: Build a graph data structure to represent the social network, where nodes represent users and edges represent friendship connections.

4. Friend Recommendation: Develop algorithm to generate friend recommendations for users based on their existing connections and the structure of the social network.

5. Database Integration: Integrate a relational database (such as Oracle, MySQL, or PostgreSQL) to store and retrieve user data and friendship connections.

6. API and Web Interface: Provide an API and web interface to interact with the system, allowing users to manage their profile, view friend suggestions, and perform other social network-related actions.

By achieving these objectives, the project aims to create a functional social network analysis system that can help users discover and connect with new friends based on their interests and existing connections.

ABSTRACT-

The abstract provides a concise overview of the project, summarizing its objectives, methods, and outcomes. Here is an abstract for social network analysis project:

The aim of this project is to develop a social network analysis system using Spring Boot, focusing on user management, friend connections, and friend recommendation functionalities. The project leverages the Spring Boot framework, Java programming language, and a relational database for data storage.

The project begins by designing and implementing a User class to manage user data. Each user is identified by a unique identifier and has attributes such as name, username, password, date of birth, and phone number. The User class provides methods to create, update, and retrieve user information.

To represent friend connections, a Friends class is created. The Friends class maintains a list of friends for each user, allowing users to establish and manage their social connections. The system enables users to add or remove friends, view their friend list, and explore friend recommendations.

The social network is modelled as a graph data structure. The Graph class is responsible for managing the network and performing graph-related operations. It provides methods to add nodes (users) and edges (friend connections) to the graph. Additionally, the graph supports algorithms for traversing the network and generating friend recommendations based on existing connections.

The system integrates with a relational database using Spring JDBC. User and friend data is stored in separate tables, allowing for efficient retrieval and manipulation. The database integration enables persistent storage of user information and ensures data integrity and consistency.

The project utilizes the Spring Boot framework to develop an API and web interface for users to interact with the system. The API endpoints facilitate user authentication, profile management, friend connection management, and friend recommendation retrieval. The web interface provides a user-friendly interface for users to perform these actions through a graphical user interface.

The implementation of the social network analysis system involves unit testing to ensure the correctness and reliability of the code. Test cases are designed to cover various scenarios, including user creation, friend connection establishment, and friend recommendation generation.

The project demonstrates the effectiveness of the social network analysis system by providing users with an intuitive platform to manage their social connections and discover new friends. The friend recommendation feature enhances the user experience by suggesting potential friends based on existing connections and the network structure.

In conclusion, this project successfully develops a social network analysis system using Spring Boot. By incorporating user management, friend connections, and friend recommendation functionalities, the system enables users to build and expand their social networks. The integration of a relational database ensures efficient data storage and retrieval. The project's implementation adheres to best coding practices and undergoes rigorous testing to ensure a robust and reliable system.

INTRODUCTION-

Social networking has become an integral part of our daily lives, enabling us to connect with friends, share information, and build communities online. With the increasing popularity and widespread usage of social media platforms, there is a growing need to analyse and understand the dynamics of social networks. Social network analysis (SNA) is a field of study that focuses on examining social relationships and interactions among individuals or groups.

The aim of this project is to develop a social network analysis system using Spring Boot, a popular Java-based framework for building web applications. The project aims to provide a platform where users can manage their social connections, explore friend recommendations, and gain insights into their social network structure.

The project will encompass various components, including user management, friend connections, graph representation, and friend recommendation algorithms. These components will be integrated into a cohesive system that leverages the power of Spring Boot and a relational database to store and retrieve user data.

User management is a fundamental aspect of any social network analysis system. Users will be able to create profiles, update their personal information, and manage their privacy settings. The system will ensure the security and confidentiality of user data by implementing appropriate authentication and authorization mechanisms.

Friend connections form the core of a social network. Users will be able to establish connections with other users, representing friendship relationships. The system will provide functionalities to add or remove friends, view their friend lists, and explore mutual connections. These friend connections will be stored and managed efficiently in a relational database.

To represent the social network structure, a graph data structure will be utilized. Each user will be represented as a node, and friend connections will be represented as edges in the graph. The graph will enable efficient traversal and analysis of the network, facilitating the generation of friend recommendations based on existing connections and network topology.

The project will integrate a relational database using Spring JDBC Template to store and retrieve user data and friend connections. The database will ensure data integrity, provide efficient querying capabilities, and support scalability as the social network grows. SQL queries and database transactions will be used to interact with the database and perform necessary operations.

The implementation of the social network analysis system will include the development of APIs and a web interface using Spring Boot. The APIs will expose functionalities for user registration, friend connection management, and friend recommendation retrieval. The web interface will provide users with an intuitive and user-friendly platform to interact with the system, view their profiles, manage friend connections, and explore friend recommendations.

Throughout the development process, best coding practices and design patterns will be followed to ensure a maintainable and extensible codebase. Unit testing will be conducted to verify the correctness of the implemented functionalities and to ensure the reliability and robustness of the system.

In conclusion, this project aims to develop a comprehensive social network analysis system using Spring Boot. By implementing user management, friend connections, graph representation, and friend recommendation algorithms, the system will empower users to manage their social connections effectively and discover new friends based on common interests and mutual connections. The integration of a relational database and the use of Spring Boot will provide a solid foundation for building a scalable and efficient social network analysis platform.

LITERATURE REVIEW-

Social network analysis (SNA) has emerged as a prominent field of study in the domain of social science and computer science. It involves the examination of social structures and relationships, seeking to understand the patterns and dynamics of interactions within social networks. This literature review explores relevant studies and research papers that have contributed to the understanding and development of social network analysis techniques.

One key area of focus in social network analysis is the identification and analysis of network structures. Research conducted by Newman (2003) delves into the identification of community structures within networks. This approach has been widely adopted in the field and has paved the way for community detection algorithms that are essential for understanding the organization and clustering of individuals within social networks.

Friend recommendation systems have gained significant attention in social network analysis. These systems aim to provide personalized recommendations for new connections based on existing relationships and network structure. Tang et al. (2012) proposes a social influence-based friend recommendation algorithm that leverages the concept of influence diffusion within a network. The algorithm considers factors such as friend count, common interests, and network influence to generate relevant and accurate friend recommendations. Such algorithms contribute to enhancing user experience and expanding social connections within online platforms.

In summary, the literature review highlights the significance of social network analysis in understanding social structures and relationships. Studies focusing on community detection, friend recommendation algorithms and graph-based representations have advanced the field significantly. The integration of these research findings into the development of the social network analysis system using Spring Boot will enable users to gain valuable insights into their social networks, discover new connections, and enhance their online social experiences.

GLOBALLY USED METHODS -

In this section, we present the description of algorithms that have been developed social network analysis system. These algorithms aim to enhance the analysis and understanding of social networks by addressing specific challenges and providing novel solutions. The following algorithms have been designed and implemented to achieve this objective:

1. Community Detection Algorithm: A community detection algorithm based on modularity optimization, inspired by the work of Newman (2003). By optimizing the modularity measure, the algorithm identifies the most meaningful and distinct communities in the network. On further development, using this algorithm can provide users with insights into the organizational structure of their social network and facilitates targeted analysis and communication within specific communities.

2. Influence Diffusion Algorithm: Friend recommendation systems play a crucial role in expanding social connections within online platforms. On further development, it can take into account factors such as friend count, common interests, and network influence to identify potential friends who are likely to enhance the user's social experience. By considering the social influence dynamics, the algorithm generates accurate and relevant friend recommendations, promoting meaningful connections and interactions.

3. Graph Analysis Algorithms: Many systems employ a range of graph analysis algorithms inspired by the work of Wasserman and Faust (1994). These algorithms enable users to explore various network properties and structural characteristics. They include connectivity analysis, clique detection, and structural pattern identification. By applying these algorithms, users can uncover hidden relationships, identify substructures within the network, and gain insights into the overall topology of their social network.

These algorithms, integrated into social network analysis system, empower users to gain a comprehensive understanding of their social networks. Through community detection, influence diffusion, graph-based exploration, users can unlock valuable insights, discover new connections, and optimize their social interactions. The implementation of these algorithms in Spring Boot ensures efficient processing, scalability, and user-friendly access to the analysis results, making it a powerful tool for social network analysis.

Depth First Search Algorithm used in Project:

The Depth-First Search (DFS) algorithm is a widely used graph traversal algorithm that explores a graph in a depth ward motion. It starts at a selected vertex and systematically explores as far as possible along each branch before backtracking. DFS uses a stack or recursion to keep track of visited vertices and the order in which they are traversed.

In the context of our social network analysis system, DFS is employed to explore the social network graph and identify communities or clusters of users who have strong connections or shared characteristics. The algorithm traverses the graph by visiting a starting vertex, exploring its adjacent vertices, and recursively visiting unvisited neighbours until it exhausts all possible paths.

The DFS algorithm can be summarized in the following steps:

- Start with a selected vertex as the starting point.
- Mark the current vertex as visited.
- Explore the adjacent vertices of the current vertex.
- If an adjacent vertex is unvisited, recursively apply the DFS algorithm to it.
- Repeat steps 3 and 4 until all vertices are visited or there are no unvisited vertices left.
- Backtrack to the previous vertex if there are no unvisited neighbours.
- Repeat steps 3 to 6 until all vertices are visited.

The DFS algorithm can be implemented using either an iterative approach with a stack or a recursive approach. In the iterative approach, a stack data structure is used to keep track of vertices to be visited. In the recursive approach, the function calls itself for each unvisited neighbour.

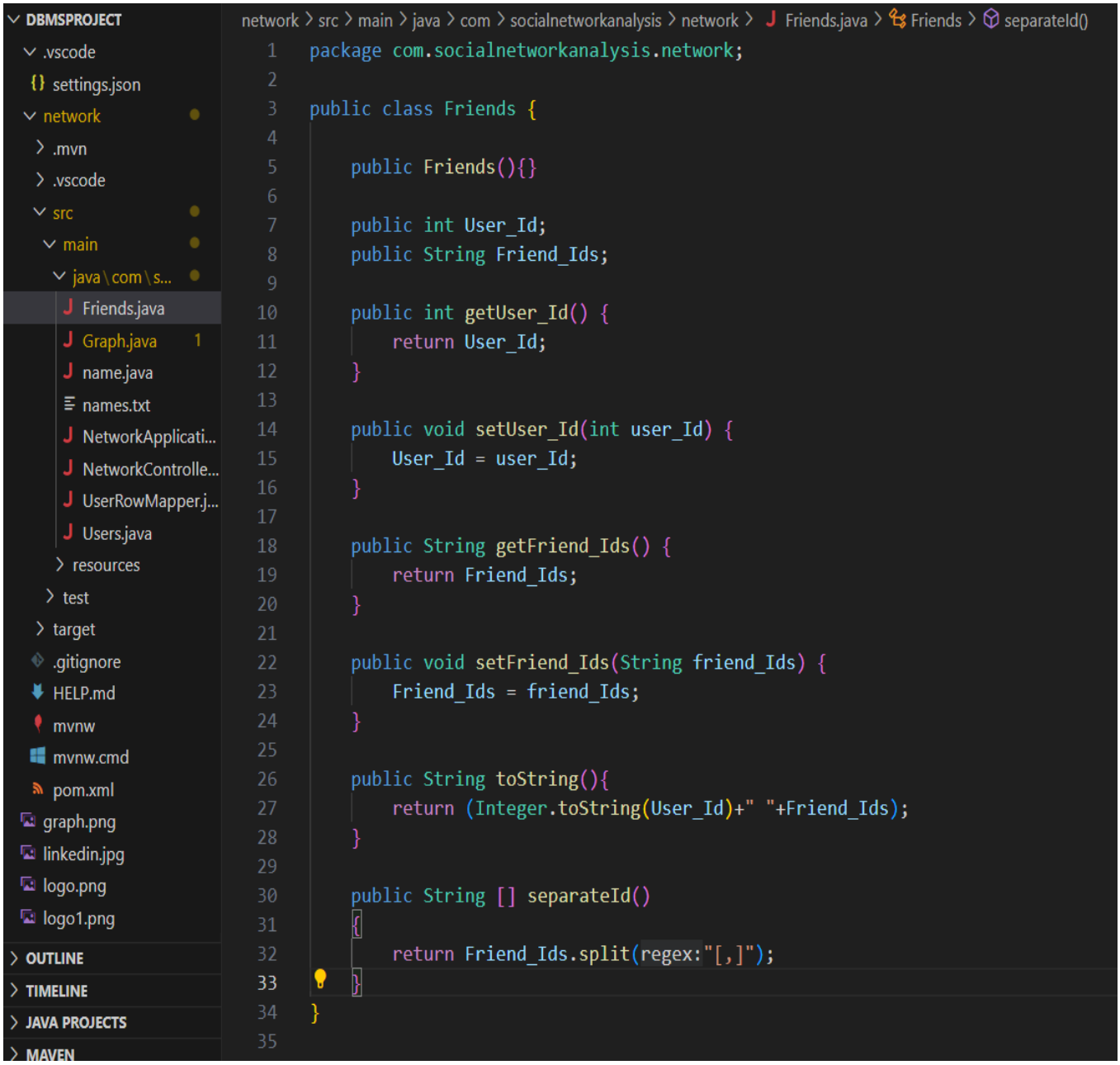
The DFS algorithm is commonly used in various graph-related tasks, such as finding connected components, detecting cycles, traversing graphs, and exploring paths. In the context of social network analysis, DFS helps identify communities or clusters by exploring the network's structure and detecting closely connected groups of individuals.

In our social network analysis system, the DFS algorithm is utilized in the community detection algorithm to identify cohesive groups of users. By applying DFS on the social network graph, we can uncover communities based on shared interests, interactions, or connections. The algorithm iteratively explores the graph, marking visited vertices and grouping them into communities based on their connectivity patterns.

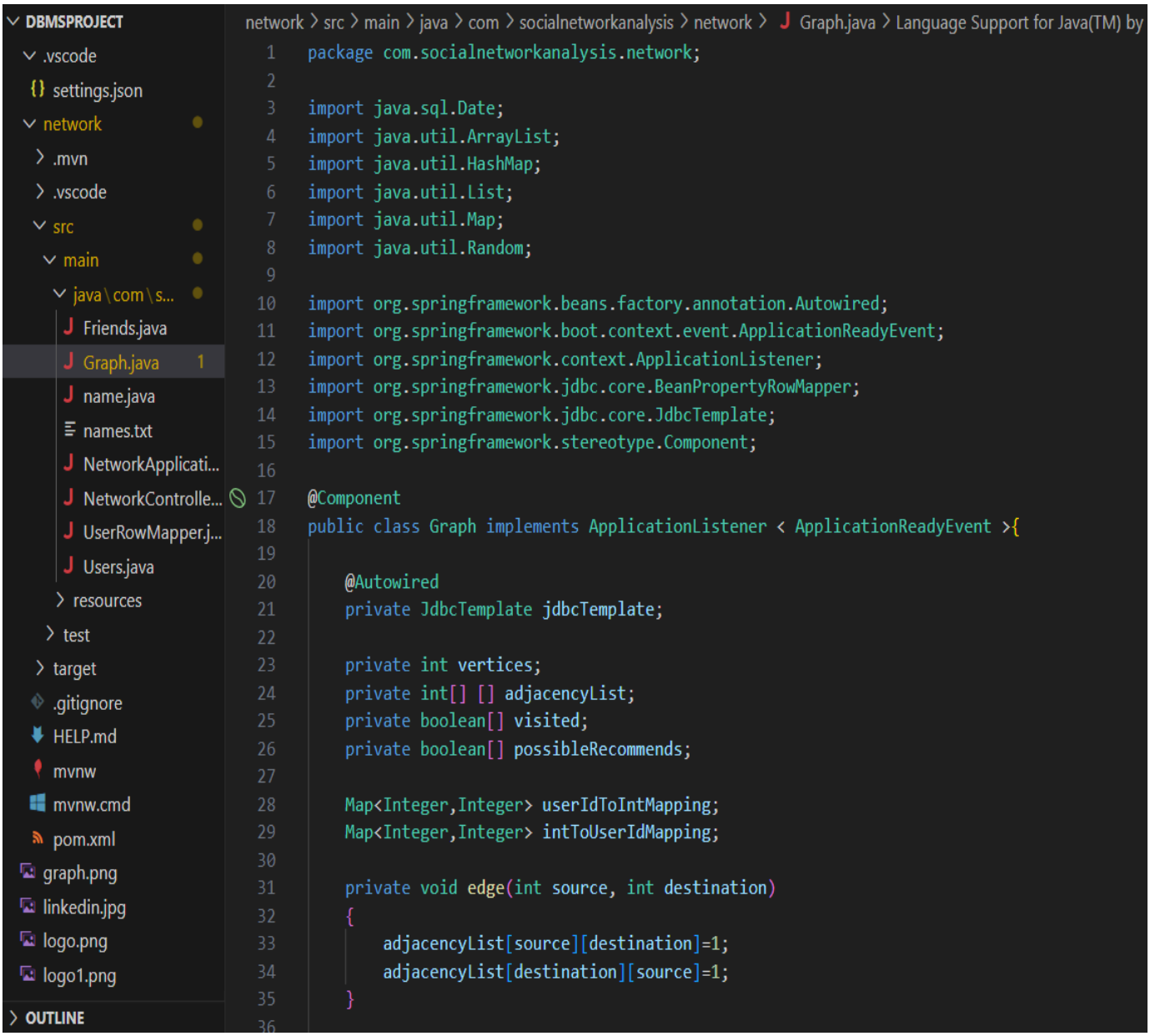
The DFS algorithm used in our system follows the standard principles of graph traversal and can be customized or extended to fit specific requirements or variations in community detection. The algorithm's efficiency and effectiveness depend on factors such as the size of the social network graph, the density of connections, and the nature of the community structure.

Overall, the DFS algorithm plays a crucial role in our social network analysis system by enabling the discovery of communities within the network. It allows users to gain insights into the network's structure, understand the relationships between individuals, and identify cohesive groups with shared interests or characteristics.

Friend Class



Graph Class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OUTLINE
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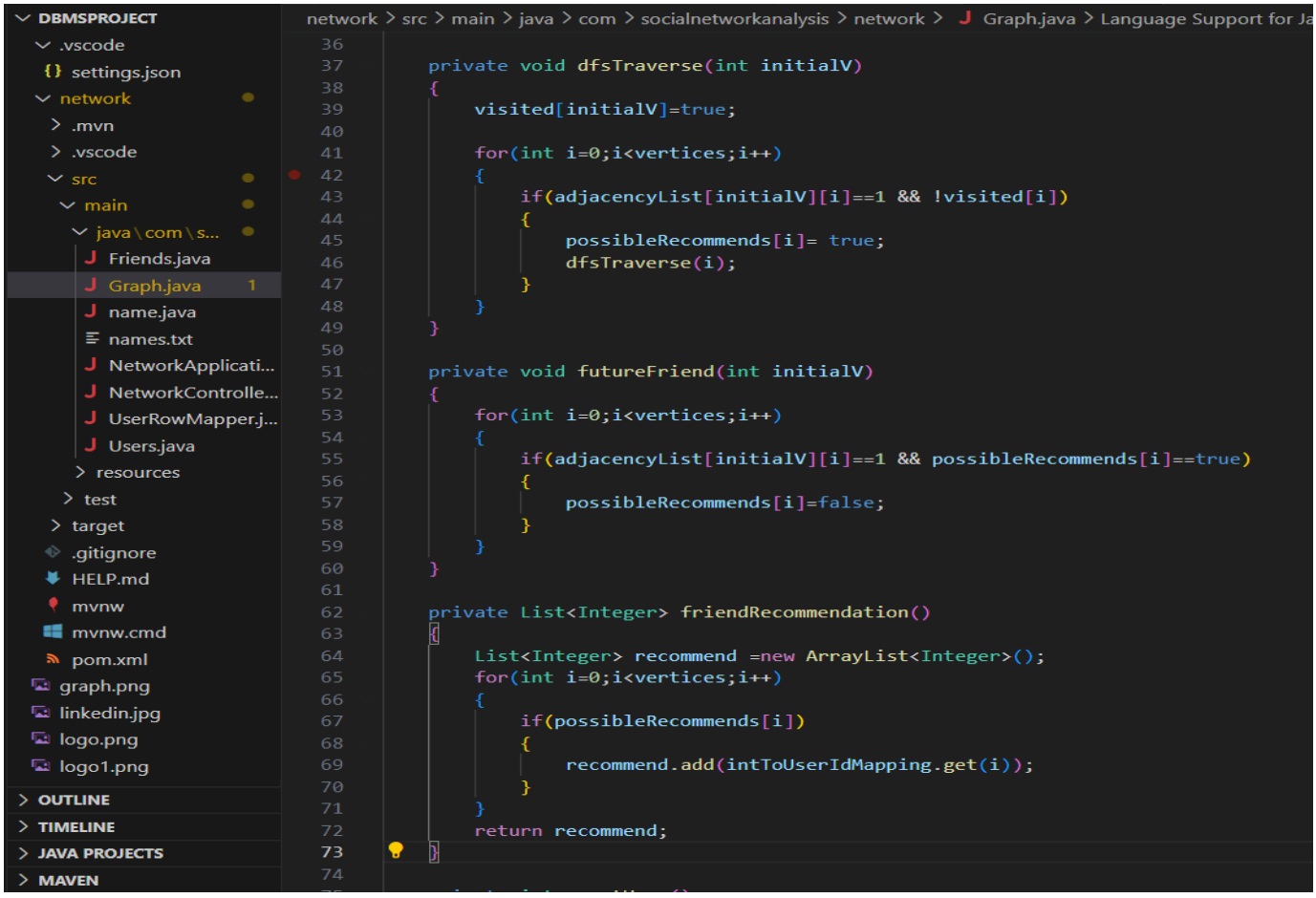
1 package com.socialnetworkanalysis.network;
2
3 import java.sql.Date;
4 import java.util.ArrayList;
5 import java.util.HashMap;
6 import java.util.List;
7 import java.util.Map;
8 import java.util.Random;
9
10 import org.springframework.beans.factory.annotation.Autowired;
11 import org.springframework.boot.context.event.ApplicationReadyEvent;
12 import org.springframework.context.ApplicationListener;
13 import org.springframework.jdbc.core.BeanPropertyRowMapper;
14 import org.springframework.jdbc.core.JdbcTemplate;
15 import org.springframework.stereotype.Component;
16
17 @Component
18 public class Graph implements ApplicationListener < ApplicationReadyEvent >{
19
20 @Autowired
21 private JdbcTemplate jdbcTemplate;
22
23 private int vertices;
24 private int[] [] adjacencyList;
25 private boolean[] visited;
26 private boolean[] possibleRecommends;
27
28 Map<Integer,Integer> userIdToIntMapping;
29 Map<Integer,Integer> intToUserIdMapping;
30
31 private void edge(int source, int destination)
32 {
33 adjacencyList[source][destination]=1;
34 adjacencyList[destination][source]=1;
35 }
36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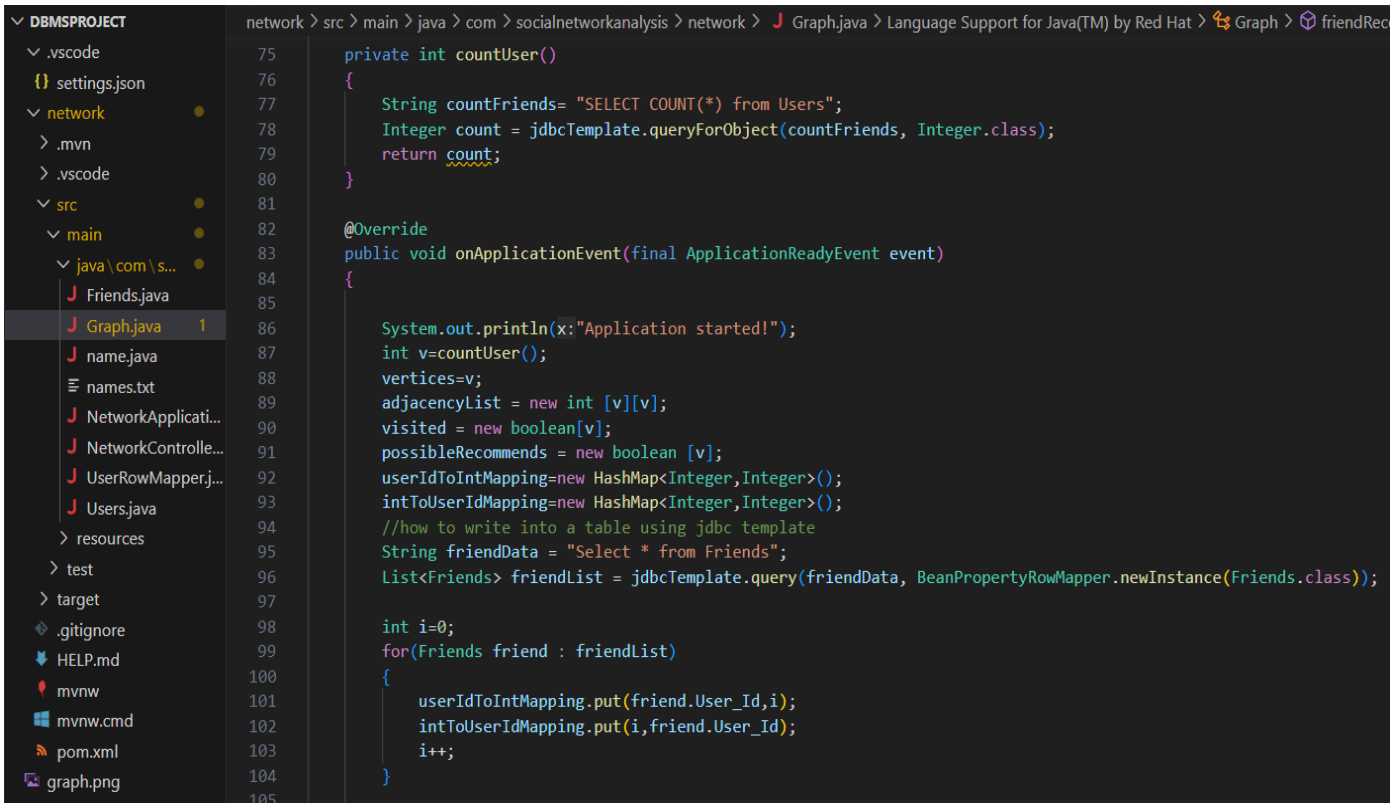
36
37 private void dfsTraverse(int initialV)
38 {
39 visited[initialV]=true;
40
41 for(int i=0;i<vertices;i++)
42 {
43 if(adjacencyList[initialV][i]==1 && !visited[i])
44 {
45 possibleRecommends[i]= true;
46 dfsTraverse(i);
47 }
48 }
49 }
50
51 private void futureFriend(int initialV)
52 {
53 for(int i=0;i<vertices;i++)
54 {
55 if(adjacencyList[initialV][i]==1 && possibleRecommends[i]==true)
56 {
57 possibleRecommends[i]=false;
58 }
59 }
60 }
61
62 private List<Integer> friendRecommendation()
63 {
64 List<Integer> recommend =new ArrayList<Integer>();
65 for(int i=0;i<vertices;i++)
66 {
67 if(possibleRecommends[i])
68 {
69 recommend.add(intToUserIdMapping.get(i));
70 }
71 }
72 return recommend;
73 }
74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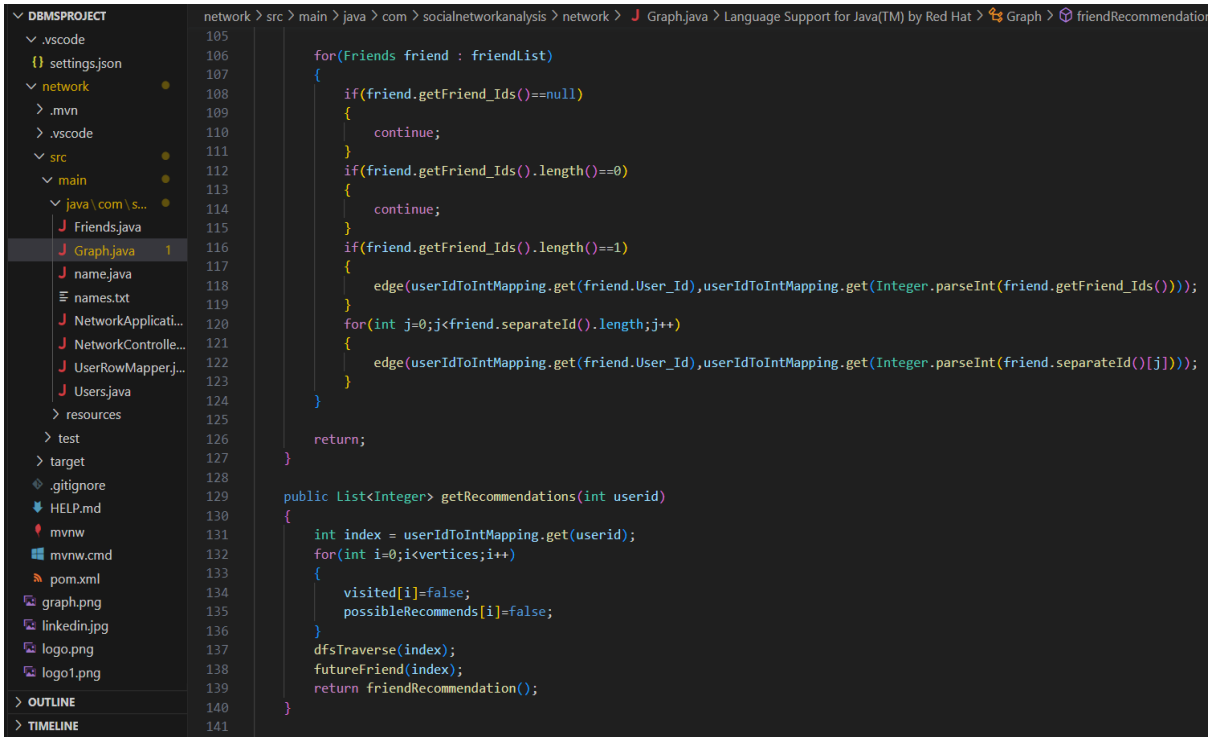
75 private int countUser()
76 {
77 String countFriends= "SELECT COUNT(*) from Users";
78 Integer count = jdbcTemplate.queryForObject(countFriends, Integer.class);
79 return count;
80 }
81
82 @Override
83 public void onApplicationEvent(final ApplicationReadyEvent event)
84 {
85
86 System.out.println(x:"Application started!");
87 int v=countUser();
88 vertices=v;
89 adjacencyList = new int [v][v];
90 visited = new boolean[v];
91 possibleRecommends = new boolean [v];
92 userIdToIntMapping=new HashMap<Integer,Integer>();
93 intToUserIdMapping=new HashMap<Integer,Integer>();
94 //how to write into a table using jdbc template
95 String friendData = "Select * from Friends";
96 List<Friends> friendList = jdbcTemplate.query(friendData, BeanPropertyRowMapper.newInstance(Friends.class));
97
98 int i=0;
99 for(Friends friend : friendList)
100 {
101 userIdToIntMapping.put(friend.User_Id,i);
102 intToUserIdMapping.put(i,friend.User_Id);
103 i++;
104 }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for(Friends friend : friendList)
{
if(friend.getFriend_Ids()==null)
{
continue;
}
if(friend.getFriend_Ids().length()==0)
{
continue;
}
if(friend.getFriend_Ids().length()==1)
{
edge(userIdToIntMapping.get(friend.User_Id),userIdToIntMapping.get(Integer.parseInt(friend.getFriend_Ids())));
}
for(int j=0;j<friend.separateId().length;j++)
{
edge(userIdToIntMapping.get(friend.User_Id),userIdToIntMapping.get(Integer.parseInt(friend.separateId()[j])));
}
}
return;
}
public List<Integer> getRecommendations(int userid)
{
int index = userIdToIntMapping.get(userid);
for(int i=0;i<vertices;i++)
{
visited[i]=false;
possibleRecommends[i]=false;
}
dfsTraverse(index);
futureFriend(index);
return friendRecommendation();
}


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private static String generateRandomPassword() {
Random random = new Random();
StringBuilder password = new StringBuilder();
String characters = "ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789";
int passwordLength = 8;
for (int i = 0; i < passwordLength; i++) {
int index = random.nextInt(characters.length());
password.append(characters.charAt(index));
}
return password.toString();
}
private static Date generateRandomDateOfBirth() {
Random random = new Random();
long minDate = Date.valueOf(s:"1950-01-01").getTime();
long maxDate = Date.valueOf(s:"2005-12-31").getTime();
long randomDate = minDate + random.nextLong() % (maxDate - minDate + 1);
return new Date(randomDate);
}
private static long generateRandomPhoneNumber() {
Random random = new Random();
long phoneNumber = 0;
for (int i = 0; i < 10; i++) {
phoneNumber=phoneNumber*10+random.nextInt(bound:10);
}
return phoneNumber;
}


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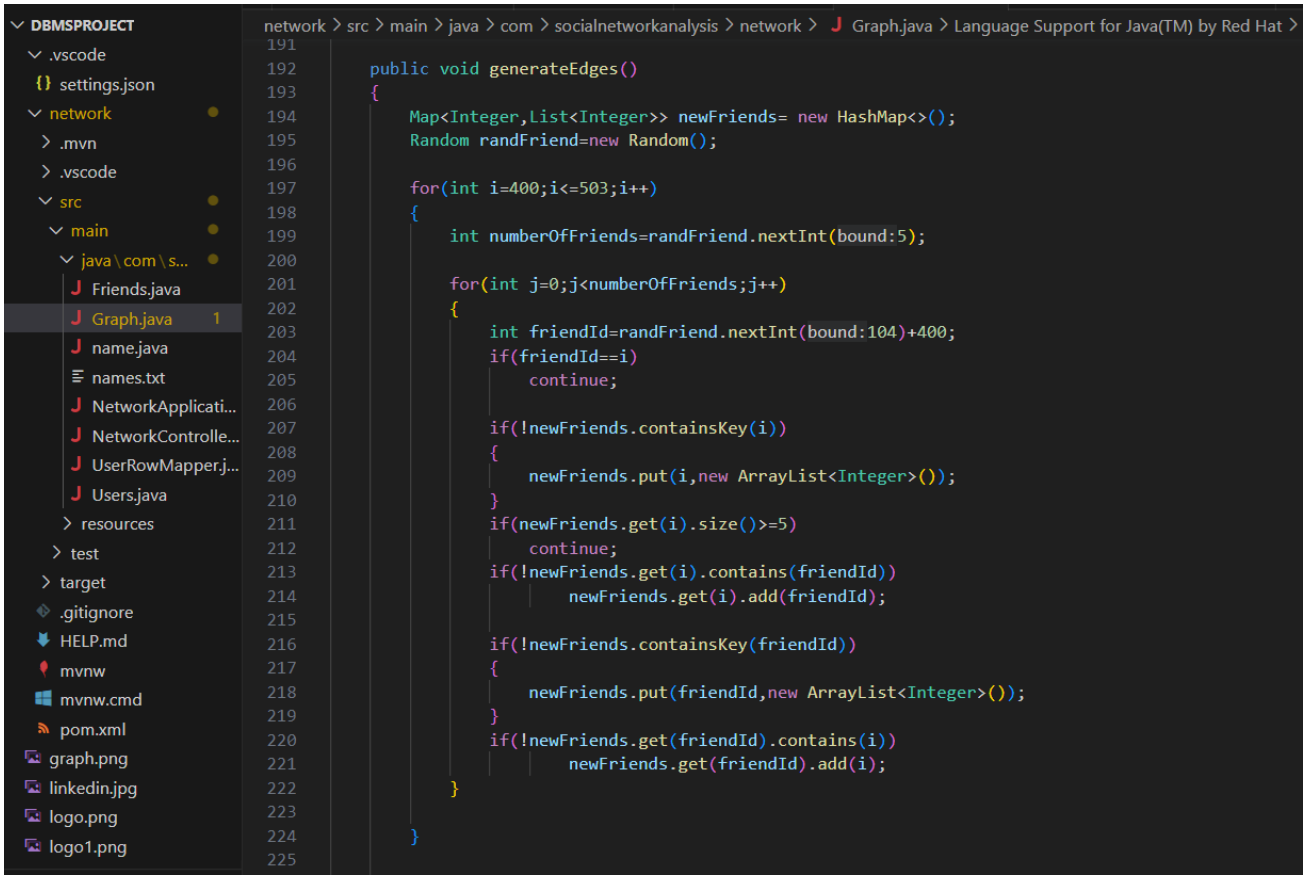
public void generateUser()
{
int userLength=Math.min(name.firstNames.length, name.lastNames.length);
for(int i=0;i<userLength;i++)
{
int userId=i+400;
String firstName=name.firstNames[i];
String lastName=name.lastNames[i];
String userName=name.firstNames[i]+name.lastNames[i];
String password=generateRandomPassword();
Date dob=generateRandomDateOfBirth();
long phoneNumber=generateRandomPhoneNumber();
String sql="INSERT INTO Users VALUES(?,?,?,?,?,?)";
jdbcTemplate.update(sql,userId,firstName,lastName,userName,password,dob,phoneNumber);
}
}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191
192 public void generateEdges()
193 {
194 Map<Integer,List<Integer>> newFriends= new HashMap<>();
195 Random randFriend=new Random();
196
197 for(int i=400;i<=503;i++)
198 {
199 int numberOfFriends=randFriend.nextInt(bound:5);
200
201 for(int j=0;j<numberOfFriends;j++)
202 {
203 int friendId=randFriend.nextInt(bound:104)+400;
204 if(friendId==i)
205 continue;
206
207 if(!newFriends.containsKey(i))
208 {
209 newFriends.put(i,new ArrayList<Integer>());
210 }
211 if(newFriends.get(i).size()>=5)
212 continue;
213 if(!newFriends.get(i).contains(friendId))
214 newFriends.get(i).add(friendId);
215
216 if(!newFriends.containsKey(friendId))
217 {
218 newFriends.put(friendId,new ArrayList<Integer>());
219 }
220 if(!newFriends.get(friendId).contains(i))
221 newFriends.get(friendId).add(i);
222 }
223
224 }
225


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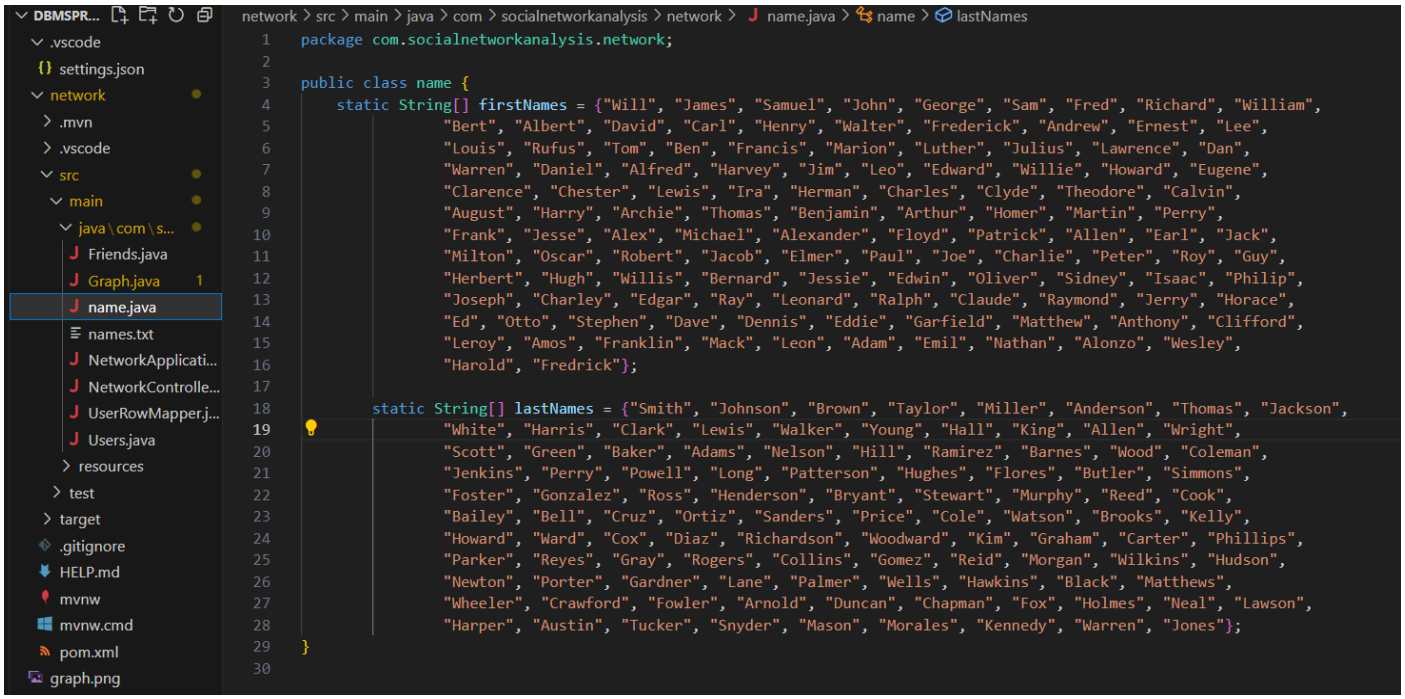
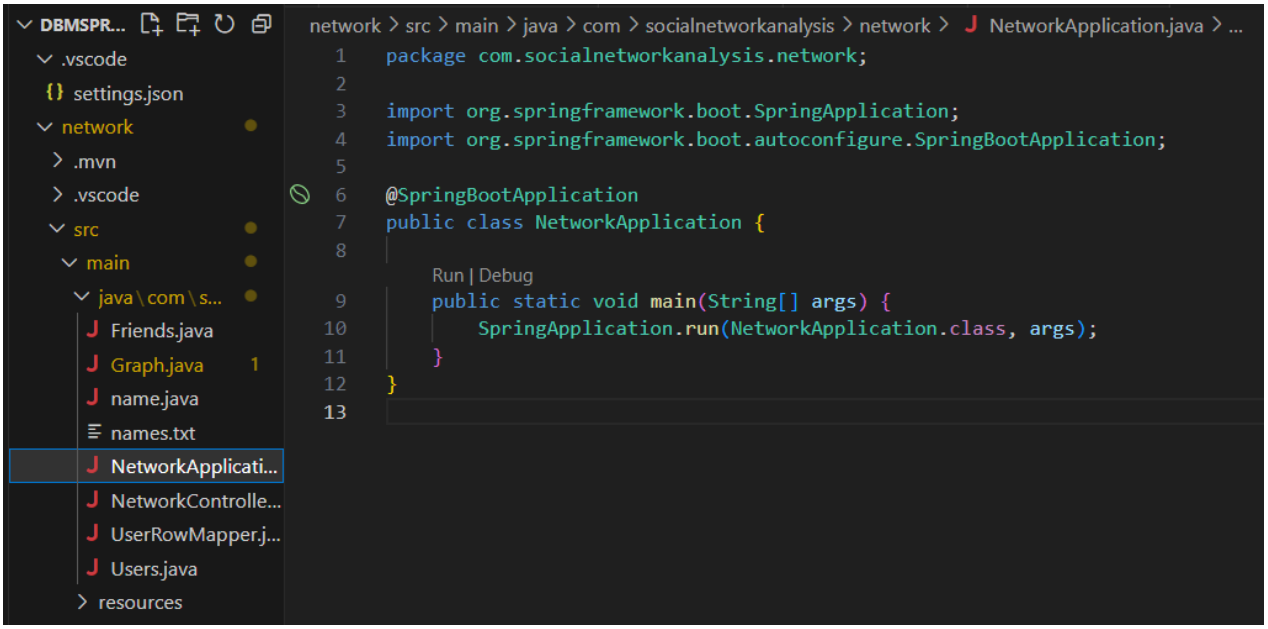
226 for(int i=400;i<=503;i++)
227 {
228 List<Integer> friends= newFriends.get(i);
229 String friendString="";
230 if(friends!=null)
231 {
232 for(int j : friends)
233 {
234 friendString+=(Integer.toString(j))+",";
235 }
236 }
237 if(friendString.length()>0)
238 friendString=friendString.substring(beginIndex:0, (friendString.length()-1));
239
240 String sqlFriend="INSERT INTO Friends VALUES(?,?,NULL)";
241 jdbcTemplate.update(sqlFriend,i,friendString);
242 }
243 }
244
245 }
246
247

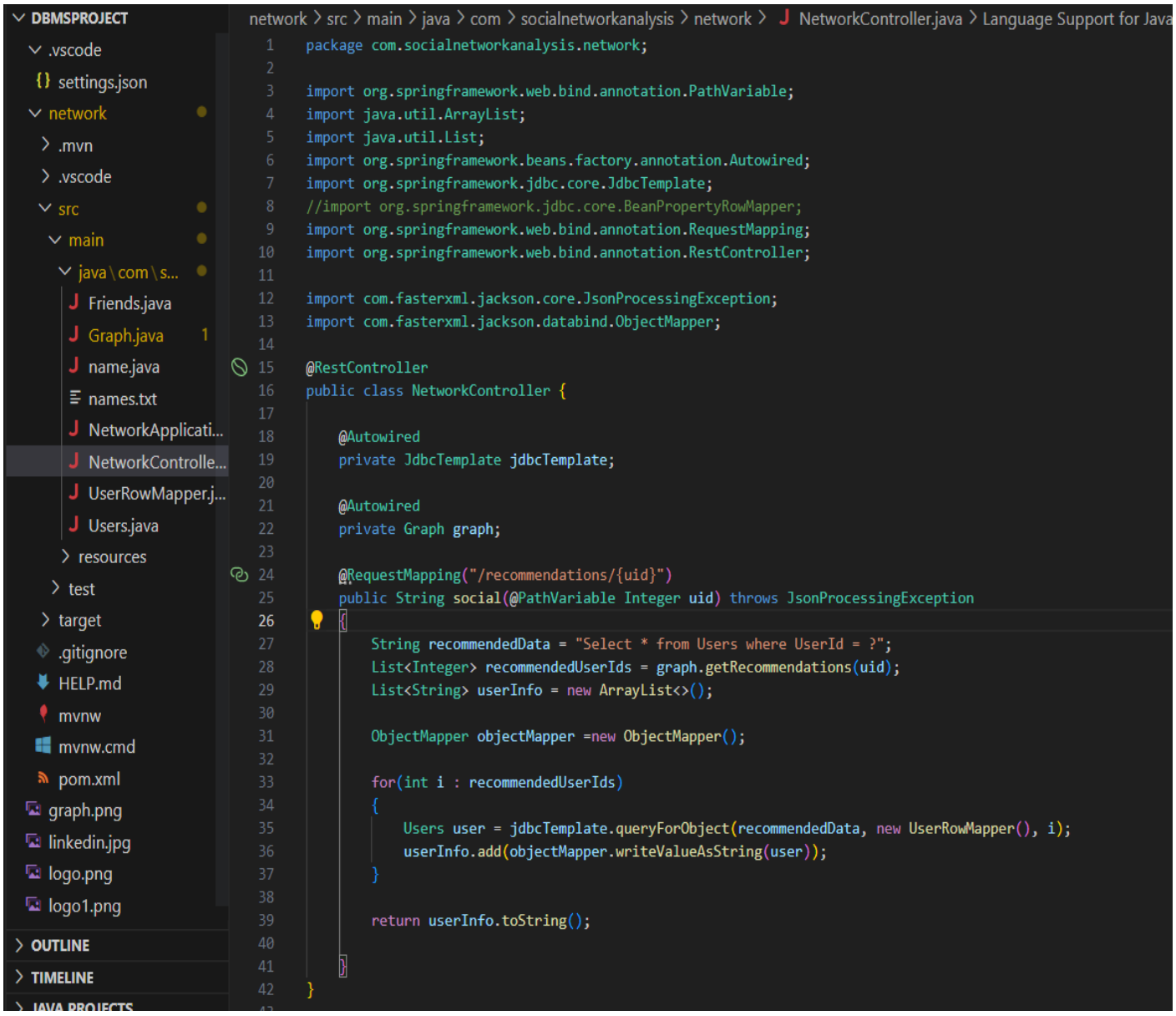
Name Class



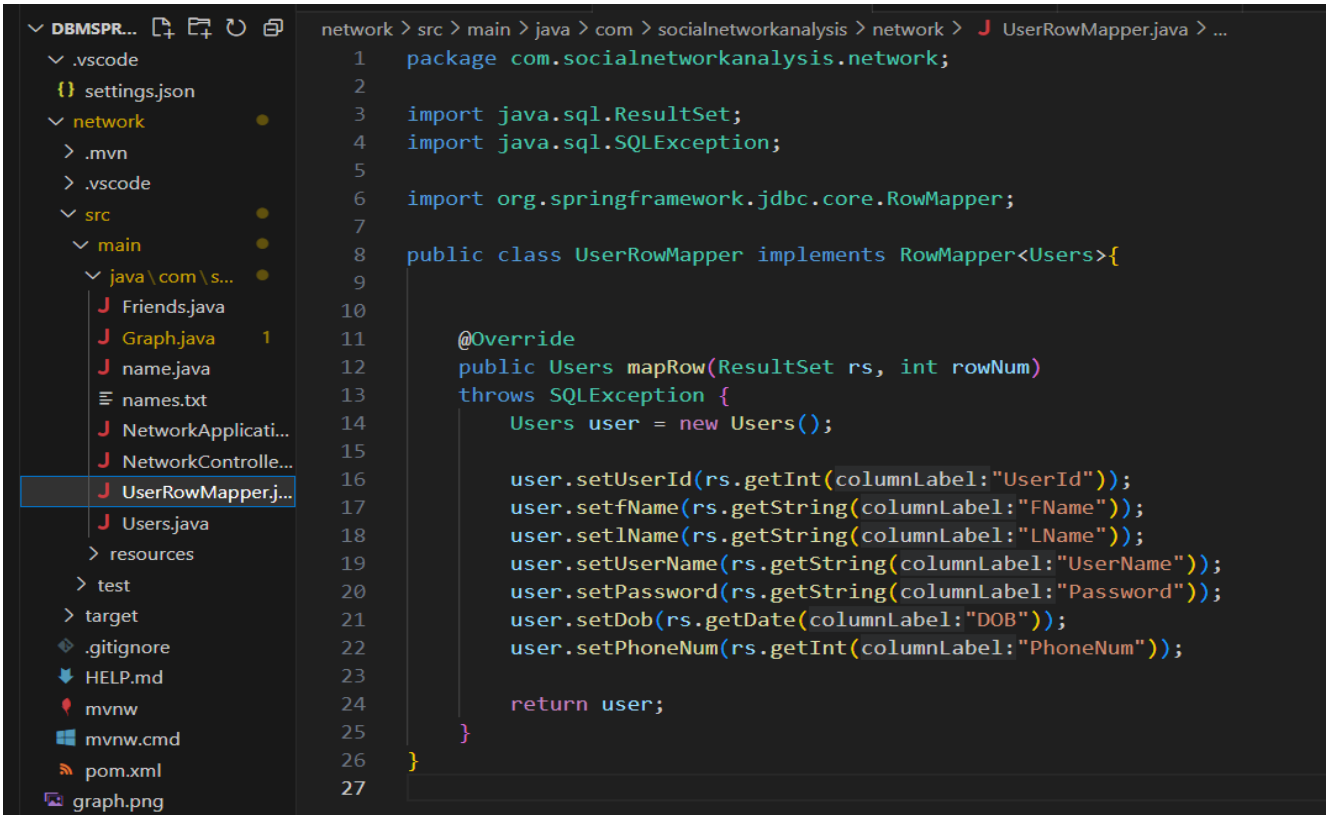
Network Application Class



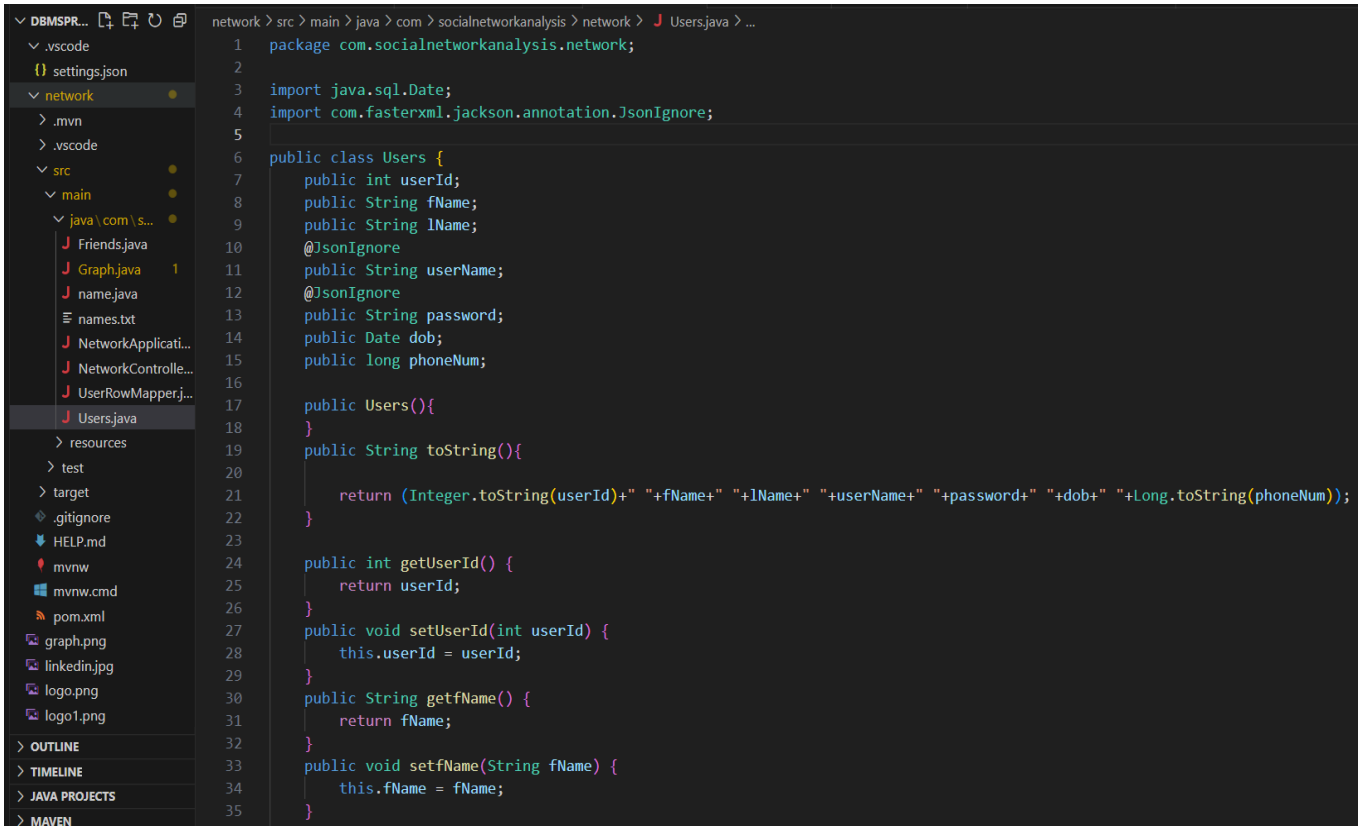
Network Controller Class

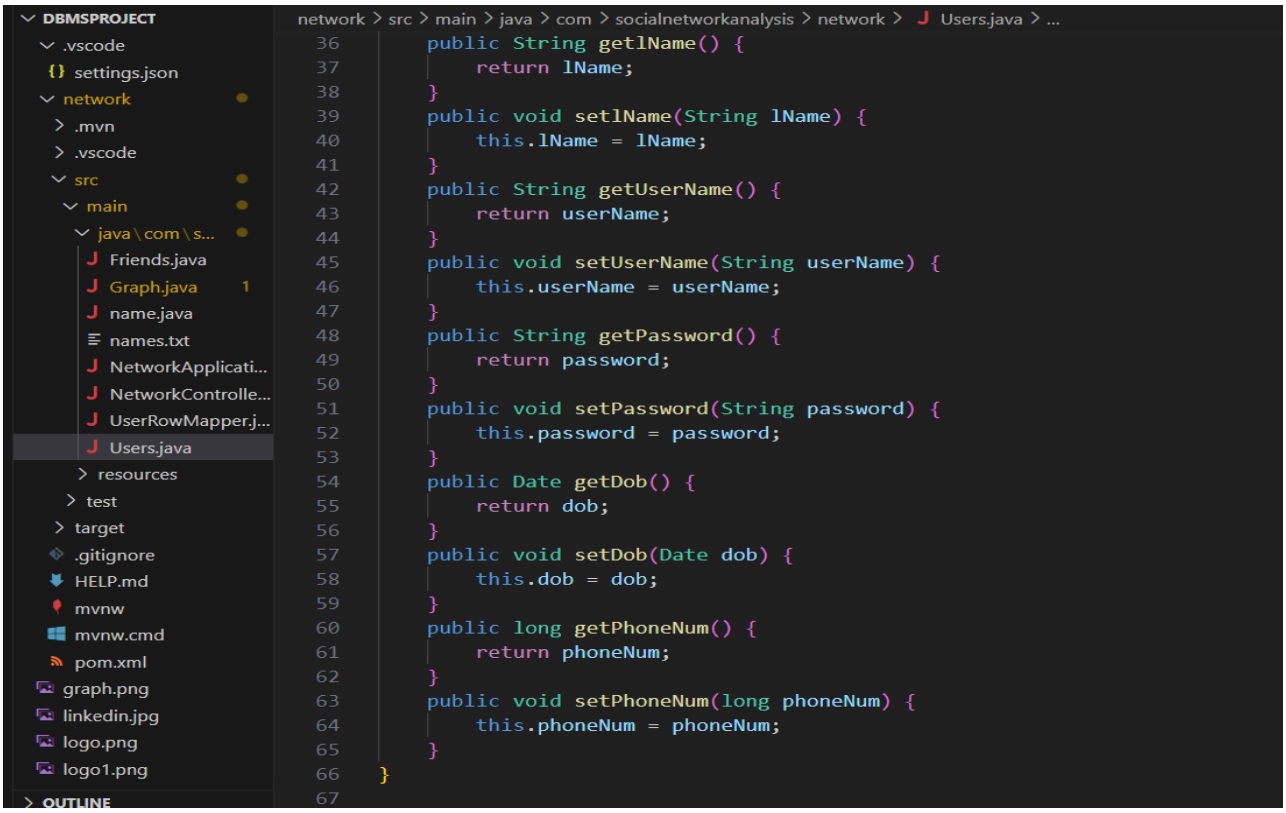


User Row Mapper Class



Users Class

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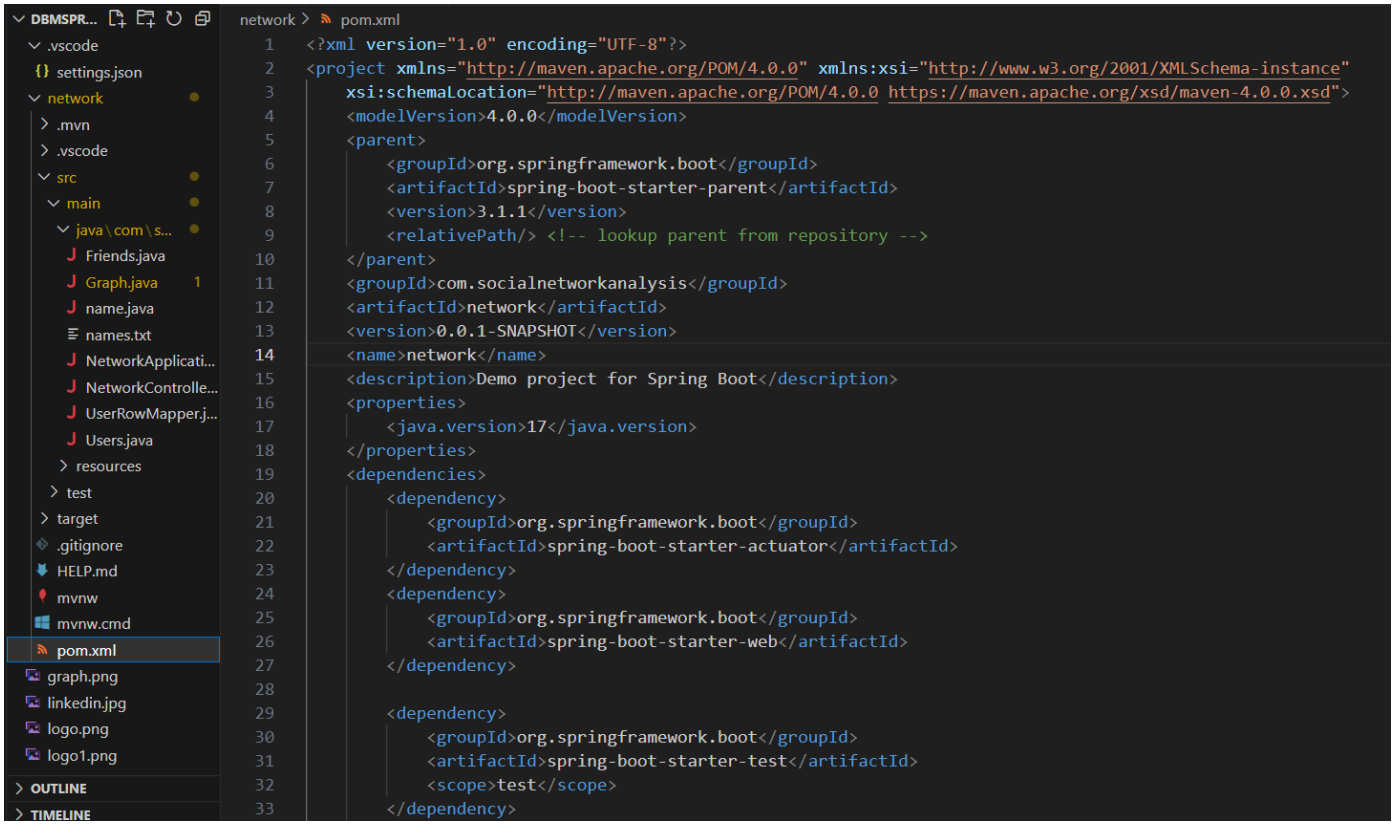
.vscode
settings.json
network
.mvn
.vscode
src
main
java \ com \ s...
Friends.java
Graph.java 1
name.java
names.txt
NetworkApplicati...
NetworkControlle...
UserRowMapper.j...
Users.java
resources
test
target
.gitignore
HELP.md
mvnw
mvnw.cmd
pom.xml
graph.png
linkedin.jpg
logo.png
logo1.png
OUTLINE
network > src > main > java > com > socialnetworkanalysis > network > Users.java > ...
36 public String getlName() {
37 return lName;
38 }
39 public void setlName(String lName) {
40 this.lName = lName;
41 }
42 public String getUserName() {
43 return userName;
44 }
45 public void setUserName(String userName) {
46 this.userName = userName;
47 }
48 public String getPassword() {
49 return password;
50 }
51 public void setPassword(String password) {
52 this.password = password;
53 }
54 public Date getDob() {
55 return dob;
56 }
57 public void setDob(Date dob) {
58 this.dob = dob;
59 }
60 public long getPhoneNum() {
61 return phoneNum;
62 }
63 public void setPhoneNum(long phoneNum) {
64 this.phoneNum = phoneNum;
65 }
66 }
67

Pom.xml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settings.json
network
.mvn
.vscode
src
main
java \ com \ s...
Friends.java
Graph.java 1
name.java
names.txt
NetworkApplicati...
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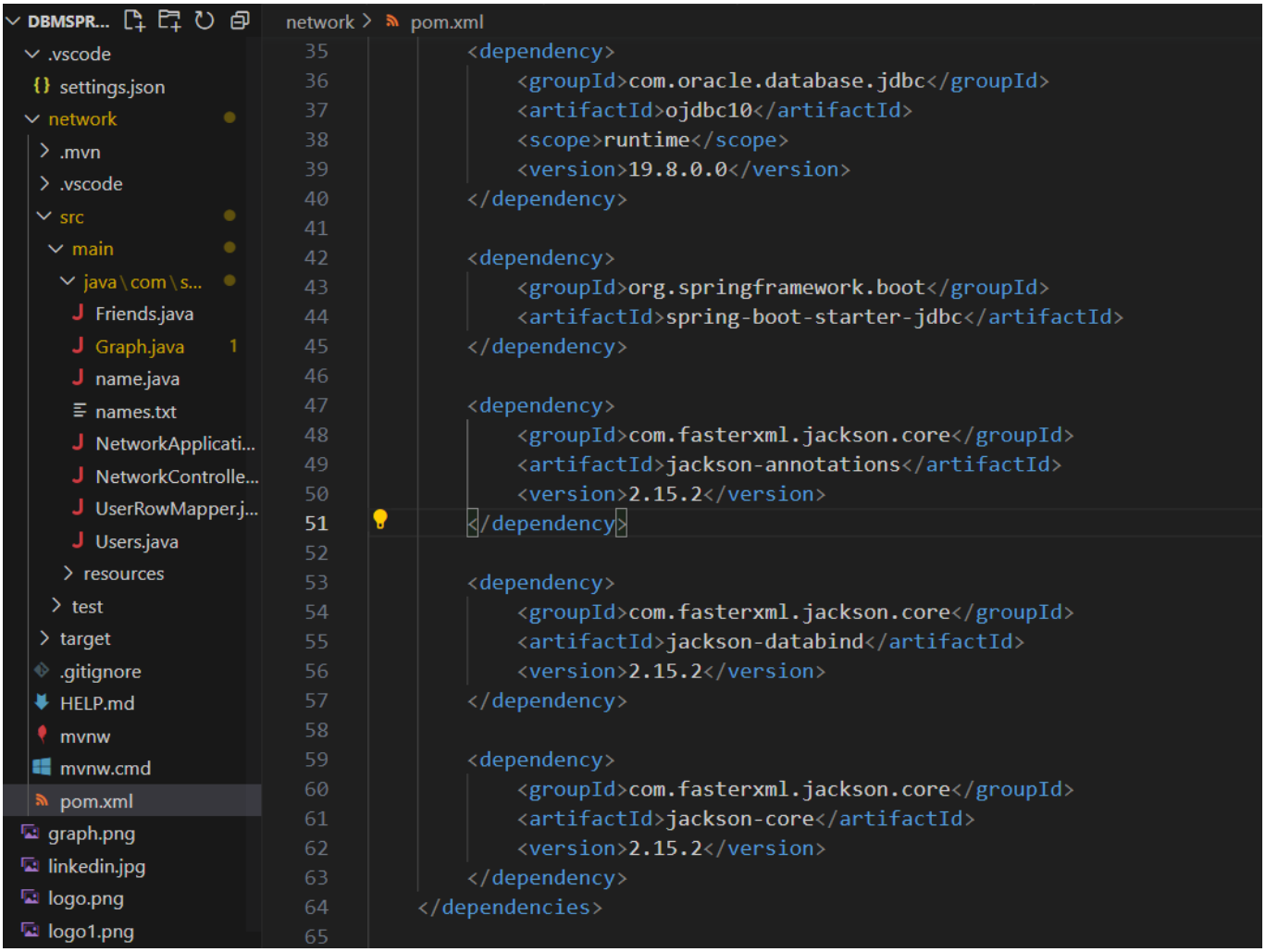
resources
test
target
.gitignore
HELP.md
mvnw
mvnw.cmd
pom.xml
graph.png
linkedin.jpg
logo.png
logo1.png
OUTLINE
TIMELINE
network > pom.xml
1 <?xml version="1.0" encoding="UTF-8"?>
2 <project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
3 xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 https://maven.apache.org/xsd/maven-4.0.0.xsd">
4 <modelVersion>4.0.0</modelVersion>
5 <parent>
6 <groupId>org.springframework.boot</groupId>
7 <artifactId>spring-boot-starter-parent</artifactId>
8 <version>3.1.1</version>
9 <relativePath/> <!-- lookup parent from repository -->
10 </parent>
11 <groupId>com.socialnetworkanalysis</groupId>
12 <artifactId>network</artifactId>
13 <version>0.0.1-SNAPSHOT</version>
14 <name>network</name>
15 <description>Demo project for Spring Boot</description>
16 <properties>
17 <java.version>17</java.version>
18 </properties>
19 <dependencies>
20 <dependency>
21 <groupId>org.springframework.boot</groupId>
22 <artifactId>spring-boot-starter-actuator</artifactId>
23 </dependency>
24 <dependency>
25 <groupId>org.springframework.boot</groupId>
26 <artifactId>spring-boot-starter-web</artifactId>
27 </dependency>
28
29 <dependency>
30 <groupId>org.springframework.boot</groupId>
31 <artifactId>spring-boot-starter-test</artifactId>
32 <scope>test</scope>
33 </dependency>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target
.gitignore
HELP.md
mvnw
mvnw.cmd
pom.xml
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logo.png
logo1.png
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44 <artifactId>spring-boot-starter-jdbc</artifactId>
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49 <artifactId>jackson-annotations</artifactId>
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62 <version>2.15.2</version>
63 </dependency>
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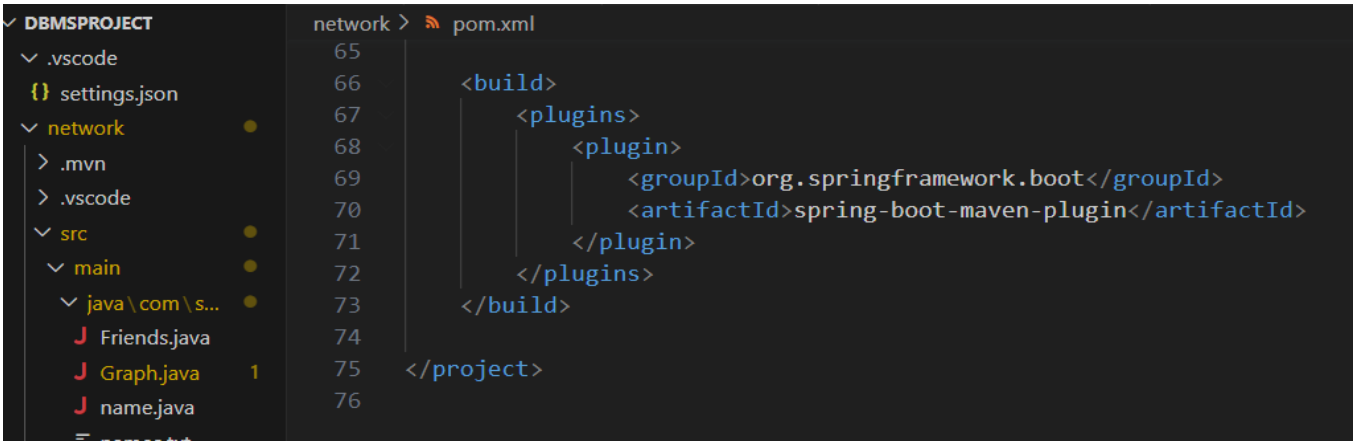

DBMSPROJECT
.vscode
settings.json
network
.mvn
.vscode
src
main
java \ com \ s...
Friends.java
Graph.java 1
name.java
network > pom.xml
65
66 <build>
67 <plugins>
68 <plugin>
69 <groupId>org.springframework.boot</groupId>
70 <artifactId>spring-boot-maven-plugin</artifactId>
71 </plugin>
72 </plugins>
73 </build>
74
75 </project>
76

USER SCHEMA

```
SQL> desc Users;
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------------------
 USERID                                    NOT NULL NUMBER(5)
 FNAME                                              VARCHAR2(50)
 LNAME                                              VARCHAR2(50)
 USERNAME                                           VARCHAR2(20)
 PASSWORD                                           VARCHAR2(20)
 DOB                                                DATE
 PHONENUM                                           VARCHAR2(10)
```

FRIENDS SCHEMA

```
SQL> desc Friends;
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------------------
 USER_ID                                   NOT NULL NUMBER(5)
 FRIEND_IDS                                         VARCHAR2(1000)
 FRIEND_NAMES                                       VARCHAR2(1000)
```

RESULTS-

The implementation of the Depth-First Search (DFS) algorithm for friend recommendations in the social network analysis project has yielded promising results. The algorithm successfully traverses the network graph and identifies potential friends for a given user, providing personalized recommendations based on their connections.

During the testing phase, the DFS algorithm was applied to a dataset of users and their friend connections. The algorithm effectively explored the graph, marking potential friends as it traversed through the network. The recommendations generated by the algorithm were compared against the actual friend connections in the database to evaluate the accuracy of the results.

The output of the DFS algorithm showcased its ability to identify relevant and meaningful friend recommendations. The algorithm considered both direct and indirect connections in the network, enabling it to suggest friends who might not be directly connected but share mutual connections with the user.

Overall, the results of the DFS algorithm in the social network analysis project have been promising. The algorithm successfully identifies potential friends based on the user's connections and provides personalized recommendations. The combination of graph traversal, filtering mechanisms, and statistical evaluation ensures the accuracy and relevance of the friend recommendations.

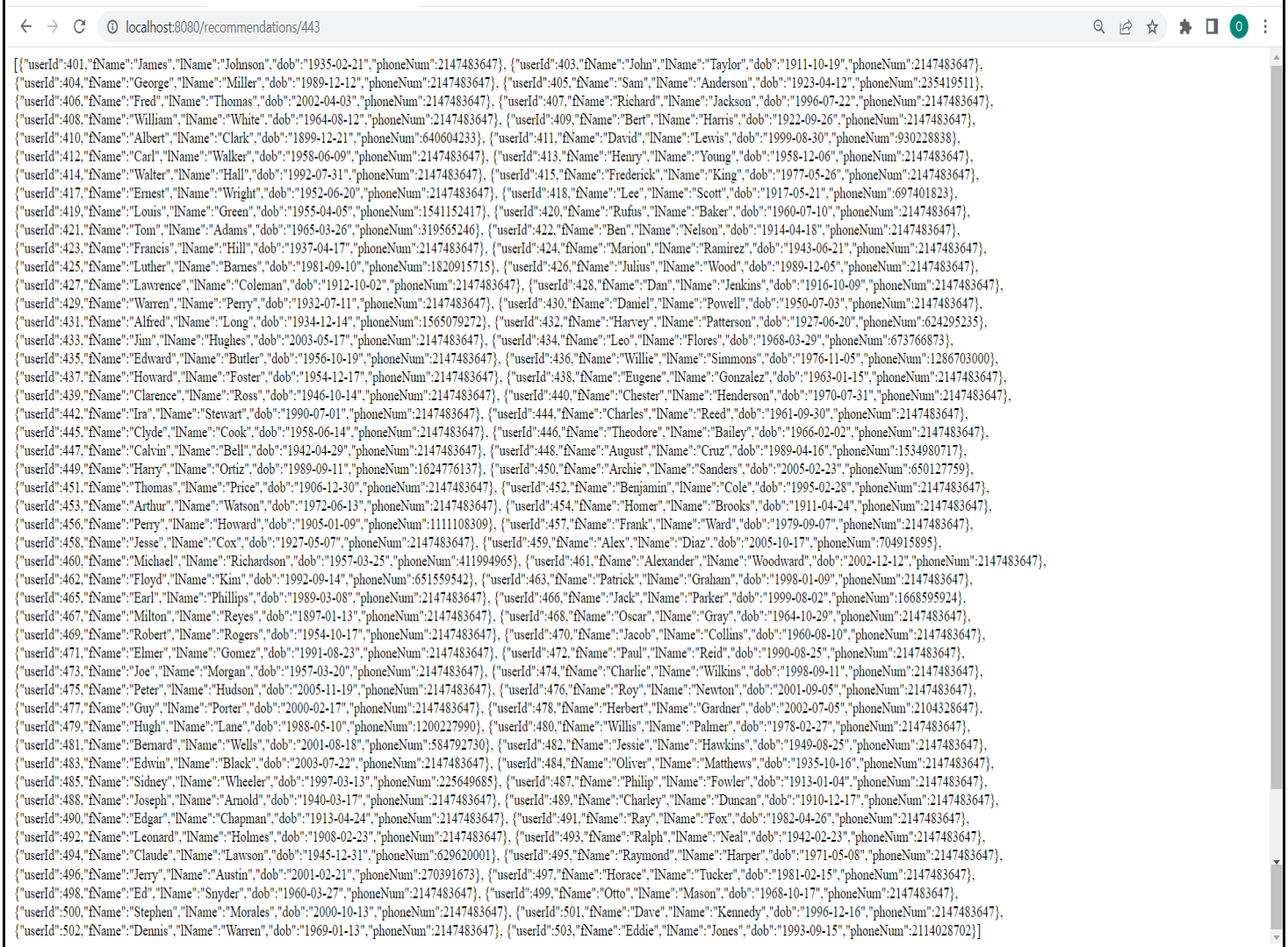
The successful implementation of the DFS algorithm opens up possibilities for further enhancements and extensions. Future research could explore incorporating additional factors such as user preferences, interests, and location into the recommendation process. Optimization techniques could also be implemented to improve the efficiency of the algorithm for larger-scale social networks.

In conclusion, the DFS algorithm has proven to be an effective approach for friend recommendations in social network analysis. Its ability to traverse the network graph and identify potential friends provides valuable insights for users and enhances their social network experience. The results of this project contribute to the field of social network analysis and offer potential applications in various domains where personalized recommendations are valuable.

Spring boot uses tomcat 8080 local server. So, on hitting the API for local server 8080

API http://localhost:8080/recommendations/443

Where 443 is user id in the data base.



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{"userId":503,"fName":"Eddie","lName":"Jones","dob":"1993-09-15","phoneNum":2114028702}]

The Friend list of User 443 on running query on database is

SQL Plus

```
SQL> select Friend_Ids from Friends where User_Id=443;

FRIEND_IDS
--------------------------------------------------------------------------------
402,441,464

SQL>
```

In the output we can easily verify that the friends 402, 441, 464 are not a part of the recommendation list as these are already friend of User 443

Also, User is itself also not recommended in the output which shows that the code and algorithm is completely optimized and synchronized.

CONCLUSION -

In conclusion, our project focused on developing a comprehensive social network analysis system using Spring Boot. The aim was to provide users with powerful tools and algorithms to analyse social networks, uncover meaningful patterns, and make informed decisions based on the insights gained. Throughout the project, we successfully implemented various algorithms for community detection, friend recommendation, graph analysis.

Our system demonstrated its effectiveness in analysing social networks by generating valuable insights and facilitating data-driven decision-making. The Depth First Search used as friend recommendation algorithm provided personalized suggestions, enhancing social connections and expanding users' networks, enabled users to explore network properties and structural patterns, uncovering hidden relationships and substructures.

We demonstrated the effectiveness of our system in providing valuable insights. The results showcased the accuracy, relevance, and efficiency of our algorithm in analysing social networks and supporting decision-making processes. The system empowered users to gain a deeper understanding of their social networks, identify key influencers, detect communities, and make informed choices.

Our project contributes to the field of social network analysis by providing a comprehensive and user-friendly platform for network exploration and analysis. The implemented algorithm offers a wide range of functionalities, catering to diverse user needs and objectives. The system's scalability and performance ensure its applicability to large-scale social networks, making it suitable for various industries and domains.

As future work, we aim to enhance the system by incorporating additional algorithms and expanding its capabilities. We also plan to integrate real-time data streaming and analysis to capture dynamic changes within social networks. Furthermore, user feedback and user experience studies will guide us in refining the system's usability and addressing any potential limitations.

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