Less Than 20 Questions

Agent 47…

Game Description:

“Agent 47” is a game that is created to predict famous characters by answering some questions. When the player will play this game, the player would think of any character, and the game will magically find out that which character the player was thinking of. It accomplishes this by asking the player up to 20 (yes or no) questions that get more and more specific until the program reaches the answer. "Agent 47" is a program that recreates the essence of the game by determining which character the player is thinking of within a subset of possibilities. The program will read in a file containing all possible solutions and associated links (questions) which the program will process and use for its decision making process.

Introduction:

Agent 47 is developed using C++ with a database of about 15 characters. It is a game based on decision tree and binary tree curated manually. The root node is the first question. This goes on inner and inner. It decides which questions to ask based on your previous answers by imitating the human thought process. This game use near-human intelligence in order to predict and answer your thoughts. The way it works is that Agent 47 will ask questions and eliminate people from its database based on answers given. User can answer Yes and No, after enough questions, it's hopefully able to correctly narrow down the database to one character if the user answer as truthfully as possible.

Development of Game:

To develop this project, the entire operation has been divided into the following step:

1. Using Flowchart to construct Decision Tree.
2. Collecting Datasets of the Characters
3. Login and Sign up

4. Building Game
5. Filing to maintain Scores

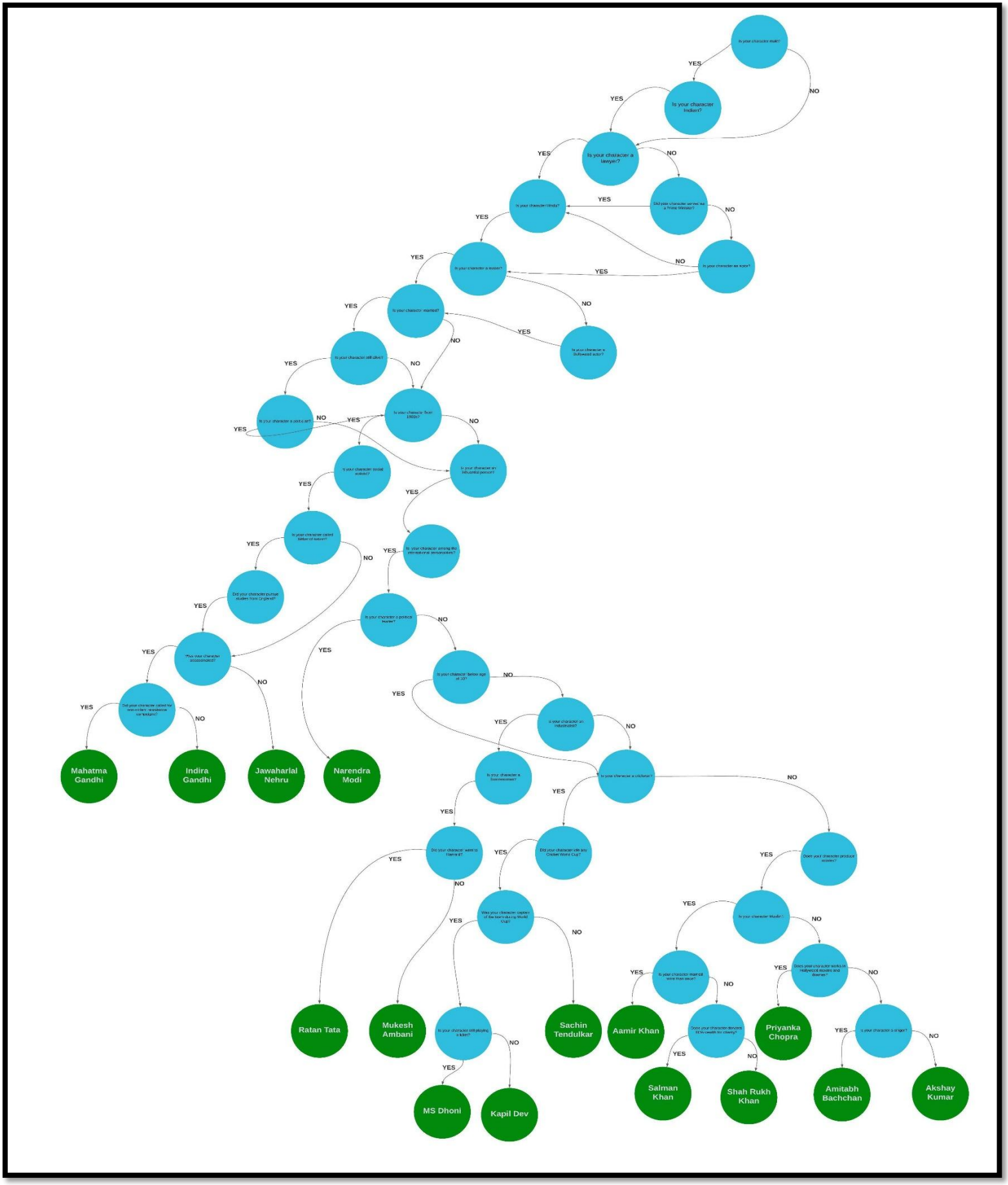
Decision Tree:

Decision tree is constructed in such a way that each branch node represents a choice between two alternatives and each leaf node represents a decision/character. In other words, this decision tree can be seen as a divide-and-conquer strategy for object classification. In this tree, lead node or answer node contains the character name and the non-leaf node or decision node contains an attribute test with a branch of another decision tree.

The program starts from the root node and then the program split each node recursively according to decision tree learning algorithm. We used decision tree for this project because it is one of the most widely used and practical methods for inductive inference. This program also uses the concepts of binary tree as each node contains a left pointer, right pointer, and a data element of type string which contains the questions asked by user. Throughout the program, when user starts guessing the character, the left and right pointers point to smaller sub-trees on either side. Some nodes contains left or right pointers as null pointer which represents it contains no element.

Illustration for the decision tree is provided, to clearly visualize the decision tree, click on the link to access the decision tree:

https://lucid.app/lucidspark/2b10f8f5-fc76-43fe-8a23-12b91b0fa133/edit?viewport_loc=1076%2C1454%2C1920%2C1872%2C0_0&invitationId=inv_edb6a5be-6a0e-497e-9540-443a8c7ed960


Is your character male?
YES
NO
Is your character Indian?
YES
Is your character a lawyer?
YES
NO
Is your character Hindu?
Did your character served as a Prime Minister?
YES
NO
Is your character an actor?
YES
NO
Is your character a leader?
YES
NO
Is your character married?
Is your character a Bollywood actor?
YES
NO
Is your character still alive?
YES
NO
Is your character a politician?
Is your character from 1900s?
YES
NO
Is your character social worker?
Is your character an influential person?
YES
NO
Is your character called father of nation?
Is your character among the international personalities?
YES
NO
Did your character pursue studies from England?
Is your character a political leader?
YES
NO
Was your character assassinated?
Is your character below age of 25?
YES
NO
Did your character called for non-violent, revolutionless war/fights?
Is your character an industrialist?
YES
NO
Mahatma Gandhi
Indira Gandhi
Jawaharlal Nehru
Narendra Modi
Is your character a businessman?
Is your character a cricketer?
YES
NO
Did your character went to Harvard?
Did your character win any Cricket World Cup?
Does your character produce movies?
YES
NO
Was your character captain of the team during World Cup?
Is your character Muslim?
Is your character married more than once?
Does your character works in Hollywood movies and dramas?
Is your character still playing cricket?
Does your character divorces if his wealth isn't sharing?
Is your character a singer?
Ratan Tata
Mukesh Ambani
Sachin Tendulkar
Aamir Khan
Priyanka Chopra
MS Dhoni
Kapil Dev
Salman Khan
Shah Rukh Khan
Amitabh Bachchan
Akshay Kumar

The following image represents the declaration of decision nodes which are actually the questions asked from user during the game:

```
31  Agent47 *Gender = new Agent47("Is your character male?");
32  Agent47 *Nationality = new Agent47("Is your character Indian?");
33  Agent47 *Lawyer = new Agent47("Is your character a Lawyer?");
34  Agent47 *Hindu = new Agent47("Is your character Hindu?");
35  Agent47 *PM = new Agent47("Did your character served as a Prime Minister?");
36  Agent47 *Leader = new Agent47("Is your character a Leader?");
37  Agent47 *Actor = new Agent47("Is your character an Actor?");
38  Agent47 *Marriage = new Agent47("Is your character Married?");
39  Agent47 *Bollywood = new Agent47("Is your character a Bollywood Actor?");
40  Agent47 *Alive = new Agent47("Is your character still Alive?");
41  Agent47 *Politician = new Agent47("Is your character a Politician?");
42  Agent47 *Era = new Agent47("Was your character born before 1920?");
43  Agent47 *SocialActivist = new Agent47("Is your character Social Activist?");
44  Agent47 *Influential = new Agent47("Is your character an Influential Person?");
45  Agent47 *Nation = new Agent47("Is your character called Father of Nation?");
46  Agent47 *Personality = new Agent47("Is your character among the International Personalities?");
47  Agent47 *Study = new Agent47("Did your character pursue studies from England?");
48  Agent47 *PoliticalLeader = new Agent47("Is your character a Political Leader?");
49  Agent47 *Assassination = new Agent47("Was your character Assassinated?");
50  Agent47 *Non_Violent = new Agent47("Did your character called for Non-Violent Resisitance Campaigns?");
51  Agent47 *Age = new Agent47("Is your character Below Age of 50?");
52  Agent47 *Industrialist = new Agent47("Is your character an Industrialist?");
53  Agent47 *Businessman = new Agent47("Is your character a Businessman?");
54  Agent47 *Cricketer = new Agent47("Is your character a Cricketer?");
55  Agent47 *Harvard = new Agent47("Did your character went to Harvard?");
56  Agent47 *CricketWorldCup = new Agent47("Did your character win any Cricket World Cup?");
57  Agent47 *Captain = new Agent47("Was your character Captain of the Team during World Cup?");
58  Agent47 *Playing = new Agent47("Is your character still Playing Cricket?");
59  Agent47 *ProduceMovies = new Agent47("Does your character Produce Movies?");
60  Agent47 *Muslim = new Agent47("Is your character Muslim?");
61  Agent47 *MarriageCount = new Agent47("Is your character Married more than once?");
62  Agent47 *Hollywood = new Agent47("Does your character works in Hollywood Movies and Dramas?");
63  Agent47 *Charity = new Agent47("Does your character Donates 90% Wealth for Charity?");
64  Agent47 *Singer = new Agent47("Is your character a Singer?");
```

The following image represents the declaration of leaf nodes which are actually the names of the characters in the game and one of them is displayed at the end of the game if user wins the game:

```
66  Agent47 *MahatmaGandhi = new Agent47("Mahatma Gandhi");
67  Agent47 *IndiraGandhi = new Agent47("Indira Gandhi");
68  Agent47 *JawaharlalNehru = new Agent47("Jawaharlal Nehru");
69  Agent47 *NarendraModi = new Agent47("Narendra Modi");
70  Agent47 *RatanTata = new Agent47("Ratan Tata");
71  Agent47 *MukeshAmbani = new Agent47("Mukesh Ambani");
72  Agent47 *MSDhoni = new Agent47("MS Dhoni");
73  Agent47 *KapilDev = new Agent47("Kapil Dev");
74  Agent47 *SachinTendulkar = new Agent47("Sachin Tendulkar");
75  Agent47 *AamirKhan = new Agent47("Aamir Khan");
76  Agent47 *SalmanKhan = new Agent47("Salman Khan");
77  Agent47 *ShahRukhKhan = new Agent47("Shah Rukh Khan");
78  Agent47 *PriyankaChopra = new Agent47("Priyanka Chopra");
79  Agent47 *AmitabhBachchan = new Agent47("Amitabh Bachchan");
80  Agent47 *AkshayKumar = new Agent47("Akshay Kumar");
```

Collecting Datasets of the characters:

Mahatma Gandhi:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (Yes)
4. Hindu (Yes)
5. Leader (Yes)
6. Married (Yes)
7. Alive (No)
8. Born Before 1920 (Yes)
9. Social Activist (Yes)
10. Father of Nation (Yes)
11. Study from England (Yes)
12. Assassinated (Yes)
13. Non-Violent Resistance (Yes)

Indira Gandhi:

1. Male (No)
2. Lawyer (No)
3. Served as PM (Yes)
4. Hindu (Yes)
5. Leader (Yes)
6. Married (Yes)
7. Alive (No)
8. Born Before 1920 (Yes)
9. Social Activist (Yes)
10. Father of Nation (No)
11. Assassinated (Yes)
12. Non-Violent Resistance (No)

Jawaharlal Nehru:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (Yes)
5. Hindu (Yes)
6. Leader (Yes)
7. Married (Yes)
8. Alive (No)
9. Born Before 1920 (Yes)
10. Social Activist (Yes)
11. Father of Nation (No)
12. Assassinated (No)

Narendra Modi:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (Yes)
5. Hindu (Yes)
6. Leader (Yes)
7. Married (Yes)
8. Alive (Yes)
9. Politician (Yes)
10. Born Before 1920 (No)
11. Influential (Yes)
12. International Personality (Yes)
13. Political Leader (Yes)

Ratan Tata:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (No)
6. Hindu (Yes)
7. Leader (Yes)
8. Married (No)
9. Born Before 1920 (No)
10. Influential (Yes)
11. International Personality (Yes)
12. Political Leader (No)
13. International Personality (Yes)
14. Political Leader (No)
15. Age < 50 (No)
16. Industrialist (Yes)
17. Businessman (Yes)
18. Harvard (Yes)

Mukesh Ambani:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (No)
6. Hindu (Yes)
7. Leader (Yes)
8. Married (Yes)
9. Alive (Yes)
10. Politician (No)
11. Influential (Yes)
12. International Personality (Yes)
13. Political Leader (No)
14. Age < 50 (No)
15. Industrialist (Yes)
16. Businessman (Yes)
17. Harvard (No)

MS Dhoni:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (No)
6. Hindu (Yes)
7. Leader (Yes)
8. Married (Yes)
9. Alive (Yes)
10. Politician (No)
11. Influential (Yes)
12. International Personality (Yes)
13. Political Leader (No)
14. Age < 50 (Yes)
15. Cricketer (Yes)
16. Won World Cup (Yes)
17. Captain during World Cup (Yes)
18. Still Playing (Yes)

Kapil Dev:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (No)
6. Hindu (Yes)
7. Leader (Yes)
8. Married (Yes)
9. Alive (Yes)
10. Politician (No)
11. Influential (Yes)
12. International Personality (Yes)
13. Political Leader (No)
14. Age < 50 (No)
15. Industrialist (No)
16. Cricketer (Yes)
17. Won World Cup (Yes)
18. Captain during World Cup (Yes)
19. Still Playing (No)

Sachin Tendulkar:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (No)
6. Hindu (Yes)
7. Leader (Yes)
8. Married (Yes)
9. Alive (Yes)
10. Politician (No)
11. Influential (Yes)
12. International Personality (Yes)
13. Political Leader (No)
14. Age < 50 (Yes)
15. Cricketer (Yes)
16. Won World Cup (Yes)
17. Captain during World Cup (No)

Aamir Khan:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (Yes)
6. Leader (Yes)
7. Married (Yes)
8. Alive (Yes)
9. Politician (No)
10. Influential (Yes)
11. International Personality (Yes)
12. Political Leader (No)
13. Age < 50 (No)
14. Industrialist (No)
15. Cricketer (No)
16. Produce Movies (Yes)
17. Muslim (Yes)
18. Married more than once (Yes)

Salman Khan:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (Yes)
6. Leader (Yes)
7. Married (No)
8. Born Before 1920 (No)
9. Influential (Yes)
10. International Personality (Yes)
11. Political Leader (No)
12. Age < 50 (No)
13. Industrialist (No)
14. Cricketer (No)
15. Produce Movies (Yes)
16. Muslim (Yes)
17. Married more than once (No)
18. Donates 90% Wealth (Yes)

Shah Rukh Khan:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (Yes)
6. Leader (Yes)
7. Married (Yes)
8. Alive (Yes)
9. Politician (No)
10. Influential (Yes)
11. International Personality (Yes)
12. Political Leader (No)
13. Age < 50 (No)
14. Industrialist (No)
15. Cricketer (No)
16. Produce Movies (Yes)
17. Muslim (Yes)
18. Married more than once (No)
19. Donates 90% Wealth (No)

Priyanka Chopra:

1. Male (No)
2. Lawyer (No)
3. Served as PM (No)
4. Actor (Yes)
5. Leader (Yes)
6. Married (Yes)
7. Alive (Yes)
8. Politician (No)
9. Influential (Yes)
10. International Personality (Yes)
11. Political Leader (No)
12. Age < 50 (Yes)
13. Cricketer (No)
14. Produce Movies (Yes)
15. Muslim (No)
16. Hollywood Movies (Yes)

Amitabh Bachchan:

1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (Yes)
6. Leader (Yes)
7. Married (Yes)
8. Alive (Yes)
9. Politician (No)
10. Influential (Yes)
11. International Personality (Yes)
12. Political Leader (No)
13. Age < 50 (No)
14. Industrialist (No)
15. Cricketer (No)
16. Produce Movies (Yes)
17. Muslim (No)
18. Hollywood Movies (No)
19. Singer (Yes)

Akshay Kumar:

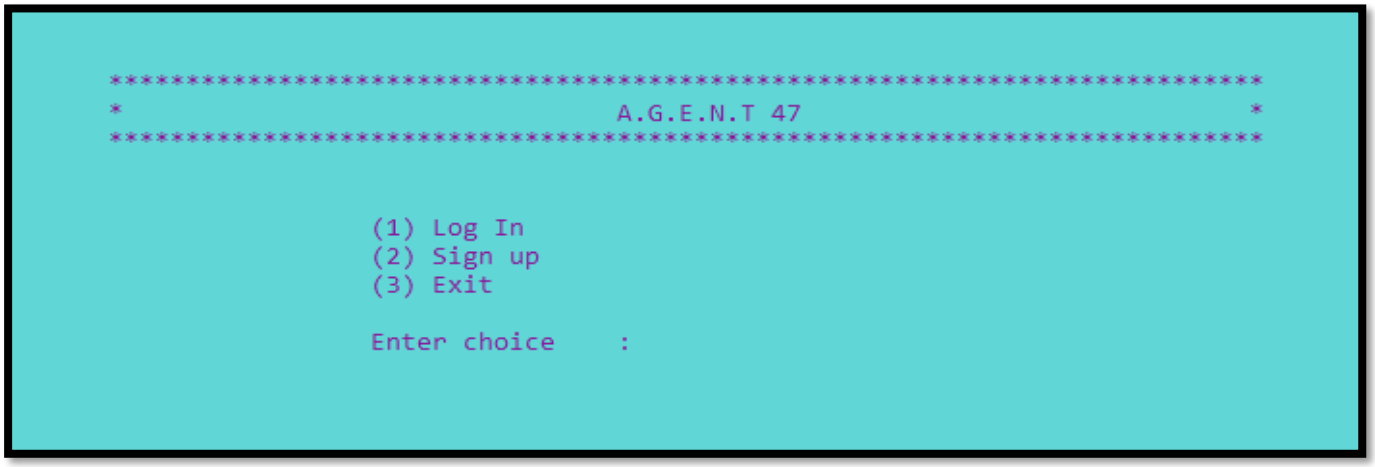
1. Male (Yes)
2. Indian (Yes)
3. Lawyer (No)
4. Served as PM (No)
5. Actor (Yes)
6. Leader (Yes)
7. Married (Yes)
8. Alive (Yes)
9. Politician (No)
10. Influential (Yes)
11. International Personality (Yes)
12. Political Leader (No)
13. Age < 50 (No)
14. Industrialist (No)
15. Cricketer (No)
16. Produce Movies (Yes)
17. Muslim (No)
18. Hollywood Movies (No)
19. Singer (No)

Login and Sign up:

When the program is compiled first time which means it has no record of the users yet then the program will never ask user to login, instead it asks the first user to sign up for an account to play the game, after the sign up of first user, when the program is compiled by other users or the same user, the program will give the option to the user to either login or sign up. Therefore, the user will access the game with the username and password.

First time compiling the program:

After first sign up of a user:



Building game:

After collecting necessary dataset and information of characters, and with the help of these datasets, a decision tree is constructed on an online platform which represents the traversal of the decision tree. Then comes the most important stage of this game which is building the game; implementing it on Dev C++ IDE and writing the program.

```
96      void BuildGame(){
97          Gender->L = Nationality;
98          Gender->R = Lawyer;
99
100         Nationality->L = Lawyer;
101         Nationality->R = NULL;
102
103         Lawyer->L = Hindu;
104         Lawyer->R = PM;
105
106         Hindu->L = Leader;
107         Hindu->R = NULL;
108
109         PM->L = Hindu;
110         PM->R = Actor;
111
112         Actor->L = Leader;
113         Actor->R = Hindu;
114
115         Leader->L = Marriage;
116         Leader->R = Bollywood;
117
118         Bollywood->L = Marriage;
119         Bollywood->R = NULL;
```

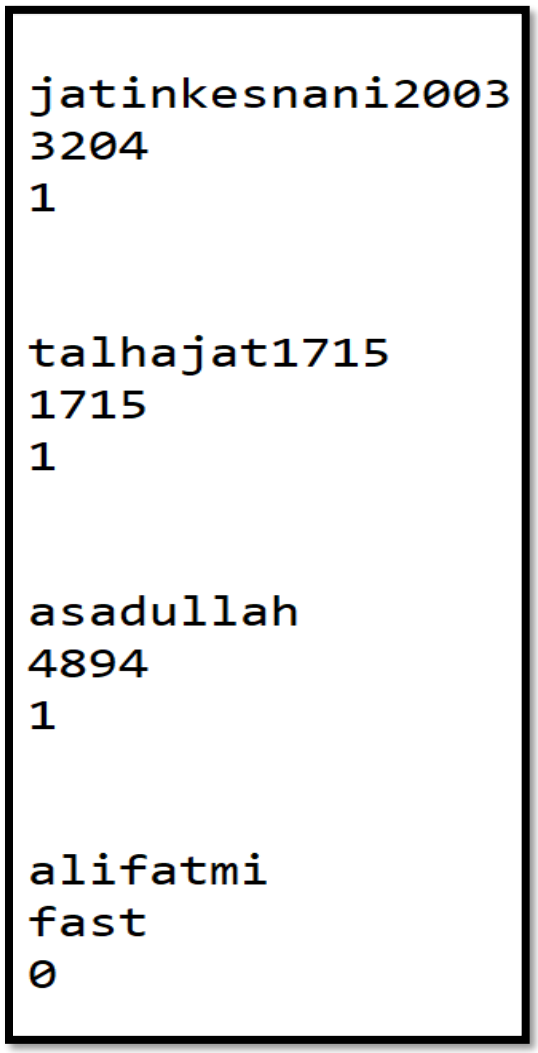
An example of the function **BuildGame** is provided through this image which represents how decision tree are linked and how does it traverse to leaf nodes.

```
MahatmaGandhi->L = NULL;
MahatmaGandhi->R = NULL;

IndiraGandhi->L = NULL;
IndiraGandhi->R = NULL;

JawaharlalNehru->L = NULL;
JawaharlalNehru->R = NULL;

NarendraModi->L = NULL;
NarendraModi->R = NULL;

RatanTata->L = NULL;
RatanTata->R = NULL;
```

This image represents leaf nodes and there left and right pointer is NULL which means that the program has traversed to the end of the decision tree and it has found the name of the character that user was searching for.

Filing to maintain scores:

There are four cases for file handling of the scores. The first case is when a new user sign up for an account and plays the game and if they win the game then their score is 1 and it is written in the file with the username and password of the user. The second case is when a new user sign up for an account and plays the game and it they lose the game then their score is 0. The third case is when an existing user log in the account and plays the game and if they win the game then their score is incremented by 1. The fourth case if when an existing user log in the account and plays the game and if they lose the game then their score is unchanged. When the user wins the game then the corresponding character that they were thinking of is also displayed on the console and when they lose the game the program tells the user that they chose wrong options while playing the game.



This screenshot was captured from "Score.txt" file. The file now contains details of four users because only they have created the account on this platform. The first three accounts represents that when the user played the game, they scored a point whether they won during sign up or after logging in whereas the last user hasn't scored a single point.

Conclusion:

Agent 47, for some is just an online played game, a game similarly to a human being playing “Guess Who?”, however for the others, it is more than that, it is an astonishing near-human intelligence program, that even with all the advances in the computing and the programming still considered as a prodigy that makes programmers and computer scientist look deeper and deeper to solve that prodigy.

So some of them mention that the Decision trees is the main key, but some other disagree and say the Binary trees is the main key, and other motion that combines elements from decision trees and binary trees, as well as probabilistic methods and machine learning. Well tell now we can’t prove nothing, therefore, the original creation of the algorithm that used in Agent 47 is still going to be a secret.