CSE201 Advanced Programming
Lab Assignment 03
2nd October 2020. Due by 11:59 pm on 6th October 2020

Topics Covered: Abstract Class, Object Class, and Generic Programming

This is a take-home lab assignment. No extensions whatsoever will be provided. Any submission after the deadline will not be evaluated. If you see any ambiguity or inconsistency in a question, please seek clarification from the teaching staff. Please read the entire text below very carefully before starting your implementation.

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Please note that you are not allowed to discuss the design/solution of the lab assignment (e.g. classroom page discussions etc.). Anyone who is found doing this will be charged with plagiarism. No excuses!

Mafia is a popular party game that requires one to think, manipulate, and deceive others in order to win. Since the pandemic, it has become rather difficult for people to host parties; hence for this assignment, you are required to develop a mafia game simulator. In this assignment,

you must use OOP concepts, especially inheritance and polymorphism, demonstration of object comparison, and object equality check**.**

Rules of the game:

Plot: There is a village of N players. A player can be either a commoner, a detective, a healer, or a mafia. A commoner only knows that he is a commoner. A detective knows all the other detectives. A mafia knows all the other Mafia players. A healer knows all other healers in the game.

Objectives: The objective for the mafias is to kill or eliminate all the non-mafias such that the ratio of the alive mafias to all others is 1:1. A player can be eliminated in two ways: 1) By being killed by the Mafia or 2) Be eliminated in a vote out. Once a player is eliminated, they cannot be brought back to life. Mafias cannot kill themselves.
The objective for all other players(except the mafias) is to eliminate the mafias through a vote out(as the Mafias cannot be killed). Therefore, by using special powers of detectives and healers, they are required to save themselves and vote out the Mafias.

Role of different type of players:

1. Mafia: To kill all other players to achieve a 1:1 ratio.
2. Detective: They can randomly test one of the players (except detective) to test whether the player is mafia or not. If they correctly identify a mafia, the caught mafia will be voted out in that round by default.
3. Healer: They randomly select a player from the game to give him a boost of 500 HP (All players, including mafias and healers themselves).
4. Commoner: They don't have any special role. They only take part in the voting process.

End of Game:
The game ends when either all mafias are voted out or the ratio of mafias to others becomes 1:1.
The Mafia wins in the latter case and loses in the former.
You need to announce the winners at the end of the game along with the roles of each player.

In this assignment, you must use OOP concepts, especially the topics on which this assignment is based.

The design/working of the game is as follows:

[A] On starting the game:

1) Each invocation of the game will be considered a new game. Hence, no need to create a database of users or saving their game. At the beginning of each execution, the user is supposed to enter the number *N,* i.e., the total number of players in the game. The

minimum number of players for the game is 6. If the player enters a number less than 6, the program asks for *N* again. **Under no circumstances should your program terminate unexpectedly.** If any invalid input is given, it should be handled properly (explained in test cases).

2) Then the user is given the option of either choosing their character (Mafia, Commoner, Detective, or Healer) on their own or be allotted a character randomly by the program. After allocating the user his/her role, there should be *N*/5 Mafias, *N*/5 Detectives, max {1, *N*/10} healers, and the remaining players should be commoners. Here, the '/' operator is floored division. For example, for *N*=11, there will be 2 mafias,2 detectives, 1 healer, and 6 commoners.

[B] Gameplay

1) The game will run in rounds. In each round, there will be fixed steps that are followed.
    a) Firstly the Mafias choose to kill a person(other than mafias). If the user is a mafia player, then he/she will be asked to choose the target.
    b) Then the detective will test a person to know whether he is mafia or not. If the user is a detective player, then he/she will be asked who they want to test.
    c) Then the healer will heal a person by giving him an HP boost as defined in HP rules. If the user is a healer player, then he/she will be asked who they want to heal.
    d) If after healing, the HP of the person killed by the Mafia reaches 0, the player dies.
    e) After this, there is a voting round where each player votes randomly, and the user(If alive) votes for whoever he/she wants to vote for. The person with the highest votes is kicked out of the game.
    f) However, if the detective tests positive on a mafia, there will be no voting, and the caught mafia will be voted out by default. Once a player is out of the game, they can not re-enter the game.
    g) If there are no detectives left, there will be no test and/or if there are no healers left, there will be no HP boost. The game will keep on moving until we arrive at an end of game condition.
    h) If there are multiple mafias then they vote collectively i.e. they decide one player to kill. In the same way, all detectives choose one player to test and healers choose one player to heal. At no point in time mafias can kill multiple players in a single round, or detectives can test multiple players, and/or healers can heal multiple players. Although when taking the vote, each player votes independently so as to protect his/her identity. [02/10/2020 4:40pm]
    i) In each round, there is fresh voting that takes place. Votes from previous rounds are not counted. Only one player is voted out in each round.[02/10/2020 4:40pm]
    j) In case the votes are tied, the voting process is repeated until there is no tie.[02/10/2020 4:40pm]

2) **HP Rules:**
    a) All commoners start with an HP of 1000 each.
    b) All mafias will start with 2500 HP each.
    c) All Detectives and Healers start with an HP of 800 each.
    d) In each Round, Healers can increase any players HP by 500.
    e) When the mafias choose a target, if their combined HP is equal to or more than that target's current HP, the target's HP becomes 0. However, if their combined HP is less than that targets current HP, the targets HP reduces by the combined HP of the mafias.
    f) Further, as damage, each mafias HP will be reduced by X/Y, where X is the initial HP of the target(before being killed), and Y is the number of alive mafias whose HP is greater than 0. If the target's HP falls below or equal to 0, the target dies.
    For example, if there are 2 mafias with HP 500 and 1000. Suppose the target has an HP of 1000. Then, since the combined HP of mafias (1500) is greater than the target's HP, the target dies. And the new HP of the mafias is 0 and 500, respectively.
    Note that mafias cannot be killed even if their HP falls to 0. They can only be voted out. Please note that HP can not fall below 0 for any player.
    In case, at the time of selection of target, one of the mafias has an HP less than X/Y, then this mafia will contribute to the damage by his total HP(making his HP to zero), and the remaining Damage will be equally divided. This process is continued until all Damage is absorbed, or the HP of all mafias becomes 0. For example, if there are two mafias mafia1 and mafia2 with HP 100 and 200 respectively and they kill a player with HP 250, then the final HP of mafias after the kill are 0 and 50.
    g) If the Healer chooses a person who was a target that died in that round itself, the target is revived, and the new HP of the target is 500. No one dies in such a situation. However, the mafias will still take the damage as explained earlier.
    In other words, the target is chosen first, and then the mafias and target take their damages, after which the healer chooses to heal someone. However, the target dies if his HP becomes zero and is not chosen by the Healer to heal.
    h) The healer can choose any player(including mafia) for the HP boost that is currently playing the game. Players that were killed/voted out in the previous rounds don't participate in any way and hence can't be chosen in any scenario. [02/10/2020 4:40pm]

3) There is only a single-player playing the game. Other players are simulated and need no input.
4) The output should give the details of the game. Several samples of output are shown below. Note that the text in red is only there to explain the game state and is not to be printed by the program.

The program prints all items in bold, and all unbolded texts are inputs by the user.

--Sample Input/Output 1 from detective's perspective-- (We are using 1 indexing)

Welcome to Mafia
Enter Number of players: 10
Choose a Character
1) Mafia
2) Detective
3) Healer
4) Commoner
5) Assign Randomly
2
You are Player6.
You are a detective. Other detectives are: [Player5]
This is a sample game. Let's assume that Player1 and Player8 are mafia. Player5 and Player6[User] are Detectives. Player7 is Healer. Rest are Commoners.
Round 1:
10 players are remaining: Player1, Player2, Player3, Player4,Player5, Player6, Player7, Player8, Player9, Player10 are alive.
Mafias have chosen their target.
Choose a player to test: 5
You cannot test a detective. Choose a player to test: 4
Player4 is not a mafia.
Healers have chosen someone to heal.
--End of actions--
Player3 has died.
Select a person to vote out: 2
Player4 has been voted out.
2--End of Round 1--

Now, the remaining members are Player1,2,5,6,7,8,9,10.
Round 2:
8 players are remaining: Player1, Player2, Player5, Player6, Player7, Player8, Player9, Player10 are alive.
Mafias have chosen their target.
Choose a player to test: 1
Player1 is a mafia.
Healers have chosen someone to heal.
--End of actions--
No one died.
Mafias selected Player9; however, the Healer chose Player9 as well, therefore new HP for Player9 is 500.

Player1 has been voted out.
Here, since the detective correctly caught the mafia, everyone voted for Player1 by default.
--End of Round 2--

Round 3:
7 players are remaining: Player2, Player5, Player6, Player7, Player8, Player9, Player10 are alive.
Mafias have chosen their target.
Choose a player to test: 2
Player2 is not a mafia.
Healers have chosen someone to heal.
--End of actions--
Player2 has died.
Select a person to vote out: 8
Player8 has been voted out.
--End of round 3--

Game Over.
The Mafias have lost.
Player1 and Player8 were mafia.
Player5 and Player6[User] were Detectives.
Player7 was Healer.
Player2, Player3, Player4,Player9, Player10 were Commoners.
--End of Sample Case--

--Sample Input/Output 2 from mafias perspective--

Welcome to Mafia
Enter Number of players: 10
Choose a Character
1) Mafia
2) Detective
3) Healer
4) Commoner
5) Assign Randomly
5
You are Player9.
You are a mafia. Other mafias are: [Player1]
This is a sample game. Let's assume that Player1 and Player9[User] are mafia. Player5 and Player6 are Detectives. Player7 is Healer. Rest are Commoners.
Round 1:

10 players are remaining: Player1, Player2, Player3, Player4,Player5, Player6, Player7, Player8, Player9, Player10 are alive.
Choose a target: 6
Detectives have chosen a player to test.
Healers have chosen someone to heal.
--End of actions--
Player6 has died.
Select a person to vote out: 5
Player5 has been voted out.
--End of Round 1--

Now, the remaining members are Player1,2,3,4,7,8,9,10.
Round 2:
8 players are remaining: Player1, Player2, Player3, Player4, Player7, Player8, Player9, Player10 are alive.
Choose a target: 8
Detectives have chosen a player to test.
Even though there are no detectives left, other players will not come to know about this.
Healers have chosen someone to heal.
--End of actions--
Player 8 has died.
Select a person to vote out: 10
Player9 has been voted out.
--End of Round 2--

Now, even though the user is dead. The game simulates on its own. Without taking any inputs from the user.
Round 3:
6 players are remaining: Player1, Player2, Player3, Player4, Player7, Player10 are alive.
Mafias have chosen their target.
Detectives have chosen a player to test.
Healers have chosen someone to heal.
--End of actions--
Player2 has died.
Player3 has been voted out.
--End of round 3--
Round 4:
4 players are remaining: Player1, Player4, Player7, Player10 are alive.
Mafias have chosen their target.
Detectives have chosen a player to test.
Healers have chosen someone to heal.
--End of actions--
Player4 has died.

Player7 has been voted out.
--End of round 4--

Game Over.
The Mafias have won. Since the ratio of alive mafias to others is 1:1, Mafias win.
Player1 and Player9[User] were mafias.
Player5 and Player6 were Detectives.
Player7 was Healer.
Player2, Player3, Player4,Player8, Player10 were Commoners.
--End of Sample Case--

--Sample Input/Output 3 from healers perspective--

Welcome to Mafia
Enter Number of players: 10
Choose a Character
1) Mafia
2) Detective
3) Healer
4) Commoner
5) Assign Randomly
3
You are Player7.
You are a healer. Other healers are: []
Since there are no other healers, the array is empty.
This is a sample game. Let's assume that Player1 and Player9 are mafia. Player5 and Player6 are Detectives. Player7[User] is Healer. Rest are Commoners.
Round 1:
10 players are remaining: Player1, Player2, Player3, Player4,Player5, Player6, Player7, Player8, Player9, Player10 are alive.
Mafias have chosen their target.
Detectives have chosen a player to test.
Choose a player to heal: 3
--End of actions--
Player6 has died.
Select a person to vote out: 5
Player5 has been voted out.
--End of Round 1--

Now, the remaining members are Player1,2,3,4,7,8,9,10.
Round 2:

8 players are remaining: Player1, Player2, Player3, Player4, Player7, Player8, Player9, Player10 are alive.
Mafias have chosen their target.
Detectives have chosen a player to test.
Even though there are no detectives left, other players will not come to know about this.
Choose a player to heal: 1
--End of actions--
Player 8 has died.
Select a person to vote out: 10
Player9 has been voted out.
--End of Round 2--

Round 3:
6 players are remaining: Player1, Player2, Player3, Player4, Player7, Player10 are alive.
Mafias have chosen their target.
Detectives have chosen a player to test.
Choose a player to heal: 9
Player9 is not in the game.
Choose a player to heal: 7
--End of actions--
Player2 has died.
Select a person to vote out: 3
Player3 has been voted out.
--End of round 3--
Round 4:
4 players are remaining: Player1, Player4, Player7, Player10 are alive.
Mafias have chosen their target.
Detectives have chosen a player to test.
Choose a player to heal: 7
--End of actions--
Player4 has died.
Select a person to vote out: 1
Player7 has been voted out.
--End of round 4--

Game Over.
The Mafias have won. Since the ratio of alive mafias to others is 1:1, Mafias win.
Player1 and Player9 were mafia.
Player5 and Player6 were Detectives.
Player7 was Healer.
Player2, Player3, Player4,Player8, Player10 were Commoners.
--End of Sample Case--

[For commoners, only input is the person to be voted out. Other players vote randomly.]