CSE 143: Computer Programming II Autumn 2019

HW3: AssassinManager (due Thursday, October 17, 2019 11:30pm)

This assignment focuses on implementing a linked list. Turn in the following file using the link on the course website:

- `AssassinManager.java` – A class that manages a game of Assassin.

You will need the support files `AssassinMain.java`, `AssassinNode.java`, and `names.txt`; place these in the same folder as your program or project. The code you submit must work properly with the unmodified versions of the provided files.

Program Details

"Assassin" is a game often played on college campuses. Each person playing has a particular target that he/she is trying to "assassinate." Generally "assassinating" a person means finding them on campus in public and acting on them in some way (e.g. saying "You're dead," squirting them with a water gun, or tagging them). One of the things that makes the game more interesting to play in real life is that initially each person knows only who they are assassinating; they don't know who is trying to assassinate them, nor do they know whom the other people are trying to assassinate.

Assassin Rules

- You start out with a group of people who want to play the game
- A circular chain of assassination targets (called the "kill ring" in this program) is established.
- When someone is assassinated, the links need to be changed to "skip" that person.

Example Game of Assassin

Let's walk through an example with five people playing: Carol, Chris, Jim, Joe, Sally. We might decide Joe should stalk Sally, Sally should stalk Jim, Jim should stalk Carol, Carol should stalk Chris, and Chris should stalk Joe. In the actual linked list that implements this kill ring, Chris's next reference would be null. But, conceptually we can think of it as though the next person after Chris is Joe, the front person in the list.

Here is a picture of this "kill ring":

$$\begin{tikzcd} \texttt{front} \arrow[d] \\ \boxed{\text{Joe}} \arrow[r] & \boxed{\text{Sally}} \arrow[r] & \boxed{\text{Jim}} \arrow[r] & \boxed{\text{Carol}} \arrow[r] & \boxed{\text{Chris}} \end{tikzcd}$$

Then, suppose Sally assassinates Jim. Sally needs a new target, so we give her Jim's target: Carol. The kill ring becomes:

$$\begin{tikzcd} \texttt{front} \arrow[d] \\ \boxed{\text{Joe}} \arrow[r] & \boxed{\text{Sally}} \arrow[r] & \boxed{\text{Carol}} \arrow[r] & \boxed{\text{Chris}} \end{tikzcd}$$

If the first person in the kill ring is assassinated, the front of the list must adjust. If Chris kills Joe, the list becomes:

$$\begin{tikzcd} \texttt{front} \arrow[d] \\ \boxed{\text{Sally}} \arrow[r] & \boxed{\text{Carol}} \arrow[r] & \boxed{\text{Chris}} \end{tikzcd}$$

In this assignment, you will write a class AssassinManager that keeps track of who is stalking whom and the history of who killed whom. You will maintain two linked lists:

- a list of people currently alive (the "kill ring") and
- a list of those who are dead (the "graveyard").

As people are killed, you will move them from the kill ring to the graveyard by rearranging links between nodes. The game ends when only one node remains in the kill ring, representing the winner.
A client program called AssassinMain has been written for you. It reads a file of names, shuffles the names, and constructs an object of your class AssassinManager. This main program then asks the user for the names of each victim to kill until there is just one player left alive (at which point the game is over and the last remaining player wins). AssassinMain calls methods of the AssassinManager class to carry out the tasks involved in administering the game.

AssassinManager

You must use our AssassinNode classs provided on the course website without modification that has the following implementation

```java
public class AssassinNode {
   public final String name; // this person's name
   public String killer; // name of who killed this person (null if alive)
   public AssassinNode next; // next node in the list

   public AssassinNode(String name) { ... }
   public AssassinNode(String name, AssassinNode next) { ... }
}
```

You cannot change final variables and fields!

In lecture and section we have been looking at nodes of type ListNode that have just two fields: a field called data of type int and a field called next that points to the next value in the list. The AssassinNode class has three fields. The first two are fields for storing data called name and killer (they are used to store the name of a player and the name of the person who killed that player). The third field is called next and it serves the same purpose as the next field in the ListNode class.

AssassinManager should have the following fields:

- a reference to the front node of the kill ring
- a reference to the front node of the graveyard (null if empty)

Do **NOT** add a size field!

Note that a requirement of this assignment is that you have *exactly* these two fields and *no others*.

AssassinManager should have the following constructor:

`public AssassinManager(List<String> names)`

This constructor should initialize a new assassin manager over the given list of people. Note that you should not save the list parameter itself as a field, nor modify the list. Instead, you should build your own kill ring of list nodes that contains these names in the same order.
If the list is empty, you should throw an IllegalArgumentException.

Do not change the list that is passed in.

For example, if the given list contains ["John", "Sally", "Fred"], your initial kill ring should represent that John is stalking Sally who is stalking Fred who is stalking John (in that order). You may assume that the names are non-empty, non-null strings and that there are no duplicates.

`AssassinManager` should also implement the following methods:

`public void printKillRing()`

This method should print the names of the people in the kill ring, one per line, indented by four spaces, as "X is stalking Y". If the game is over, then instead print "X is stalking X".

X and Y are names of the players

For example, using the names in the example game above, the output is:

```
>>     Joe is stalking Sally
>>     Sally is stalking Jim
>>     Jim is stalking Carol
>>     Carol is stalking Chris
>>     Chris is stalking Joe
```

If the game is over and Chris is the winner, so Chris is the only name in the kill ring, the output is:

```
>>     Chris is stalking Chris
```

Indent the output using four spaces, not tabs!

`public void printGraveyard()`

This method should print the names of the people in the graveyard, one per line, with each line indented by four spaces, with output of the form "name was killed by name". It should print the names in the opposite of the order in which they were killed (most recently killed first, then next more recently killed, and so on). It should produce no output if the graveyard is empty.

For example, using the names from above, if Jim is killed, then Chris, then Carol, the output is:

```
>>     Carol was killed by Sally
>>     Chris was killed by Carol
>>     Jim was killed by Sally
```

`public boolean killRingContains(String name)`

This method should return true if the given name is in the current kill ring and false otherwise. It should ignore case in comparing names; so, "salLY" should match a node with a name of "Sally".

`public boolean graveyardContains(String name)`

This method should return true if the given name is in the current graveyard and false otherwise. It should ignore case in comparing names; so, "CaRoL" should match a node with a name of "Carol".

`public boolean gameOver()`

This method should return true if the game is over (the kill ring has one person) and false otherwise.

`public String winner()`

This method should return the name of the winner of the game, or `null` if the game is not over.

`public void` **`kill`**`(String name)`

This method should record the assassination of the person with the given name, transferring the person from the kill ring to the front of the graveyard. This operation should not change the relative order of the kill ring (i.e. the links of who is killing whom should stay the same other than the person who is being killed). This method should ignore case in comparing names.
A node remembers who killed the person in its killer field, and you must set the value of this field.
You should throw an `IllegalStateException` if the game is over, or throw an `IllegalArgumentException` if the given name is not part of the kill ring. If both of these conditions are true, the `IllegalStateException` takes precedence.

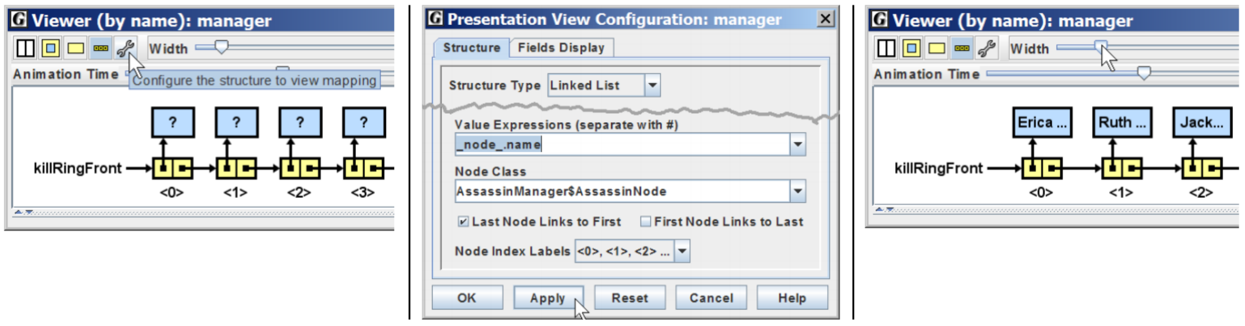
Exceptions should be thrown as soon as possible in the method.

Try to write simple code, and use inline comments to clarify anything complex.

The kill method is the hardest one, so write it last. Use the debugger and `println` statements liberally to debug problems in your code. You will likely have a lot of `NullPointerException` errors, infinite loops, etc. and will have a very hard time tracking them down unless you are comfortable with debugging techniques.

jGRASP's Debugger

We recommend that you use jGRASP's debugger even if you use Eclipse. The jGRASP debugger has a structure viewer to see what your list looks like by dragging one of your fields from the debug window outside the window. By default the viewer won't show you the name in each node (it will show a "?" instead). Fix this by clicking the wrench icon, then in the "Value Expressions" box, type: `_node_.name`, Click OK, and you should see the names in the nodes. You can also drag the width scrollbar to see the names better.



Structure Type: Linked List
Value Expressions (separate with #): _node_.name
Node Class: AssassinManager$AssassinNode
[✓] Last Node Links to First
[ ] First Node Links to Last
Node Index Labels: <0>, <1>, <2> ...

Constraints

This is meant to be an exercise in linked list manipulation. As a result, you must adhere to the following rules while implementing `AssassinManager`:

- You may not construct any arrays, `ArrayLists`, `LinkedLists`, `Stacks`, `Queues`, or other data structures; you must use list nodes.
- If there are n names in the list of Strings passed to your constructor, you should create exactly n new `AssassinNode` objects in your constructor. As people are killed, you have to move their node from the kill ring to the graveyard by changing references, without creating any new node objects or changing the name fields of the nodes.
- Your constructor will create the initial kill ring of nodes, and then your class may not create any more nodes for the rest of the program. You are allowed to declare as many local variables of type `AssassinNode` (like `current` from lecture) as you like. `AssassinNode` variables are not node objects and therefore don't count against the limit of n nodes.
- In particular, to receive full credit, your solution should be efficient in the sense that it does not have any nested loops that loop over the names. We will see on Monday that this means all of your methods should run in $\mathcal{O}(n)$ time where n is the number of names in the list.

You are not required to turn in any testing code for this assignment, but you should write some of your own testing code. `AssassinMain` requires every method to be written in order to compile, and it never generates any of the exceptions you have to handle, so it is not exhaustive.

Circular Lists

Some students try to store the kill ring using a "circular" linked list (where the list's final element stores a next reference back to the front). It is significantly more difficult to write bug-free code using a circular list. There is no need to use a circular list for this assignment, because you can always get back to the front via the fields of your `AssassinManager`. If you feel strongly that you want to use a circular list, you may, but it will make the program significantly more difficult to write so we discourage it. **We will not provide assistance in the IPL or office hours to help you implement the circular list solution.**

Sample Log of Execution

Make sure to match the output *exactly*.

Your program should reproduce the format and behavior demonstrated in this log (user-input underlined).

```
>> Welcome to the CSE143 Assassin Manager
>>
>> What name file do you want to use this time? names3.txt
>> Do you want the names shuffled? (y/n)? n
>>
>> Current kill ring:
>>     Athos is stalking Porthos
>>     Porthos is stalking Aramis
>>     Aramis is stalking Athos
>> Current graveyard:
>>
>> next victim? Aramis
>>
>> Current kill ring:
>>     Athos is stalking Porthos
>>     Porthos is stalking Athos
>> Current graveyard:
>>     Aramis was killed by Porthos
>>
>> next victim? Athos
>>
>> Game was won by Porthos
>> Final graveyard is as follows:
>>     Athos was killed by Porthos
>>     Aramis was killed by Porthos
```

Continued on next page.

Style Guidelines and Grading

Unless otherwise specified, your solution should use only material covered so far. Part of your grade will come from appropriately utilizing linked lists and nodes as described previously.

Avoid Redundancy

Factor out any redundancy in your methods.

Create "helper" method(s) to capture repeated code. Any helper methods you create must be `private` so outside code cannot call them. If you find that multiple methods in your class do similar things, you should create helper method(s) to capture the common code.

Data Fields

Properly encapsulate your objects by making data your fields `private`. Avoid unnecessary fields; use fields to store important data of your objects but not to store temporary values only used in one place. Fields should always be initialized inside a constructor or method, never at declaration.

Java Style Guidelines

Appropriately use control structures like loops and if/else statements. Avoid redundancy using techniques such as methods, loops, and factoring common code out of if/else statements. Properly use indentation, good variable names, and types. Do not have any lines of code longer than 100 characters. Please refer to the Style Guide and the General Style Deductions.