CSE 143: Computer Programming II — Winter 2021

Take-home Assessment 3: AssassinManager *due January 28, 2021 11:59pm*

This assignment will assess your mastery of the following objectives:

- Implement a well-designed Java class to meet a given specification.
- Create and manipulate a linked list.
- Manipulate linked list nodes in an efficient manner.
- Follow prescribed conventions for code quality, documentation, and readability.

Overview: The Assassin Game

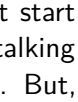
"Assassin" is a game often played on college campuses. Each person playing has a particular target that he/she is trying to "assassinate." Generally "assassinating" a person means finding them on campus in public and acting on them in some way (e.g. saying "You're dead," squirting them with a water gun, 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. That is, the person who was assassinated passes their target on to the person who assassinated them.

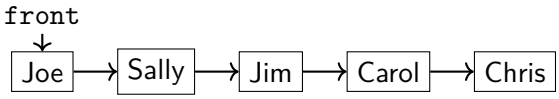
Example Game of Assassin

Let's walk through an example with five people playing: Carol, Chris, Jim, Joe, Sally. We might start with Joe stalking Sally, Sally stalking Jim, Jim stalking Carol, Carol stalking Chris, and Chris stalking 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.

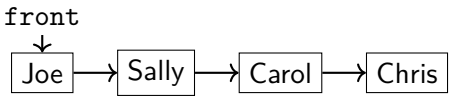


Note the last person in the list will not have an explicit target. See below for information and warnings about using a circular list.

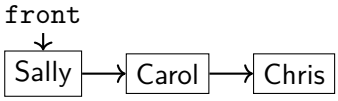
Here is a picture of this "kill ring":



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



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



Program Behavior

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

- a list of people currently alive (the "kill ring") and
- a list of those who have been assassinated (the "graveyard").

As people are assassinated, 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.

Sample execution log

```
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
```

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 assassinate 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

To implement your lists, you must use our `AssassinNode` class provided in Ed without modification. The class is summarized here:

AssassinNode class

```
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 class section we have been looking at nodes of type `ListNode` (or `IntListNode`) 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 assassinated that player). The third field is called `next` and it serves the same purpose as the next field in the `ListNode` class.

Your `AssassinManager` class must have exactly 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 assessment is that you have *exactly* these two fields and *no others*.

Your `AssassinManager` class 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.

Your `AssassinManager` class 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 kill ring from the example game on the first page of this spec, 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 "X was killed by Y". It should print the names in the opposite of the order in which they were assassinated (most recently assassinated first, then next most recently assassinated, and so on). It should produce no output if the graveyard is empty.

For example, using the kill ring 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 (i.e. the kill ring contains exactly 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 yet.

`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 stalking 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.

Your method 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!

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

Be sure to remove or comment out any debugging `println` calls before you submit.

The `kill` method is the hardest to complete, so we strongly suggest you write it last. Use the jGRASP 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.

Implementation Guidelines

The learning objectives for this assessment are explicitly related to manipulating linked lists. To that end, you are limited in how you may implement the operations required for `AssassinManager`. Specifically, you must adhere to the following rules:

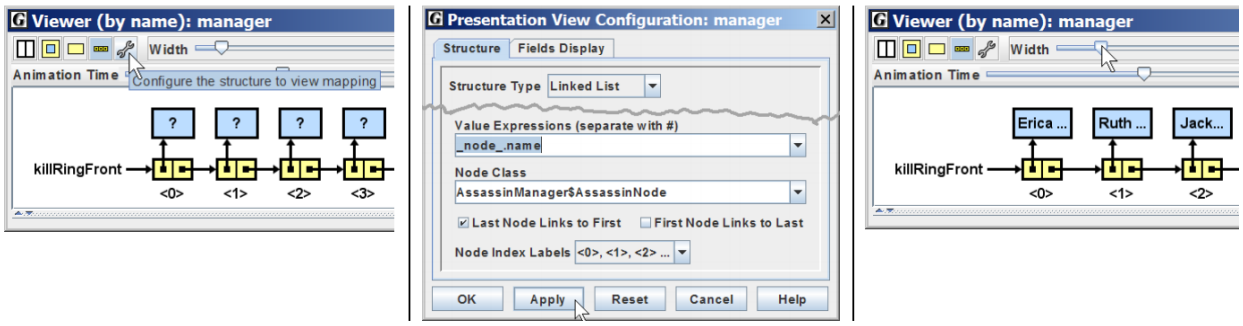
- You may not construct any arrays, `ArrayLists`, `LinkedLists`, `Stacks`, `Queues`, or other data structures; you must use instances of `AssassinNode` and manipulate them yourself.
- If there are n names in the list of `Strings` passed to your constructor, you must create exactly n new `AssassinNode` objects in your constructor. You may not create any additional node objects, and you may not create node objects in any other methods. In addition, you may not modify the `name` field of nodes after they have been created. As people are assassinated, you will move the existing node from the kill ring to the graveyard by changing references. You must not create any new node objects or change the `name` field of the nodes.
- You may declare as many *references* to `AssassinNode` objects (i.e. local variables of type `AssassinNode` as you like. `AssassinNode` refernces are not node objects and therefore do not count against the limit of n nodes described above.
- Your constructor should be "efficient" in the sense that it should not use any nested loops to construct the initial kill ring. (We will learn in class that this is called $\mathcal{O}(n)$ time, where n is the number of names in the list.)

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 assessment, 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 we believe it will make the program significantly more difficult to write, and we strongly discourage it. *We will not provide assistance in office hours to help you implement the circular list solution.*

jGRASP Debugger

We recommend that you use the jGRASP debugger for this assessment, even if you are primarily working in another IDE or in Ed. 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.



Code Quality Guidelines

In addition to producing the behavior described above, your code should be well-written and meet all expectations described in the grading guidelines, Code Quality Guide, and Commenting Guide. For this assessment, pay particular attention to the following elements:

Factor out any redundancy in your methods.

Avoid Redundancy

If you find that multiple methods in your class do similar things, you should create helper method(s) to capture the common code. All helper methods should be declared as `private`.

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.

Exceptions

The specified exceptions must be thrown correctly in the specified cases. Exceptions should be thrown as soon as possible, and no unnecessary work should be done when an exception is thrown. Exceptions should be documented in comments, including the type of exception thrown and under what conditions.

Commenting

Each method should have a header comment including all necessary information as described in the Commenting Guide. Comments should be written in your own words (i.e. not copied and pasted from this spec) and should not include implemenation details.

Running and Submitting

If you believe your behavior is correct, you can submit your work by clicking the "Mark" button in the Ed assessment. You will see the results of some automated tests along with tentative grades. **These grades are not final until you have received feedback from your TA.**

You may submit your work as often as you like until the deadline; we will always grade your most recent submission. Note the due date and time carefully—**work submitted after the due time will not be accepted**.

Getting Help

If you find you are struggling with this assessment, make use of all the course resources that are available to you, such as:

- Reviewing relevant examples from class
- Reading the textbook
- Visiting office hours
- Posting a question on the message board

Collaboration Policy

Remember that, while you are encouraged to use all resources at your disposal, including your classmates, **all work you submit must be entirely your own**. In particular, you should **NEVER** look at a solution to this assessment from another source (a classmate, a former student, an online repository, etc.). Please review the full policy in the syllabus for more details and ask the course staff if you are unclear on whether or not a resource is OK to use.

Reflection

In addition to your code, you must submit answers to short reflection questions. These questions will help you think about what you learned, what you struggled with, and how you can improve next time. The questions are given in the file `AssassinManagerReflection.txt` in the Ed assessment; type your responses directly into that file.