

CSCI 200 Project—Creating a Game Using a Map-Based Graph

For this final project, you'll implement your own role-playing computer game using a *map-based graph*. You get to design the game layout yourself, but always remember to keep things simple especially early on. Part of this project is to learn how to build a graph structure using maps. You'll find the instructions presented in this write-up to be minimal giving you the freedom to envision and create your own game so feel free to capitalize on that. Be creative and ambitious!

The project is due in class on Friday, May 3, and counts 18 points of the final grade. *You will demonstrate your project in class on that day. There will be no extensions into finals week.*

This is a project, not a lab, so you're mostly on your own. Please work in your assigned pairs. You may discuss general questions of design and implementation with other students, but do not share code or allow other students to see your code. If you are stuck, you may also ask the professor or TA for advice, but you must work out the design and implementation details yourself.

Preliminaries

Working with your partner, start by sketching on paper a design for the layout of a role-playing game with at least ten locations. Give each location a *unique* name-label and decide how to connect the locations as a directed graph. For this exercise, the starting location should be unreachable once the player leaves it; in graph terms, the starting location has at least one edge going out but none coming in. Include at least one dead-end location that the player can get to, but can't leave, and maybe a pair of locations that only have outgoing edges leading to each other. Otherwise, it should be possible to get from any location to any other location in some sequence of steps, but for some pairs of locations, it should require three or more steps to get from one to another.

Decide on the properties for each location: a character, a color, a weapon, an enemy, a tool, etc. To keep things simple, you may limit each location to one instance of each property; i.e., a location can have one character/color/weapon/enemy/tool/etc. or none, but not several. If you want to implement multiple instances of a property at a location, you'll need to use a collection for that property. For each location, assign values for each property. Include the location label (name) as one of the properties.

Important note about your design: Please do not include components that might be offensive to other people in the class, such as components that show racism, sexism, or excessive violence.

Part 1: File representation of the graph and the *LocationDescription* class

(This part is due at the beginning of lab on April 23; however, you should be farther along that this on that date.)

Using the *sampleLibrary.BookCollection* data file from a previous lab as a model, create a text file for the locations and their properties. Each entry should have one line for each property, starting with the location label. If a location doesn't have a particular property, choose a special symbol to put on that line to indicate it doesn't have the property. In this way, each entry will have the same number of lines, so reading the file will be straightforward.

Create a second text file, using a similar format, for the connections among locations. Each entry should start with the location label on the first line, the number of (outgoing) connections on the second line and the labels of locations it has connections to on subsequent lines. Alternatively, you may include a pair of locations on each line to indicate a connection going from the first location to the second location.

Finally, create a *LocationDescription* Java class, modeled on the *BookDescription* class that encapsulates the properties of a location. Include suitable constructors, accessor methods, mutator methods, and an overridden *toString* method.

Part 2: The *GameLayout* class

Create a *GameLayout* class modeled on the *BookCollection* class. It should have the following two instance variables (along with others you decide are necessary):

```
//associates a given location label with a set of connected locations
private Map<String, Set<String>> connections;

//associates a given location with its description object
private Map<String, LocationDescription> descriptions;
```

Note that you are using Java classes, not ZH classes in this project.

Your *GameLayout* class should have methods that enable you to:

1. create a new *GameLayout* by reading connections and information from specified files formatted as described above
2. iterate over all locations; the method should return an *Iterator* object that yields location names, one-by-one
3. iterate over all connections for a given location; the method should return an *Iterator* object that yields location names, one-by-one, for the given location
4. get a particular location description for a given location name-label
5. update the description of a location by adding/removing/updating a property
6. write the current state of the *GameLayout* to specified files

Test that your *GameLayout* class contains and preserves correct information by reading it from files, writing it to different files and comparing the results.

Part 3: The test driver class

Create a class that simulates the play of the game. It should begin with the user at the starting location. At any time, the user *should* be able to:

1. list the names of all possible locations without their connections or descriptions
2. list the properties at the current location (including its label/name)
3. list all locations connected to the current location
4. move to one of the adjacent locations through a connection
5. search (described below in *Part 5*, extra credit)

Part 4: Making the game more realistic

Create a new interactive driver program that simulates the play of the game. The game interface should be GUI-based using Swing (the *javax* package). You may use a purely text-based interface, but doing so results in a loss of two points on the project.

The player of any interesting computer game typically has a mission to complete; otherwise, the game would be very boring. In this case, it's your job to design and implement the interface. Please be creative and ambitious—this is *your* game! Here are some suggestions for making your game more realistic:

- A mission may be something like arriving at a particular destination, finding a location with a certain property value, or finding *all* locations with a certain property value.
- A player may have to complete more than one mission to win the game or may have a choice of missions.
- The program may generate missions randomly; for example, the program might select the destination location randomly each time a new game begins, or it might randomly select the property or properties the player needs to find to accomplish the mission.
- You might incorporate the concept of a player's life/energy along with a cost associated with visiting each location; for example, a player may have an original life/energy value that goes down every time they visit a new location, encounter an adversary, or rescue a kitten from a tree.
- The life/energy reduction value for visiting a location may vary from game to game or even from visit to visit. You could use this approach to simulate a fight or other kind of struggle.
- There might also be randomly occurring life/energy boosts.
- The game ends when all missions are complete (win), no life/energy remains (death), or the player arrives at a dead-end.
- If you want to try a multi-player game, save this feature for last, and don't try to do a network version. Just have the players take turns at the same computer.

Part 5: Searching for a needle in a haystack (2 points extra-credit)

Choose one or more of your location properties (such as potion or enemy) and implement a search method in the *GameLayout* class for a specified value of that property. Search should proceed from the current location and follow connections, using the following breadth-first search algorithm based on the one we discussed in class:

```
algorithm breadth-first search (location, desired property)
  create a new empty queue of locations
  enqueue location
  mark location
  while the queue is not empty do
    dequeue current location
    if desired property is at current location then
      unmark all locations      // to allow for future searches
      return current location //i.e. return first match
    end if
    for each unmarked neighbor of current location do
      mark neighbor
      enqueue neighbor
    end for
  end while
  unmark all locations // to allow for future searches
  return null          //i.e. no matches found
end breadth-first search
```

To mark locations, add a *boolean mark* instance variable to your *LocationDescription* class and make sure it is initialized to *false*. Then include *mark*, *unmark*, and *getMark* methods for the class.

Add a search command to your driver class that gets a property value from the user and then searches for that property value starting from the current location. Report the location where the algorithm found the property value, if it finds it; otherwise report that it didn't find it. Test your search method on several property values starting from several locations, including finding properties that are in the layout but are not reachable from the current position.

Part 6: Demonstrating your game

You will demonstrate your finished game during the lab period on Friday, May 3. Your demo should take about ten minutes, and you should show all the features in your game during that time. Pay particular attention to explaining what you did for Part 4 to make your game more realistic; this aspect will be a significant portion of your grade for the project. In addition, submit a one-page printed report to your lab instructor that includes your names and summarizes the features that you added for Part 4. You don't need to write an essay—a list of bullet points is acceptable—but please remember that it is your responsibility to draw attention to what makes your game distinctive from a programming point of view. *Don't expect the instructor to figure this out from your code!*

!!! HAVE FUN !!!