CS 116 Section 4 PROJECT

Spring 2016

Grade: Up to 12 points.

Rules:

- To be worked on individually.
- Must be presented to the instructor in person in order to be graded.
- Similar projects will both receive a grade of zero regardless as to who did the actual work. Therefore giving your files to someone else will cost you the grade also.

Due Date: 04/28 11:59PM on Blackboard

- **Must sign up for a time slot on the above designated date for you to present the project.**
- **Presentation in person on Friday 4/29 as per the times slots schedule to be decided during the second week of April. You will pick a slot during the class times on 04/11 and 04/13. Time slots are awarded on first come first served basis. Your presentation will last about 10 minutes. If you cannot make any of the available slots, then let the instructor know before 04/15. After that date no accommodations will be made.**
- **During the presentation to the grader, you will be asked to run the program on your laptop. If it runs, then present a hard copy of the program and other documentation required to the grader and be prepared to answer questions about your coding. Lack of understanding of the design and the code presented will result in a zero grade!**

  You can get partial credit based on your design and your code even if your classes are not compiled or the project is not producing the correct result (in this case your presentation could last slightly longer). You should be able to explain your work. No project presentations the week of the final exams. Anyone who misses the appointment will receive a grade of zero.
- **Upload all files on Blackboard two hours minimum before your presentation session starts. You can't make any changes after the submission.**
- **You must work this project by yourself. No groups are allowed. Ask for help early enough. You can work with me the TAs and/or ARC.**

- **There will be lectures devoted to the project intermittently over the weeks of April 11th and April 18th.**

WHAT TO PRESENT AND SUBMIT

- A PowerPoint file that has a diagram that shows your classes and their relationships and other information required (as described in the "deliverables" section)
- The source code files.
- The compiled files (unless your program does not compile).

PROJECT DESCRIPTION

Design a multi-object application containing inheritance.[1]

1. Requirements Document for a Power Usage Simulation System - Read this article on "Smart appliances learning to save power grid" to get the context for this project. http://www.msnbc.msn.com/id/21760974/

2. An appliance consists of a type (string), the "on" wattage used (integer), the "off" wattage used (integer), the probability (floating point, i.e. .01=1%) that the appliance is "on" at any time, the location (represented by an 8 digit numeric account number), and a unique, system-generated appliance ID. Multiple appliances are at each location, and duplicate appliances can be at the same location (each appliance with its own unique appliance ID). Appliances can either be regular or smart. Smart appliances (if "on") can sense the load on the power grid and reduce their average wattage used by switching to the "off" state, which uses lower power.

   Note: The file "ApplianceDetail.txt" provided with the project has a sample list of different types of appliances. The code ApplianceGenerator.java (also provided with the project) uses this file, to generate an input file which your application will use.

3. A Power Usage Simulation System needs to be able to manage a collection of appliances (both regular and smart). A user should be allowed to find, add and delete an appliance, or use an input file to add appliances.

4. A user also should be able to view subsets of appliances (all appliances for a location, or all appliances of a particular type across all locations). The user should be able to view a summary report of the total number of locations, and total number of each appliances of each type.

[1] Acknowledgement: Originally prepared by Matt Bauer

5. Finally, using the Power Usage Simulation System, the user will be able to run a simulation loop for a user specified time length and user timing interval. This simulation loop will determine in each time interval the total wattage on the power grid by summing the wattage used by each appliance (if an appliance is "on" or not is determined by its probability). If the total wattage exceeds the user defined warning level for the grid, the simulation must determine which "on" smart appliances to cycle off (reduce the power) for that interval, while minimizing the noticeable effect on each location. In extreme cases, turning off the power to particular locations for an interval may be necessary (a brown out). When the next interval starts, each appliance's "on"/"off" status is again determined by its probability of being on. The simulation system must publish a report of which appliances/locations were effected during each interval.

   Implement (and create additional Test Cases for this class) the simulation part of the Power Usage Simulation System

   - Prompt the user for a wattage warning level for the grid.
   - Allow the user to take (or change) the default simulation time length (24 hours), and the default simulation timing interval (5 minutes).
   - Run the simulation and apply your algorithm to manage the appliances to keep the usage below the wattage warning level.
   - When the simulation is complete, output the following:
     - A summary report to the screen the total number of locations effected in each interval for the entire simulation run, and the max effected location.
     - A detailed report to a file containing the appliances/locations were effected during each interval.

Some background: Discrete Event Simulator

You will be using the concept of discrete event simulation to simulate the power usage. A Discrete Event Simulator uses a computer program (basically a loop counting some time intervals, minutes for example) to simulate time moving forward and random arrival and handling of some sort of event. So every iteration of the loop is equal to one time interval, and we will randomly generate the time the next event will occur. When we reach that time, we will handle the event (here just count it and output it) and generate the time for the next event. A random exponential integer will tell us how many minutes till the next event, the interval between events time (this time can be zero!).

A sample code for discrete simulation is provided along with the project in EventSimulator.java. Use this code for your project as you see fit.

Sample run of EventSimulator.java

How many minutes long is the simulation? 100
Minute:0 Event#1
Minute:2 Event#2
Minute:6 Event#3
Minute:6 Event#4
Minute:17 Event#5
Minute:17 Event#6
Minute:22 Event#7
Minute:36 Event#8
Minute:42 Event#9
Minute:42 Event#10
Minute:42 Event#11
Minute:43 Event#12
Minute:45 Event#13
Minute:57 Event#14
Minute:58 Event#15
Minute:58 Event#16
Minute:73 Event#17
Minute:96 Event#18
Number of events = 18

Deliverables

1. Create slides in Powerpoint with the following information
    - Design info:
        - A design for the project using class diagram designs
        - Create Class Diagrams for all the requirements.
        - Show the associations between the classes
        - Add Attributes to the Class Diagrams.
        - Create test cases for each class (tables with short descriptions).
    - A description of your strategy to cycle off smart appliances and strategy to "brown out" a location.
2. Source code
3. Compiled code

Submission

- Zip all files mentioned in the deliverables section and name the zip file using your last name followed by your first name followed by the name of the assignment

  i.e. Doe_Jane_Project.zip

  Upload the zip file on the Project folder on Blackboard.

Q & A for the project Updated 04/07 (Will update if I get more questions)

1. How do we know where the appliances are located? Where do we get location from? (data not in generator) **The input file contains the location of each appliance, the location (represented by an 8 digit numeric account number).**
2. In the simulation report, does the final report need to list appliance affected individually or as a final number? **Both a detail report and summary report of which appliances/locations were effected during each interval is required.**
3. Do you have an algorithm to determine the brown-out location? or do we code that? **You have to come up with an algorithm to determine the brown-out location.**
4. What are the restrictions on the amounts of appliances we need to use? What is the limit on how many appliances? **Default 10,000 appliances, but also allow the user to set differently when simulation starts.**
5. What should be the upper/lower bound limit for the time interval of the simulation length? **Let's just do one day, 24 hours. Default interval length is 5 minutes, but also allow the user to set differently when simulation starts.**
6. How will the input file be formatted, what delimiter? **See the ApplianceGenerator.java with it's input file ApplianceDetail.txt. This generates a comma delimited input file.**
7. Should the user be allowed to set wattage limit to zero? **no**
8. What is the report for and how detailed should it be? **The user should be able to view a summary report of the total number of locations, and total number of each appliances of each type. Also, the simulation system must publish a report of which appliances/locations were effected during each**

interval. Both a detail report and summary report of which appliances/locations were effected during each interval is required.

9. How do we know the time interval of "off"? **At the start of each interval, get the "probability on" number from each appliance (for example .2 or 20% on), call the random number generator, if it returns a number <= .2, the appliance is on during that interval, otherwise it is off during that interval.**
10. Should user be allowed to set different values on appliances? **Yes**
11. Is there user-defined time movement? **Yes, the simulation interval is user defined, take a default of 5 minutes.**
12. How would the user delete/add objects during simulation? **All add/deletes need to be completed before a simulation run.**
13. What criterion should be used for adding input; ApplianceId, location or Appliancetype? **See the ApplianceGenerator.java with it's input file ApplianceDetail.txt. This generates a comma delimited input file. Also, theRequirements Document specifies data types, any probabilities should be between 0 and 1, any wattage usages should be >=0.**
14. Is it ok to just make the applianceType static in each class so that everytime an Appliance object or SmartAppliance object is created, it automatically has its type set. **No, Appliance Types are read in from the input file**
15. How is the probability determined for each smart device for each new run of the simulator? **The on/off probabilites and percentage saved by smart are read in from the input file, and can be changed by the user before a simulation run. But are not changed within the simulation run.**
16. How will each appliance have a unique system id? **Your system must assign the appliance IDs as they are created. We know one method to do this using a static counter.**
17. How do we decide whether to turn off the power to a smart device, or it is just going to be a random choice? **That is up to you to determine. A random choice is one approach, but there are other systematic ways that might do a better job.**
18. How is the report supposed to be published? **Write to a text file.**
19. How are we supposed to know the load the plant can handle? **User input**
20. Do we have to read an input file or insert it manually? **Yes you will need to support both reading the input file and allowing the user to add/delete/update appliances manually.**
21. Are we supposed to make a sub class for regular appliances **Yes you should use inheritance**
22. Can we find subsets of appliances i.e form a new array every time or write a search algorithm? **Yes, but you may start to see problems with memory limits.**

23. The range of time length should be pre-defined or prompt the user to define it at the beginning of the program? **Let's just do one day, 24 hours. Default interval length is 5 minutes, but also allow the user to set differently when simulation starts.**
24. What about the range of interval? **the integer interval should be allowed to be as short as 1 minute and as long as 15 minutes**
25. What is the maximum number of appliances available at a certain time? **Default 10,000 appliances, but also allow the user to set differently when simulation starts.**
26. If the total wattage exceeds the user defined warning level, the system will turn off, then should system send the detail information of the grid (like which is the highest wattage consumer)? **No, the system should just determine which smart appliances or brown outs are necessary to bring the demand down (and record what was done for reporting)**
27. When the total wattage get closed to the user-defined warning level, should the system prompt the user for reaction, or should a precaution procedure to be innate built inside the program? **Messages are nice, but no user interaction should be necessary within the simulation run.**
28. Do all smart appliances decrease power by the same amount? How do we know what each appliance decreases by when turns to smart power if they all don't decrease by the same amount? **No, each smart appliance type has its own reduction in wattage used percentage. This is given in input file, or user defined if an appliance is manually added/changed.**
29. When is a 'Brown Out' necessary? **It is for your system to determine if you think it is "better" to shut an entire location off, or to just try to manage with smart appliance control.**
30. Can Smart Appliance be turn off completely? **Only if you "brown out" the location, or in the next interval the appliance is off.**
31. Should the report being published at the end of the simulation contain the wattage the appliance used before it was caused to turn off and its new off wattage, etc. or just what appliances and locations wattages were decreased? **just what appliances and locations wattages were decreased**
32. Should the user be able to modify an existing appliance's information? **Yes**
33. Since a user can add/delete appliances, would it be a good idea to have a few smart appliances that are permanent so that way a user can't try to create regular appliance only locations? **Not necessary to control this, let the user change appliances as they want.**
34. It states that a brown out is possible in extreme cases, is it possible to cause all the locations to turn off, 'black out' or should it be coded in a way to prevent the situation? **No it is not necessary to handle this special case**

35. How many types of appliances are being used and what are they? **Default 10,000 appliances, but also allow the user to set differently when simulation starts. See the ApplianceGenerator.java with it's input file ApplianceDetail.txt. This generates a comma delimited input file.**
36. It is mentioned that the Power Usage Simulation System tells which Smart Appliances to cycle off due to the data found in the simulation. If this process is supposed to minimize the noticeable effect on each location, does each appliance have a different tolerance that should be associated with it or is it assumed that all Smart Appliances relatively use the same amount of power so all minimized effects are standardized? **It is up to you to determine if certain appliance types should have different tolerance levels for being turned down. See the ApplianceGenerator.java with it's input file ApplianceDetail.txt to see the list of available appliance types.**
37. Is the goal to keep as many appliances on at each location possible or would it be just as acceptable to completely shutdown all appliances at a single location in order to keep appliances on in another? **It is for your system to determine if you think it is "better" to shut an entire location off, or to just try to manage with smart appliance control.**
38. It is understood that the user specifies the total length of the simulations but does the user also specify the time intervals or are those randomly decided by the simulator? **Let's just do one day, 24 hours. Default interval length is 5 minutes, but also allow the user to set differently when simulation starts. the integer interval should be allowed to be as short as 1 minute and as long as 15 minutes**
39. Can regular appliances be turned off if required? **Only if you 'brown out' the location, or in the next interval the appliance is off.**