

**Gebze Technical University  
Computer Engineering**

**CSE 222 - 2018 Spring**

**HOMEWORK 1 REPORT**

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# **1 INTRODUCTION**

## **1.1 Problem Definition**

Problem is to create a data structure like a single linked list to keep some experiments. Experiments contain day, setup, time, completed status and accuracy informations. Each experiment should follow the other in the list. Also the first experiments of each day should point to each other.

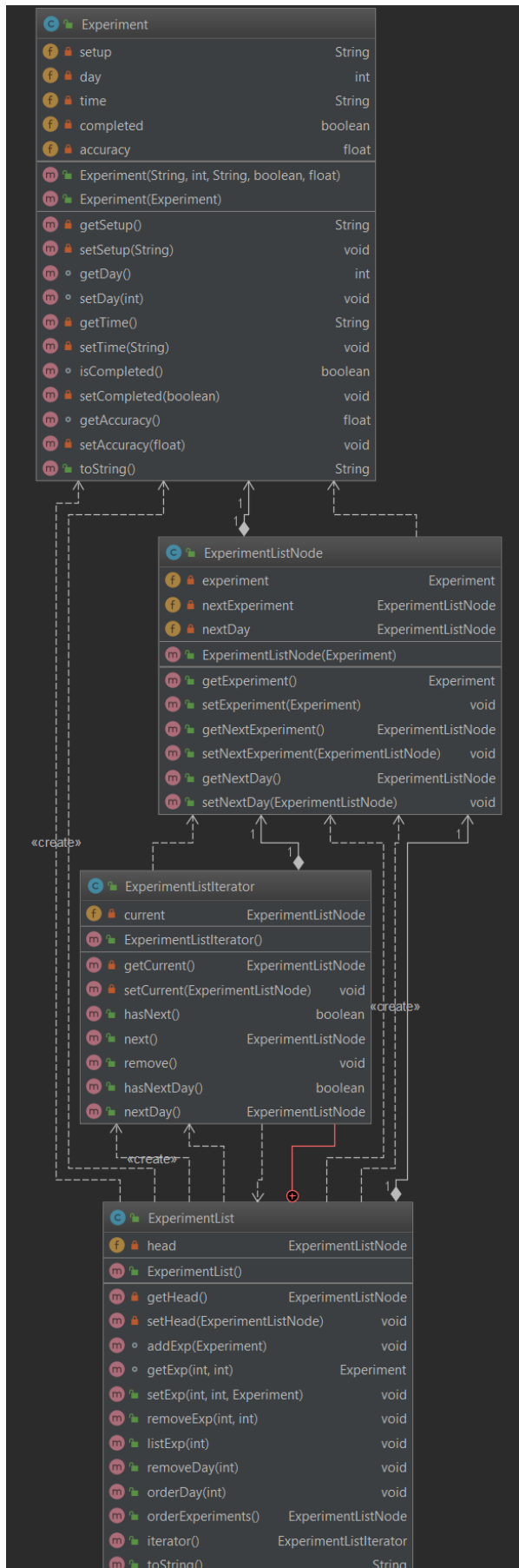
## **1.2 System Requirements**

To solve this problem it is required to simulate some sort of single linked list structure that can hold experiment objects in them. A class that represents that kind of list structure is a requirement. Each linked is made out of nodes in theory, so there must be a class to represent that as well. All the experiments must be represented, which has to be done by another class. An iterator is required to traverse through the list, which has to be implemented as a class too.

To do operations required on the assignment, there must be a existing list. (Except adding, since it creates the list)

## 2 METHOD

## 2.1 Class Diagrams



## 2.2 Use Case Diagrams

Not required.

## 2.3 Other Diagrams (optional)

Not required.

## 2.4 Problem Solution Approach

To solve the problem it was required to simulate some kind of single linked list structure. 4 classes (including main) got created during the solution process. One class for creating nodes of the list, one class to represent the experiments, one class that represents the experiment list itself.

### a) Experiment Class:

This class is used to represent experiments.

Experiments have these datas;

-Setup

-Day

-Time

-Completed status

-Accuracy

In this class, these data's getter and setter functions are implemented, so as the constructor, a copy constructor and the toString method.

### b) ExperimentListNode Class:

This class is used to represent experiment list nodes. This class contains these variables:

-Experiment: Is the experiment that is required to hold in the node.

-NextExperiment : Is the next experiment that the current experiment is pointing.

-NextDay: Is the next day that the current experiment is pointing.

In this class, these variable's getter and setter methods are implemented so as the constructor.

### c) ExperimentList Class:

This class is used to represent experiment list itself. This class implements the Iterable interface so it can use a iterator inside.

This class only has one variable which is the head of the list in the type of ExperimentListNode. Getter and setter methods are implemented in the class for the head as well.

### **-ExperimentListIterator Inner Class:**

ExperimentList class has an inner class ExperimentListIterator which represents the iterator of the list. This class has one variable which is the current value of the iterator, in the type of ExperimentListNode.

This class has getter and setter methods for the “current” variable, and also a constructor which initialises the iterator to point to the head. This class implements the iterator interface so it overrides hasNext(), next() and remove() methods. As an addition to those overrides to make traversing through days easier, hasNextDay() and nextDay() methods are implemented.

ExperimentList class has the following methods:

**-addExp(Experiment e):** Adds the given experiment to the list. Does the checks for if the list is empty, or the experiment is on an existing day or not. Then creates a new node with the given experiment and adds the experiment to the list. The addition is done to the end of the day that the experiment provide. If the day doesn't exist, it just becomes the first experiment of that day.

**-getExp(int day , int index):** Returns the experiment at the given day and index. Method first finds the starting experiment of the given day then traverses the list until it founds the given index of the day. If there is not enough element it throws and exception. If the day doesnt exist in the list, it throws an exception too.

**-setExp(int day, int index, Experiment e):** Sets the given experiment to the given day and index. It does day and index checks and also empty list checks and throws exceptions if necessary.

**-removeExp(int day , int index):** Removes the experiment at the given day and index. It does the day and index checks so as the empty list check and throws exceptions if necessary. This method uses ExperimentListIterator's remove method to remove the elements.

**-listExp(int day):** Lists the completed experiments of the given day. It does the day and empty list checks and throws necessary exceptions. First iterator goes to the first experiment of the given day then traverses and prints the experiments one by one until the day changes.

**-removeDay(int day):** Removes the experiments of a given day. First it finds the given day in the list then removes the experiments one by one using the ExperimentListIterator's remove method. It also does the day check and empty list check and throws exceptions if necessary.

**-orderDay(int day):** Orders the given day's experiments according to their accuracy. Two iterators traverse until they reach the end, then one of them is incremented by one so it can traverse ahead to check if there are any smaller elements.

**-orderExperiments():** Orders all the experiments according to their accuracy. First to not change the list, method copies all the current list to another list. Then two iterators are sent to do the search for the sorting. Returns the head of the newly created list.

**-iterator():** Returns a new ExperimentListIterator object. Overridden method for the implementation of Iterable

**-toString():** Overriding of the toString method to print a list better.

## 3 RESULT

### 3.1 Test Cases

Except normal usage of the methods, test cases include wrong day and index entries. And they are all handled.

### 3.2 Running Results

The outputs are from the current working program.

```
2 -----CONSTRUCTING THE LIST-----
3 Experiment Setup:E1
4 Day:1
5 Time:10:02:24
6 Completed:false
7 Accuracy:1.0
8
9 Experiment Setup:E2
10 Day:2
11 Time:10:02:24
12 Completed:true
13 Accuracy:61.45
14
15 Experiment Setup:E3
16 Day:2
17 Time:10:02:24
18 Completed:true
19 Accuracy:53.45
20
21 Experiment Setup:E4
22 Day:3
23 Time:10:02:24
24 Completed:true
25 Accuracy:5.45
26
27 Experiment Setup:E8
28 Day:3
29 Time:10:02:24
30 Completed:true
31 Accuracy:16.54
32
33 Experiment Setup:E5
34 Day:4
35 Time:10:02:24
36 Completed:true
37 Accuracy:54.45
38
39 Experiment Setup:E6
40 Day:5
41 Time:10:02:24
42 Completed:true
43 Accuracy:16.54
44
45
46 -----ADD TEST-----
47 Experiment Setup:E1
48 Day:1
49 Time:10:02:24
50 Completed:false
51 Accuracy:1.0
52
53 Experiment Setup:E2
54 Day:2
55 Time:10:02:24
56 Completed:true
57 Accuracy:61.45
58
59 Experiment Setup:E3
60 Day:2
61 Time:10:02:24
62 Completed:true
63 Accuracy:53.45
64
65 Experiment Setup:E4
66 Day:3
67 Time:10:02:24
68 Completed:true
69 Accuracy:5.45
70
71 Experiment Setup:E8
72 Day:3
73 Time:10:02:24
74 Completed:true
75 Accuracy:16.54
76
77 Experiment Setup:E5
78 Day:4
79 Time:10:02:24
80 Completed:true
81 Accuracy:54.45
82
83 Experiment Setup:E7
84 Day:4
85 Time:10:02:24
86 Completed:true
87 Accuracy:26.54
88
89 Experiment Setup:E6
90 Day:5
91 Time:10:02:24
92 Completed:true
93 Accuracy:16.54
94
95 Experiment Setup:E9
96 Day:6
97 Time:10:02:24
98 Completed:true
99 Accuracy:1.54
100
101
```

```

102 -----GET EXP TEST-----152
103 Experiment Setup:E4      153 Experiment Setup:E6
104 Day:3                   154 Day:5
105 Time:10:02:24          155 Time:10:02:24
106 Completed:true         156 Completed:true
107 Accuracy:5.45          157 Accuracy:16.54
108 --Testing with wrong index--
109 No such index           158
110 -----SET EXP TEST-----159 Experiment Setup:E9
111 Experiment Setup:E1      160 Day:6
112 Day:1                   161 Time:10:02:24
113 Time:10:02:24          162 Completed:true
114 Completed:false         163 Accuracy:1.54
115 Accuracy:1.0            164
116                         165
117 Experiment Setup:E3      166 --Testing to set a experiment with a different day value to
118 Day:2                   check exception handling--
119 Time:10:02:24          167 Mismatch of given experiment and chosen experiment
120 Completed:true         168
121 Accuracy:53.45         169 -----REMOVE EXP TEST-----
122                         170 Experiment Setup:E1
123 Experiment Setup:E3      171 Day:1
124 Day:2                   172 Time:10:02:24
125 Time:10:02:24          173 Completed:false
126 Completed:true         174 Accuracy:1.0
127 Accuracy:53.45         175
128                         176 Experiment Setup:E3
129 Experiment Setup:E4      177 Day:2
130 Day:3                   178 Time:10:02:24
131 Time:10:02:24          179 Completed:true
132 Completed:true         180 Accuracy:53.45
133 Accuracy:5.45          181
134                         182 Experiment Setup:E3
135 Experiment Setup:E8      183 Day:2
136 Day:3                   184 Time:10:02:24
137 Time:10:02:24          185 Completed:true
138 Completed:true         186 Accuracy:53.45
139 Accuracy:16.54         187
140                         188 Experiment Setup:E4
141 Experiment Setup:E5      189 Day:3
142 Day:4                   190 Time:10:02:24
143 Time:10:02:24          191 Completed:true
144 Completed:true         192 Accuracy:5.45
145 Accuracy:54.45         193
146                         194 Experiment Setup:E8
147 Experiment Setup:E7      195 Day:3
148 Day:4                   196 Time:10:02:24
149 Time:10:02:24          197 Completed:true
150 Completed:true         198 Accuracy:16.54
151 Accuracy:26.54         199
                          200 Experiment Setup:E5
                          201 Day:4
                          202 Time:10:02:24
                          203 Completed:true
                          204 Accuracy:54.45
                          205
                          206 Experiment Setup:E7
                          207 Day:4
                          208 Time:10:02:24
                          209 Completed:true
                          210 Accuracy:26.54
                          211
                          212 Experiment Setup:E9
                          213 Day:6
                          214 Time:10:02:24
                          215 Completed:true
                          216 Accuracy:1.54
                          217
                          218
                          219 --Testing invalid day--
                          220 Index or day mismatch

```

```

221 -----LIST EXP TEST-----
222 Experiment Setup:E5
223 Day:4
224 Time:10:02:24
225 Completed:true
226 Accuracy:54.45
227 Experiment Setup:E7
228 Day:4
229 Time:10:02:24
230 Completed:true
231 Accuracy:26.54
232
233 --Testing invalid day--
234 Invalid day
235 -----REMOVE DAY TEST-----
236 Experiment Setup:E1
237 Day:1
238 Time:10:02:24
239 Completed:false
240 Accuracy:1.0
241
242 Experiment Setup:E3
243 Day:2
244 Time:10:02:24
245 Completed:true
246 Accuracy:53.45
247
248 Experiment Setup:E3
249 Day:2
250 Time:10:02:24
251 Completed:true
252 Accuracy:53.45
253
254 Experiment Setup:E5
255 Day:4
256 Time:10:02:24
257 Completed:true
258 Accuracy:54.45
259
260 Experiment Setup:E7
261 Day:4
262 Time:10:02:24
263 Completed:true
264 Accuracy:26.54
265
266 Experiment Setup:E9
267 Day:6
268 Time:10:02:24
269 Completed:true
270 Accuracy:1.54
271
272
273 --Testing with an invalid day--
274 There is no such given day in the list.
275 -----ORDER DAY TEST-----
276 Experiment Setup:E1
277 Day:1
278 Time:10:02:24
279 Completed:false
280 Accuracy:1.0
281
282 Experiment Setup:E3
283 Day:2
284 Time:10:02:24
285 Completed:true
286 Accuracy:53.45
287
288 Experiment Setup:E3
289 Day:2
290 Time:10:02:24
291 Completed:true
292 Accuracy:53.45
293
294 Experiment Setup:E5
295 Day:4
296 Time:10:02:24
297 Completed:true
298 Accuracy:54.45
299
300 Experiment Setup:E7
301 Day:4
302 Time:10:02:24
303 Completed:true
304 Accuracy:26.54

```

```

305
306 Experiment Setup:E9
307 Day:6
308 Time:10:02:24
309 Completed:true
310 Accuracy:1.54
311
312
313 --Testing with a invalid day--
314 There is no such day.
315 -----ORDER EXPERIMENTS TEST
-----
316 Experiment Setup:E1
317 Day:0
318 Time:10:02:24
319 Completed:false
320 Accuracy:1.0
321
322 Process finished with exit code 0

```



## Time Complexities of The Methods:

Methods	Best Case	Average Case	Worst Case
addExp	$O(1)$	$O(n)$	$O(n)$
getExp	$O(n)$	$O(n)$	$O(n)$
setExp	$O(n)$	$O(n)$	$O(n)$
removeExp	$O(n)$	$O(n)$	$O(n)$
listExp	$O(n)$	$O(n)$	$O(n)$
removeDay	$O(n)$	$O(n)$	$O(n)$
orderDay	$O(n)$	$O(n^2)$	$O(n^2)$
orderExp	$O(n)$	$O(n^2)$	$O(n^2)$

**addExp** : adding the first experiment only adds to the head so it has constant complexity. Rest of the adding conditions require not nested loops which ends up with the complexity at  $O(n)$ .

**getExp** : To get the requested experiment 2 not nested loops has to loop no matter what so from  $O(2n)$  the time complexity is  $O(n)$ .

**setExp** : If exceptions are ignored, the method will executed 2 not nested loops so from  $O(2n)$  the time complexity is  $O(n)$ .

**removeExp** : To remove the experiment either 2 not nested loops has to loop or if the experiment is at the head it will call the remove method which also has an  $O(n)$  time complexity. So it is either  $O(2n) \rightarrow O(n)$  or just  $O(n)$  from the method call.

**listExp** : Method will use 2 not nested loops no matter what so from  $O(2n) \rightarrow O(n)$ .

**removeDay** : Method will use 2 not nested loops no matter what so from  $O(2n) \rightarrow O(n)$ .

**orderDay** : Method uses 2 not nested and 2 nested loops. The worst case would be entering all the loops yet  $O(n^2+2n) \rightarrow O(n^2)$ . The best case would be  $O(n)$  where there is one element and  $n$  would be 1.

**orderExperiments** : Method uses 2 not nested and 2 nested loops. The worst case would be entering all the loops yet  $O(n^2+2n) \rightarrow O(n^2)$ . The best case would be  $O(n)$  where there is one element and  $n$  would be 1.

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