GIT Department of Computer Engineering CSE 222
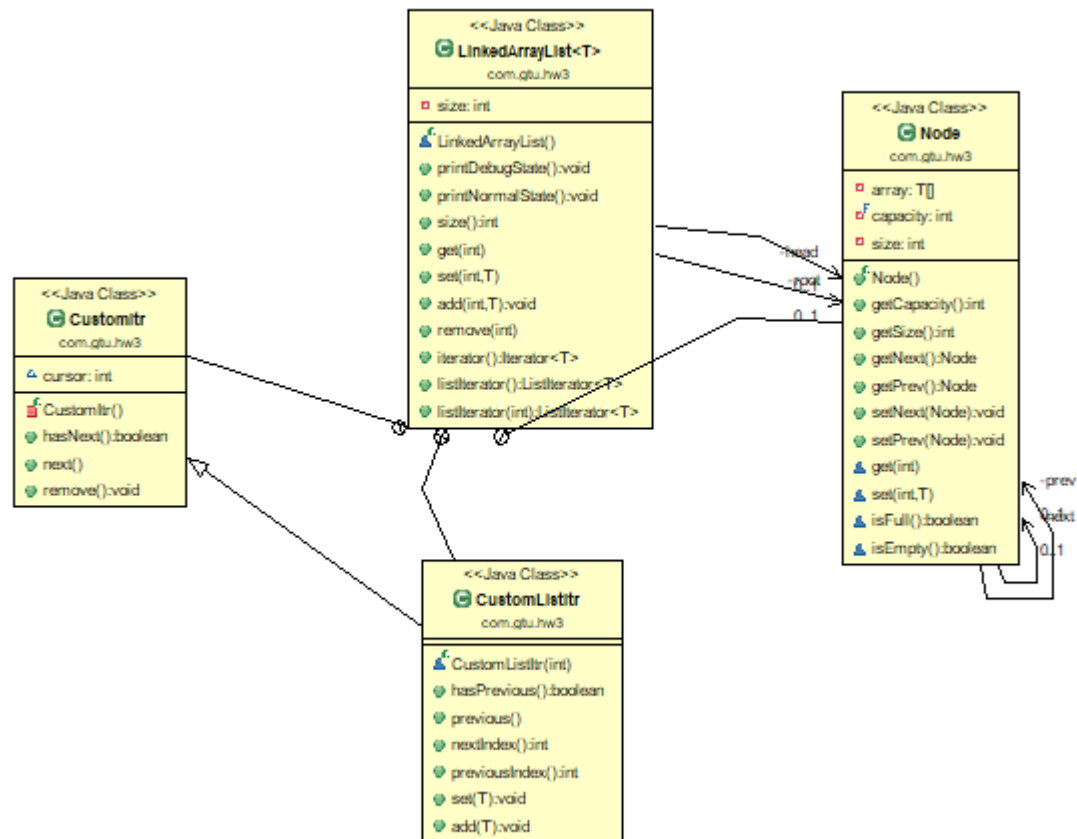# Homework # 3

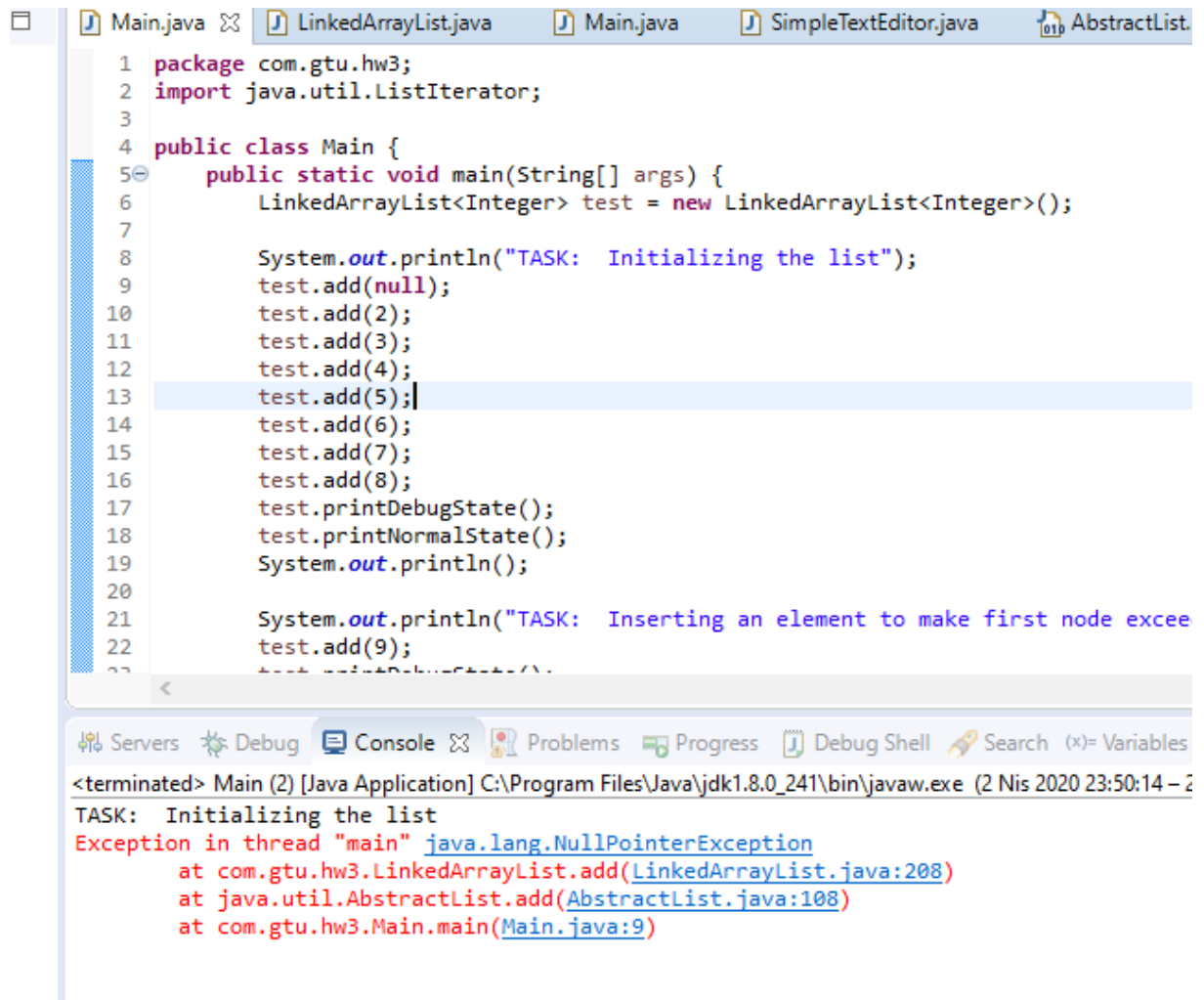**BERKE BELGIN**
171044065

QUESTION 1

1. CLASS DIAGRAMS

2. PROBLEM SOLUTION APPROACH

In this problem i implemented a Linked list that every node of the list holds an array of type T elements. Every node has an array and when we add an element into the array if the array is full then our list creates a new node and transfers half of the all elements of previous node into the new one. That way we prevent spamming nodes with just one elements when an element inserted into not last but one before the last.

3. TEST CASES

```java
1  package com.gtu.hw3;
2  import java.util.ListIterator;
3
4  public class Main {
5      public static void main(String[] args) {
6          LinkedArrayList<Integer> test = new LinkedArrayList<Integer>();
7
8          System.out.println("TASK:  Initializing the list");
9          test.add(null);
10         test.add(2);
11         test.add(3);
12         test.add(4);
13         test.add(5);
14         test.add(6);
15         test.add(7);
16         test.add(8);
17         test.printDebugState();
18         test.printNormalState();
19         System.out.println();
20
21         System.out.println("TASK:  Inserting an element to make first node excee
22         test.add(9);
```

Servers Debug Console Problems Progress Debug Shell Search (x)= Variables

<terminated> Main (2) [Java Application] C:\Program Files\Java\jdk1.8.0_241\bin\javaw.exe (2 Nis 2020 23:50:14 – 2

```
TASK:  Initializing the list
Exception in thread "main" java.lang.NullPointerException
        at com.gtu.hw3.LinkedArrayList.add(LinkedArrayList.java:208)
        at java.util.AbstractList.add(AbstractList.java:108)
        at com.gtu.hw3.Main.main(Main.java:9)
```

4. RUNNING AND RESULTS

TASK: Initializing the list
DEBUG: [1, 2, 3, 4, 5, 6, 7, 8]
INFO: [1, 2, 3, 4, 5, 6, 7, 8]

TASK: Inserting an element to make first node exceed its capacity
DEBUG: [1, 2, 3, 4, n, n, n, n] [5, 6, 7, 8, 9, n, n, n]
INFO: [1, 2, 3, 4, 5, 6, 7, 8, 9]

TASK: Inserting an element into given index (0)
DEBUG: [10, 1, 2, 3, 4, n, n, n] [5, 6, 7, 8, 9, n, n, n]
INFO: [10, 1, 2, 3, 4, 5, 6, 7, 8, 9]

TASK: Setting the value of the element in given index (0)
DEBUG: [0, 1, 2, 3, 4, n, n, n] [5, 6, 7, 8, 9, n, n, n]
INFO: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

TASK: Removing the element in given index (0)
DEBUG: [1, 2, 3, 4, n, n, n, n] [5, 6, 7, 8, 9, n, n, n]
INFO: [1, 2, 3, 4, 5, 6, 7, 8, 9]

TASK: Inserting elements into given index (0)
DEBUG: [-4, -3, -2, -1, 0, n, n, n] [1, 2, 3, 4, n, n, n, n] [5, 6, 7, 8, 9, n, n, n]
INFO: [-4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

TASK: Removing the element (1) in given index (5)
TASK: Removing the element (2) in given index (5)

TASK: Removing the element (3) in given index (5)
TASK: Removing the element (4) in given index (5)
DEBUG: [-4, -3, -2, -1, 0, n, n, n] [5, 6, 7, 8, 9, n, n, n]
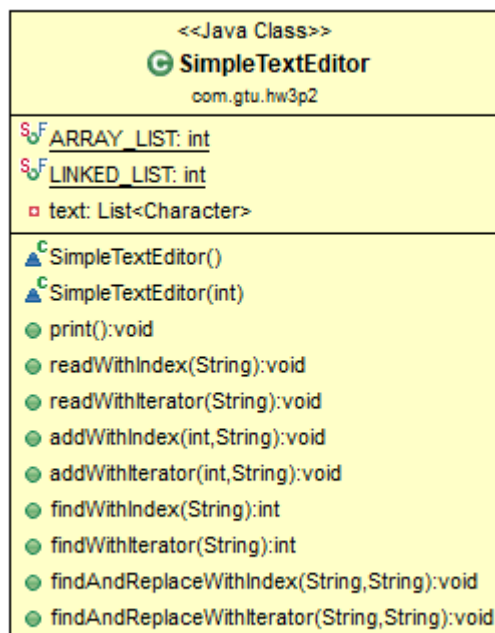INFO: [-4, -3, -2, -1, 0, 5, 6, 7, 8, 9]

TASK: Clearing the list
DEBUG: null
INFO: []

TASK: Initializing the list
DEBUG: [-4, -3, -2, -1, 0, n, n, n]
INFO: [-4, -3, -2, -1, 0]

TASK: Printing the list with an iterator
ITER: [-4, -3, -2, -1, 0]
TASK: Printing the list with a for loop
    INDEX: [-4, -3, -2, -1, 0]

QUESTION 2
1. CLASS DIAGRAMS

2. PROBLEM SOLUTION APPROACH

In this problem i implemented a simple text editor class which handles simple operations like find replace add read. To achieve these tasks i created a two methods for each. One for handling operations without iterators and the other is handling operations with iterators. And in this class we are able to hold data with two different structures. One is with a linked list and the other is an array list. And then i measured every variation of methods and logged them in a log file.

3. TEST CASES

```
22        }
23
24⊖     public static void main(String[] args) {
25            final String INPUT_FILE_PATH= "";
26            final String INPUT_FILE_PATH_2= "input/input_text_2.txt";
27            SimpleTextEditor ArrayListTestIndex = new SimpleTextEditor(SimpleTextEditor.ARRAY_LIST);
28            SimpleTextEditor ArrayListTestIterator = new SimpleTextEditor(SimpleTextEditor.ARRAY_LIST);
29            SimpleTextEditor LinkedListTestIndex = new SimpleTextEditor(SimpleTextEditor.LINKED_LIST);
30            SimpleTextEditor LinkedListTestIterator = new SimpleTextEditor(SimpleTextEditor.LINKED_LIST);
31            Logger logger = initLogger();
32            long startTime = 0;
33            long endTime = 0;
34            int findIndex = -1;
35            String SongVerse =
36                    "[Verse 1]\n" +
37                    "Now you all know\n" +
38                    "The bards and their songs\n" +
39                    "When hours have gone by\n" +
40                    "I'll close my eyes\n" +
41                    "In a world far away\n" +
42                    "We may meet again\n" +
43                    "But now hear my song\n" +
44                    "About the dawn of the night\n" +
```

```
🖧 Servers  🐞 Debug  🖳 Console ⊠  🔲 Problems  🔩 Progress  🔟 Debug Shell  🔗 Search  (x)= Variables  ●₀ Breakpoints  🔗 Expressions
<terminated> Main (3) [Java Application] C:\Program Files\Java\jdk1.8.0_241\bin\javaw.exe  (2 Nis 2020 23:48:29 – 23:48:33)

java.io.FileNotFoundException:
        at java.io.FileInputStream.open0(Native Method)
        at java.io.FileInputStream.open(FileInputStream.java:195)
        at java.io.FileInputStream.<init>(FileInputStream.java:138)
        at java.util.Scanner.<init>(Scanner.java:611)
        at com.gtu.hw3p2.SimpleTextEditor.readWithIndex(SimpleTextEditor.java:64)
        at com.gtu.hw3p2.Main.main(Main.java:84)
Exception in thread "main" java.lang.NullPointerException
        at com.gtu.hw3p2.SimpleTextEditor.readWithIndex(SimpleTextEditor.java:68)
        at com.gtu.hw3p2.Main.main(Main.java:84)
```

4. RUNNING AND RESULTS

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + index: Reading the text completed in 15.8214 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + iterator: Reading the text completed in 3.7586 nanoseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + index: Reading the text completed in 2.4262 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + iterator: Reading the text completed in 1.4854 nanoseconds

----AL INDEX----------------------
When Mr. Bilbo Baggins of Bag End announced that hewould shortly be celebrating his eleventy-first birthday witha party of special magnificence, there was much talk andexcitement in Hobbiton.Bilbo was very rich and very peculiar, and had been thewonder of the Shire for sixty years, ever since his remarkabledisappearance and unexpected return. The riches he hadbrought back from his travels had now become a local legend,and it was popularly believed, whatever the old folk mightsay, that the Hill at Bag End was full of tunnels stuffed withtreasure. And if that was not enough for fame, there was alsohis prolonged vigour to marvel at. Time wore on, but itseemed to have little effect on Mr. Baggins. At ninety he wasmuch the same as at fifty. At ninety-nine they began to callhimwell-preserved; butunchangedwould have been nearer themark. There were some that shook their heads and thoughtthis was too much of a good thing; it seemed unfair thatanyone should possess (apparently) perpetual youth as wellas (reputedly) inexhaustible wealth.'It will have to be paid for,' they said. 'It isn't natural, andtrouble will come of it!'But so far trouble had not come; and as Mr. Baggins wasgenerous with his money, most people were willing to for-give him his oddities and his good fortune. He remainedon visiting terms with his relatives (except, of course, theSackville-Bagginses), and he had many devoted admirersamong the hobbits of poor and unimportant families. But hehad no close friends, until some of his younger cousins beganto grow up.
28the fellowship of the ringThe eldest of these, and Bilbo's favourite, was young FrodoBaggins. When Bilbo was ninety-nine he adopted Frodo ashis heir, and brought him to live at Bag End; and the hopes ofthe Sackville-Bagginses were finally dashed. Bilbo and Frodohappened to have the same birthday,

September22nd. 'Youhad better come and live here, Frodo my lad,' said Bilboone day; 'and then we can celebrate our birthday-partiescomfortably together.' At that time Frodo was still in histweens, as the hobbits called the irresponsible twentiesbetween childhood and coming of age at thirty-three.Twelve more years passed. Each year the Bagginses hadgiven very lively combined birthday-parties at Bag End; butnow it was understood that something quite exceptionalwas being planned for that autumn. Bilbo was going to beeleventy-one,111, a rather curious number, and a very re-spectable age for a hobbit (the Old Took himself had onlyreached130); and Frodo was going to bethirty-three,33,animportant number: the date of his 'coming of age'.Tongues began to wag in Hobbiton and Bywater; andrumour of the coming event travelled all over the Shire. Thehistory and character of Mr. Bilbo Baggins became onceagain the chief topic of conversation; and the older folksuddenly found their reminiscences in welcome demand.No one had a more attentive audience than old HamGamgee, commonly known as the Gaffer. He held forth atThe Ivy Bush, a small inn on the Bywater road; and he spokewith some authority, for he had tended the garden at BagEnd for forty years, and had helped old Holman in the samejob before that. Now that he was himself growing old andstiff in the joints, the job was mainly carried on by his young-est son, Sam Gamgee. Both father and son were on veryfriendly terms with Bilbo and Frodo. They lived on the Hillitself, in Number3Bagshot Row just below Bag End

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Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + index: Reading the text completed in 7.3034 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + iterator: Reading the text completed in 0.9101 nanoseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + index: Reading the text completed in 0.8786 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + iterator: Reading the text completed in 0.4175 nanoseconds

----AL INDEX-----------------------
The Bard's Song - Blind Guardian

???

Tomorrow will take us away
Far from home
No one will ever know our names
But the bards' songs will remain

...

----AL ITERATOR--------------------
The Bard's Song - Blind Guardian

???

Tomorrow will take us away
Far from home
No one will ever know our names
But the bards' songs will remain

...

----LL INDEX-----------------------
The Bard's Song - Blind Guardian

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----LL ITERATOR---------------------
The Bard's Song - Blind Guardian

???

Tomorrow will take us away
Far from home
No one will ever know our names
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...

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + index: Finding the index of word "Tomorrow" completed in 0.0379 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + iterator: Finding the index of word "Tomorrow" completed in 0.038 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: Finding the index of word "Tomorrow" using indexes...
Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + index: Finding the index of word "Tomorrow" completed in 0.0576 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: Finding the index of word "Tomorrow" using iterators...
Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + iterator: Finding the index of word "Tomorrow" completed in 0.0249 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + index: Inserting word "[Chorus]" on top of the found word completed in 0.017 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + iterator: Inserting word "[Chorus]" on top of the found word completed in 0.0144 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + index: Inserting word "[Chorus]" on top of the found word completed in 0.0123 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + iterator: Inserting word "[Chorus]" on top of the found word completed in 0.0137 miliseconds

----AL INDEX-----------------------
The Bard's Song - Blind Guardian

???

[Chorus]
Tomorrow will take us away
Far from home

No one will ever know our names
But the bards' songs will remain

...

----AL ITERATOR--------------------
The Bard's Song - Blind Guardian

???

[Chorus]
Tomorrow will take us away
Far from home
No one will ever know our names
But the bards' songs will remain

...

----LL INDEX-----------------------
The Bard's Song - Blind Guardian

???

[Chorus]
Tomorrow will take us away
Far from home
No one will ever know our names
But the bards' songs will remain

...

----LL ITERATOR--------------------
The Bard's Song - Blind Guardian

???

[Chorus]
Tomorrow will take us away
Far from home
No one will ever know our names
But the bards' songs will remain

...

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + index: Replacing "???" with the verse of the song completed in 0.0785 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: ArrayList + iterator: Replacing "???" with the verse of the song completed in 0.0661 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + index: Replacing "???" with the verse of the song completed in 0.2283 miliseconds

Nis 02, 2020 11:47:33 PM com.gtu.hw3p2.Main main
INFO: LinkedList + iterator: Replacing "???" with the verse of the song completed in 0.0757 miliseconds

----AL INDEX-----------------------

The Bard's Song - Blind Guardian

[Verse 1]
Now you all know
The bards and their songs
When hours have gone by
I'll close my eyes
In a world far away
We may meet again
But now hear my song
About the dawn of the night
Let's sing the bard's song

[Chorus]
Tomorrow will take us away
Far from home
No one will ever know our names
But the bards' songs will remain

...

----AL ITERATOR---------------------
The Bard's Song - Blind Guardian

[Verse 1]
Now you all know
The bards and their songs
When hours have gone by
I'll close my eyes
In a world far away
We may meet again
But now hear my song
About the dawn of the night
Let's sing the bard's song

[Chorus]
Tomorrow will take us away
Far from home
No one will ever know our names
But the bards' songs will remain

...

----LL INDEX------------------------
The Bard's Song - Blind Guardian

[Verse 1]
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When hours have gone by
I'll close my eyes
In a world far away
We may meet again
But now hear my song
About the dawn of the night
Let's sing the bard's song

[Chorus]
Tomorrow will take us away

Far from home
No one will ever know our names
But the bards' songs will remain

...

----LL ITERATOR--------------------
The Bard's Song - Blind Guardian

[Verse 1]
Now you all know
The bards and their songs
When hours have gone by
I'll close my eyes
In a world far away
We may meet again
But now hear my song
About the dawn of the night
Let's sing the bard's song

[Chorus]
Tomorrow will take us away
Far from home
No one will ever know our names
But the bards' songs will remain

...
----

5. ANALYSIS OF THE PERFORMANCE

Array List index
    read : $O(n)$
    add : $O(n^2)$
    find : $O(n^2)$
    findAndReplace : $O(n^{'3})$

Array List with iterator
    read: $O(n)$
    add: $O(n^2)$
    find: $O(n^2)$
    findAndReplace: $O(n^{'3})$

Linked List index
    read: $O(n)$
    add: $O(n^{'2})$
    find: $O(n^2)$
    findAndReplace: $O(n^3)$

Linked List with iterator
    read: $O(n)$
    add: $O(n^2)$
    find: $O(n^2)$
    findAndReplace: $O(n^{'3})$