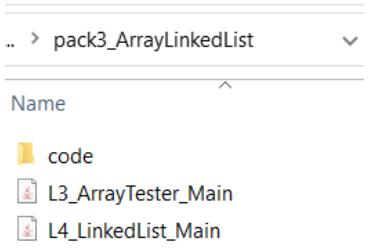
Objective(s) : understanding handling operations on an array.

task 0:



Create a folder pack3_ArrayLinkedList. Inside the folder create package code

Given MyArrayBasic class in package code with the following methods

- void add(int d) – append d into an array

- void insert(int d, int index) – insert value d into the array at position index. Keep the order of the data unchanged.

```
package code;
public class MyArrayBasic {
  protected int MAX_SIZE = 5;
  protected int data[] = new int[MAX_SIZE];
  protected int size = 0;

  …
}
```

- int find(int d) – return the index of value d in the array, else -1 (either ordered or unordered)

- int binarySearch(int d) – binary search in ordered array. return the index of value d in the array, else -1

- void delete(int index) – delete from ordered array i.e. the order of the data remains unchanged.

- MyArray(int … a) – a constructor creating the first MAX_SIZE

Understand its mechanism through the following test code (L3_ArrayTester.java)

```
// import code.MyArray;
import code.MyArrayBasic;

class L3_ArrayTester_Main {
  public static void main(
                String[] args) {
      println("-demo1-------");
      arrayBasic_demo1();
      println("-demo2-------");
      arrayBasic_demo2();
      println("-demo3-------");
      arrayBasic_demo3();
  }
  …
}
```

```
static private void arrayBasic_demo1() {
  MyArrayBasic demo =
           new MyArrayBasic(7,6,8,1,2,3);
  println(demo);
}
static private void arrayBasic_demo2() {
  MyArrayBasic demo = new MyArrayBasic();
  demo.insert(9, 0);
  demo.insert(7,0);
  demo.insert(5,0);
  println(demo);
  println("5 is at " + demo.find(5));
  println("5 is at " + demo.binarySearch(5));
  demo.delete(1);
  println(demo);
}
static private void arrayBasic_demo3() {
  MyArrayBasic demo = new MyArrayBasic(null);
  demo.add(3);  demo.add(7);
  demo.add(5);  demo.add(4);
  demo.add(6);
  //index out of bound due to overflow
  demo.add(1);
}
```

task 1: implement class MyArray which extends MyArrayBasic with the following enhancements:

- MyArray() – a constructor with default MAX_SIZE = 100_000

- MyArray(int max) – a constructor with with supplied MAX_SIZE;

- boolean isFull() – return true if there is not available cell to insert d (insertion would cause an exception)

- Boolean isEmpty() – return true if there is no data in the array (deletion would cause an exception)

- int [] expandByK(int k) – implicitly allocate a k * MAX_SIZE array to prevent overflow addition (add() method)

- int [] expand() – default k = 2 i.e. call expandByK(2); i.e. double the array's capacity

```
import code.MyArray;
import code.MyArrayBasic;

class L3_ArrayTesterPackX {
  public static void main(
            String[] args) {
    …
    println("-demo4-----");
    myArray_demo4();
    println("-task2-----");
    task2();
  }
```

```
static private void myArray_demo4() {
  MyArray demo = new MyArray(5);
  demo.delete(0);
  demo.add(3);
  demo.add(7);
  demo.add(5);
  demo.add(4);
  demo.add(6);
  demo.add(1);
  println(demo);
}
```

task 2: use System.currentTimeMillis() to measure time performance. Notice the time it takes for each data size.

```
static private void task2() {
  for (int N = 200_000;
               N <= 10 * 200_000; N += 200_000) {
    long start = System.currentTimeMillis();
    MyArray mArray = new MyArray(N);
    for (int n = 1; n <N; n++)
      mArray.add((int)(Math.random()*1000));

    long time = (System.currentTimeMillis() - start);
    println(N + "\t\t" + time);
  }
  println("with expansion");
  for (int N = 200_000;
                N <= 10 * 200_000; N += 200_000) {
    long start = System.currentTimeMillis();
    MyArray mArray = new MyArray();
    for (int n = 1; n <N; n++)
       mArray.add((int)(Math.random()*1000));

    long time = (System.currentTimeMillis() - start);
    println(N + "\t\t" + time);
  }
}
```

Run task2() 3 times. Write down the result execution time to the bellowed table.

If you adjust the size of the initial N (and step size), correct it to the table as well.

N	MyArray(N)			MyArray()		
	1st	2nd	3rd	1st	2nd	3rd
200_000						
400_000						
600_000						
800_000						
1_000_000						
1_200_000						
1_400_000						
1_600_000						
1_800_000						
2_000_000						

In your opinion,

1. Given the different characteristic between the fixed sized and the expandable array (MyArray(N) vs. MyArray()), which type of array's execution time should be faster?

2. In your opinion, how this experiment should be improved such that the execution time should reflect its true characteristic.

submission: MyArray_XXYYYY.java and this pdf.

Due date: TBA