

Program Structures and Algorithms Sec -8

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Assignment-3

Task 1: (Part 1) You are to implement three (3) methods (*repeat*, *getClock*, and *toMillisecs*) of a class called *Timer*.

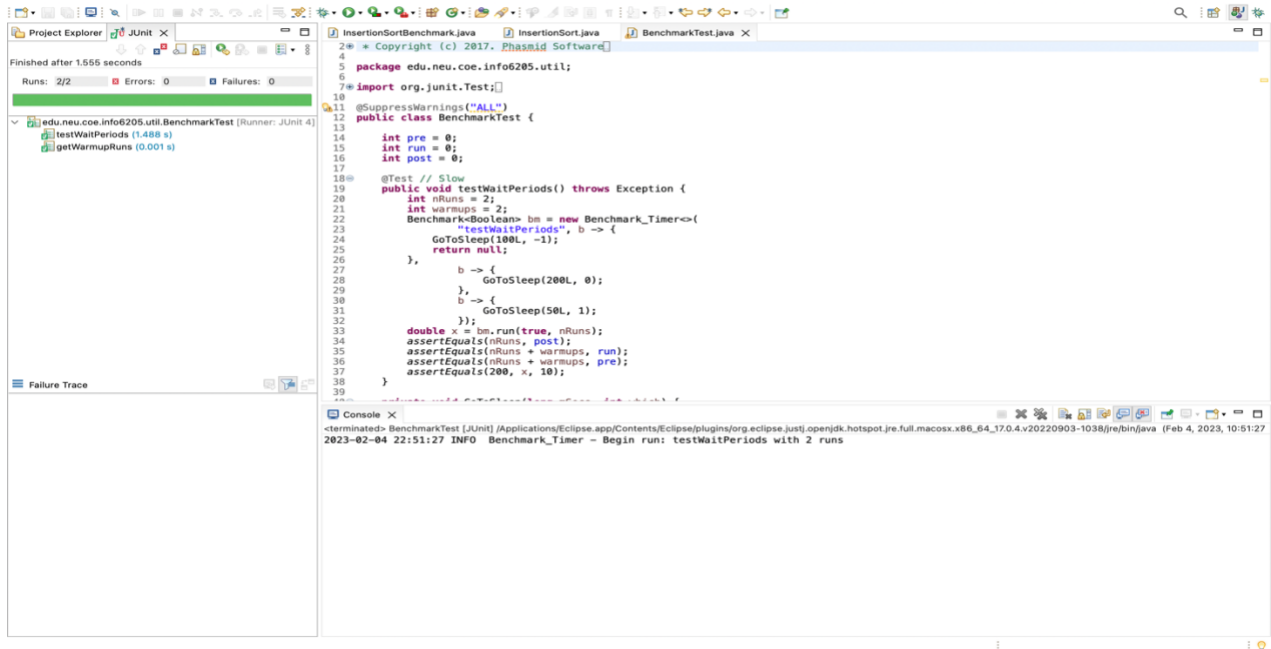
1)TIMER TEST CASES:

The screenshot displays an IDE environment with the following components:

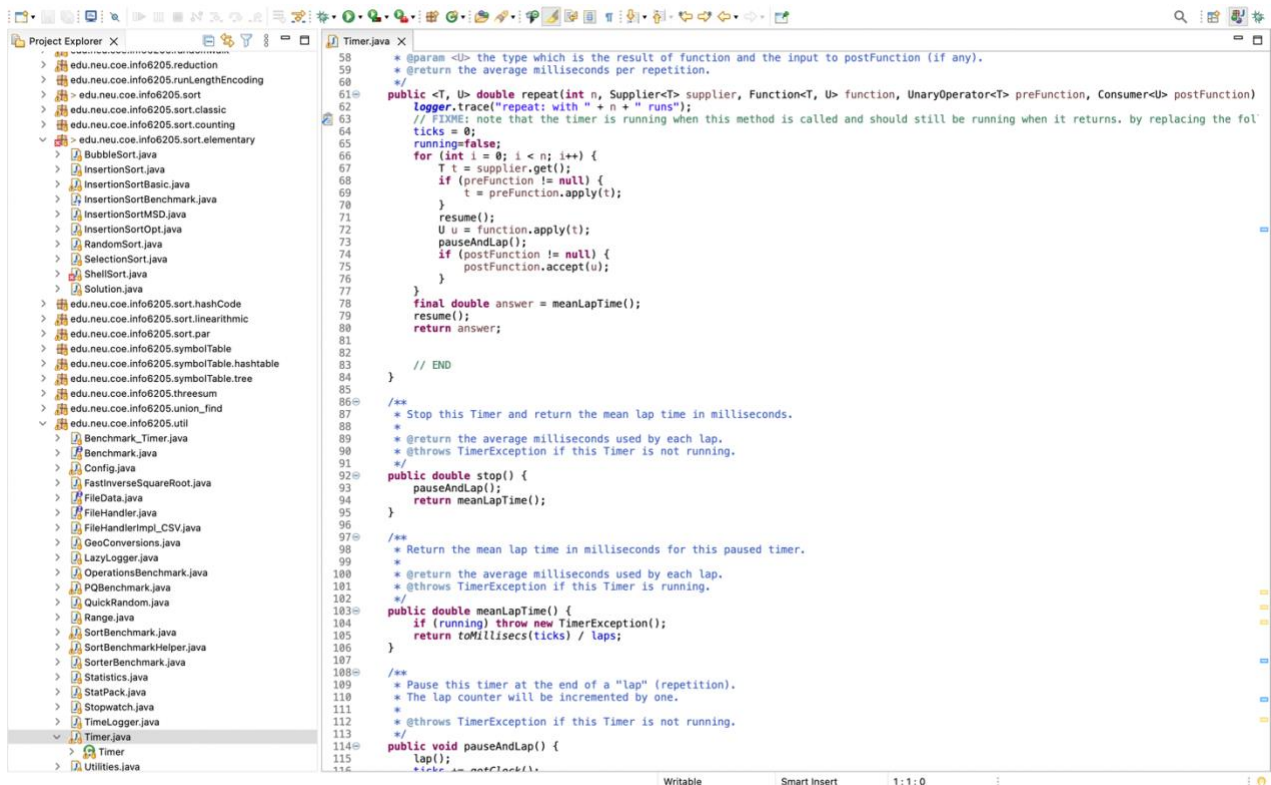
- Project Explorer:** Shows the test suite 'edu.neu.coe.info6205.util.TimerTest' with 11 tests. The status bar indicates 'Runs: 11/11', 'Errors: 0', and 'Failures: 0'.
- Test Results:** A list of test cases and their execution times:
 - testPauseAndLapResume0 (0.244 s)
 - testPauseAndLapResume1 (0.318 s)
 - testLap (0.211 s)
 - testPause (0.210 s)
 - testStop (0.108 s)
 - testMillisecs (0.106 s)
 - testRepeat1 (0.130 s)
 - testRepeat2 (0.246 s)
 - testRepeat3 (0.604 s)
 - testRepeat4 (0.373 s)
 - testPauseAndLap (0.107 s)
- Code Editor:** Shows the 'TimerTest.java' file with the following test methods:

```
14 post = 0;
15 result = 0;
16
17
18 @Test
19 public void testStop() {
20     final Timer timer = new Timer();
21     GoToSleep(TENTH, 0);
22     final double time = timer.stop();
23     assertEquals(TENTH_DOUBLE, time, 10);
24     assertEquals(1, run);
25     assertEquals(1, new PrivateMethodTester(timer).invokePrivate("getLaps"));
26 }
27
28 @Test
29 public void testPauseAndLap() {
30     final Timer timer = new Timer();
31     final PrivateMethodTester privateMethodTester = new PrivateMethodTester(timer);
32     GoToSleep(TENTH, 0);
33     timer.pauseAndLap();
34     final Long ticks = (Long) privateMethodTester.invokePrivate("getTicks");
35     assertEquals(TENTH_DOUBLE, ticks / 166, 12);
36     assertFalse((Boolean) privateMethodTester.invokePrivate("isRunning"));
37     assertEquals(1, privateMethodTester.invokePrivate("getLaps"));
38 }
39
40 @Test
41 public void testPauseAndLapResume0() {
42     final Timer timer = new Timer();
43     final PrivateMethodTester privateMethodTester = new PrivateMethodTester(timer);
44     GoToSleep(TENTH, 0);
45     timer.pauseAndLap();
46     timer.resume();
47     assertTrue((Boolean) privateMethodTester.invokePrivate("isRunning"));
48     assertEquals(1, privateMethodTester.invokePrivate("getLaps"));
49 }
50
51 @Test
52 public void testPauseAndLapResume1() {
53     final Timer timer = new Timer();
54     GoToSleep(TENTH, 0);
55     timer.pauseAndLap();
56     timer.resume();
57     assertTrue((Boolean) privateMethodTester.invokePrivate("isRunning"));
58     assertEquals(1, privateMethodTester.invokePrivate("getLaps"));
59 }
```
- Console:** Shows the test execution output, including the message 'terminated> TimerTest [JUnit] [Applications/Eclipse.app/Contents/Eclipse/plugins/org.eclipse.justi.openjdk.hotspot.jre.full.macosx.x86_64_17.0.4.v20220903-1038/jre/bin/java (Feb 4, 2023, 9:47:25 PM - 6'.

2)BENCHMARK TEST CASES:



CODE TIMER:



The screenshot displays an IDE interface with three main panels:

- Project Explorer:** Shows a project structure with a package `edu.neu.coe.info8205.sort.elementary` containing several test classes: `testMutatingInsertionSort (0.151 s)`, `sort0 (0.009 s)`, `sort1 (0.000 s)`, `sort2 (0.008 s)`, `sort3 (0.002 s)`, and `testStaticInsertionSort (0.003 s)`.
- JUnit Runner:** Displays the execution results of the tests, indicating they were completed successfully.
- Source Editor:** Shows the source code for `InsertionSort.java`. The code includes a `Helper` class for swapping elements, a `sort` method that implements insertion sort, and a `DESCRIPTION` string. The code is annotated with Javadoc comments and uses a `mutatingSort` method.

The `InsertionSort.java` code is as follows:

```
45 * @param helper an explicit instance of Helper to be used.
46 */
47 public InsertionSort(Helper<X> helper) {
48     super(helper);
49 }
50
51 public InsertionSort() {
52     this(BaseHelper.getHelper(InsertionSort.class));
53 }
54
55 /**
56  * Sort the sub-array xs:from:to using insertion sort.
57  * @param xs sort the array xs from "from" to "to".
58  * @param from the index of the first element to sort
59  * @param to the index of the first element not to sort
60  */
61 // for(int j=from+1;j<to;j++) {
62 //     int i=j;
63 //     while(i > from && helper.swapStableConditional(xs, i)){
64 //         i--;
65 //     }
66 //     either above or below both will work
67
68 public void sort(X[] xs, int from, int to) {
69     final Helper<X> helper = getHelper();
70     for(int j=from+1;j<to;j++) {
71         int i=j-1;
72         while(i >= from && helper.swapStableConditional(xs, i+1)){
73             i--;
74         }
75     }
76
77     // FIXME
78     // END
79
80 public static final String DESCRIPTION = "Insertion sort";
81
82 public static <T extends Comparable<T>> void sort(T[] ts) {
83     new InsertionSort<T>().mutatingSort(ts);
84 }
85
86 }
```

The console output at the bottom shows the IDE's startup information, including the Java version (17.0.4) and the IDE version (2023.03.0).

Task 3: Implementing the main program (or you could do it via your own unit tests) to actually measure the time for sorted , partially sorder, random , reverse arrays.

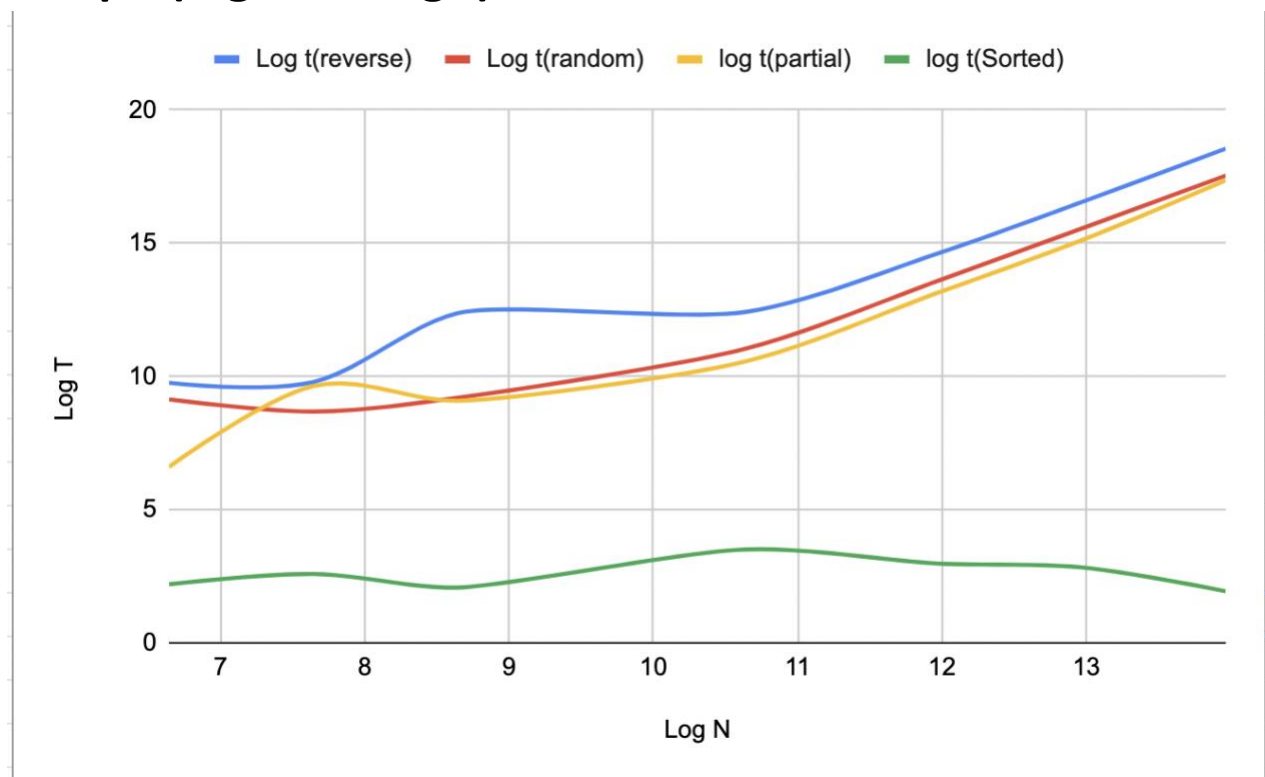
```

89      System.out.println("Time taken for random taken array when n = " + n + " is " + (endTime-startTime)/Math.pow(10,6));
90    }
91
92    private static void partiallySorted(int n) throws Exception{
93        final List<Integer> list = new ArrayList<>();
94        Random random = new Random();
95        for(int i=0; i<n/2;i++){
96            list.add(random.nextInt());
97        }
98        for(int i=n/2; i<n;i++){
99            list.add(i);
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VALUES FOR LOG N AND LOG T:

	A	B	C	D	E	
1	Log N	Log t(reverse)	Log t(random)	log t(partial)	log t(Sorted)	
2	6.64385619	9.760442192	9.141149198	6.605479518	2.196607044	
3	7.64385619	9.793265151	8.681825211	9.639414877	2.584962501	
4	8.64385619	12.37850946	9.202532815	9.088345691	2.073134705	
5	10.64385619	12.42619922	11.0480897	10.57187113	3.50779464	
6	11.96578428	14.60950578	13.57872153	13.13182353	2.977279923	
7	12.96578428	16.54233477	15.5541204	15.11178774	2.832890014	
8	13.96578428	18.55336602	17.5410941	17.35956084	1.938473998	

Graph (log N vs Log t):



Conclusion:

The time taken for the array which is in reverse order will be more as it needs more looping to sort the array fully as it is entirely in reverse order. And the time taken between partially sorted and random array will be almost same, to be precise random array will take little more time compared to partially sorted as the partial sorted array will need a smaller number of loops (already sorted half of its part) to sort it fully compared to random sorted which will need more time(loops). And finally, the sorted array which is already sorted will take very less time as it is already sorted.