Program Structures and Algorithms
Fall 2022(SEC 06)

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Task:

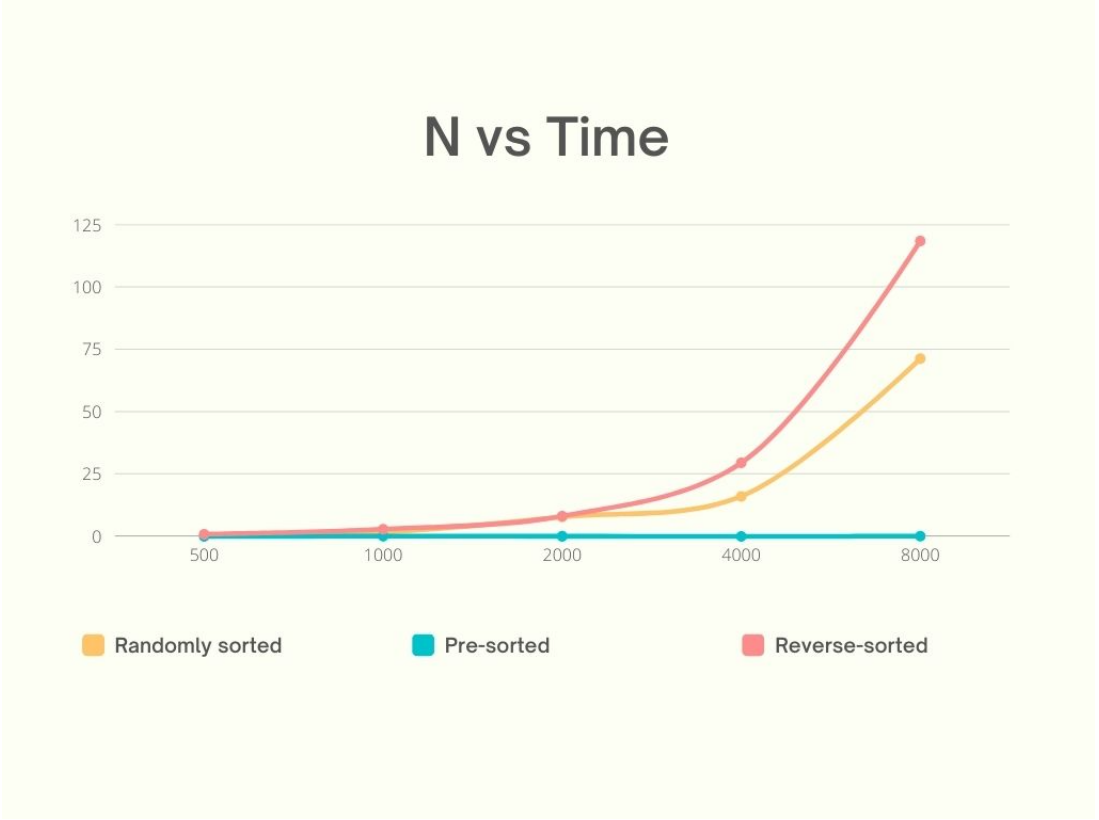
- **(Part 1) You are to implement three (3) methods (*repeat*, *getClock*, and *toMillisecs*) of a class called *Timer*. Please see the skeleton class that I created in the repository. *Timer* is invoked from a class called *Benchmark_Timer* which implements the *Benchmark* interface.**
- **Part 2) Implement *InsertionSort* (in the *InsertionSort* class) by simply looking up the insertion code used by *Arrays.sort.* If you have the *instrument = true* setting in *test/resources/config.ini*, then you will need to use the *helper* methods for comparing and swapping (so that they properly count the number of swaps/compares). The easiest is to use the *helper.swapStableConditional* method, continuing if it returns true, otherwise breaking the loop. Alternatively, if you are not using instrumenting, then you can write (or copy) your own compare/swap code. Either way, you must run the unit tests in *InsertionSortTest*.**
- **(Part 3) Implement a main program (or you could do it via your own unit tests) to actually run the following benchmarks: measure the running times of this sort, using four different initial array ordering situations: random, ordered, partially-ordered and reverse-ordered. I suggest that your arrays to be sorted are of type *Integer*. Use the doubling method for choosing *n* and test for at least five values of *n.* Draw any conclusions from your observations regarding the order of growth.**

Relationship Conclusion: After timing randomly sorted, pre-sorted and reverse-sorted for 5 values of N, it can be concluded that reversely sorted elements take the most time to be sorted and already sorted elements take the least time to be sorted.

Evidence to support that conclusion:

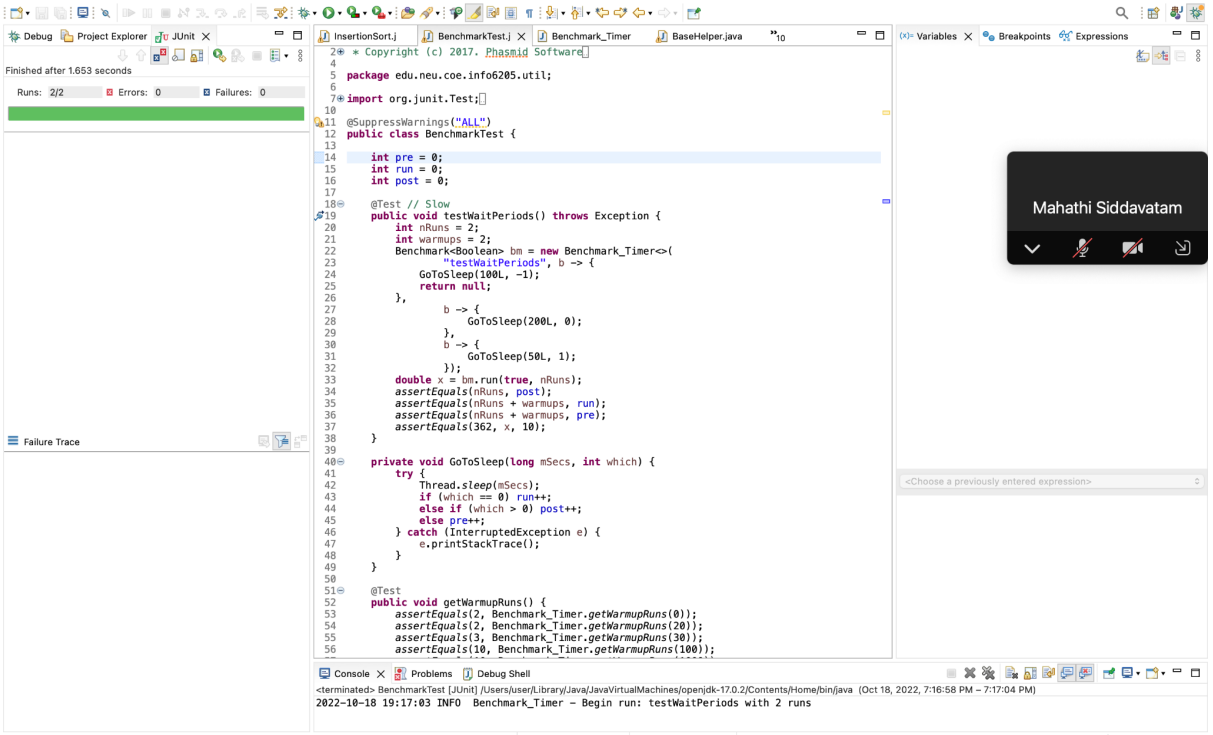
	Random	Sorted	Reverse Sc
500	0.511	0.003	0.821
1000	1.601	0.017	2.873
2000	7.735	0.015	8.132
4000	16.023	0.008	29.47
8000	71.257	0.02	118.482

Graphical Representation:

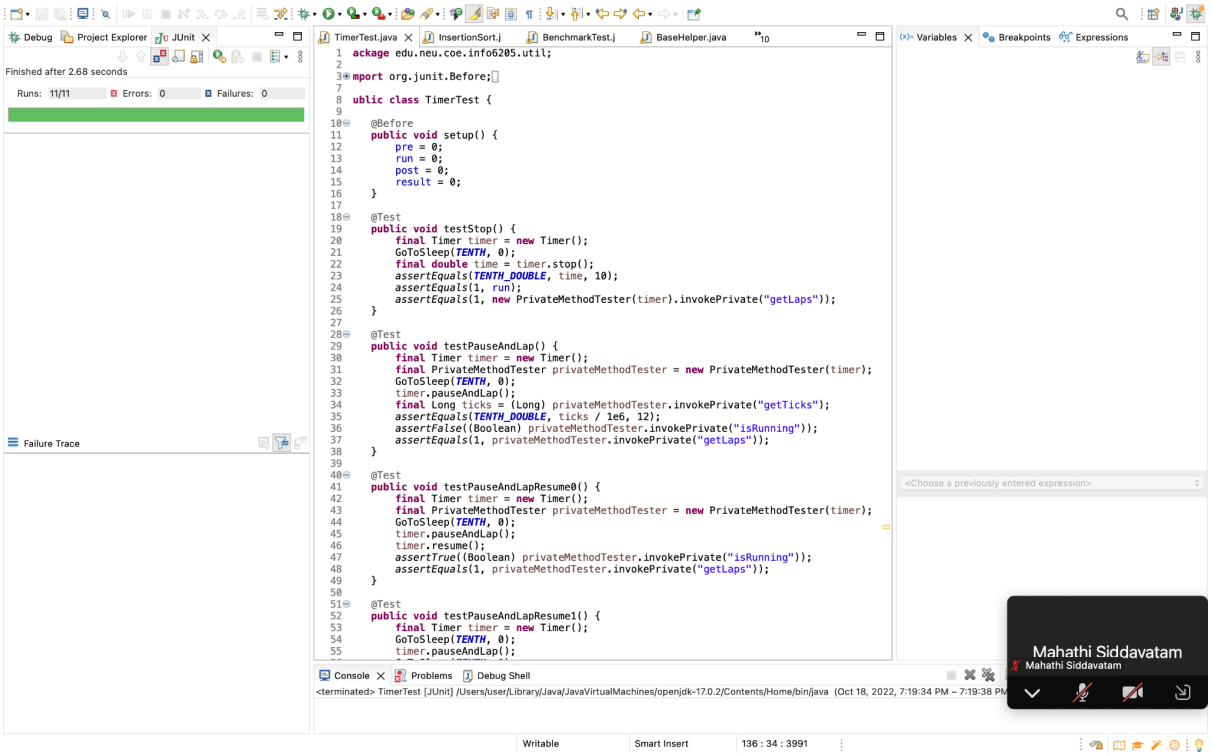


Unit Test Screenshots:

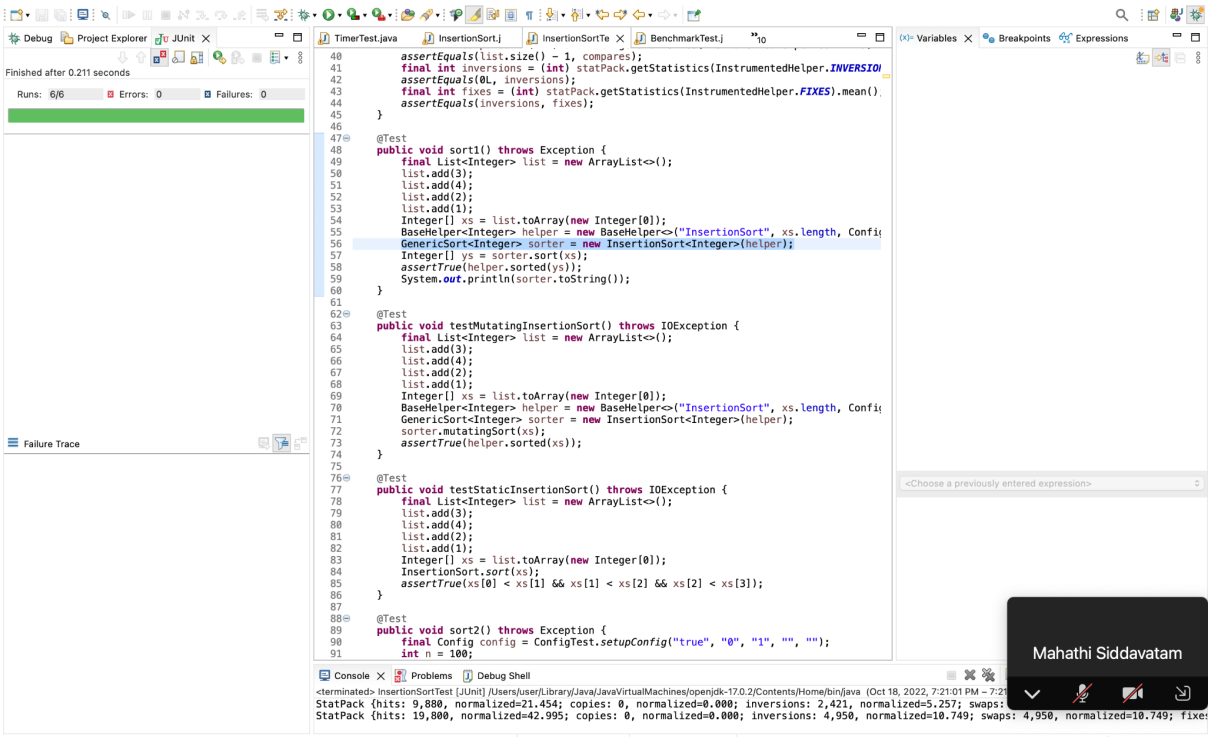
BenchmarkTest:



TimerTest:



InsertionSortTest:


Debug
Project Explorer
JUnit
Finished after 0.211 seconds
Runs: 6/6
Errors: 0
Failures: 0
Failure Trace
TimerTest.java
InsertionSort.j
InsertionSortTe
BenchmarkTest.j
40 assertEquals(list.size() - 1, compares);
41 final int inversions = (int) statPack.getStatistics(InstrumentedHelper.INVERSIO
42 assertEquals(0L, inversions);
43 final int fixes = (int) statPack.getStatistics(InstrumentedHelper.FIXES).mean()
44 assertEquals(inversions, fixes);
45 }
46
47 @Test
48 public void sort1() throws Exception {
49 final List<Integer> list = new ArrayList<>();
50 list.add(3);
51 list.add(4);
52 list.add(2);
53 list.add(1);
54 Integer[] xs = list.toArray(new Integer[0]);
55 BaseHelper<Integer> helper = new BaseHelper<>("InsertionSort", xs.length, Confi
56 GenericSort<Integer> sorter = new InsertionSort<Integer>(helper);
57 Integer[] ys = sorter.sort(xs);
58 assertTrue(helper.sorted(ys));
59 System.out.println(sorter.toString());
60 }
61
62 @Test
63 public void testMutatingInsertionSort() throws IOException {
64 final List<Integer> list = new ArrayList<>();
65 list.add(3);
66 list.add(4);
67 list.add(2);
68 list.add(1);
69 Integer[] xs = list.toArray(new Integer[0]);
70 BaseHelper<Integer> helper = new BaseHelper<>("InsertionSort", xs.length, Confi
71 GenericSort<Integer> sorter = new InsertionSort<Integer>(helper);
72 sorter.mutatingSort(xs);
73 assertTrue(helper.sorted(xs));
74 }
75
76 @Test
77 public void testStaticInsertionSort() throws IOException {
78 final List<Integer> list = new ArrayList<>();
79 list.add(3);
80 list.add(4);
81 list.add(2);
82 list.add(1);
83 Integer[] xs = list.toArray(new Integer[0]);
84 InsertionSort.sort(xs);
85 assertTrue(xs[0] < xs[1] && xs[1] < xs[2] && xs[2] < xs[3]);
86 }
87
88 @Test
89 public void sort2() throws Exception {
90 final Config config = ConfigTest.setupConfig("true", "0", "1", "", "");
91 int n = 100;
Variables
Breakpoints
Expressions
<Choose a previously entered expression>
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Console
Problems
Debug Shell
<terminated> InsertionSortTest [JUnit] /Users/user/Library/Java/JavaVirtualMachines/openjdk-17.0.2/Contents/Home/bin/java (Oct 18, 2022, 7:21:01 PM – 7:21
StatPack {hits: 9,880, normalized=21.454; copies: 0, normalized=0.000; inversions: 2,421, normalized=5.257; swaps:
StatPack {hits: 19,800, normalized=42.995; copies: 0, normalized=0.000; inversions: 4,950, normalized=10.749; swaps: 4,950, normalized=10.749; fixes
Writable
Smart Insert
56 : 74 [65]