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Program Structures & Algorithms

Fall 2021

Assignment No. 2

GitHub URL: <https://github.com/Nithya-Viswanathan/INFO-6205-Assignments.git>

◎ **Task (List down the tasks performed in the Assignment)**

1. Completed the missing code in Timer.java
2. Made sure all the unit tests ran
3. Wrote a main function for four different kinds of Arrays
4. Measured the time for each kind of array with various lengths
5. Plotted the time vs length of array to understand the complexity

◎ **Relationship Conclusion:**

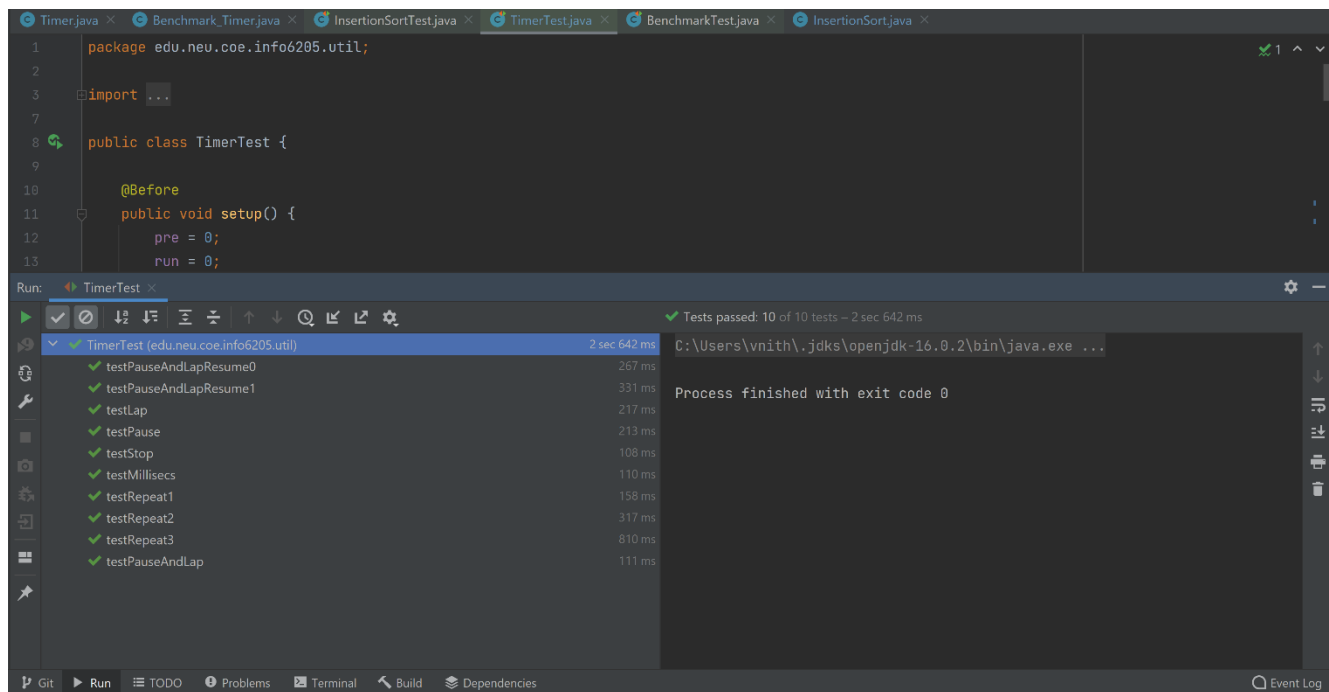
The following time complexity was observed in the output for each kind of input:

1. Random Array: $O(n^2)$
2. Ordered Array: $O(n)$
3. Partially-ordered Array: $O(n^2)$

4. Reversed Array: $O(n^2)$

⦿ Evidence to support the conclusion:

1. Unit Tests of TimerTest:



```
1 package edu.neu.coe.info6205.util;
2
3 import ...
4
5
6
7
8 public class TimerTest {
9
10     @Before
11     public void setup() {
12         pre = 0;
13         run = 0;
14     }
15 }
```

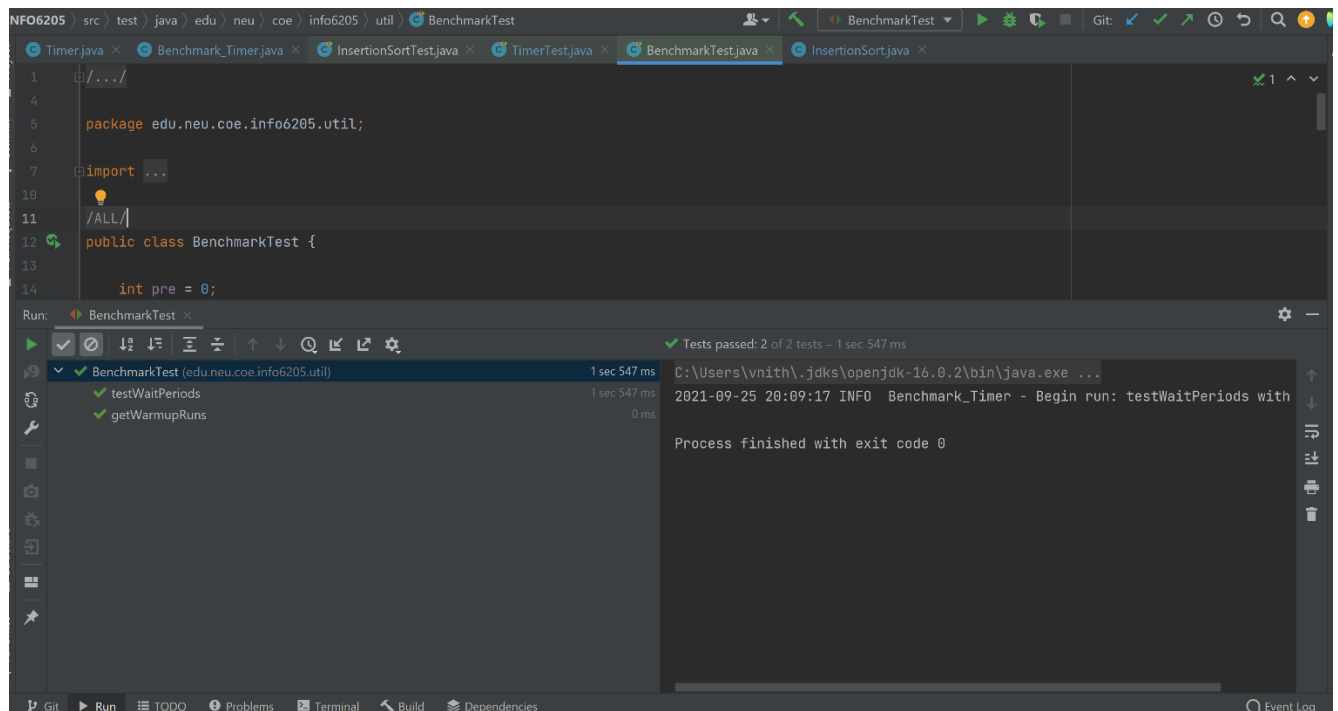
Run: TimerTest

Tests passed: 10 of 10 tests – 2 sec 642 ms

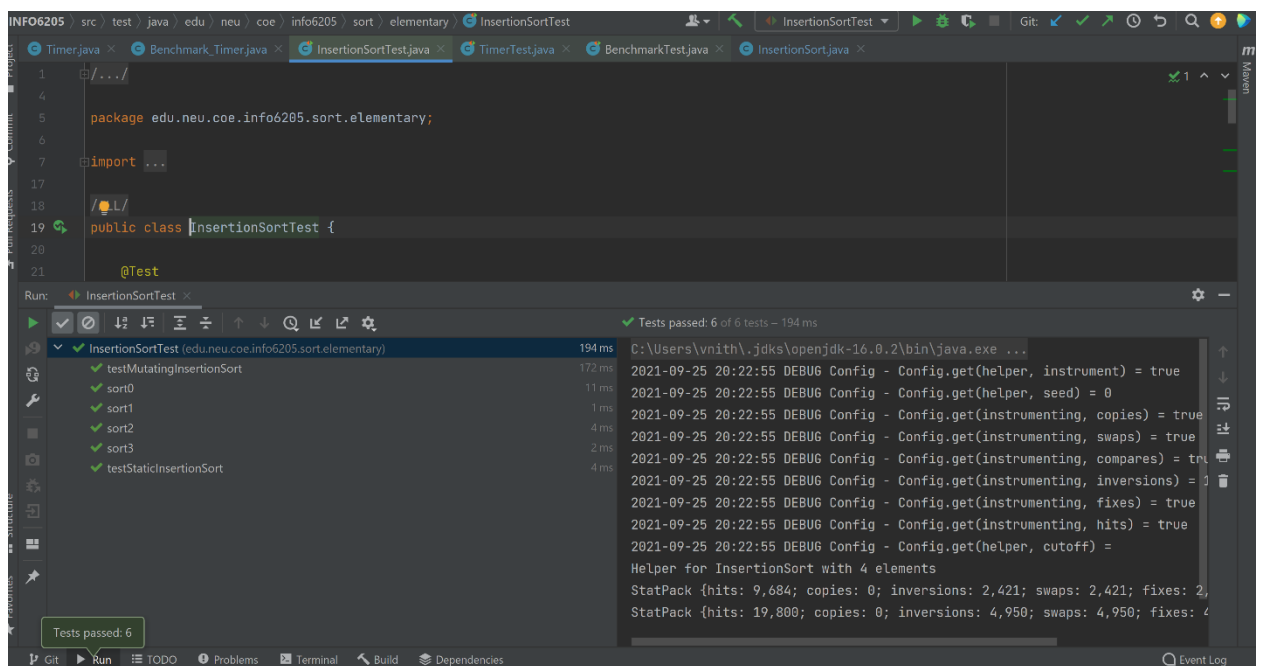
Test Name	Duration
TimerTest (edu.neu.coe.info6205.util)	2 sec 642 ms
testPauseAndLapResume0	267 ms
testPauseAndLapResume1	331 ms
testLap	217 ms
testPause	213 ms
testStop	108 ms
testMillisecs	110 ms
testRepeat1	158 ms
testRepeat2	317 ms
testRepeat3	810 ms
testPauseAndLap	111 ms

Process finished with exit code 0

2. Unit Tests of BenchmarkTest:



3. Unit Tests for InsertionSortTest:



4. Ouput for Array Size of 100:

```
Size of array: 100
2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Random array | Average time to sort: 0.07 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Ordered array | Average time to sort: 0.0 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Partially-ordered array | Average time to sort: 0.06 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Reverse-ordered array | Average time to sort: 0.14 milliseconds
```

5. Output for Array Size of 200:

```
Size of array: 200
2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Random array | Average time to sort: 0.06 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Ordered array | Average time to sort: 0.0 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Partially-ordered array | Average time to sort: 0.04 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Reverse-ordered array | Average time to sort: 0.14 milliseconds
```

6. Output for Array Size of 400:

```
Size of array: 400
2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Random array | Average time to sort: 0.31 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Ordered array | Average time to sort: 0.0 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Partially-ordered array | Average time to sort: 0.18 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Reverse-ordered array | Average time to sort: 0.53 milliseconds
```

7. Output for Array Size of 800:

```
Size of array: 800
2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Random array | Average time to sort: 0.99 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Ordered array | Average time to sort: 0.0 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Partially-ordered array | Average time to sort: 0.8 milliseconds

2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Reverse-ordered array | Average time to sort: 2.17 milliseconds
```

8. Output for Array Size of 1600:

```
Size of array: 1600
2021-09-25 20:27:24 INFO Benchmark_Timer - Begin run: Results with 100 runs
Random array | Average time to sort: 3.34 milliseconds

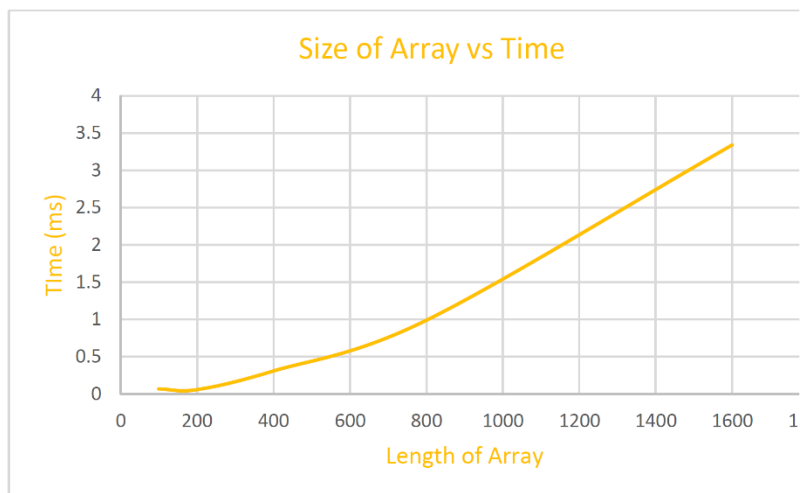
2021-09-25 20:27:25 INFO Benchmark_Timer - Begin run: Results with 100 runs
Ordered array | Average time to sort: 0.01 milliseconds

2021-09-25 20:27:25 INFO Benchmark_Timer - Begin run: Results with 100 runs
Partially-ordered array | Average time to sort: 2.53 milliseconds

2021-09-25 20:27:25 INFO Benchmark_Timer - Begin run: Results with 100 runs
Reverse-ordered array | Average time to sort: 5.85 milliseconds
```

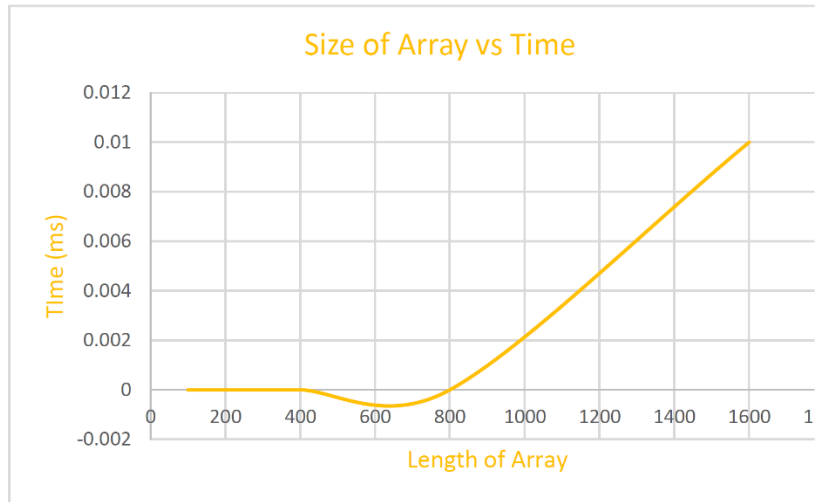
9. Graph: Random Array

100	0.07
200	0.06
400	0.31
800	0.99
1600	3.34



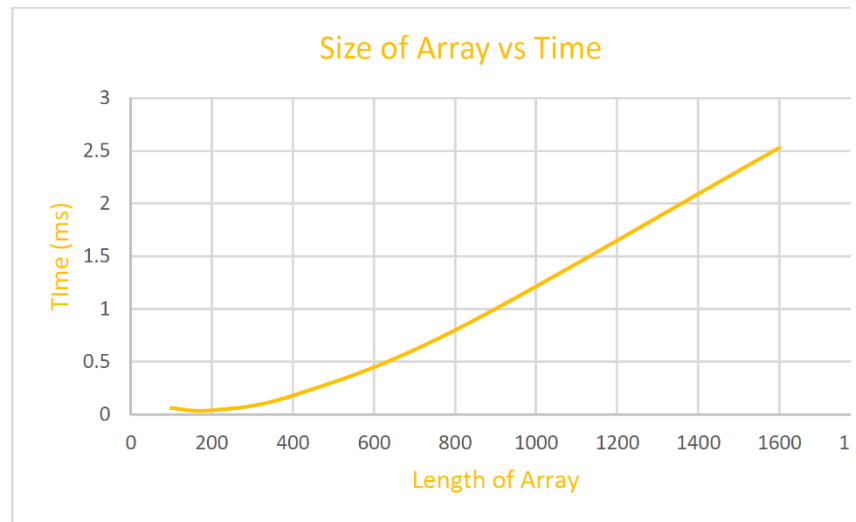
10. Graph: Ordered Array

100	0
200	0
400	0
800	0
1600	0.01



11. Graph: Partially-ordered Array

100	0.06
200	0.04
400	0.18
800	0.8
1600	2.53



12. Graph: Reversed Array

100	0.14
200	0.14
400	0.53
800	2.17
1600	5.85

