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Program Structures & Algorithms
Fall 2021
Assignment 2

1. Tasks Performed in the Assignment :

- a. Implemented the code for methods mentioned in Timer and InsertionSort class and created a new class for testing insertion sort for different types of array
- b. Ran the experiment using a doubling method for 5 different values of n where n is the number of elements in the array.
- c. Plotted the excel graph for Random, Partial, Ordered & Reversed ordered array
- d. Ensured that all the test cases ran successfully

2. Relationship conclusion:

Mean sort time for # of elements **less than 500** are in the following order.

Random Order > PartialOrdered > Reverse Ordered > Ordered

Console Output:

```
-----  
Number of elements: 500  
2021-09-26 16:44:13 INFO Benchmark_Timer - Begin run: Randomly Ordered with 100 runs  
Randomly Ordered | mean sort time (in ms): 1.89  
2021-09-26 16:44:13 INFO Benchmark_Timer - Begin run: PartialOrdered with 100 runs  
PartialOrdered | mean sort time (in ms): 0.88  
2021-09-26 16:44:13 INFO Benchmark_Timer - Begin run: Ordered with 100 runs  
Ordered | mean sort time (in ms): 0.46  
2021-09-26 16:44:13 INFO Benchmark_Timer - Begin run: Reverse Ordered with 100 runs  
Reverse Ordered | mean sort time (in ms): 0.88  
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```

Mean sort time for # of elements **greater than 500** are in the following order.

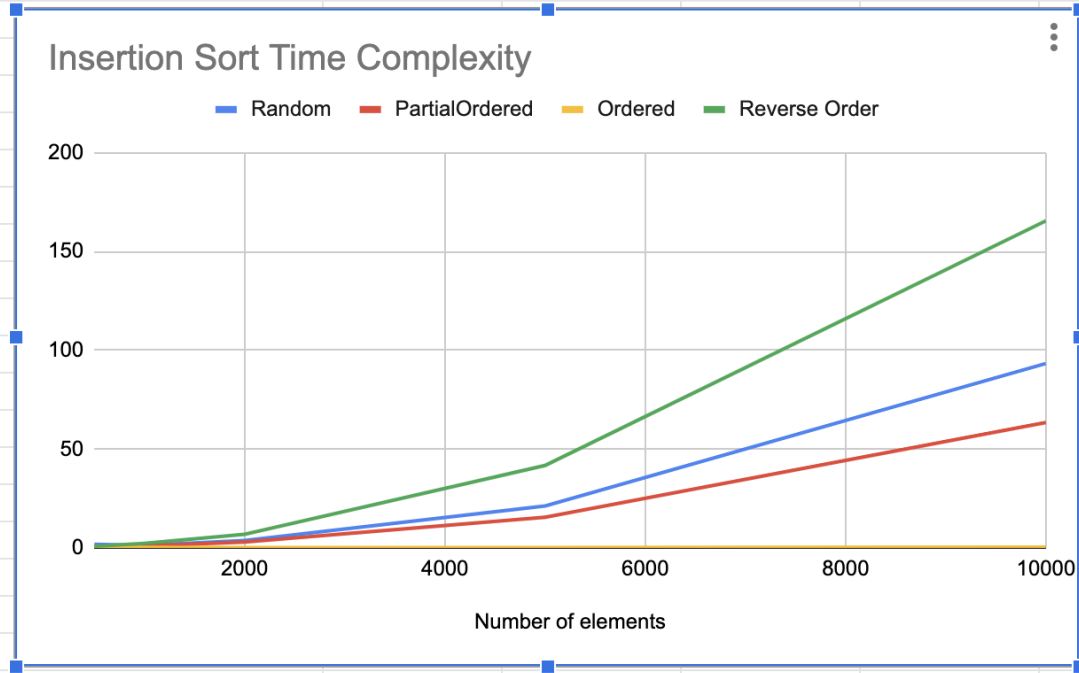
Reverse Ordered > Randomly Ordered > PartialOrdered > Ordered

Console Output:

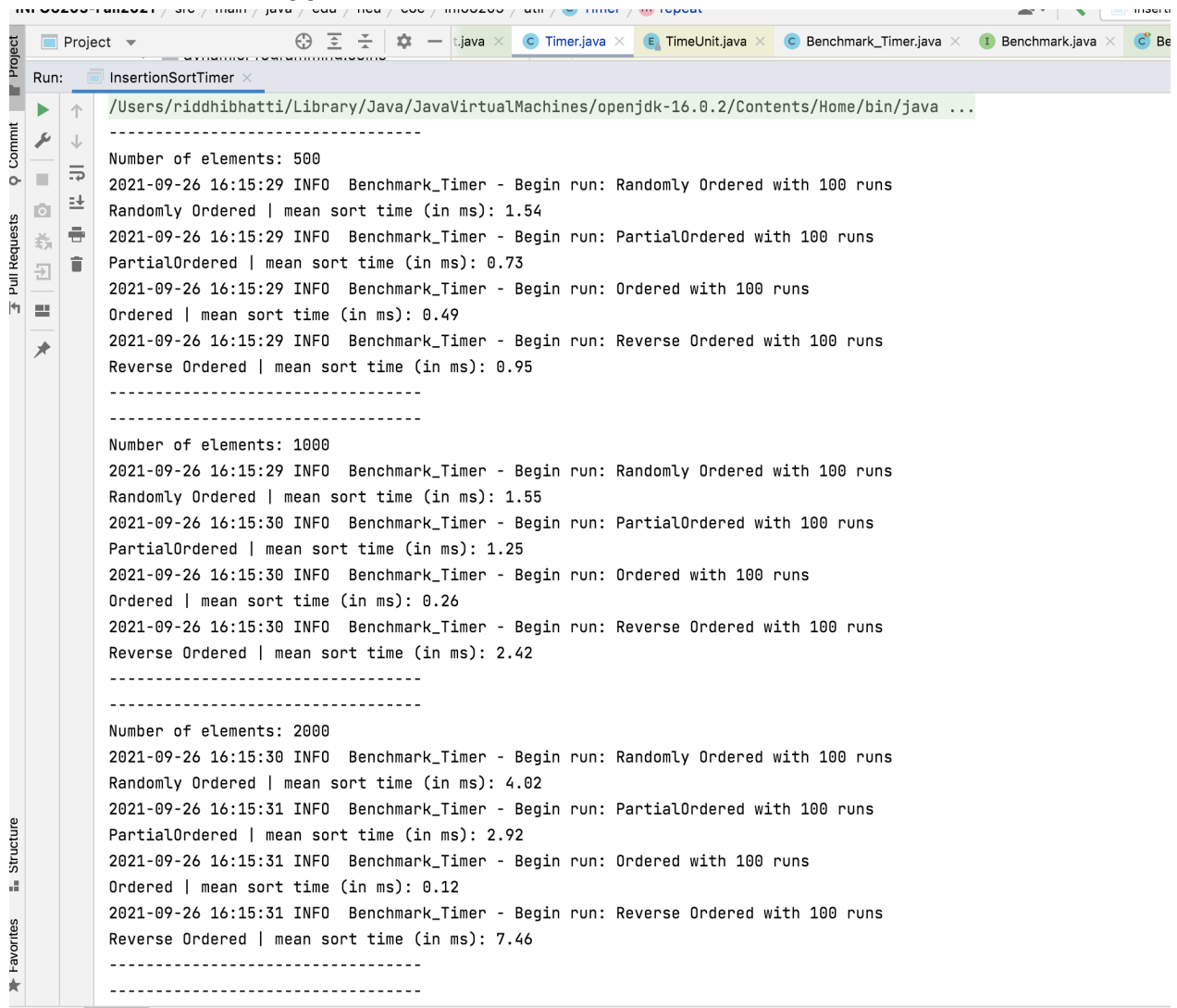
```
-----  
Number of elements: 10000  
2021-09-26 16:44:24 INFO Benchmark_Timer - Begin run: Randomly Ordered with 100 runs  
Randomly Ordered | mean sort time (in ms): 93.3  
2021-09-26 16:44:34 INFO Benchmark_Timer - Begin run: PartialOrdered with 100 runs  
PartialOrdered | mean sort time (in ms): 63.45  
2021-09-26 16:44:42 INFO Benchmark_Timer - Begin run: Ordered with 100 runs  
Ordered | mean sort time (in ms): 0.38  
2021-09-26 16:44:42 INFO Benchmark_Timer - Begin run: Reverse Ordered with 100 runs  
Reverse Ordered | mean sort time (in ms): 165.52  
-----
```

D17

	A	B	C	D	E	F
2	Number of elements	Random	PartialOrdered	Ordered	Reverse Order	
3	500	1.89	0.88	0.46	0.88	
4	1000	1.28	1	0.25	2.32	
5	2000	3.75	2.97	0.13	6.86	
6	5000	21.21	15.55	0.17	41.74	
7	10000	93.3	63.45	0.38	165.52	
8						



3. Evidence to support conclusion



The screenshot shows an IDE window with a project named 'InsertionSortTimer'. The main editor displays the output of a Java program. The output is organized into three sections, each starting with a separator line of dashes. The first section is for 'Number of elements: 500', the second for 'Number of elements: 1000', and the third for 'Number of elements: 2000'. Each section contains four lines of log output, one for each sorting method: Randomly Ordered, Partially Ordered, Ordered, and Reverse Ordered. Each line includes a timestamp, log level (INFO), and the class name 'Benchmark_Timer'. The log messages indicate the start of a run with 100 repetitions and the resulting mean sort time in milliseconds.

```
-----  
Number of elements: 500  
2021-09-26 16:15:29 INFO Benchmark_Timer - Begin run: Randomly Ordered with 100 runs  
Randomly Ordered | mean sort time (in ms): 1.54  
2021-09-26 16:15:29 INFO Benchmark_Timer - Begin run: Partially Ordered with 100 runs  
Partially Ordered | mean sort time (in ms): 0.73  
2021-09-26 16:15:29 INFO Benchmark_Timer - Begin run: Ordered with 100 runs  
Ordered | mean sort time (in ms): 0.49  
2021-09-26 16:15:29 INFO Benchmark_Timer - Begin run: Reverse Ordered with 100 runs  
Reverse Ordered | mean sort time (in ms): 0.95  
-----  
Number of elements: 1000  
2021-09-26 16:15:29 INFO Benchmark_Timer - Begin run: Randomly Ordered with 100 runs  
Randomly Ordered | mean sort time (in ms): 1.55  
2021-09-26 16:15:30 INFO Benchmark_Timer - Begin run: Partially Ordered with 100 runs  
Partially Ordered | mean sort time (in ms): 1.25  
2021-09-26 16:15:30 INFO Benchmark_Timer - Begin run: Ordered with 100 runs  
Ordered | mean sort time (in ms): 0.26  
2021-09-26 16:15:30 INFO Benchmark_Timer - Begin run: Reverse Ordered with 100 runs  
Reverse Ordered | mean sort time (in ms): 2.42  
-----  
Number of elements: 2000  
2021-09-26 16:15:30 INFO Benchmark_Timer - Begin run: Randomly Ordered with 100 runs  
Randomly Ordered | mean sort time (in ms): 4.02  
2021-09-26 16:15:31 INFO Benchmark_Timer - Begin run: Partially Ordered with 100 runs  
Partially Ordered | mean sort time (in ms): 2.92  
2021-09-26 16:15:31 INFO Benchmark_Timer - Begin run: Ordered with 100 runs  
Ordered | mean sort time (in ms): 0.12  
2021-09-26 16:15:31 INFO Benchmark_Timer - Begin run: Reverse Ordered with 100 runs  
Reverse Ordered | mean sort time (in ms): 7.46  
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```

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Reverse Ordered | mean sort time (in ms): 7.46
-----

Number of elements: 5000
2021-09-26 16:15:32 INFO  Benchmark_Timer - Begin run: Randomly Ordered with 100 runs
Randomly Ordered | mean sort time (in ms): 23.03
2021-09-26 16:15:34 INFO  Benchmark_Timer - Begin run: PartialOrdered with 100 runs
PartialOrdered | mean sort time (in ms): 17.39
2021-09-26 16:15:36 INFO  Benchmark_Timer - Begin run: Ordered with 100 runs
Ordered | mean sort time (in ms): 0.4
2021-09-26 16:15:36 INFO  Benchmark_Timer - Begin run: Reverse Ordered with 100 runs
Reverse Ordered | mean sort time (in ms): 45.54
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Number of elements: 10000
2021-09-26 16:15:41 INFO  Benchmark_Timer - Begin run: Randomly Ordered with 100 runs
Randomly Ordered | mean sort time (in ms): 90.01
2021-09-26 16:15:51 INFO  Benchmark_Timer - Begin run: PartialOrdered with 100 runs
PartialOrdered | mean sort time (in ms): 67.33
2021-09-26 16:15:59 INFO  Benchmark_Timer - Begin run: Ordered with 100 runs
Ordered | mean sort time (in ms): 0.22
2021-09-26 16:15:59 INFO  Benchmark_Timer - Begin run: Reverse Ordered with 100 runs
Reverse Ordered | mean sort time (in ms): 180.48
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Process finished with exit code 0

```

runLengthEncoding

sort

120

assertEquals(expected: 10, run);

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assertEquals(expected: 0, pre);

Run: TimerTest

Tests passed: 10 of 10 tests – 2 sec 478 ms

TimerTest (edu.neu.coe.i 2 sec 478 ms)

testPauseAndLapResume0 424 ms

testPauseAndLapResume1 318 ms

testLap 210 ms

testPause 210 ms

testStop 105 ms

testMillisecs 105 ms

testRepeat1 127 ms

testRepeat2 244 ms

testRepeat3 629 ms

testPauseAndLap 106 ms

Process finished with exit code 0

