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Program Structures & Algorithms

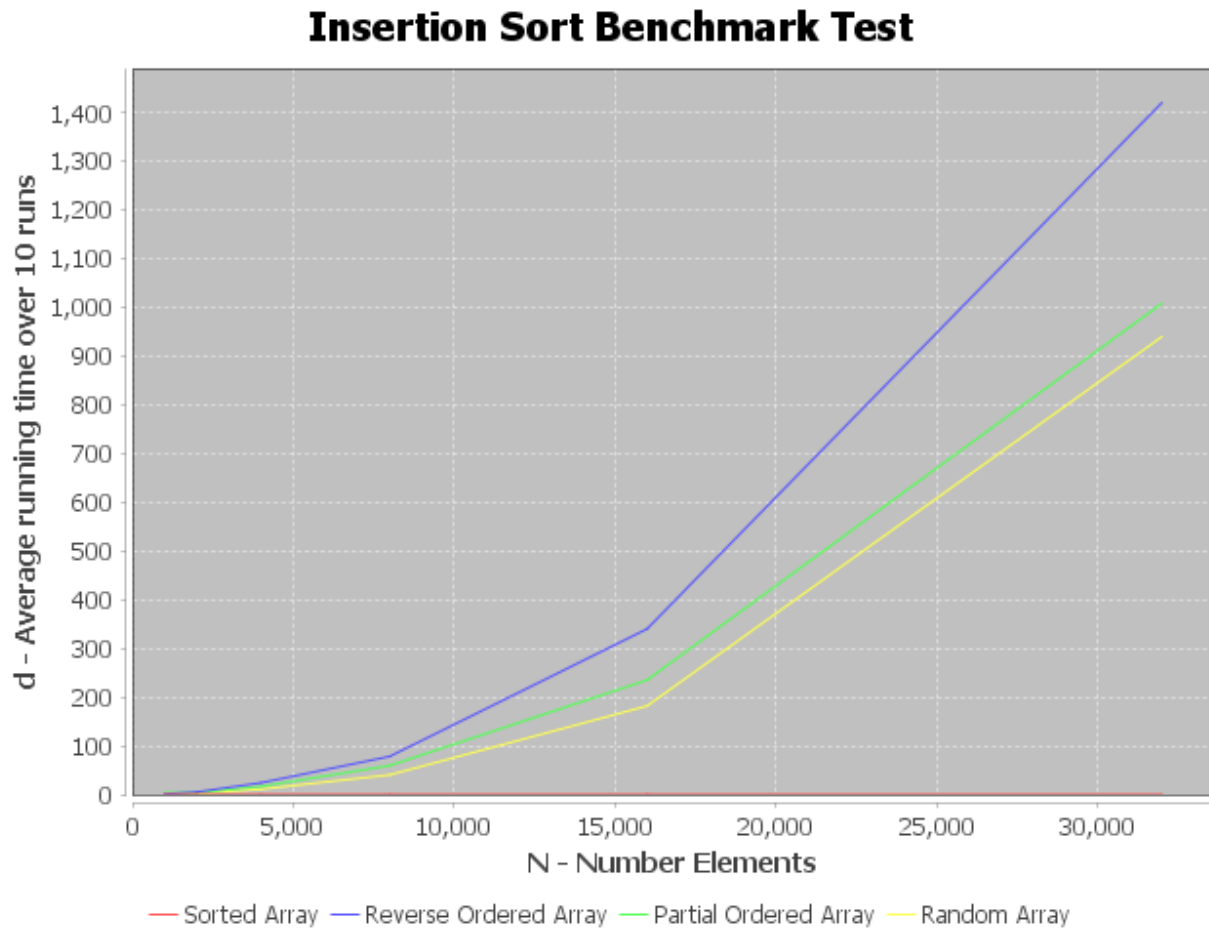
Fall 2021

Assignment No. 2

1. Tasks Performed

1. Implement the functions for *Timer.java*, run unit tests for *TimerTest* using modified values for the average running time.
2. Implement the InsertionSort algorithm in the *InsertionSort* class and use the *Helper* class.
3. Added a Unit test for insertion sort to *BenchmarkTimerTest*
4. Added a main method to insertion sort to perform a doubling benchmark test.

2. Observation



Based on the graph seen we can infer that for a random ordering where the expected running time of InsertionSort is $O(N^2)$ is matching closely to the observed running time.

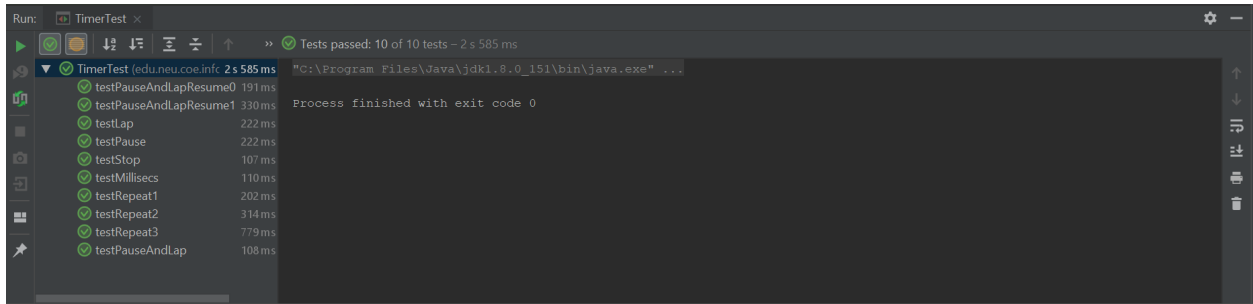
3. Output

Main Function in InsertionSort.java

```
Run: InsertionSort x
"C:\Program Files\Java\jdk1.8.0_151\bin\java.exe" ...
*****N=1000*****
    Sorted order(N=1000) = 0.0 ms
    Partial order(N=1000) = 3.7 ms
    Reverse order(N=1000) = 1.2 ms
    Randome order(N=1000) = 0.0 ms
*****N=2000*****
    Sorted order(N=2000) = 0.0 ms
    Partial order(N=2000) = 3.4 ms
    Reverse order(N=2000) = 5.0 ms
    Randome order(N=2000) = 2.0 ms
*****N=4000*****
    Sorted order(N=4000) = 0.0 ms
    Partial order(N=4000) = 16.5 ms
    Reverse order(N=4000) = 23.9 ms
    Randome order(N=4000) = 10.8 ms
*****N=8000*****
    Sorted order(N=8000) = 0.0 ms
    Partial order(N=8000) = 59.3 ms
    Reverse order(N=8000) = 78.1 ms
    Randome order(N=8000) = 40.2 ms
*****N=16000*****
    Sorted order(N=16000) = 0.0 ms
    Partial order(N=16000) = 234.8 ms
    Reverse order(N=16000) = 339.7 ms
    Randome order(N=16000) = 181.6 ms
*****N=32000*****
    Sorted order(N=32000) = 0.0 ms
    Partial order(N=32000) = 1007.4 ms
    Reverse order(N=32000) = 1419.2 ms
    Randome order(N=32000) = 939.1 ms
```

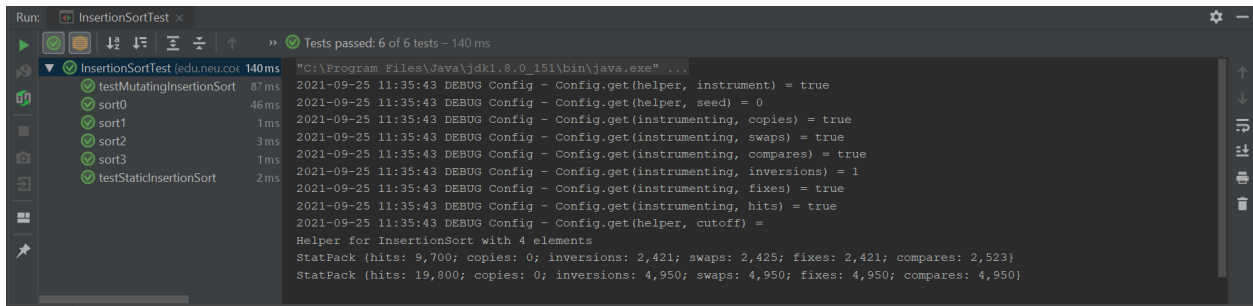
4. Unit Tests

TimerTest



Note: Delta values needed to be modified for the tests to work, this is due to differences in wait times depending on the thread pool configuration.(Only for TimerTest)

InsertionSortTest



BenchmarkTest

