

# Program Structures and Algorithms

## Spring 2024

### Assignment-3

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**Github Link:** <https://github.com/tarunangrish-neu/INFO6205>

**Task:** For this assignment, we were supposed to implement the Timer.java class, which can be utilised as a Stopwatch. This can be particularly helpful when we are implementing any function and want to calculate the time taken by the program to execute. It's a neat little implementation of the functionality and after that we had to implement Insertion Sort and time the execution time for different types of arrays, given as the input. Please find the execution time and benchmark analysis below:

```
Insertion Sort Time Complexity Analysis
Sorting Analysis for N: 2500 items
Random Array - Time elapsed: 29ms
Ordered Array - Time elapsed: 38917ns
Partially ordered array - Time elapsed: 19ms
Reverse ordered array - Time elapsed: 20ms

Sorting Analysis for N: 5000 items
Random Array - Time elapsed: 40ms
Ordered Array - Time elapsed: 21541ns
Partially ordered array - Time elapsed: 38ms
Reverse ordered array - Time elapsed: 67ms

Sorting Analysis for N: 10000 items
Random Array - Time elapsed: 143ms
Ordered Array - Time elapsed: 35334ns
Partially ordered array - Time elapsed: 135ms
Reverse ordered array - Time elapsed: 241ms

Sorting Analysis for N: 20000 items
Random Array - Time elapsed: 409ms
Ordered Array - Time elapsed: 52541ns
Partially ordered array - Time elapsed: 394ms
Reverse ordered array - Time elapsed: 807ms

Sorting Analysis for N: 40000 items
Random Array - Time elapsed: 1604ms
Ordered Array - Time elapsed: 102584ns
Partially ordered array - Time elapsed: 1726ms
Reverse ordered array - Time elapsed: 3191ms
```

Array	2500	5000	10000	20000	40000
Random	29ms	40ms	143ms	409ms	1604ms
Ordered	38917ns	21541ns	35334ns	52541ns	102584ns
Partially Ordered	19ms	38ms	135ms	394ms	1726 ms
Reverse Ordered	20ms	67ms	241ms	807ms	3191 ms

## Unit Test:

The screenshot shows an IDE window with the 'Run' tab selected. The test suite 'InsertionSortTest' has passed 6 of 6 tests in 177ms. The tests and their durations are:

- testMutatingInsertionSort: 135ms
- sort0: 21ms
- sort1: 13ms
- sort2: 6ms
- sort3: 1ms
- testStaticInsertionSort: 1ms

The output console shows the following messages:

```
/Library/Java/JavaVirtualMachines/jdk-11.0.16.1-jdk/Contents/Home/bin/java ...  
Helper for InsertionSort with 4 elements  
StatPack {hits: 9,888, normalized=21.454; copies: 0, normalized=0.000; inversions: 2,421, normalized=5.257; swaps: 2,421, normalized=5.257; fixes: 2  
StatPack {hits: 19,888, normalized=42.995; copies: 0, normalized=0.000; inversions: 4,950, normalized=10.749; swaps: 4,950, normalized=10.749; fixes: 2  
Process finished with exit code 0
```

The bottom status bar indicates the file path: `INFO6205 > src > test > java > edu > neu > coe > info6205 > sort > elementary > InsertionSortTest`. The IDE theme is 'GitHub Dark (Material)' and the font settings are '22:14 LF UTF-8 4 spaces'.