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Program Structures & Algorithms
Fall 2021
Assignment No. 2

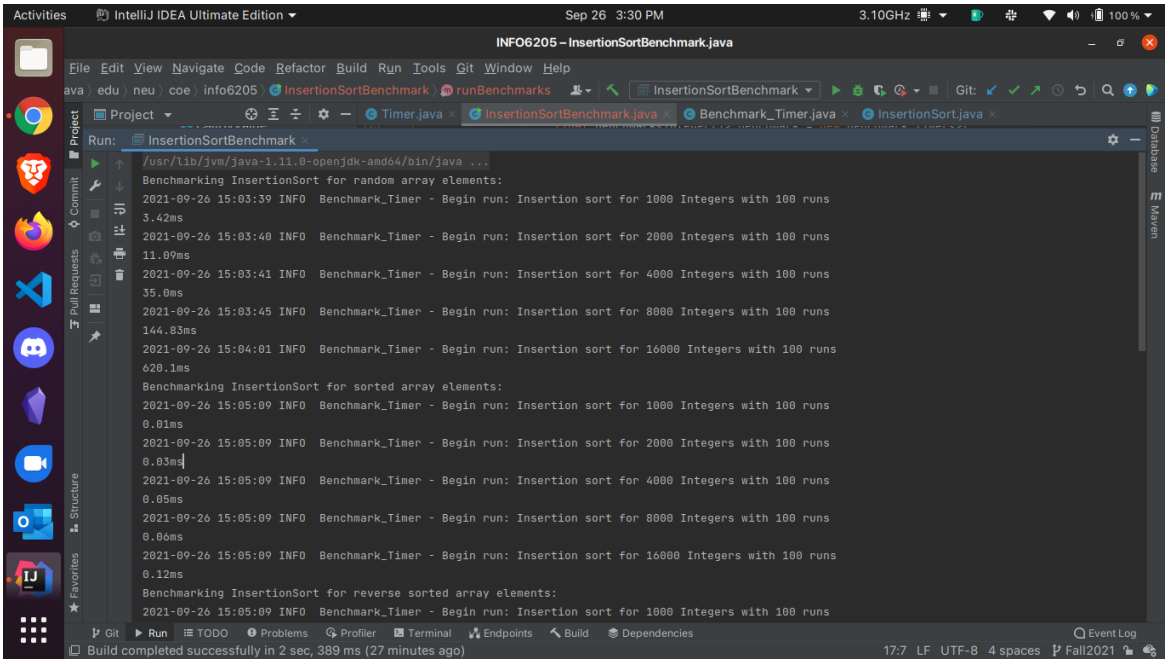
- **Tasks:**
  - Implemented the code to Benchmark any algorithm(code).
  - Insertion sort implementation using the helper methods.
  - Wrote and executed the main program to run the benchmarks for Insertion sort with various types like Ordered elements, Reverse ordered elements, Partially ordered elements, Randomly ordered elements.

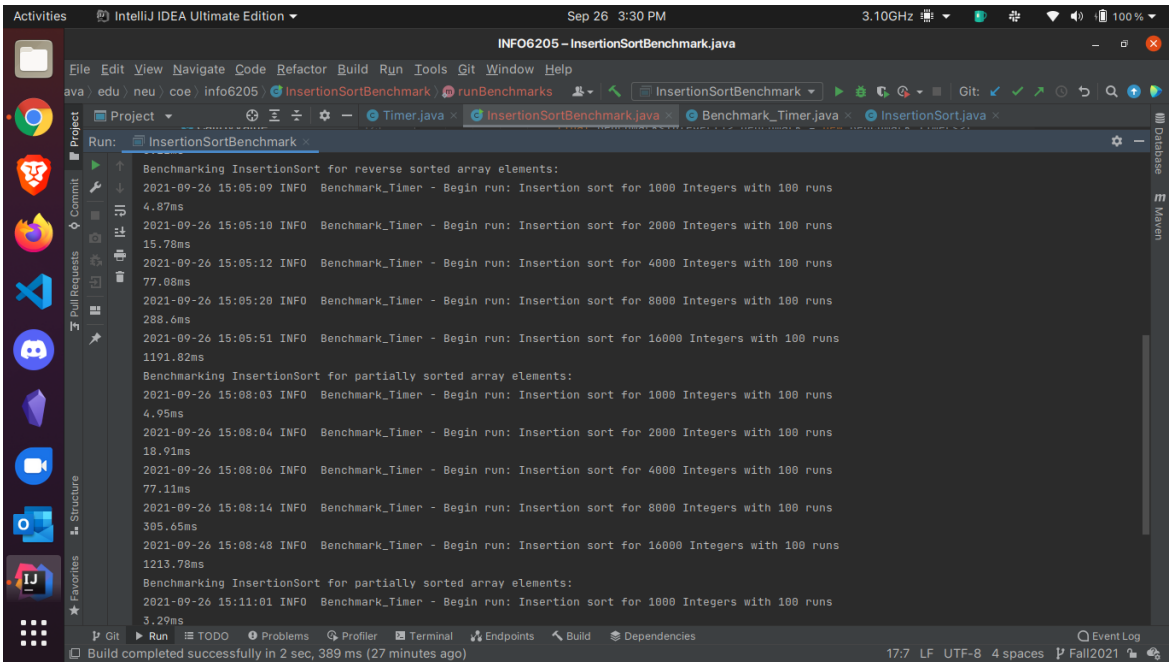
- **Relationship Conclusion:**
  - The relationship between the **number of elements in the array** and **the running time of the Insertion sort algorithm** is **O(N^2) - Worst Case** in the worst case i.e. for the reversed sorted array as well as a randomly ordered array and for **an ordered array** it is **O(N) - Best case.**
  - This means that for the reverse ordered array and a randomly ordered array *if we double the number of elements in the array, the running time increases four times (squared)*.
  - And for the sorted array, if we double the number of elements in the array, the running time increases in **N** times.
  - For the partially sorted array, this relationship is somewhere between the **Worst-case - O(N^2)** and the **Best-case - O(N)** but almost similar to the worst case which is **O(N^2)**.

(To be continued...)

- **Evidence to support the conclusion:**

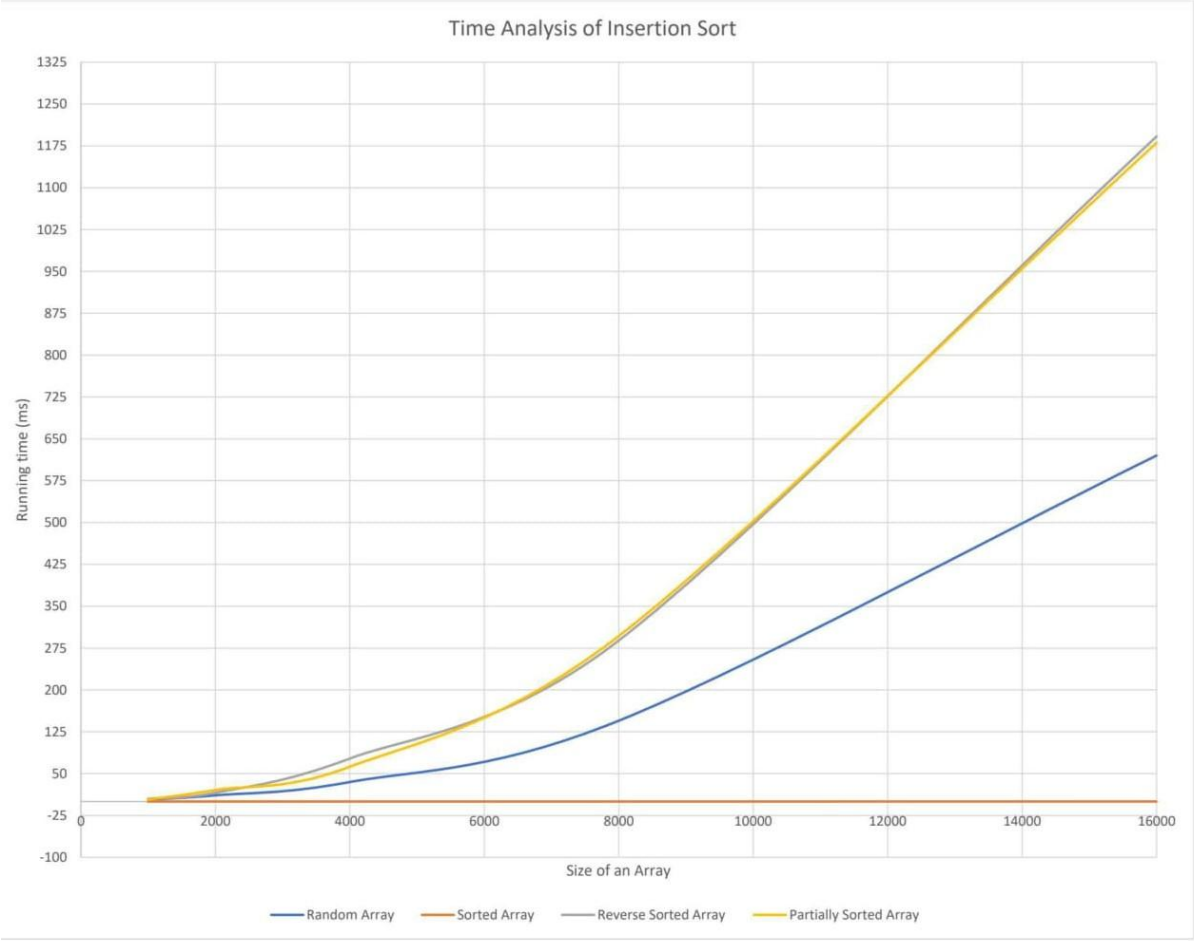
1. The output of the program:





2. Graphical Representation:

N	Random Array	Sorted Array	Reverse Sorted Array	Partially Sorted Array
1000 Raw Time	3.42ms	0.01ms	4.87ms	3.29ms
2000 Raw Time	11.09ms	0.03ms	15.75ms	20.65ms
4000 Raw Time	35.00ms	0.05ms	77.08ms	62.42ms
8000 Raw Time	144.83ms	0.06ms	288.6ms	296.56ms
16000 Raw Time	620.10ms	0.12ms	1191.82ms	1180.41ms



- **Unit Tests Results:**

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