Program Structures and Algorithms

Spring 2023(SEC –01)

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**Task:**

**TASK 1.** In this assignment, we have to implement three methods, repeat, getClock, and toMillisecs, in the Timer class. The Timer class will be invoked from the Benchmark\_Timer class, which implements the Benchmark interface.

**TASK 2.** We have to implement InsertionSort in elementary folder. We must run the unit tests in InsertionSortTest.

**TASK 3**. We have to implement a main program or unit tests to measure the running times of a sort algorithm using four different initial array ordering situations: random, ordered, partially-ordered, and reverse-ordered. The arrays to be sorted should be of type Integer, and the doubling method should be used to choose n. At least five values of n should be tested. The goal is to draw conclusions from the observations regarding the order of growth.

* **I have implemented this main method in file InsertionSortBenchmarks.java in edu.neu.coe.info6205.util**

**Relationship Conclusion:**

According to Doubling Hypothesis:

Time 𝑇(𝑛) = 𝑎𝑁b

Order of growth with N = log ratio = b ≈ 1.3

**Evidence to support that conclusion:**

**For: Type1. Random Array**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 1000 | 2000 | 4000 | 8000 | 16000 | 32000 |
| T | 0.006 | 0.006 | 0.006 | 0.012 | 0.026 | 0.054 |
| Ratio | - | 1 | 1 | 2 | 2.166 | 2.166 |
| Log2 (Ratio) |  |  |  | 1.22 | 1.22 | 1.0544 |

So considering b ≈ 1.3

Time T for 16000,

0.026 = a \* (16000)1.3

a = 0.026/291981.93

a = 8.904689e-8

a = 8.904689 \* 10-8

* So for 32000
* Time 𝑇(𝑛) = 𝑎𝑁b
* T = 8.904689 \* 10-8 \* (32000)1.3
* T = 8.904689 \* 10-8 \* 718943.84
* T = 0.062

Graphical user interface, text

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**Graphical Representation:**

* **Case 1 Random**

**Chart, line chart

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* **Case 2 Ordered**

**Chart, line chart

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* **Case 3 Reverse Ordered**

**Chart, line chart

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* **Case 4 Partially Ordered**

Chart, line chart

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**Unit Test Screenshots:**

* **Insertion Sort Tests**

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* Timer Tests

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* Benchmark Tests

Graphical user interface, text

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