**Program Structures and Algorithms**

**Spring 2023(SEC –1)**

**Assignment-2**

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**a) Test cases:**

**A picture containing scatter chart

Description automatically generated**

**b) Benchmark Observations**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **N** |  | **Quadratic** |  | **Quadrithimic** |  | **Cubic** |  |
|  |  | **(millisecond)** |  | **(millisecond)** |  | **(millisecond)** |  |
| **250** | **Raw Time** | 1.06 |  | .94 |  | 5.71 |  |
|  | **Normalized** | 16.96 |  | 1.89 |  | .37 |  |
| **500** | **Raw Time** | 2.38 |  | 3.48 |  | 42.82 |  |
|  | **Normalized** | 9.52 |  | 1.55 |  | .34 |  |
| **1000** | **Raw Time** | 4.40 |  | 15.50 |  | 333.20 |  |
|  | **Normalized** | 4.40 |  | 1.56 |  | .33 |  |
| **2000** | **Raw Time** | 19.00 |  | 77.20 |  | 2656.00 |  |
|  | **Normalized** | 4.75 |  | 1.76 |  | .33 |  |
| **4000** | **Raw Time** | 106.60 |  | 373.40 |  | 21438.60 |  |
|  | **Normalized** | 6.66 |  | 1.95 |  | .33 |  |
| **8000** | **Raw Time** | 601.67 |  | 1738.67 |  |  |  |
|  | **Normalized** | 9.40 |  | 2.10 |  |  |  |
| **16000** | **Raw Time** | 3103.50 |  | 7385.00 |  |  |  |
|  | **Normalized** | 12.12 |  | 2.07 |  |  |  |

**Chart, line chart

Description automatically generatedTime vs N graph plot**

As we can see from the chart we plotted based on the benchmark values, we can see a clear distinction between time taken by different solution. As expected, quadratic solution gives us the best time complexity.

**c) Why quadratic methods work?**

Our goal here is establish the difficulty level of the problem and develop optimal algorithms.

Instead of considering the triplet as 3 single entities and performing the solution in an exhaustive way (), we can consider that the triplet is made up of a pair and single element. In that case we have at least pairs to solve a 3 Sum problem, this way we are able to reduce the time complexity of the solution from to , hence quadratic is the best possible solution to solve the problem.

Based on the time consumed by the quadratic solution in the time spreadsheet illustrated above, we are able to prove that the quadratic solution is the most optimal solution.