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Section 1
CS 201 Homework 2

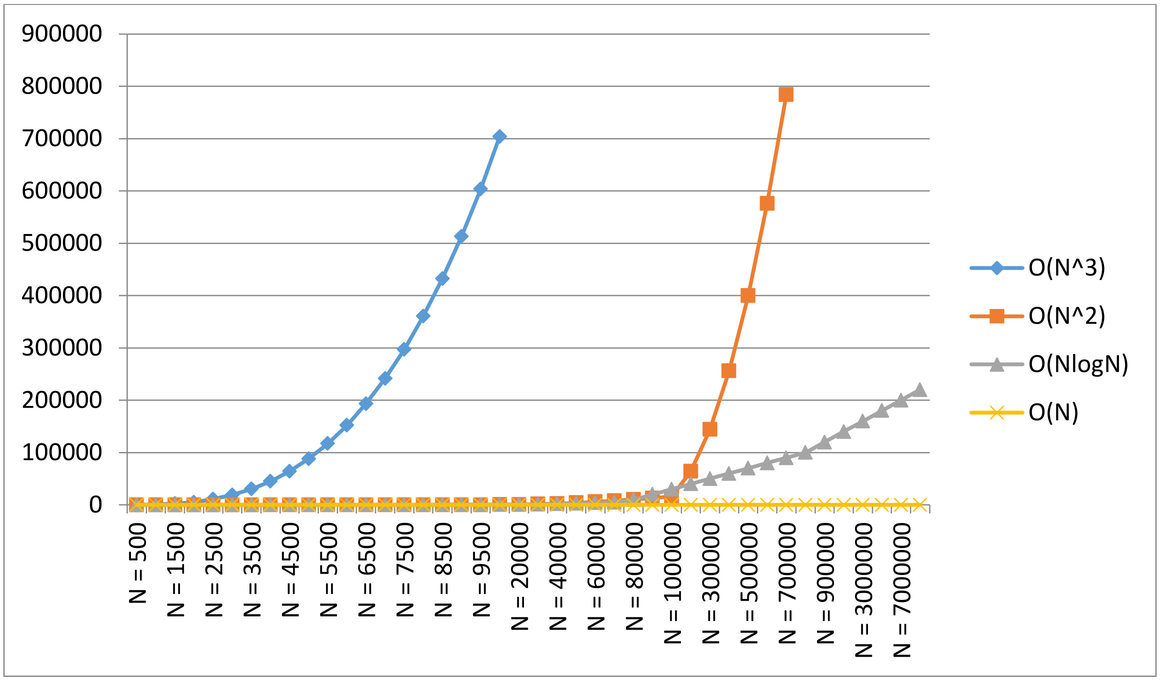
# The Max Sum Problem

Below is the table for the expected values

| | **Algorithm Time (MILLI SECONDS)** | | | |
|---|---|---|---|---|
| **Size (N)** | O(N^3) | O(N^2) | O(NlogN) | O(N) |
| N = 500 | 88 | 0.4 | 20 | 1 |
| N = 1000 | 704 | 1.6 | 40 | 1 |
| N = 1500 | 2376 | 3.6 | 60 | 1 |
| N = 2000 | 4902 | 6.4 | 80 | 1 |
| N = 2500 | 11000 | 10 | 100 | 1 |
| N = 3000 | 19008 | 14.4 | 120 | 1 |
| N = 3500 | 30184 | 19.6 | 140 | 1 |
| N = 4000 | 45056 | 25.6 | 160 | 1 |
| N = 4500 | 64152 | 32.4 | 180 | 1 |
| N = 5000 | 88000 | 40 | 200 | 1 |
| N = 5500 | 117128 | 48.4 | 220 | 1 |
| N = 6000 | 152064 | 57.6 | 240 | 1 |
| N = 6500 | 193336 | 67.6 | 260 | 1 |
| N = 7000 | 241472 | 78.4 | 280 | 1 |
| N = 7500 | 297000 | 90 | 300 | 1 |
| N = 8000 | 360448 | 102.4 | 400 | 1 |
| N = 8500 | 432344 | 115.6 | 500 | 1 |
| N = 9000 | 513216 | 129.6 | 600 | 1 |
| N = 9500 | 603592 | 144.4 | 700 | 1 |
| N = 10000 | 704000 | 160 | 800 | 1 |
| N = 20000 | N/A | 640 | 900 | 1 |
| N = 30000 | N/A | 1440 | 1000 | 1 |
| N = 40000 | N/A | 2560 | 2000 | 1 |
| N = 50000 | N/A | 4000 | 3000 | 2 |
| N = 60000 | N/A | 5760 | 4000 | 2 |
| N = 70000 | N/A | 7840 | 5000 | 2 |
| N = 80000 | N/A | 10240 | 10000 | 2 |
| N = 90000 | N/A | 12960 | 20000 | 2 |
| N = 100000 | N/A | 16000 | 30000 | 2 |
| N = 200000 | N/A | 64000 | 40000 | 2 |
| N = 300000 | N/A | 144000 | 50000 | 2 |
| N = 400000 | N/A | 256000 | 60000 | 2 |
| N = 500000 | N/A | 400000 | 70000 | 2 |
| N = 600000 | N/A | 576000 | 80000 | 2 |
| N = 700000 | N/A | N/A | 90000 | 3 |
| N = 800000 | N/A | N/A | 100000 | 5 |
| N = 900000 | N/A | N/A | 120000 | 7 |
| N = 1000000 | N/A | N/A | 140000 | 9 |

| | | | | |
|---|---|---|---|---|
| N = 3000000 | N/A | N/A | 160000 | 13 |
| N = 5000000 | N/A | N/A | 180000 | 30 |
| N = 7000000 | N/A | N/A | 200000 | 50 |
| N = 10000000 | N/A | N/A | 220000 | 70 |

## Corresponding graph for expected values



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Below is the table for the practical values obtained from the codes in the file Algorithms.cpp

| | Algorithm Time (MILLI SECONDS) | | | |
|---|---|---|---|---|
| **Size** | O(N^3) | O(N^2) | O(NlogN) | O(N) |
| N = 500 | 88 | 0 | 0 | 0 |
| N = 1000 | 688 | 3 | 0 | 0 |
| N = 1500 | 2315 | 6 | 0 | 0 |
| N = 2000 | 5459 | 9 | 0 | 0 |
| N = 2500 | 10749 | 15 | 0 | 0 |
| N = 3000 | 18362 | 20 | 1 | 0 |
| N = 3500 | 29060 | 27 | 0 | 0 |
| N = 4000 | 43350 | 34 | 0 | 0 |
| N = 4500 | 61691 | 44 | 1 | 0 |
| N = 5000 | 84593 | 53 | 0 | 0 |
| N = 5500 | 112642 | 66 | 0 | 0 |
| N = 6000 | 146490 | 76 | 0 | 0 |
| N = 6500 | 185574 | 91 | 0 | 0 |
| N = 7000 | 232455 | 105 | 1 | 0 |
| N = 7500 | 274123 | 120 | 1 | 0 |
| N = 8000 | 319212 | 139 | 1 | 0 |
| N = 8500 | 371223 | 154 | 1 | 0 |
| N = 9000 | 434963 | 173 | 1 | 0 |
| N = 9500 | 501292 | 194 | 1 | 0 |
| N = 10000 | 592312 | 214 | 1 | 0 |
| N = 20000 | N/A | 857 | 1 | 0 |
| N = 30000 | N/A | 1943 | 2 | 0 |
| N = 40000 | N/A | 3545 | 3 | 0 |
| N = 50000 | N/A | 5411 | 4 | 1 |
| N = 60000 | N/A | 7759 | 5 | 1 |
| N = 70000 | N/A | 10779 | 5 | 1 |
| N = 80000 | N/A | 13798 | 7 | 1 |
| N = 90000 | N/A | 17422 | 8 | 1 |
| N = 100000 | N/A | 21539 | 123 | 1 |
| N = 200000 | N/A | 86130 | 430 | 1 |
| N = 300000 | N/A | 193827 | 832 | 2 |
| N = 400000 | N/A | 332910 | 1239 | 2 |
| N = 500000 | N/A | 439177 | 3506 | 2 |
| N = 600000 | N/A | N/A | 16302 | 2 |
| N = 700000 | N/A | N/A | 56320 | 3 |
| N = 800000 | N/A | N/A | 132829 | 4 |
| N = 900000 | N/A | N/A | 435023 | 7 |
| N = 1000000 | N/A | N/A | 1242919 | 10 |
| N = 3000000 | N/A | N/A | N/A | 23 |
| N = 5000000 | N/A | N/A | N/A | 34 |
| N = 7000000 | N/A | N/A | N/A | 50 |
| N = 10000000 | N/A | N/A | N/A | 79 |

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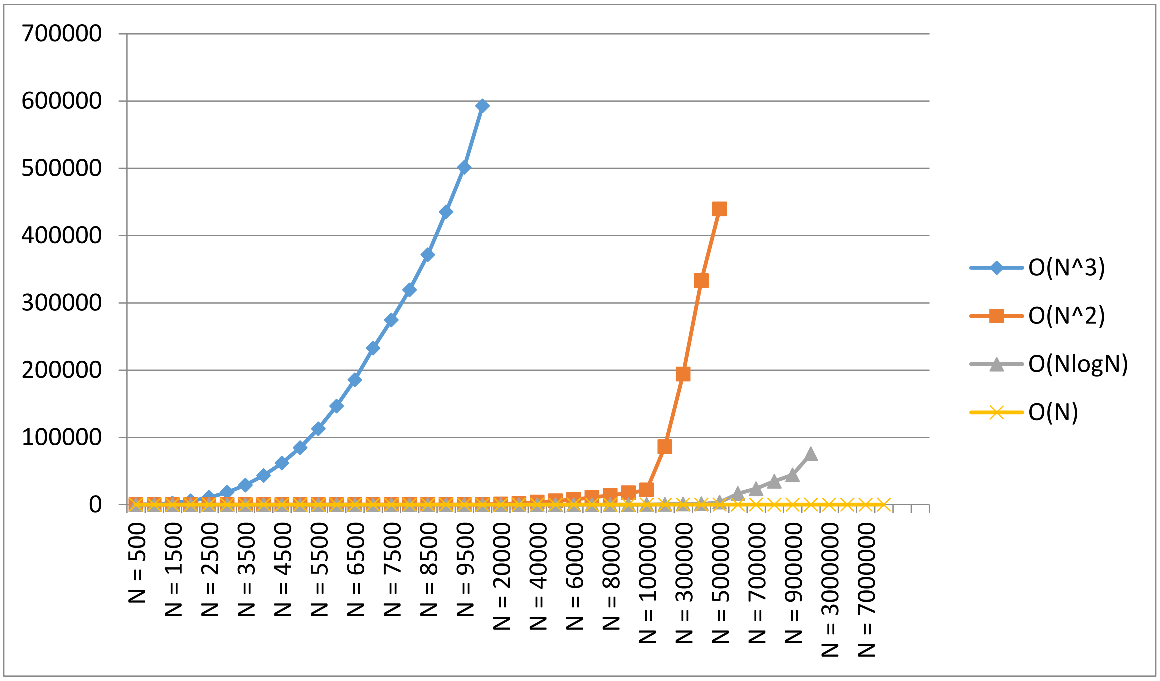
Corresponding Graph for practical values



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## Observations:

The high scale sizes that I used for practical data for the algorithms resulted in inaccurate values, which made the comparison of the graphs differ. In addition, high values for algorithm running in N^3 time were unable to be calculated after a size of N as 100000, while the values NlogN can go up to a size of a 10000000. The same logic can be applied for the quadratic function. Another factor is the computer's speed which alters execution time, which makes the actual results different from the expected results. The differences in results are in-consistent, and they only have an impact up until a certain point so the functions overall have a general same pattern and only differ in minor amounts. The cubed and quadratic functions have similar to their expected ones, but the small changes are negligible for such high values of N. But when we take a look at the graph of the function running at a time of NlogN, we notice more differences in the results. Other than the initial values which had same time complexities, as they were too small for the computer to measure. The graphs of O(n) and O(nlogn) in general had a gradual increase and they had a different set of values causing incorrect scaling for the graphs. As a overall conclusion we notice o(n) had the fastest time taken, with minor increase in time, and its graph calculation was accurate in comparison to expected values. O(nlogn) behaved in the same way, but performed a little slower than O(n) and hence its graph has noticaeable changes witha less steep gradient when we compare it with quadratic and cubic functions, which had close values to their expected values, being the two slowest functions.

## Specifications of my computer:

Processor: Intel Core i3-5010u CPU @ 2.10GHz

Installed Memory (RAM): 6.00GB 750 GB HDD

System Type: 64 bit operating system, x64 based processor windows 8