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COEN 179

Homework 1

1. Based on the results of the run, we see some fairly large increases of the run times after a few increases in N. The increases, however, are not all so large that they would approach an exponential growth – O(n^2). If all the loops ran with something like an N complexity, then the overall complexity could potentially be as bad as O(n^3). The second loop is based off of the first, so their combined complexity is O(n^2). The third nested loop is based off of the second, giving at best a complexity approaching O((logn)^1/2) because of the stopping conditions. However, at worst it will continue as an O(m), giving a potential worst complexity of O(n^3). At best, the overall complexity will be no better than O(n^2(logn)^1/2). So the complexity must lie somewhere between O(n^2(logn)^1/2) and O(n^3), likely leaning towards the O(n^3).

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| --- | --- |
| N | Steps |
| 10 | 756 |
| 20 | 7685 |
| 40 | 82101 |
| 100 | 1955248 |
| 200 | 21839454 |
| 400 | 245465274 |
| 1000 | 6039920475 |
| 2000 | 68240888784 |
| 4000 | Too long to run |
| 10000 | Too long to run |

2. The program calculates the square root of a given number algorithmically – using addition and division. Here, the steps to calculate are quite small, and do not increase quickly. Given the slowness of the growth, it is likely no worse than linear. To find the square root of a number, in the worst case of the algorithm, you would need to work through at most half of the input. This would give a likely complexity for the algorithm of O(logn). If the precision changed to use more digits, I would not change my answer. In the worst case of performing calculations, the previously found root will no longer match due to the required precision. However, the next step is almost guaranteed to return a value that fulfills the precision requirement as the next calculation should exceed the new limit. If only one or two steps are added to perform the algorithm, then that is a negligible increase to the complexity of the algorithm. The complexity will remain the same, around O(logn).

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| Input | Steps |
| 4 | 3 |
| 16 | 5 |
| 36 | 5 |
| 62 | 6 |
| 256 | 7 |
| 89321 | 11 |
| 1500000 | 14 |
| 12345678900987654321 | 36 |