COMP 250 Assignment #1

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4) a) all times in nanoseconds

Digits	iterativeAddition	standardMultiplication	recursiveMultiplication	recursiveFastMultiplication
2	25607	12168	2641	6343
4	1123810	18085	3840	11505
8	22255274667	71755	24398	34669
16	too slow	178501	53373	99326
32	too slow	594616	200413	225357
64	too slow	1936504	813360	713286
128	too slow	7563881	2912893	2053967
256	too slow	30971324	11031940	6093984
512	too slow	122604025	45693739	18158892
1024	too slow	508340027	184399704	55414889
2048	too slow	2064707268	743952790	218404874
4096	too slow	8991897380	3787743571	609691302

Patterns

iterativeAddition: too hard to tell given the small numbers of x

standardMultiplication: increases by roughly a factor of 4 over the last five trials

recursiveMultiplication: increases by roughly a factor of 4 over three of the last four trials, then increases by a roughly a factor of 5 between the second-last and last trial

recursiveFastMultiplication: increases by roughly a factor of 3 between 512 digits and 1024 digits, and roughly a factor of 4 over the last two trials

b) Used functions in part c) to predict T(x = 8192)

iterativeAddition: $T(8192) \approx 9.5 \times 10^{8575}$ ns ≈ 3.01×10^{8559} years ≈ 2.2×10^{8549} times the age of the universe

standardMultiplication : $T(8192) \approx 3.7022\ x\ 10^{10}$ ns ≈ 37.02 s

recursiveMultiplication : $T(8192) \approx 1.628 \times 10^{10}$ ns ≈ 16.28 s

recusiveFastMultiplication : $T(8192)$ ≈ 2 069 589 666 ns ≈ 2.07 s

c) Used Excel linear regression

iterativeAddition: $T(x) = 66.59e^{2.41x}$

- Note: measured running time of x = 1, 2, …, 9 to get a more accurate function

standardMultiplication : $T(x) = 568.34x^2 - 137767x + 10^7$

recursiveMultiplication : $T(x) = 260.58x^2 - 148576x + 10^7$

recursiveFastMultiplication : $T(x) = 24.803x^2 + 48961x - 4 * 10^6$

d) compared values in chart

faster than iterativeAddition: n = 2

faster than standardMultiplication: n = 2

faster than recursiveMultiplication: n = 64