Algorithm Design

M. T. Goodrich and R. Tamassia

Solution of Exercise R-1.7

The numbers in the first row are quite large. The table below calculates it approximately in powers of 10. People might also choose to use powers of 2. Being close to the answer is enough for the big numbers (within a few factors of 10 from the answers shown).

	1 Second	1 Hour	1 Month	1 Century
$\log n$	$2^{10^6} \approx 10^{300000}$	$2^{3.6\times 10^9} \approx 10^{10^9}$	$2^{2.6\times 10^{12}} \approx 10^{0.8\times 10^{12}}$	$2^{3.1\times 10^{15}} \approx 10^{10^{15}}$
$\sqrt{n}$	$\approx 10^{12}$	$\approx 1.3\times 10^{19}$	$\approx 6.8\times 10^{24}$	$\approx 9.7\times 10^{30}$
n	10^6	3.6×10^9	$\approx 2.6\times 10^{12}$	$\approx 3.12\times 10^{15}$
$n\log n$	$\approx 10^5$	$\approx 10^9$	$\approx 10^11$	$\approx 10^{14}$
n^2	1000	6×10^4	$\approx 1.6\times 10^6$	$\approx 5.6\times 10^7$
n^3	100	≈ 1500	≈ 14000	≈ 1500000
2^n	19	31	41	51
$n!$	9	12	15	17

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Solution of Exercise R-1.10

The Loop1 method runs in $O(n)$ time.

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Solution of Exercise R-1.11

The Loop2 method runs in $O(n)$ time.

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Solution of Exercise R-1.12

The Loop3 method runs in $O(n^2)$ time.

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Solution of Exercise R-1.13

The Loop4 method runs in $O(n^2)$ time.

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Solution of Exercise R-1.19

By the definition of big-Oh, we need to find a real constant $c > 0$ and an integer constant $n_0 \geq 1$ such that $(n+1)^5 \leq c(n^5)$ for every integer $n \geq n_0$. Since $(n+1)^5 = n^5 + 5n^4 + 10n^3 + 10n^2 + 5n + 1$, $(n+1)^5 \leq c(n^5)$ for $c = 8$ and $n \geq n_0 = 2$.

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Solution of Exercise R-1.23

By the definition of big-Omega, we need to find a real constant $c > 0$ and an integer constant $n_0 \geq 1$ such that $n^3 \log n \geq cn^3$ for $n \geq n_0$. Choosing $c = 1$ and $n_0 = 2$, shows $n^3 \log n \geq cn^3$ for $n \geq n_0$, since $\log n >\geq 1$ in this range.

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Solution of Exercise C-1.7

To say that Al's algorithm is "big-oh" of Bill's algorithm implies that Al's algorithm will run faster than Bill's for all input greater than somenon-zero positive integer n_0. In this case, $n_0 = 100$.