

Advanced Dominance Rankings

Additional functions arise in more sophisticated analysis than we will do in this course:

$$n! \gg c^n \gg n^3 \gg n^2 \gg n^{1+\epsilon} \gg n \log n \gg n \gg \sqrt{n} \gg \log^2 n \gg \log n \gg \log n / \log \log n \gg \log \log n \gg \alpha(n) \gg 1$$

Asymptotic Dominance in Action

n	$f(n)$	$\lg n$	n	$n \lg n$	n^2	2^n	$n!$
10		$0.003 \mu s$	$0.01 \mu s$	$0.033 \mu s$	$0.1 \mu s$	$1 \mu s$	3.63 ms
20		$0.004 \mu s$	$0.02 \mu s$	$0.086 \mu s$	$0.4 \mu s$	1 ms	77.1 years
30		$0.005 \mu s$	$0.03 \mu s$	$0.147 \mu s$	$0.9 \mu s$	1 sec	8.4×10^{15} yrs
40		$0.005 \mu s$	$0.04 \mu s$	$0.213 \mu s$	$1.6 \mu s$	18.3 min	
50		$0.006 \mu s$	$0.05 \mu s$	$0.282 \mu s$	$2.5 \mu s$	13 days	
100		$0.007 \mu s$	$0.1 \mu s$	$0.644 \mu s$	$10 \mu s$	4×10^{13} yrs	
1,000		$0.010 \mu s$	$1.00 \mu s$	$9.966 \mu s$	1 ms		
10,000		$0.013 \mu s$	$10 \mu s$	$130 \mu s$	100 ms		
100,000		$0.017 \mu s$	0.10 ms	1.67 ms	10 sec		
1,000,000		$0.020 \mu s$	1 ms	19.93 ms	16.7 min		
10,000,000		$0.023 \mu s$	0.01 sec	0.23 sec	1.16 days		
100,000,000		$0.027 \mu s$	0.10 sec	2.66 sec	115.7 days		
1,000,000,000		$0.030 \mu s$	1 sec	29.90 sec	31.7 years		

Implications of Dominance

- Exponential algorithms get hopeless fast.
- Quadratic algorithms get hopeless at or before 1,000,000.
- $O(n \log n)$ is possible to about one billion.
- $O(\log n)$ never sweats.