Big-O Part a: Asymptotic Analysis of Functions

lan Ludden

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Motivation

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• Most (useful) code takes different amounts of time on different input sizes.

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- We mostly care about what happens when *n* is big.

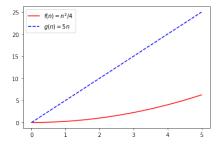
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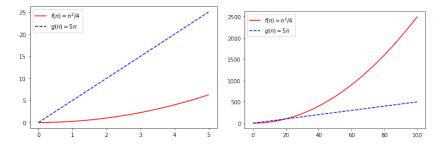
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Asymptotic Analysis

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Asymptotic Analysis

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Definition

Given functions $f, g : \mathbb{N} \to \mathbb{R}$, we say f and g are **asymptotically similar** ($f(n) \approx g(n)$) if (and only if)

$$\lim_{n\to\infty}\frac{f(n)}{g(n)}=c,$$

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We say *f* is **asymptotically smaller** than $g(f(n) \ll g(n))$ if (and only if)

$$\lim_{n\to\infty}\frac{f(n)}{g(n)}=0.$$

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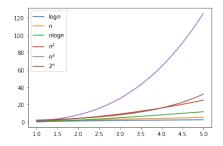
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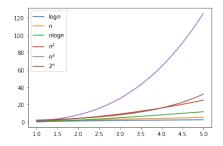
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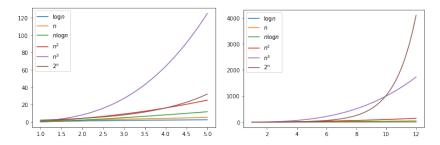
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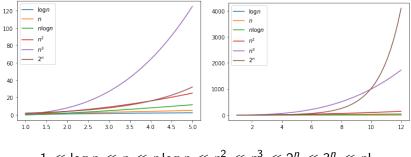
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 $1 \ll \log n \ll n \ll n \log n \ll n^2 \ll n^3 \ll 2^n \ll 3^n \ll n!$

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Not a fan of limits? Just look at fastest-growing term.

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Example 1

$$f(n) = 13n + n! + 5$$
 versus $g(n) = 6^n + 4n^4 - 2$

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