Intro: Asymptotic Notation

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Data Structures and Algorithms
Algorithmic Toolbox

Learning Objectives

- Understand the basic idea behind asymptotic runtimes.
- Describe some of the advantages to using asymptotic runtimes.

Last Time

Computing Runtimes Hard

- Depends on fine details of program.
- Depends on details of computer.

Idea

All of these issues can multiply runtimes by (large) constant.

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All of these issues can multiply runtimes by (large) constant. So measure runtime in a way that ignores constant multiples.

Problem

Unfortunately, 1 second, 1 hour, 1 year only differ by constant multiples.

Solution

Consider asymptotic runtimes. How does runtime scale with input size.

Approximate Runtimes

	n	$n \log n$	n^2	2^n
$n = 20$	1 sec	1 sec	1 sec	1 sec
$n = 50$	1 sec	1 sec	1 sec	13 day
$n = 10^2$	1 sec	1 sec	1 sec	$4 \cdot 10^{13}$ year
$n = 10^6$	1 sec	1 sec	17 min	
$n = 10^9$	1 sec	30 sec	30 year	
max n	10^9	$10^{7.5}$	$10^{4.5}$	30

$$\log n \prec \sqrt{n} \prec n \prec n \log n \prec n^2 \prec 2^n$$

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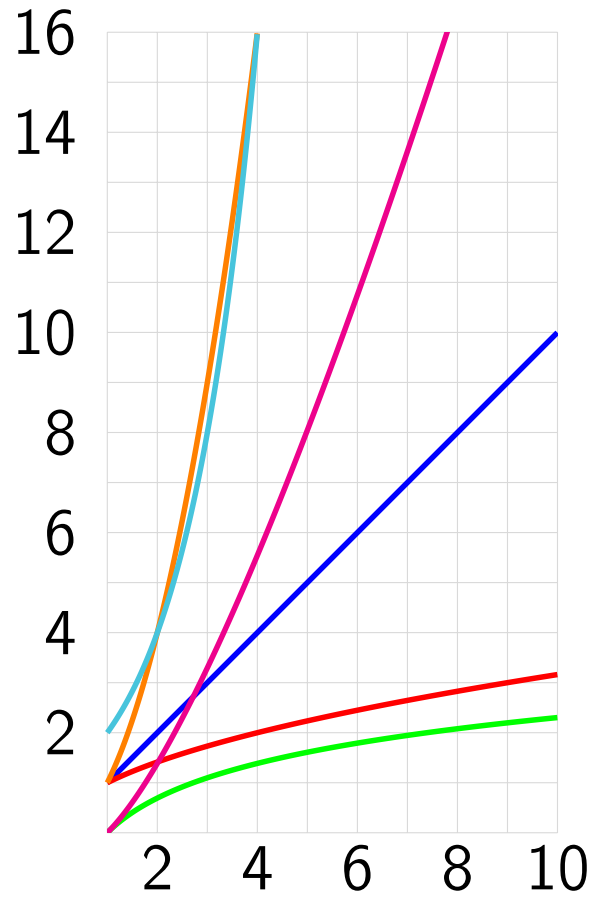

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