CS 341 Course Notes

Fall 2025 - Trevor Brown

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Contents

1 Introduction, Review of Asymptotics

Definition 1.1 (Cost of Algorithms)

- Parameterized by an integer n, called the **size**

Runtime of a particular instance:

$$T(I) = \text{runtime on input } I$$

Worst case runtime (default choice):

$$T_{\text{worst}}(n) = \max_{I \text{ of size } n} T(I)$$

Best case runtime, not used much in this course:

$$T_{\text{best}}(n) = \min_{I \text{ of size } n} T(I)$$

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Remark

We will sometimes use more than one parameter:

- Number of rows and columns in a matrix
- Vertices and edges in a graph

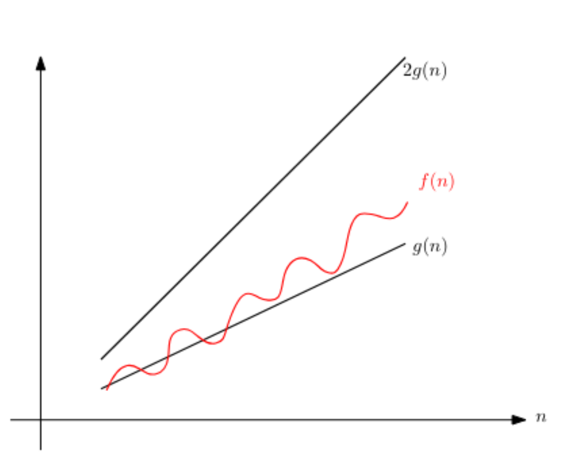
1.1 Asymptotic Notation

Consider two function $f(n),\ g(n)$ with values in $\mathbb{R}_{>0}$

Definition 1.1.1

Big-O:

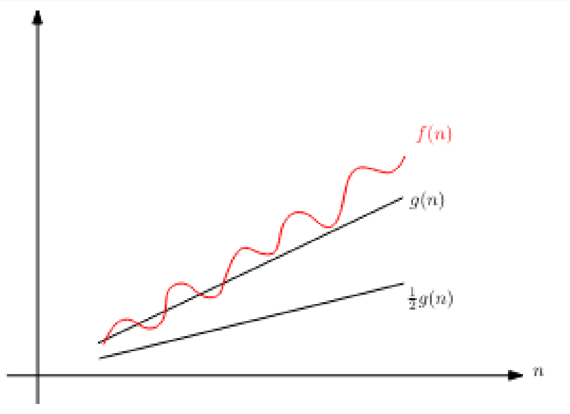
1. We say that $f(n) \in O(g(n))$ if there exists $C > 0$ and n_0, such that for $n \geq n_0$, $f(n) \leq Cg(n)$



Definition 1.1.2

Big-Ω:

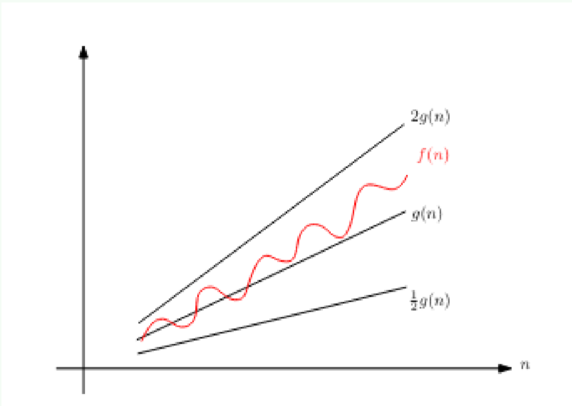
1. We say that $f(n) \in \Omega(g(n))$ if for all $C > 0$, there exists n_0 such that for $n \geq n_0$, $f(n) \geq Cg(n)$
2. Equivalent to $g(n) \in O(f(n))$



Definition 1.1.3

Θ:

1. We say that $f(n) \in \Theta(g(n))$ if $f(n) \in O(g(n))$ and $f(n) \in \Omega(g(n))$
2. In particular true if $\lim_{\infty} \frac{f(n)}{g(n)} = C$ for some $0 < C < \infty$



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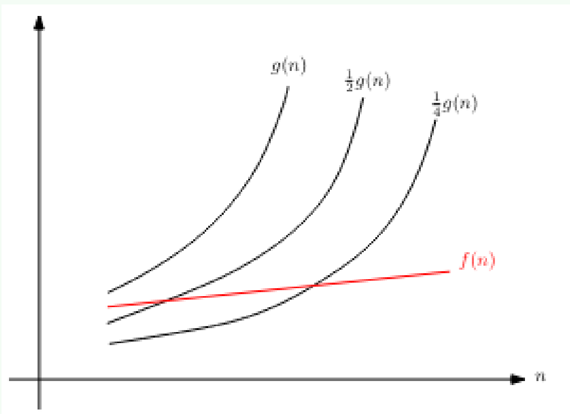
Definition 1.1.4

little-o:

1. We say that $f(n) \in o(g(n))$ if for all $C > 0$, there exists n_0 such that for $n \geq n_0$, $f(n) \leq Cg(n)$
2. Equivalent to $\lim_{n\to\infty} \frac{f(n)}{g(n)} = 0$



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