

**make
history.**



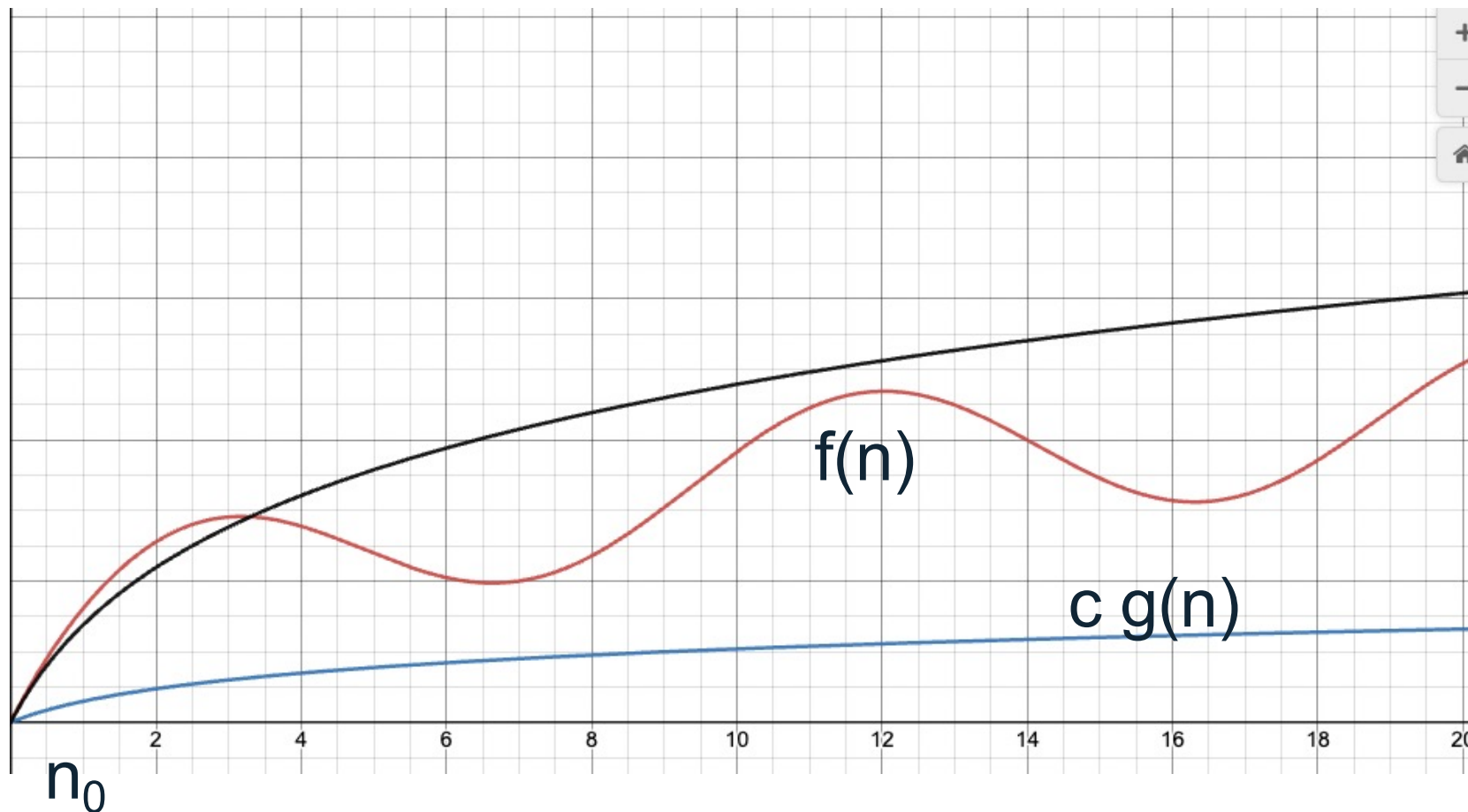
Other Complexity Notations

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Big Ω – Lower bound

We say that $f(n)$ is in $\Omega(g(n))$ iff (if and only if)

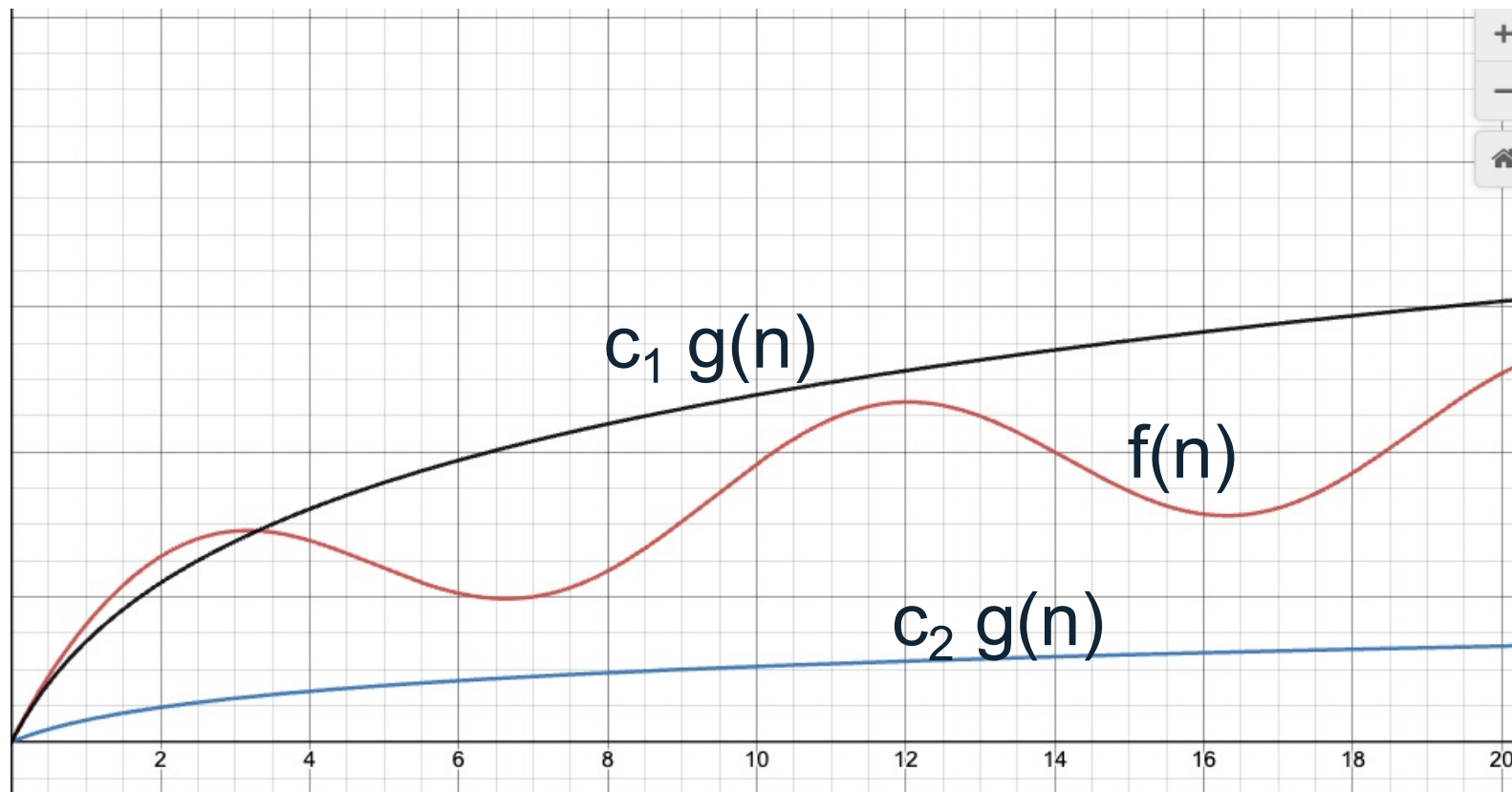
$\exists c \in R^+, \exists n_0 \in N$, such that $\forall n \geq n_0 : f(n) \geq c g(n)$.



Big Θ Tight bound

$f(n) = \Theta(g(n))$ iff (if and only if):

$f(n) = O(g(n))$ and $f(n) = \Omega(g(n))$.



Polynomials of degree k are in $\Theta(n^k)$:
 $a_k n^k \leq a_k n^k + \dots + a_1 n + a_0 \leq (a_k + \dots + a_1 + a_0) n^k$

Little o Upper bound

$\forall c \in \mathbb{R}^+, \exists n_0 \in \mathbb{N}, \text{ such that } \forall n \geq n_0 \text{ such that } f(n) < cg(n) \left(\left| \frac{f(n)}{g(n)} \right| < c \right).$

In other words:

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

Examples:

$$n = o(n^2).$$

$$\log n = o(n).$$

If $f(n) = o(g(n))$ then $f(n) = O(g(n))$.

However, Little o does not allow the same growth rate.



Summary of the notations

- **Big O** and **Little o** are upper bounds. **Little o** is stronger than **Big O** because it does not allow for the same growth rate ($g(n)$ grows faster than $f(n)$).
- **Big Ω** is a lower bound.
- **Big Θ** is a tight bound (upper and lower together).