$\Theta \quad \Omega \quad O \quad o \quad \omega$

$f(n) \in \Theta(g(n)) \iff \{ \exists\, n_0, c_1, c_2$

$\forall\, n > n_0 \quad c_1 g(n) \leq f(n) \leq c_2 g(n) \}$

$$f(n) \in \theta(g(n)) \iff \left\{ \exists\, n_0, c_1, c_2 \right.$$

$$\forall\, n > n_0 \quad c_1 g(n) \leq f(n) \leq c_2 g(n)$$

$$f(n) = 5n^2 - 20 \in \theta(n^2)$$

$$\underbrace{c_1 n^2 \leq 5n^2 - 20}\ \leq c_2 n^2$$

$$c_1 n^2 \leq 5n^2 - 20$$

$$c_1 \leq 5 - \frac{20}{n^2}$$

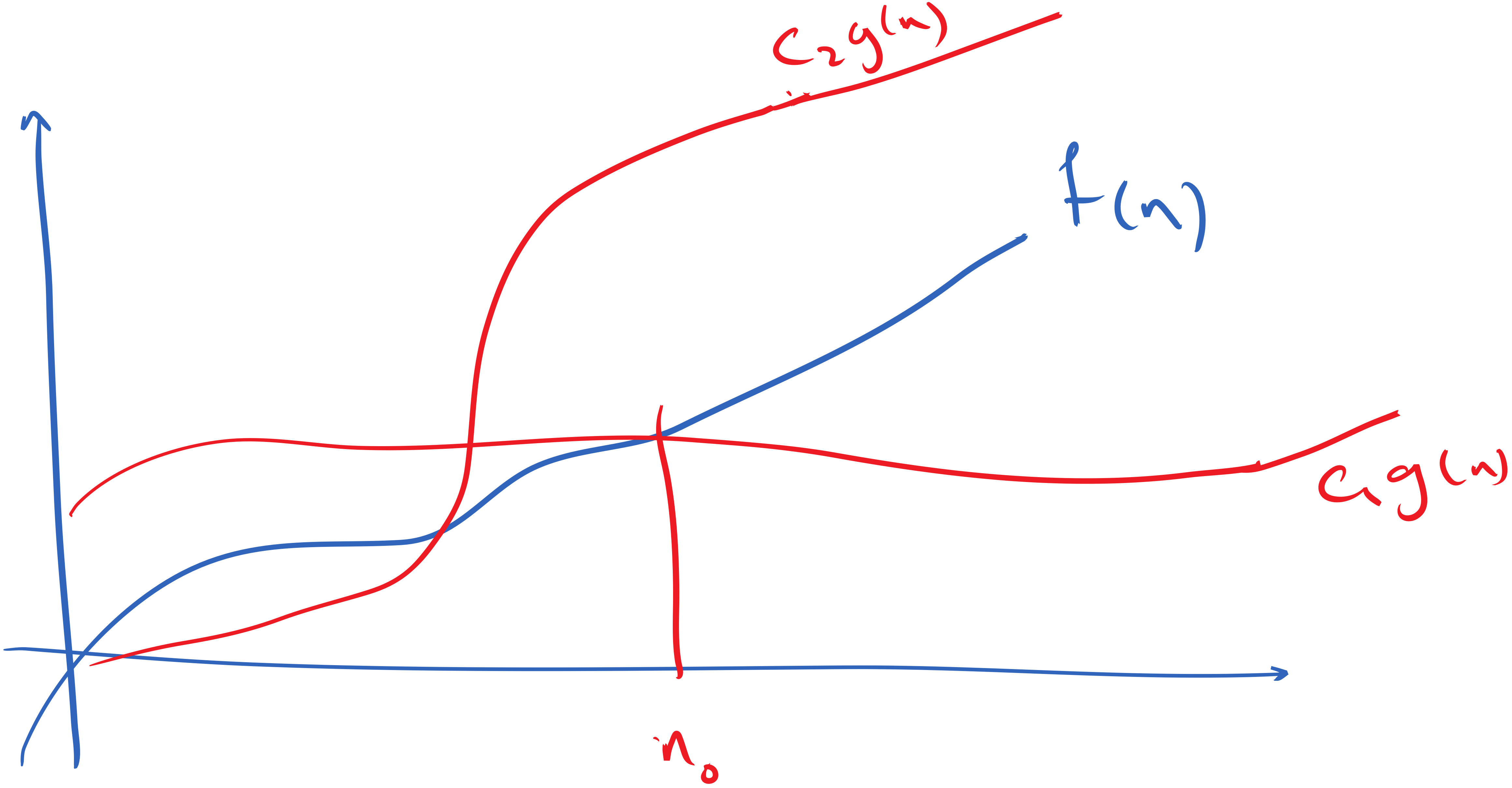
$$c_1 \leq 5 - \frac{20}{n^2}$$

$$n_0 = \sqrt{20}$$

$$c_1 = 4$$

$$5 - \frac{20}{n^2} \leq c_2$$

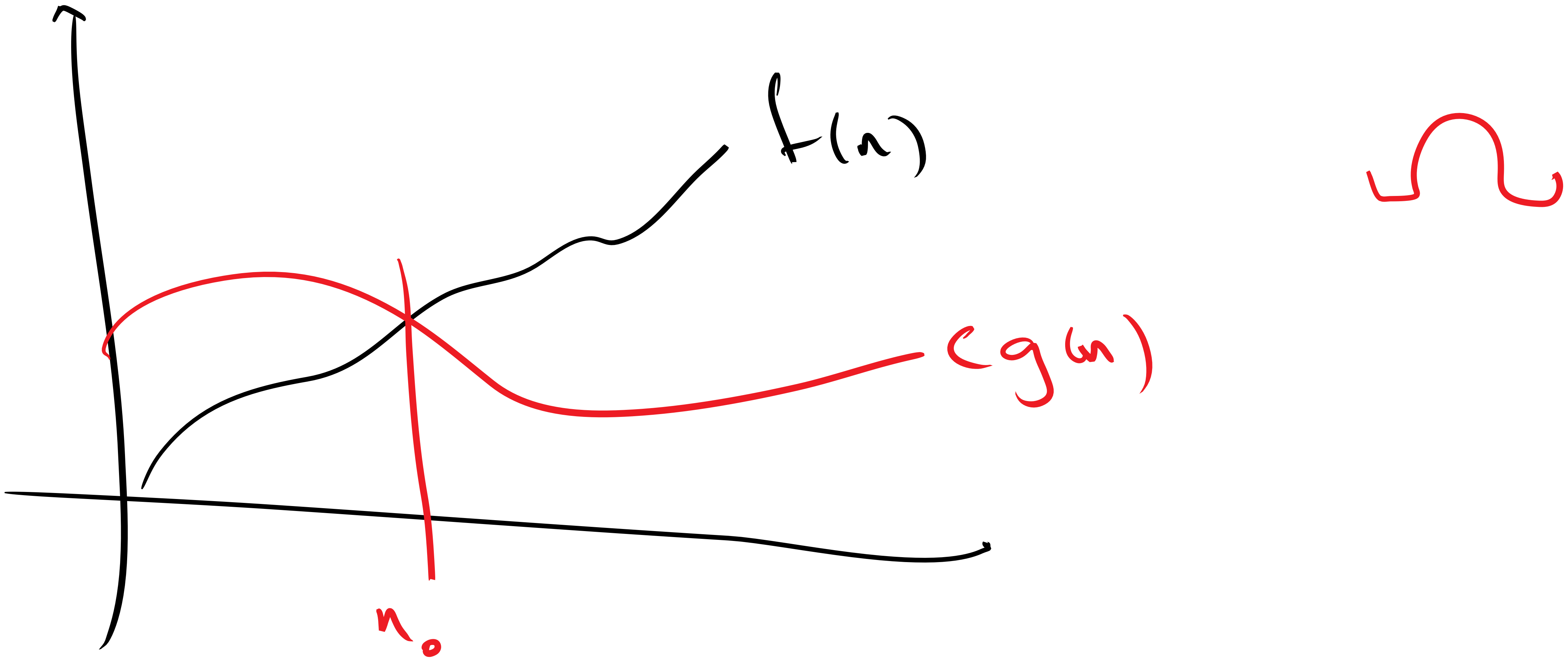
$$c_2 = 5$$

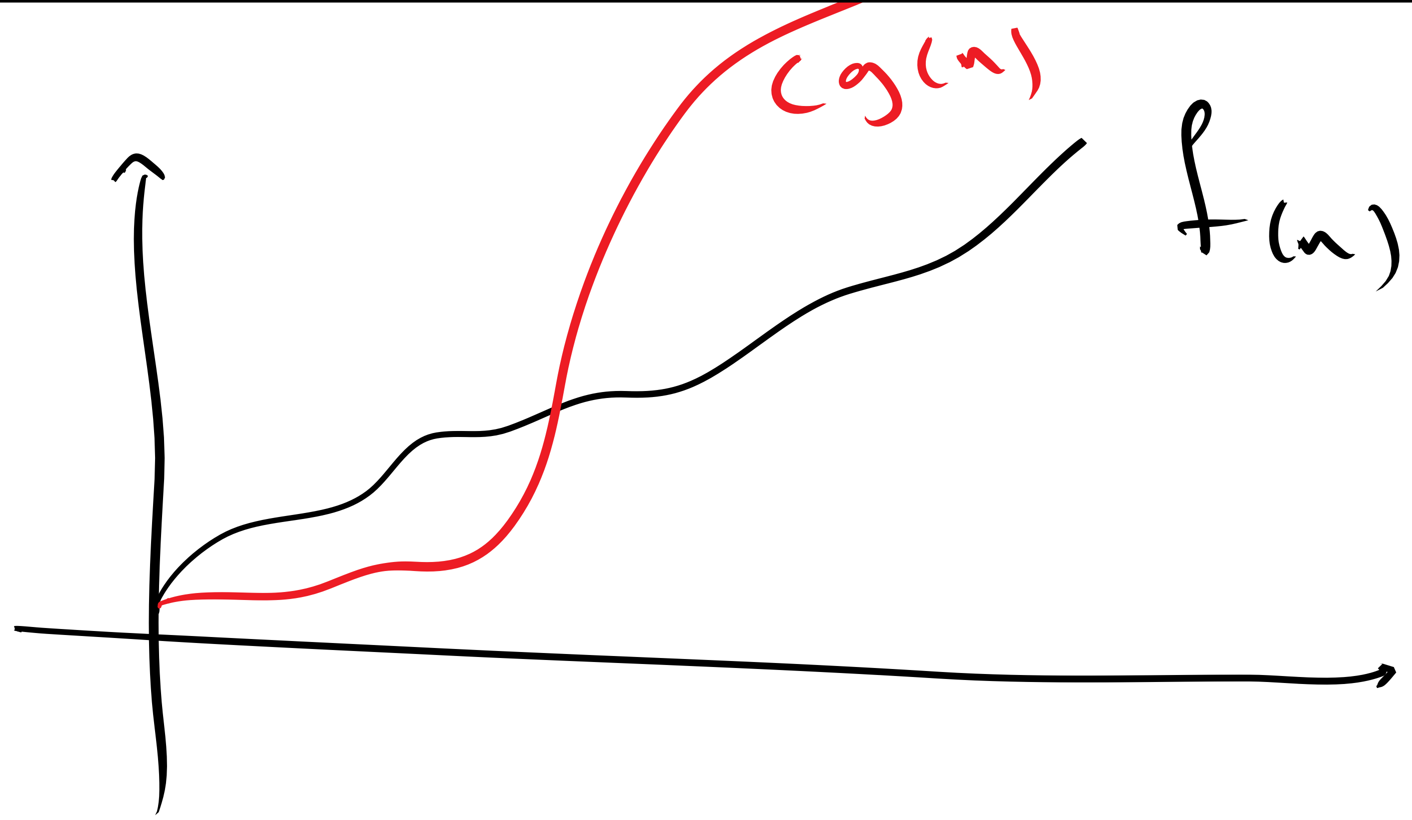


c2g(n)
f(n)
c1g(n)
n0

$$f(n) \in O(g(n)) : \{ \exists\, n_0, c \;\; \forall\, n > n_0 : f(n) \leq c\,g(n) \}$$

$$f(n) \in \Omega(g(n)) : \{ \exists\, n_0, c \;\; \forall\, n > n_0 : c\,g(n) \leq f(n) \}$$


f(n)
cg(n)
n₀
Ω


cg(n)
f(n)

جست و جو در لیست :

$B(n) = 1$

$W(n) = n$

$$A(n) = \sum_{i=1}^{n} \frac{1}{n} \times i = \frac{1}{n} \sum_{i=1}^{n} i = \frac{1}{\cancel{n}} \times \frac{\cancel{n}(n+1)}{2} = \frac{n+1}{2}$$

احتمال حضور عنصر در لیست P

$$A(n) = \sum_{i=1}^{n} \frac{P}{n} \times i + (1-P) \times n = \frac{P}{\cancel{n}} \times \frac{\cancel{n}(n+1)}{2} + (1-P) \times n$$

$f(n) \in \Theta(g(n))$

O

Ω

$\exists\, c_1, c_2, n_0 \quad \forall n \geq n_0 \quad \underbrace{c_1 g(n) \leq \overbrace{f(n)}\!}\!\!\overbrace{\;\leq c_2 g(n)}$

$$f(n) \in o_{\text{small}}(g(n))$$

$$\forall c>0 \ \exists n_0>0 \ \forall n>n_0 \quad 0<f(n) \leq cg(n)$$

$$n^2+2n \in o(n^2)$$

$$n^2+2n \leq cn^2$$

$$1+\frac{2}{n} \leq c$$

$$\overbrace{n^2+4n}^{f} \in \Omega(\overbrace{n^3}^{g})$$

$f(n) \in \Omega(g(n))$ $\quad \forall n > n_0$

$\exists c, n_0 > 0 :$ $\quad c\,g(n) \leq f(n)$

$$c n^3 \leq n^2 + 4n$$

$$c \leq \frac{1}{n} + \frac{4}{n^2}$$

$$\cancel{c = 0}$$

$$4n^2 + 3n - 5 \in \theta(n^2)$$

$\forall n > n_0$

$\exists n_0, c_1, c_2 > 0 \quad : \quad c_1 n^2 \le 4n^2 + 3n - 5 \le c_2 n^2$

$$c_1 \le 4 + \frac{3}{n} - \frac{5}{n^2} \le c_2$$

$n_0 = \sqrt{5}$ $\qquad c_1 \le 3$ ✓ $\qquad n_0 = 3$ $\qquad c_2 \ge 5$

$\log_a^n \in \Theta(\log_b^n)$ $\quad a<b$

$c_1 \log_b^n \le \log_a^n \le c_2 \log_b^n$

$\overline{\log_b^n}$ $\quad c_1 \le \dfrac{\log_a^n}{\log_b^n} \le c_2$

عدد ثابت

$f(n)$ $\quad \theta \; \Omega \; \omega \; o \quad$ $g(n)$

$$\lim_{n\to\infty} \frac{f(n)}{g(n)} \begin{cases} \infty \\ c \\ 0 \end{cases}$$

∞:

رسم f ا g أسرع

$f(n) \in \Omega(g(n))$, $f(n) \in \omega(g(n))$

$g(n) \in O(f(n))$ $\quad g(n) \in o(f(n))$

c:

$f(n) \in \theta(g(n))$ $\quad f(n) \in \Omega(g(n))$, نفس

$f(n) \in O(g(n))$ $\quad g(n) \in \theta(f(n))$

0:

رسم f ا g أبطأ

$f(n) \in O(g(n))$ $\quad f(n) \in o(g(n))$

$g(n) \in \Omega(f(n))$ $\quad g(n) \in \omega(f(n))$

$$\sqrt{n} \in \Theta(\log_a(n))$$

$$\lim_{n\to\infty} \frac{\sqrt{n}}{\log_a n} \overset{hop}{=} \lim \frac{\frac{1}{2\sqrt{n}}}{\frac{1}{n \ln a}} = \lim \frac{n \ln a}{2\sqrt{n}} =$$

$$\lim_{n\to\infty} \frac{\ln a}{\frac{1}{2\sqrt{n}}} = \frac{\sqrt{n}}{\ln a}$$

$$= \infty$$