$C_1(n) = \frac{n(n+1)}{2}$ $\boxed{n}$ $\boxed{2n}$ $\approx \frac{n^2}{2}$

Input size $= 2n$

$C_2(n) = \frac{2n(2n+1)}{2}$

$\frac{C_2(n)}{C_1(n)} = \frac{(2n)^2}{n^2} = 4$

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- worst case: n
- best case: 1
- average case

Solution 1:

average $= \frac{1+2+3+\cdots+n}{n}$

$= \frac{n(n+1)/2}{n}$

$= \frac{(n+1)}{2}$

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$1+2+3+\cdots+(n-1)+n$

$n+(n-1)+(n-2)+\cdots+2+1$

$(n+1)+(n+1)+(n+1)+\cdots(n+1)+(n+1)$

$n(n+1)$

$1+2+\cdots+n = \frac{n(n+1)}{2}$

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p: probability of finding K in A

- if we find K in A operation
  $K \to 1, 2, \ldots, n$
- we do not find K:
  n operation

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Average case

$p\frac{(1+2+\cdots+n)}{n}+(1-p)n$

$p\left(\frac{n+1}{2}\right)+(1-p)n$

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Indicate how much the function's value changes if n becomes $4n$

- $\log_2 n$ - 2^n
- $\sqrt{n}$
- n^2
- n^3

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$C_1(n) = \sqrt{n}$

$C_2(n) = \sqrt{4n}$

$\dfrac{C_2(n)}{C_1(n)} = \dfrac{\sqrt{4n}}{\sqrt{n}} = \dfrac{\sqrt{2^2 n}}{\sqrt{n}} = \dfrac{2\sqrt{n}}{\sqrt{n}} = 2$

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$C_1(n) = \log_2 n$

$C_2(n) = \log_2 4n$

$\dfrac{C_2(n)}{C_1(n)} = \dfrac{\log_2 4 \times n}{\log_2 n} = \dfrac{\log_2 4 + \log_2 n}{\log_2 n} = \dfrac{\log_2 4}{\log_2 n} + 1$

$C_2(n) - C_1(n) = \log_2 4 + \log_2 n - \log_2 n = \log_2 4 = 2$

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$C_1(n) = n^2$

$C_2(n) = (4n)^2$

$\dfrac{C_2(n)}{C_1(n)} = \dfrac{4^2 n^2}{n^2} = 16$

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$C(n) = \underbrace{3n^3}+\underbrace{4n^2}$
$\underbrace{+5\,\underline{n}}+\underbrace{2}$

$= \cancel{3}n^3$

$= n^3$

$= O(n^3)$

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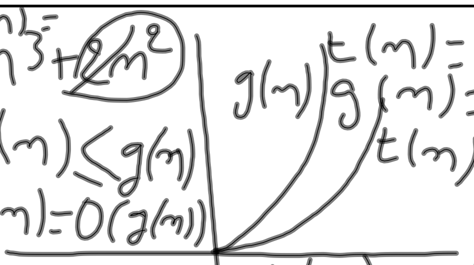
$t(n) = n^3 + \cancel{2}n^2$

$t(n) \le g(n)$

$t(n) = O(g(n))$



$t(n) = n^2$

$g(n) = n^3$

$t(n) = n^2$

$g(n) = n^3$

$t(n) \in O(g(n))$

$t(n) = O(n^3)$

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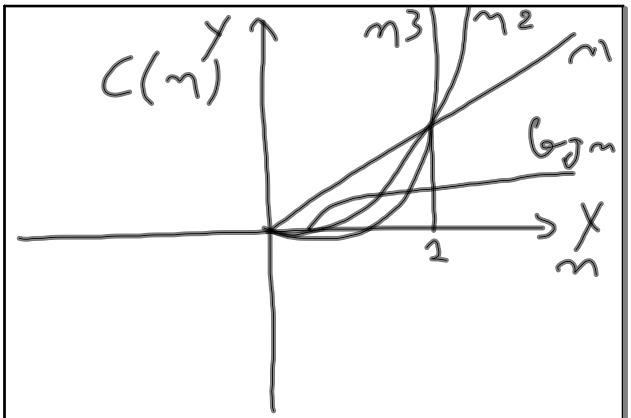

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$- n(n+1) = n^2 + n$

$- 2000 n^2 = 2000 n^2$

$100 n^2$

$0.01 n^3$

$(n-1)!$

$n! = n(n-1)!$

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Are the following assertions true?

$- n \in O(n^2)$ T

$- 100n + 5 \in O(n^2)$ T

$- \frac{1}{2} n(n-1) \in O(n^2)$ T

$t(n) \in O(g(n))$

$t(n) \leq g(n)$

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Big O:

$t(n) = O(g(n))$

if there exists n_0 and c such that:

$t(n) \leq c\, g(n)$ for all $n \geq n_0$

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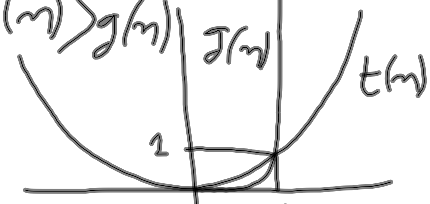
$t(n) = n^2,\ g(n) = n^3$

$[0,1)\ t(n) > g(n)$



$[1, \infty[$

$t(n) \leq g(n)$

$n_0 = 1$

$c = 1$

$t(n) = O\,g(n)$ for $n \geq 1$

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$100 \underline{n + 5 \in O(n^2)}$

c, n_0

$- n \in [0,1)\ n \geq n^2$

$- n \in [1, +\infty[\ n \leq n^2$

$100n+5 \leq 100 n^2 + 5$

$t(n) \leq 100 n^2 + 5n^2$

$= (105) n^2$

$t(n) \leq 105 n^2$

$n_0 = 1, c = 105$

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