Lista 1

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I

① number of atoms $- 10^{78} - 10^{81}$

length of binary string $- 500$

$2^{500} = (2^{10})^{50} \approx (10^3)^{50} = 10^{150}$

$10^{150} > 10^{82}$

② Insert Sort n^2 Quick Sort $2n \log n$

1 comparsinon $- 1,2\,ns$

$n = 1000$

IS) $1000^2 \cdot 1.2\,ns = 1200000\,ns = 1.2\,ms$

QS) $2000 \cdot \ln(1000) \cdot 1.2\,ns \approx 16579\,ns \approx 16.6\,\mu s$

$n = 1,000,000$

IS) $1.2 \cdot 10^{12}\,ns = 1.2 \cdot 10^3\,s = 20\,min$

QS) $33157225\,ns \approx 33\,ms$

$n = 200,000,00$

IS) $4.8 \cdot 10^{16}\,ns = 4.8 \cdot 10^7 \approx 1.5\,y$

QS) $8.8\,s$

$1\,day = 86400\,s = 8.64 \cdot 10^{13}\,ns$

IS) $1.2 \cdot n^2 = 8.64 \cdot 10^{13}$

$n^2 = 7.2 \cdot 10^{13}$

$n \approx 8485281$

QS) $1.2 \cdot 2n \log n = 8.64 \cdot 10^{13}$

$n \log n = 3.6 \cdot 10^{13}$

$n \approx 1.29 \cdot 10^{12}$

II

① $\bar{v}_1 = [1,2,3]$ $\bar{v}_2 = [5,3,4]$

$d(\bar{v}_1, \bar{v}_2) = \sqrt{(1-5)^2 + (2-3)^2 + (3-4)^2} =$

$= \sqrt{16+1+1} = \sqrt{18} = 3\sqrt{3}$

② $\bar{v}_1 = [1,1,1,0,1]$ $\bar{v}_2 = [0,0,1,1,0]$

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$\bar{v}_2 = [0,0,1,1,0]$

$|H_d(v_1, v_2)| = 4$

③ $\bar{v}_1 = [1,2,1]$ $\bar{v}_2 = [1,-1,0]$

$\cos\alpha = \frac{\bar{v}_1 \circ \bar{v}_2}{|\bar{v}_1||\bar{v}_2|}$

$\bar{v}_1 \circ \bar{v}_2 = 1 \cdot 1 + 2 \cdot (-1) \cdot 1 \cdot 0 = -1$

$|\bar{v}_1| = \sqrt{1^2 + 2^2 + 1^2} = \sqrt{6}$

$|\bar{v}_2| = \sqrt{2}$

$\cos\alpha = -\frac{1}{\sqrt{12}\sqrt{6}} = -\frac{1}{12}$

④ $\ln n! = n \ln n - n$ —

$\binom{2n}{n} = \frac{(2n)!}{n!(2n-n)!} = \frac{(2n)!}{2(n!)} =$

$= \frac{2n\ln(2n) - 2n}{2(n\ln n - n)} - \frac{n\ln(2n) - n}{n\ln n - n} =$

$= \frac{\ln(2n) - 1}{\ln n - 1}$

III