Q⇒ There are n persons standing on a straight line, & they want to gather at any one point on the line. Each person knows their current position x_i, & speed with which they walk v_i. Help them to find out in what minimum time they can gather at one point.

$n \le 10^5$, $-10^9 \le x_i \le 10^9$, $1 \le v_i \le 10^9$ → integer

$n = 5$

x_i	v_i
-1	5
10	3
4	2
7	10
8	1

5	
-1	5
10	3
4	2
7	10
8	1

ans → 1.5

↓ print ans with precision of 10^{-6}

coordinates of people

x_1 x_2 x_3 ---------- x_i ---------- x_n

→ Each person might be travelling with a diff speed.

Let's say the point of meeting comes as x

Each person will take $\frac{|x_i - x|}{v_i}$ time to reach x

and total time taken by all to reach x will be

→ $\max\left(\frac{|x_i - x|}{v_i}\right)$

$$T(x) = \max\left(\frac{|x_i - x|}{v_i}\right) \quad \forall i$$

$T(x)$ → total time taken by people to meet at x

we have to minimize this $T(x)$

→ Minimax problem

minimum of a maximum

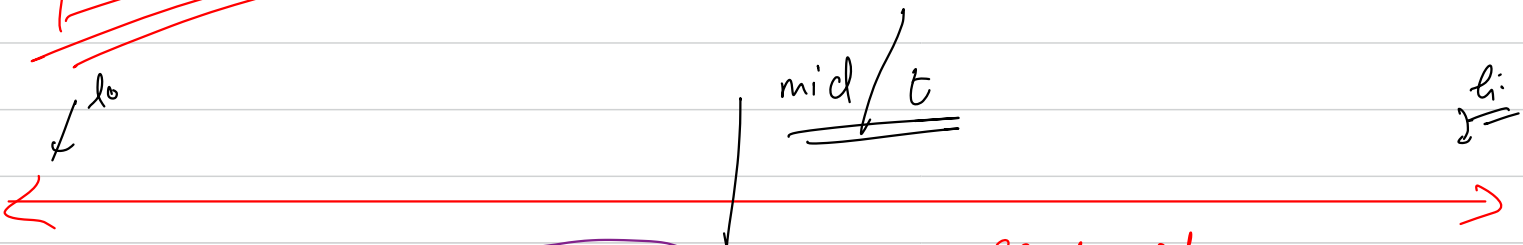
BS² → good

problem is to first find that valid x

time ← $T(x) =$ max $\left(\frac{|x_i - x|}{v_i}\right)$

$T(x)$ → minimum $T(x)$

Binary search



search space will reduce time

if $T(x) \leq mid$

↳ go left

else go right

x is unknown

$$\max\left(\frac{|x_i - x|}{v_i}\right) \leq t$$

$\forall i \rightarrow \frac{|x_i - x|}{v_i} \leq t$

$|x_i - x| \leq v_i \times t$

$x_i - t v_i \leq x \leq x_i + t \times v_i$

inequality → has range of value

for $i=0$

for $i=1$ →

for $i=2$

$\forall i$

hold range

intersection of valid ranges

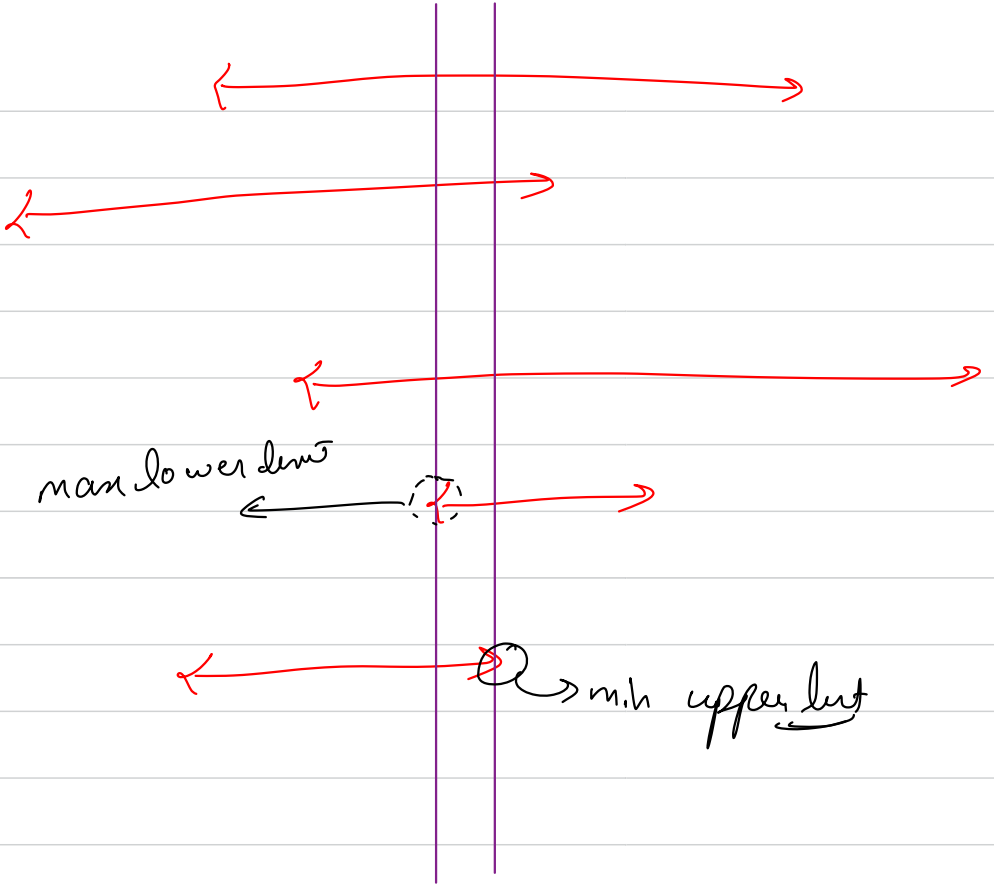
We saw that the common part of the ranges is the part when for every i $\frac{|x_i - x|}{v_i} \leq t$

So,

if this intersection exists that means we have a valid ans

Otherwise

no valid range


max lower bound
min upper bound

Q) You have a list of n integers. Your task is to divide them into K segments so that maximum sum on the segment in minimum possible.

$n, K \leq 10^5$ $\quad a_i \leq 10^9$

Print the minimum possible maximum sum.

↳

$n = 10 \quad K = 4$

$\{1, 3, 2, 4\}, \{10\}, \{8, 4\}, \{2, 5, 3\}$

10 10 12 10

ans → 12

Don't keep the loop const.

$$O\left(n \times \log \frac{1}{\epsilon}\right)$$

$0 \longrightarrow p^2$

R

AT

AT − R

AT − 2R

AT − 3R

AT − NR

iterations

$AT \rightarrow p^2$

$\therefore N \approx \frac{AT}{R}$

$T \times 50 \times 10^6 \times 20$

$\approx 10^8$

$O\left(T \times n \times \frac{p^2}{R} \log p^2\right)$

$O\left(T n p^2 \log p^2\right)$

$8 + 28 + 38 \text{ ----- }$

$8(1 + 2 + 3 \text{ ------ } p)$

$\frac{p \times (p+1)}{2} \times 8 \longrightarrow \approx p^2$