

Ternary search is used to find a minima or maxima in a given range . Unlike binary search where we partition the current range in two parts by taking a mid value , here we take two mid values say  $m_1, m_2$  and break the range in three smaller partitions . Let us understand this with an example . Read the problem statement in the link given below :

<http://codeforces.com/contest/782/problem/B>

Let us consider a point P where , when all n friends meet at point P , the time required will be minimized . If we move away from that point in either direction then total time taken by all friends to reach the point will be more than time taken to reach point P . Here we have to find a minima i.e. point P . So we can use ternary search here .

We have made it clear that we want to find a minima and now let us consider two mid values  $m_1, m_2$  and the range on which we using ternary search be  $[l, r]$  and here  $l, r, m_1, m_2$  represent distance from origin . Then

$$m_1 = l + (r - l) / 3$$

$$m_2 = r - (r - l) / 3$$

But how to determine new range from this values ? We will make a function , say  $fn(x)$  which will return us the amount of time taken by all friends to reach some point x .

Now , if  $fn(m_1) > fn(m_2)$  , we will reduce our search range to  $[m_1, r]$  i.e. we will make  $l = m_1$  because if time taken to reach  $m_1$  is more than that of  $m_2$  , then we will never find our minima in range  $[l, m_1]$  , so we are just discarding that range .

Similarly , if  $fn(m_1) < fn(m_2)$  then we will reduce our search range to  $[l, m_2]$  i.e. we make  $r = m_2$ .

These shift of l and r will become exactly opposite if we want to find a maxima.

Now the main part , all these values should be used as double data types and usually we keep breaking condition in while loop as :  $r >= l$  .

But here we will use breaking condition as :  $r - l > \text{max\_error\_allowed}$  . Because when l and r have come closer than the max. error that is permitted in the answer then we can break the loop and give our answer as either l or r .

Here are some problems that you can solve on ternary search:

<https://www.hackerearth.com/problem/algorithm/rescuer-1/>

<http://codeforces.com/contest/782/problem/B>

<http://codeforces.com/problemset/problem/578/C>

<https://www.codechef.com/problems/CPOINT>