University of New South Wales (UNSW)

Algorithm Design & Analysis

Formatif Submission

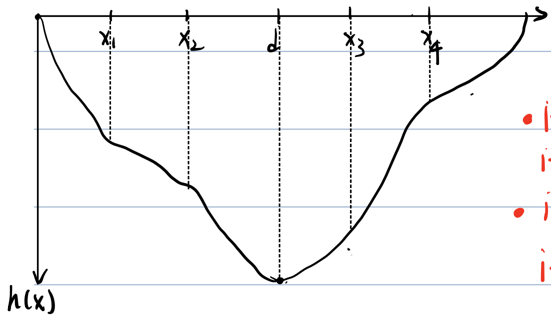
(R) Marinara Trench

Submitted By:
Yingjie Cai
z5540730
2024/09/25 13:30

Tutor:
Kieren Huynh

September 25, 2024

a): ($h(x)$ represents the depth)
Because the depth strictly increases from 0 to d and decreases from d to n.
then we have $h(x_1) < h(x_2) < h(d)$; $h(d) > h(x_3) > h(x_4)$ according to the sketch



- if $d < 10$, then we have $h(d) > h(10) > h(20)$
$h(10) = 600 < h(20) = 800$. it's impossible.
- if $10 < d < 20$, then we have $h(10) < d$, $h(20) < d$
it's possible because of no contradictory
- if $d > 20$, then we have $h(10) < h(20) < h(d)$
it's also possible. So the position $d > 10$ is possible

b): Algorithm: randomly choose 2 points n_1, n_2 ($n_1 < n_2$), the distance between them is $\frac{n}{2}$ (n is the length of trench). Then compare $h(n_1)$ and $h(n_2)$

- if $h(n_1) > h(n_2)$ according to a), the deepest point range is $\boxed{0 \sim n_2}$, then $n = n_2 - 0$
- if $h(n_1) < h(n_2)$, the deepest point range is $\boxed{n_1 \sim n}$ then $n = n - n_1$
- if $h(n_1) = h(n_2)$, the deepest point range is $\boxed{n_1 \sim n_2}$, then $n = n_2 - n_1$

Repeat until the search range smaller than 0.01 km

c): according to b. everytime choose 2 points, we reduce the search range to an extent. So assuming the reduced ratio is k $k (0 < k < 1)$ Then we have $T(n) = aT(\frac{n}{b}) + O(n^d)$ $a = 1$, we split it into 1 subproblem (like binary search) $b = k$, $O(n^d) = 2$ so $d = 0$ (everytime we chose '2' points). $\log_b a = \log_k 1 = 0$, $d = 0$ So $\log_b a = d$
Then $T(n) = O(n^d \log n) = O(\log n)$
The number of measurement: $2 \cdot \log n$.