Some Common Guesses

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$$T(n)=T(n-1)+1$$

•
$$T(n)=T(n-1)+n$$

$$O(n^2)$$

•
$$T(n)=T(n-1)+n^2$$

$$O(n^3)$$

•
$$T(n)=T(n-1)+1/n$$

•
$$T(n)=T(n/2)+1$$

•
$$T(n)=T(n/2)+n$$

•
$$T(n)=2T(n/2)+n$$

•
$$T(n)=2T(n/2)+n^2$$

$$O(n^2)$$

Question 1:

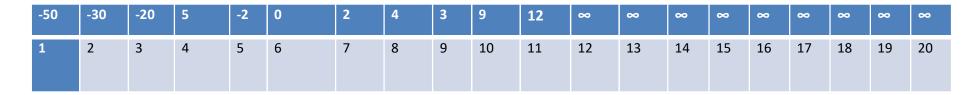
- **Input:** An sorted array of n-distinct element
- Output: Find any element A[i] such that A[i] == i

-50 -30	-20 -10	<mark>-2</mark>	0	2	4	6	9	11	12	14	15	17	19	20	<mark>25</mark>	27	30
1 2	3 4	<mark>5</mark>	6	7	8	9	10	11	12	13	14	15	16	17	<mark>18</mark>	19	20

- When we came to the middle element in Binary Search 1st place is 9 so if we go left then 9th place value cannot be 9 but if we go right i.e. 11th position value can be 10 or 11 so there is a hope of going right
- Answer- Binary Search (logn)

Question 2:

- <u>Input:</u> An array of n-elements in which until some places all are integers and afterwards all are infinity.
- Output: Find 1st position of infinity



Answer: After applying Binary Search, we reach at middle element and at this position we check whether it is integer or ∞ , it says I am integer than ∞ must lie at its right side. Now, it reach to right side's middle, then it compare with 1^{st} left element, ask are you ∞ or integer not then it says yes I am ∞

Question 3:

- Input: A sorted array of n-distinct element
- Output: find any 2 element a & b such that a+b=1000

100	200	300	400	500	600	700	800
1	2	3	4	5	6	7	8

- Linear Search = O(n^2)
- Binary Search = O(nlogn)

(0) SUBSTITUTION METHOD

step 1: Guess the form of solution strakenos ent boil ot noitoubris lesitamentem eall : & dete and whow that the solution works.

region method can be used to establish upper or lower bounds on a securation.

0

dolue the recurrence T(n) = &T(Ln/21)+n by 1=(1)7 shot bouts noitutitedule

Guess the Solution. $T(n) = O(n\log n)$ is $T(n) \leq C \cdot (n\log n) = O$ the Mathematical Induction.

Base Condition n = 1 $T(n) = O(n\log n)$ $T(n) = O(n\log n)$ $T(n) = O(n\log n)$ $T(n) = O(n\log n)$ Guess the Solution. the Mathematical Induction.

Base Condition n= 1

T(1) € C-1. log1 1 ≤0 False

27(1)+2 \(\) c.2
2+2 \(\) a.c \(\) Touce
: T(K) & CKlogk for 2 < K < 0

Industive step.
Assume that it is true for 1/2.

surt is a pal a.s > (c/n)T n=1 so for is ti take ounts at such su woll T(n) & cologn we know that $T(n) = 2T\left(\left\lfloor \frac{n}{2} \right\rfloor\right) + n$ 2.ch log n + n

Remove floor as

2 > [Ma] exlogk for K= N/2 $\leq Cu(\sqrt{2d^2u} - \sqrt{2d^2s}) + u$ $\leq eupdr - cu + u$ $\leq \frac{\text{cupd}^{2}U}{\text{cupd}^{2}U} + (1-c)U$ ·· T(n) = O(nlogn) Consider the sucurrence $T(n) = T\left(\left\lfloor \frac{2}{n}\right\rfloor\right) + 1, \quad T(n) = 0$ Guessing the dolution $n^{\log_2 t} = n^\circ = t$ let $T(n) = O(\log n)$ case 2 = 1. rodu Use Mathematical Induction 1 Base Condition

0 = 1

T(1) \leq c.log1 \pm \leq 0 False When n = 2 $T(2) \leq$ c.log2 $T(1) + 1 \leq$ c \pm \leq c. Time

Now we assume it is true still k for 2≤ K≤ n T(K) < C. log K

Doductive step.

Assume that it is true for $n \mid a$ ie $T(n \mid a) \leq c \cdot \log \frac{n}{a}$ is true

How we have to show that it is true for $n \mid a \mid a \mid a \mid a$ $T(n) \leq c \cdot \log n$

We know that $T(n) = T\left(\left\lfloor \frac{n}{2} \right\rfloor\right) + 1$