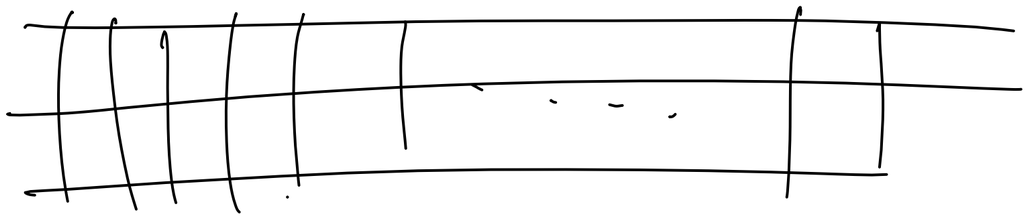
09.09.2024

ED(i, j) : Edit distance.

Input: String A: [1 - - - n]

B: [1 - - - m].

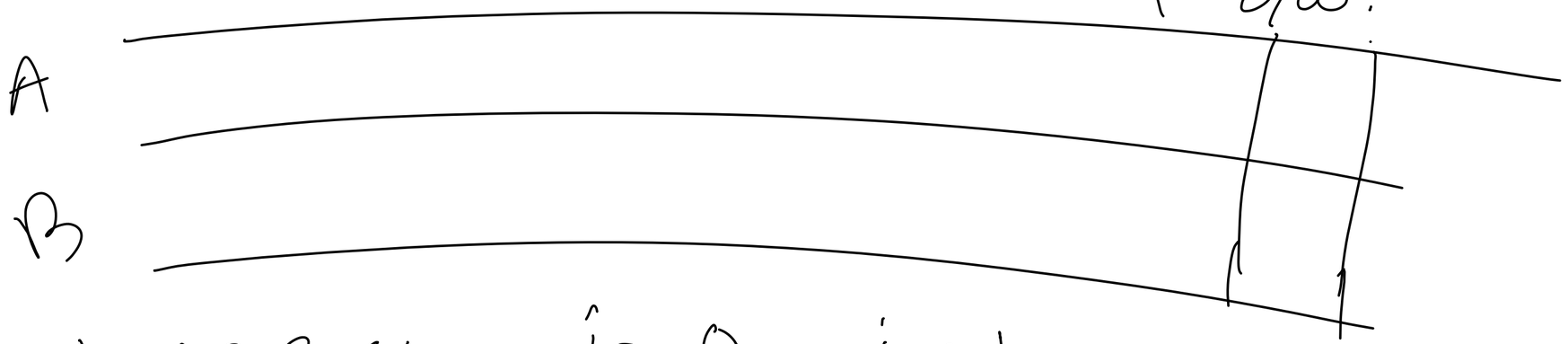


$\begin{cases} A[1 \cdots i] & 1 \le i \le n \\ B[1 \cdots j] & 1 \le j \le m \end{cases}$

i = 0 / j = 0 ≡ empty string.

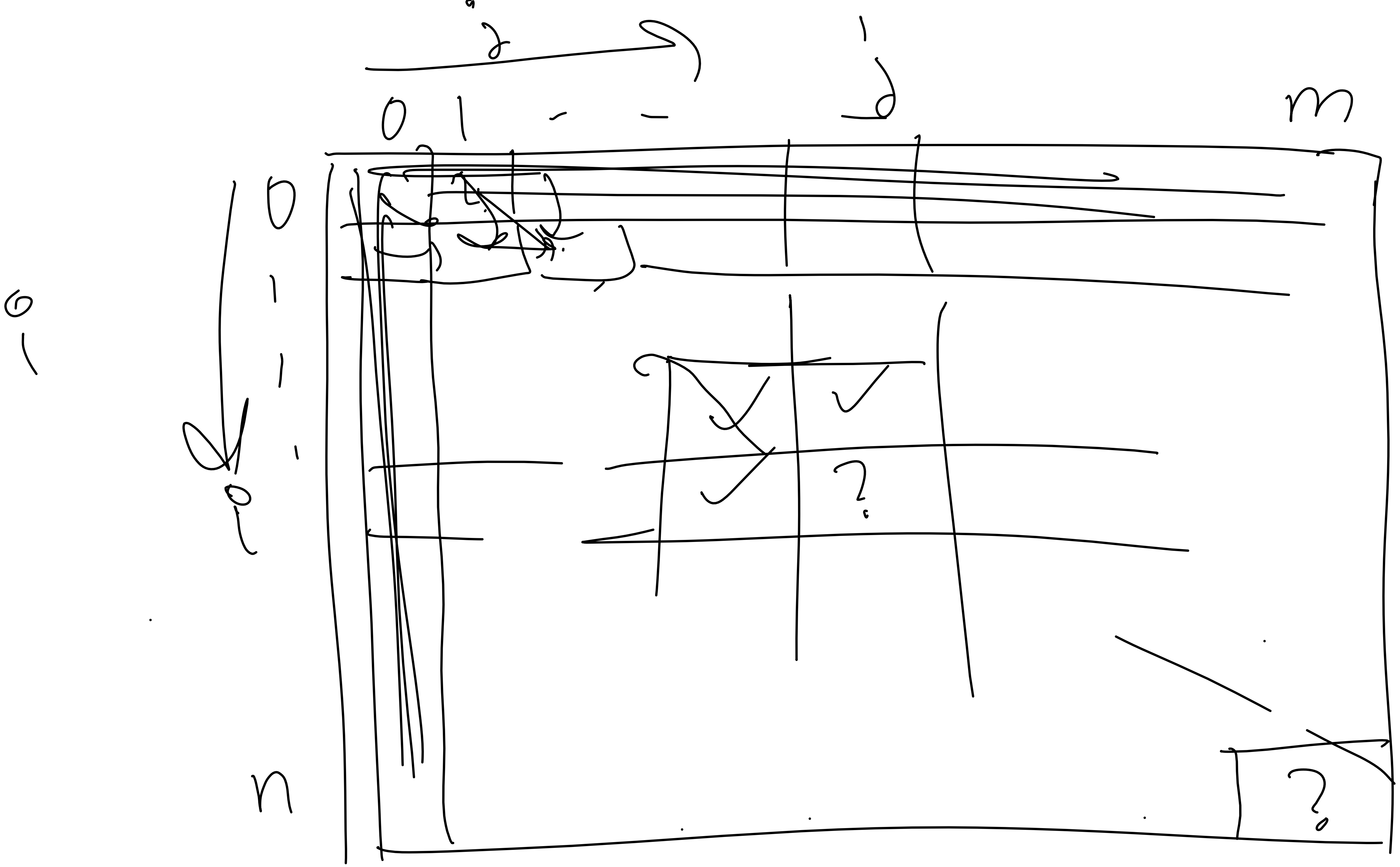
$$ED(i,j) = \begin{cases} ED(i,j-1)+1 \\ ED(i-1,j)+1 \\ ED(i-1,j-1)+\delta(i,j) \end{cases}$$

$\delta(i,j)$: 0 if agree, 1 o/w.

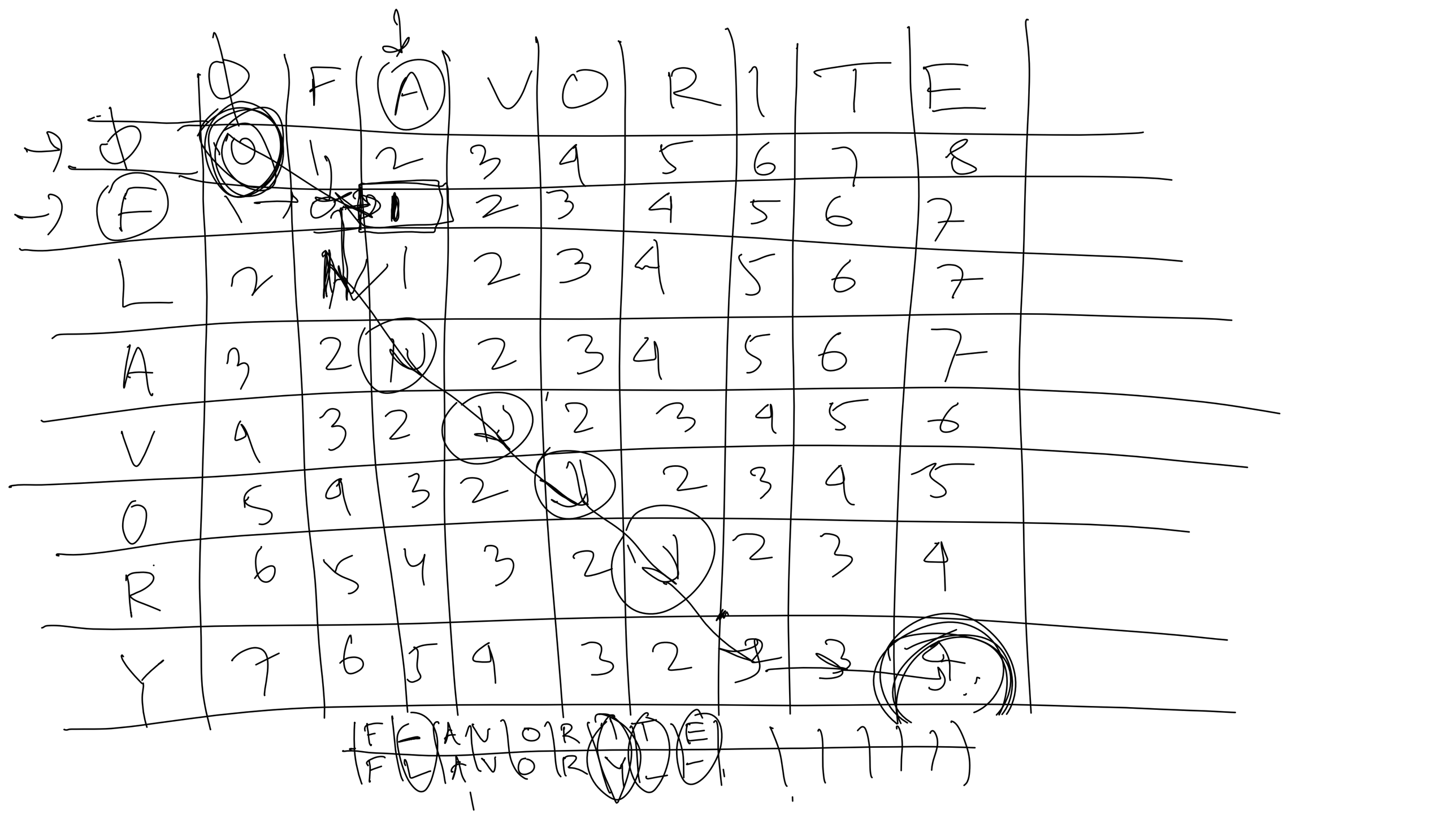


base case: $i = 0, j = 0, 1, \ldots, m.$

$$ED(0,j) = j$$
$$ED(i,0) = i$$



ED[n,m].


D F A V O R T E
D 0 1 2 3 4 5 6 7 8
F 1 1 2 2 3 4 5 6 7
L 2 2 1 2 3 4 5 6 7
A 3 2 2 2 3 4 5 6 7
V 4 3 2 3 2 3 4 5 6
O 5 4 3 2 3 2 3 4 5
R 6 5 4 3 2 3 2 3 4
Y 7 6 5 4 3 3 3 3 4
FAVORITE
FLAVORITE

Procedure EditDist. (A, B, n, m)

~~ED ← empty~~ // n = length(A), m = length(B)

ED ← empty table of size (n+1) × (m+1)

for j = 0 to (m+1)

    ED(0, j) ← j

for i = 0 to (n+1)

    ED(i, 0) ← i

for i = 1 to (n+1)

    for j = 1 to (m+1)

$$ED(i,j) = \min \begin{cases} ED(i-1,j) + 1 \\ ED(i,j-1) + 1 \\ ED(i-1,j-1) + 1 & \text{if } A[i] \neq B[j] \\ ED(i-1,j-1) & \text{if } A[i] = B[j] \end{cases}$$

Exercise: Modify the pseudocode so that it also returns an alignment?

align_A , align_B ← (n+m) empty arrays

Time Complexity : $\Theta(nm)$

~~FAVORITE~~

FAVORITE

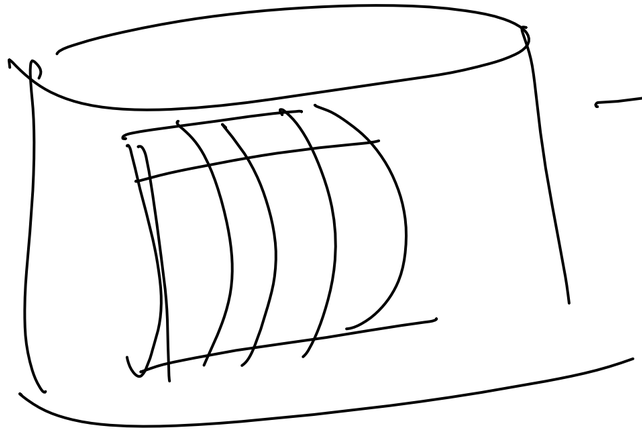
FLAVORY

- DP is always associated with DP Table.

(i, j)

- Defining subproblems is extremely important.

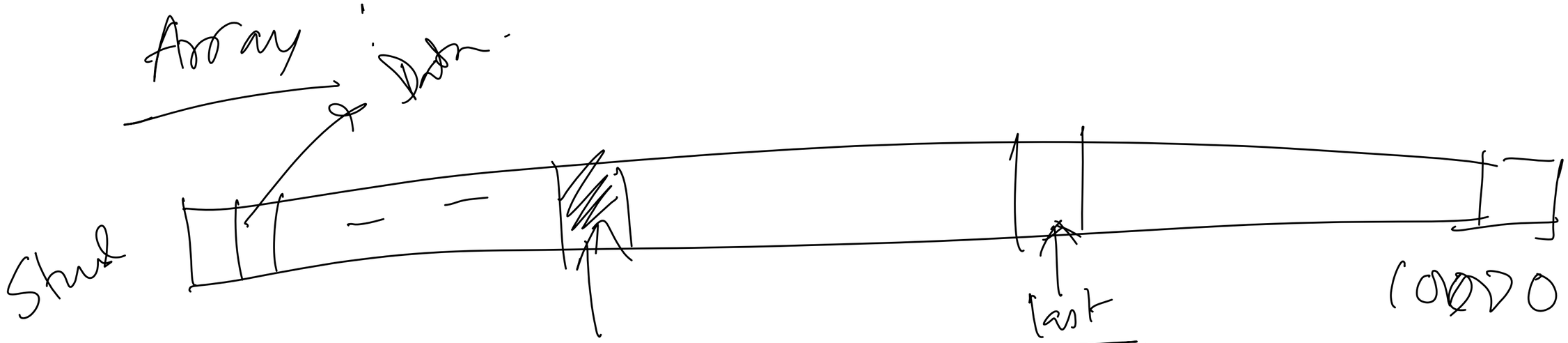
Binary Search Tree



→ roll no, Contact, CPI, transcript.

struct
student

- insert.
- delete.
- search.
  (roll no, data)



- insert:

stud[last] ← new

last ++.

O(1)

- ~~delete~~? search. ~ O(n).

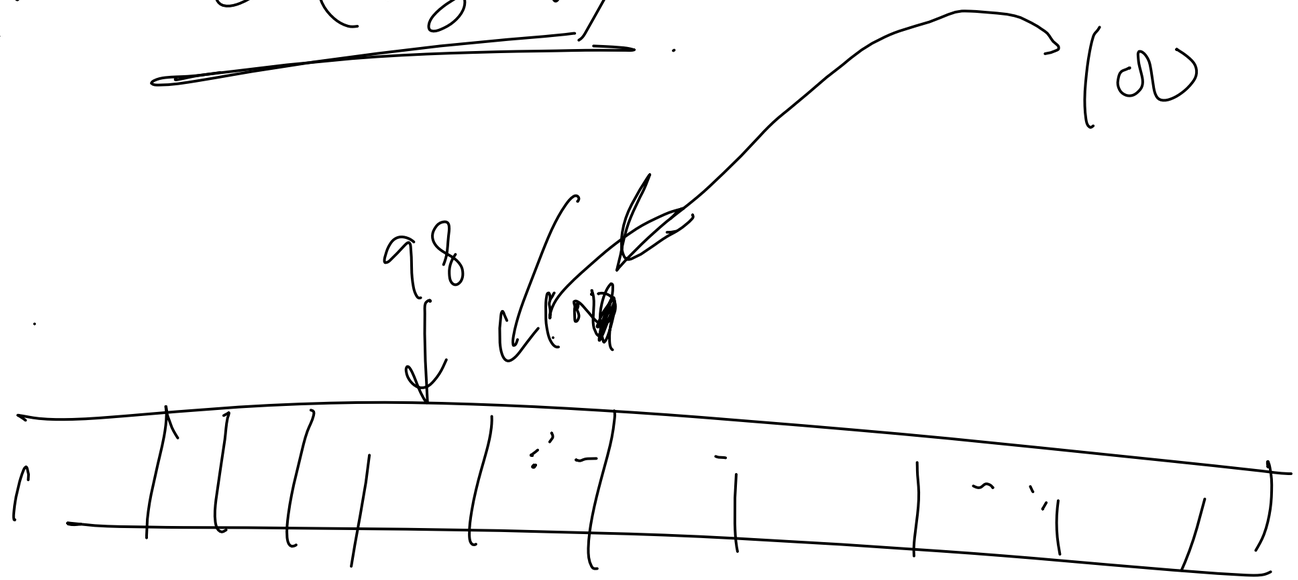
- delete ?.

Sorted Array

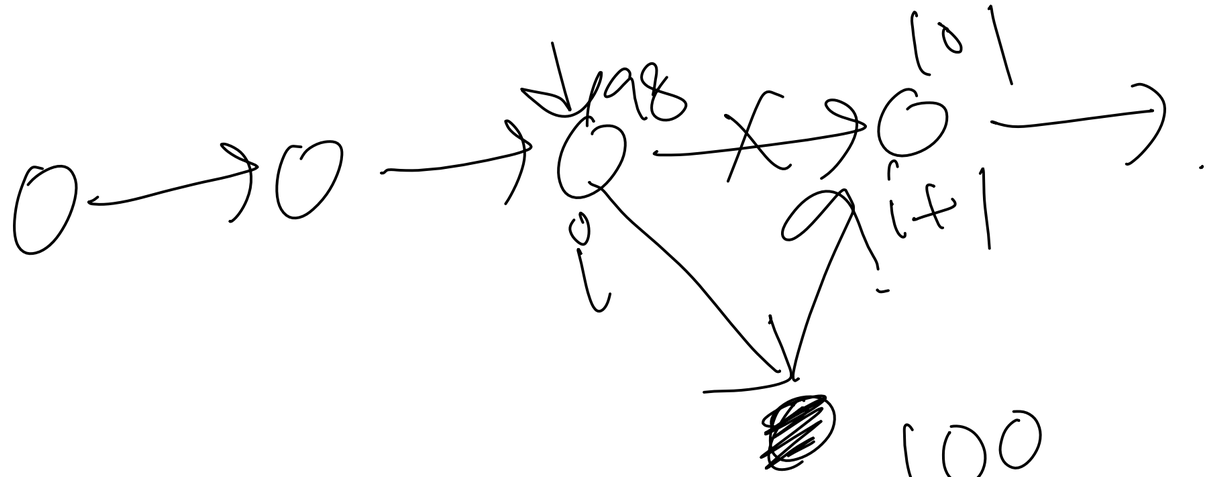
Search: O(log n)

Insert

O(n)



Delete



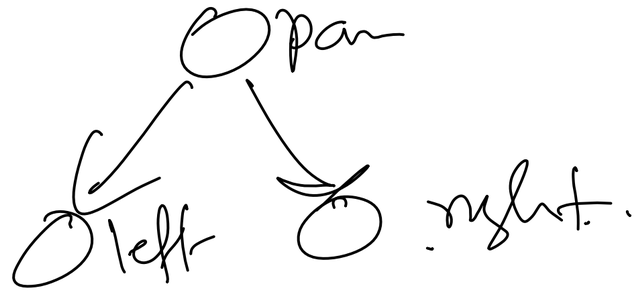
(Balancing) Binary Search Tree

Insert
Delete
Search

$O(\log n)$

19, 431, 572, 72, 1042, 2, 3

Binary Tree : [Directed]




```
struct Node{
    Node *left
    Node *right
    Node *parent
    int key;
};
```

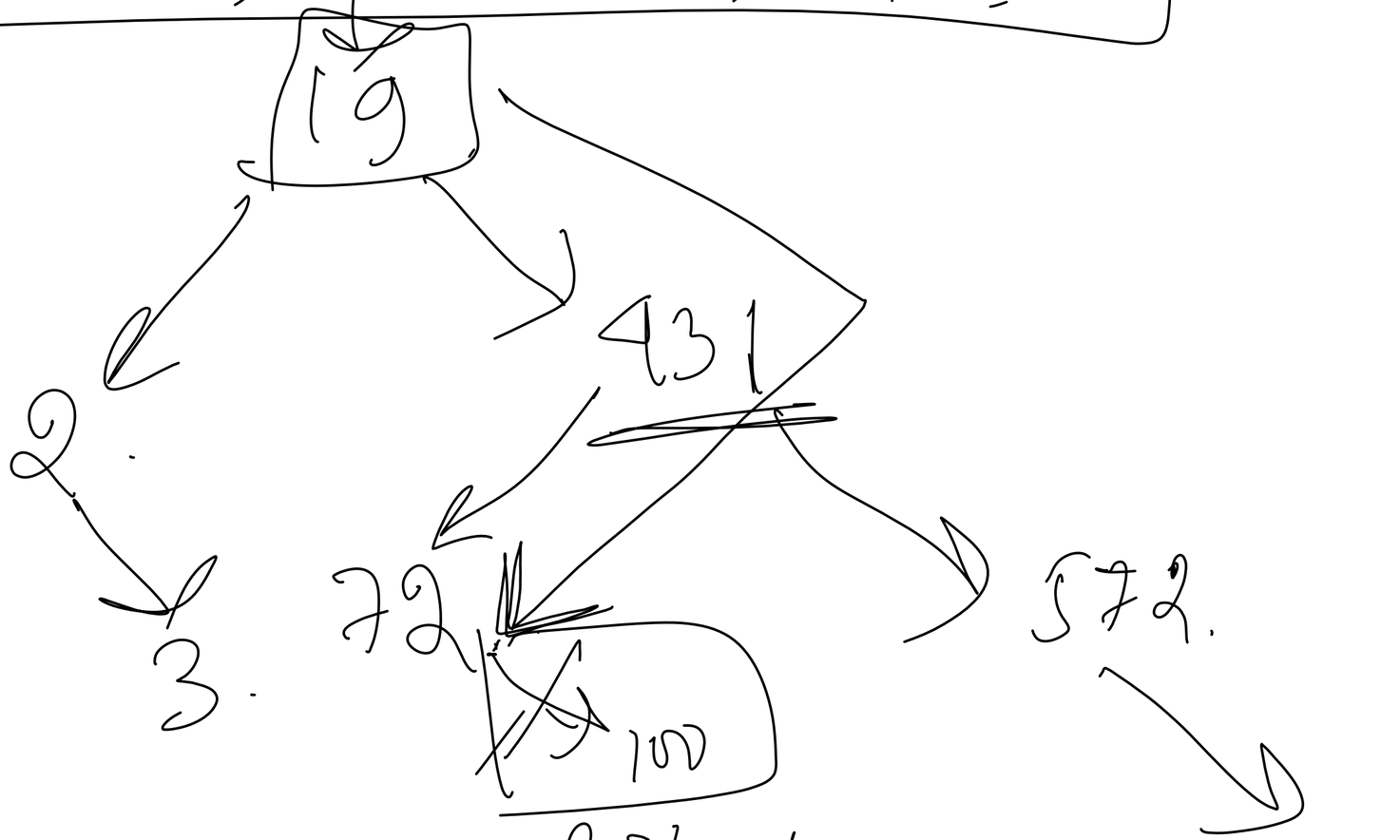
Node.left

Node.right

Node.parent

Node.key

19, 431, 572, 72, 1042, 2, 3.



572 ? yes

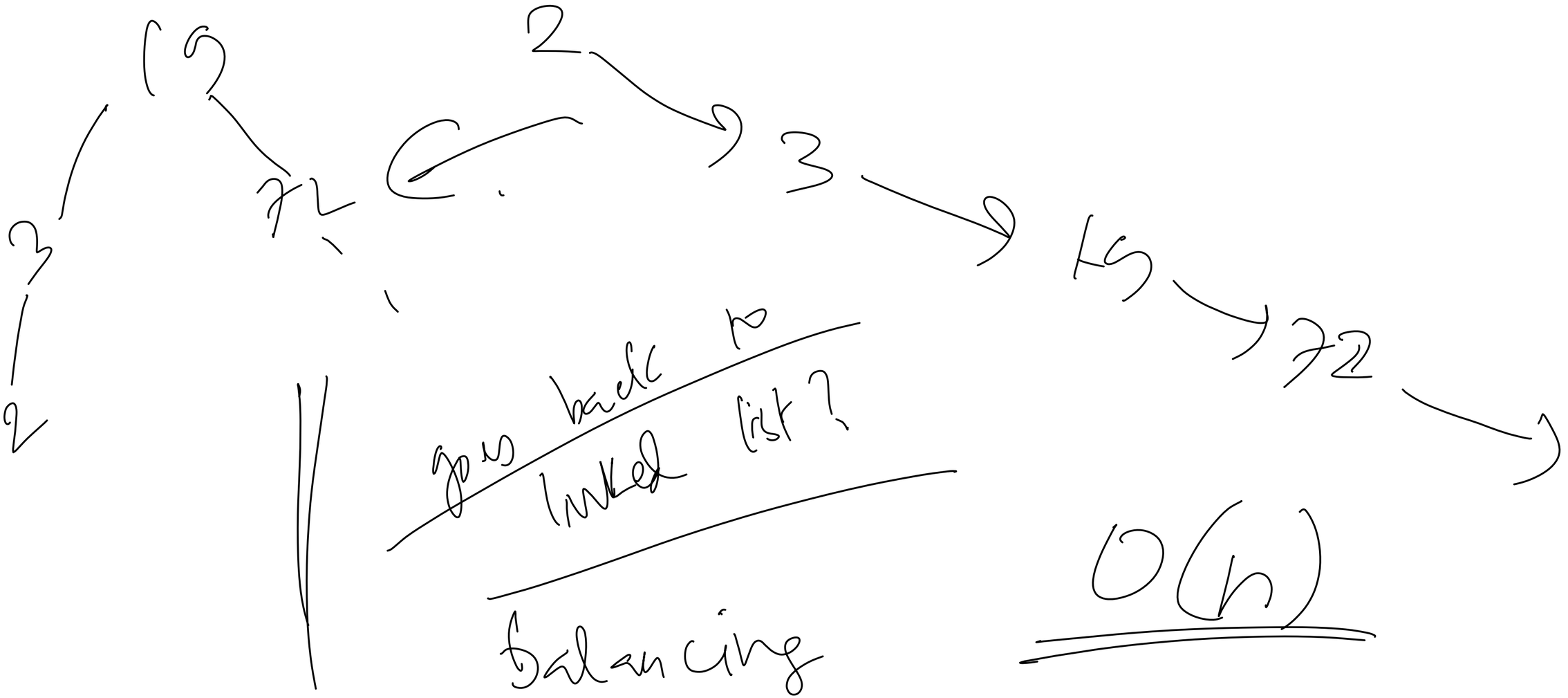
572 == 572

TRUE

Assumption:- keys are distinct.

- total ordering between key

2, 3, 19, 72, 431, 572, 1092.



- Insert
- ~~Del~~ Search
- Delete