

# HASHING - 1

WELCOME!!

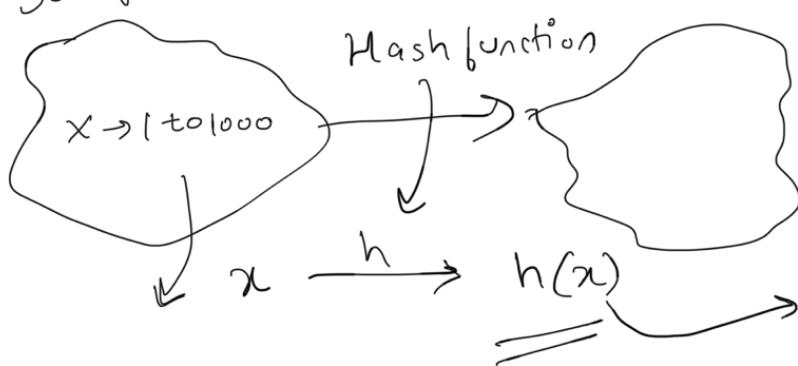
1. Pace ↑

2. Doubt Session →

3. More Problems! →

## HASHING

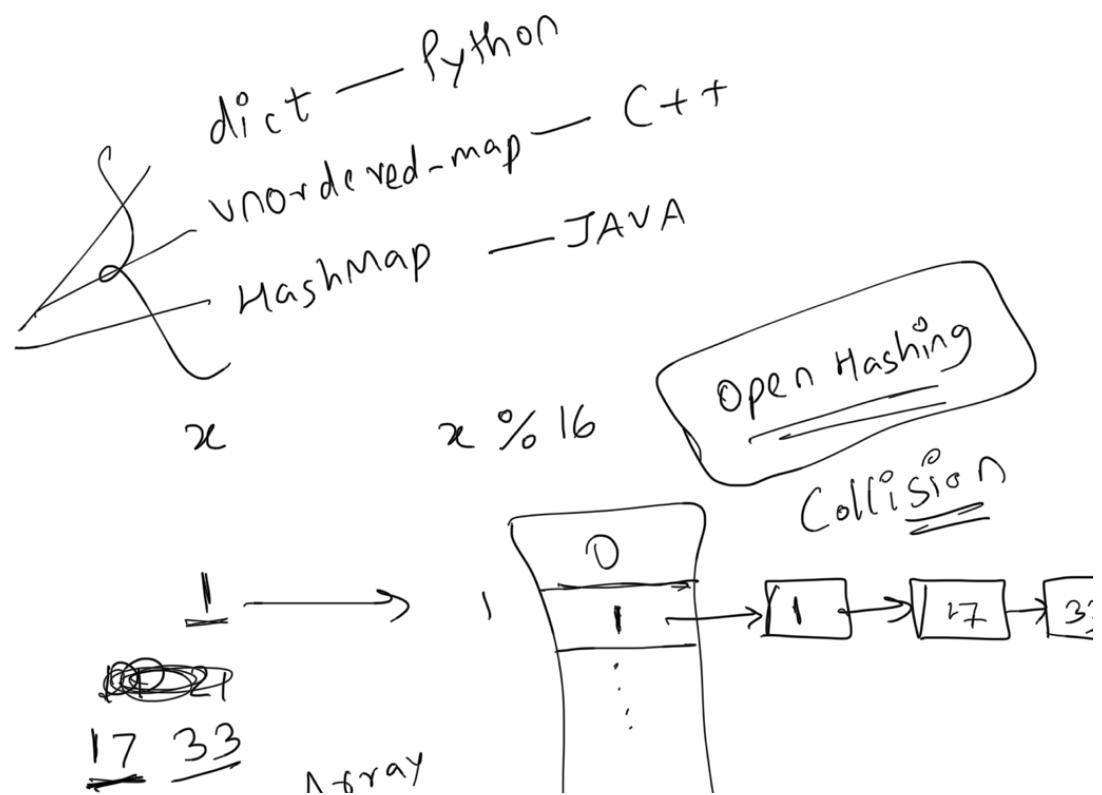
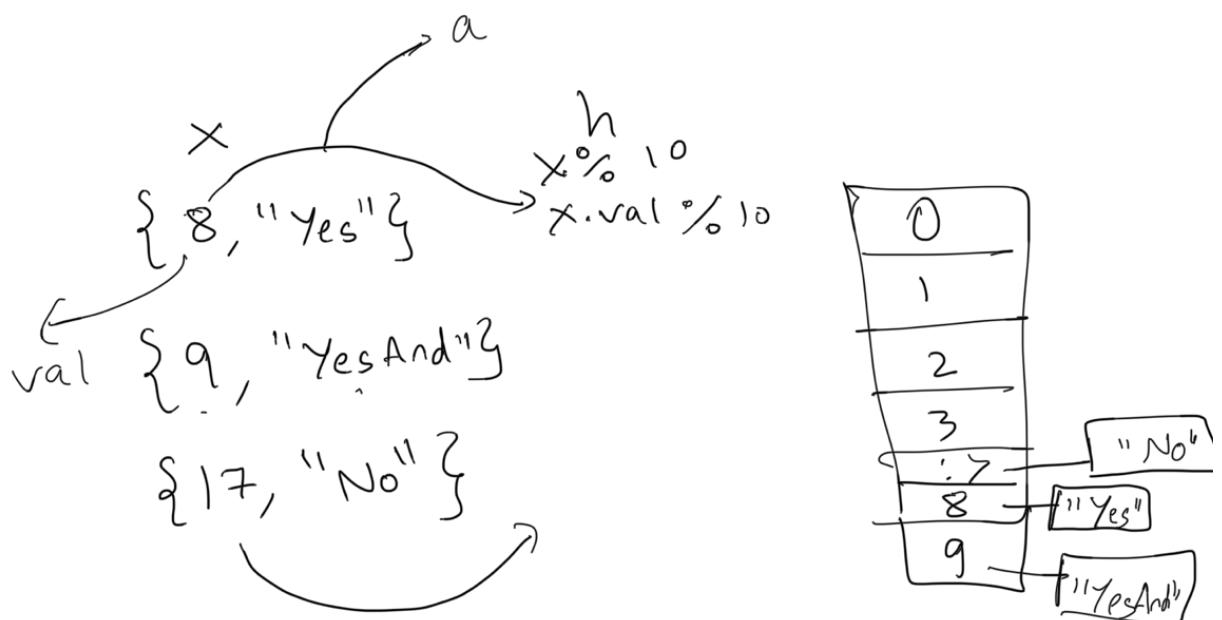
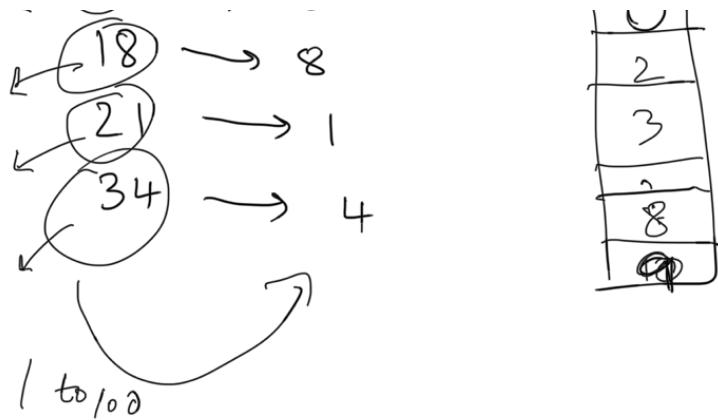
Set of values.



$$x \xrightarrow{h} \frac{x \% 10}{8}$$

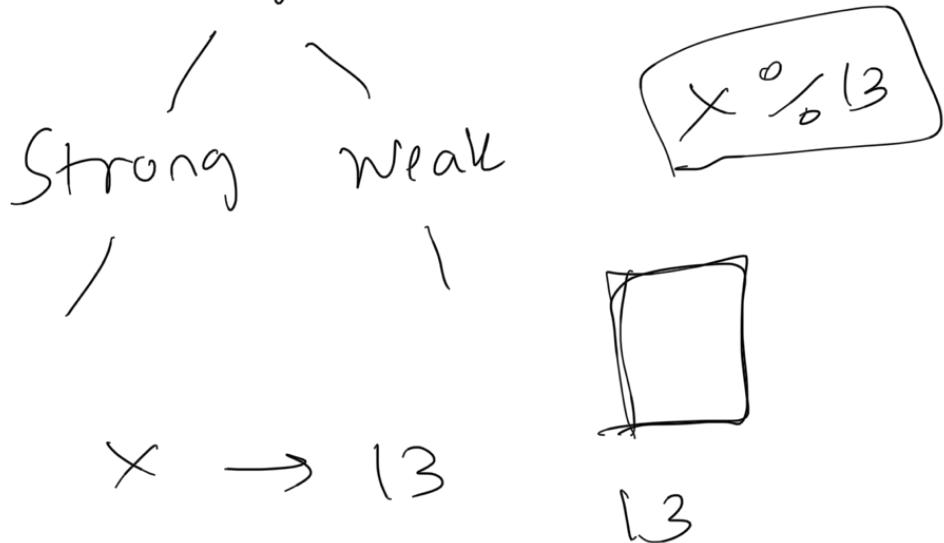
$\leftarrow \textcircled{8} \rightarrow$

$1 \overline{0}$





Hash function



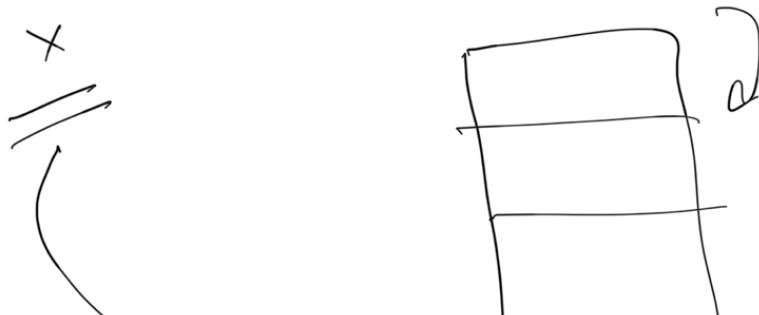
Hash Maps

insert("x")

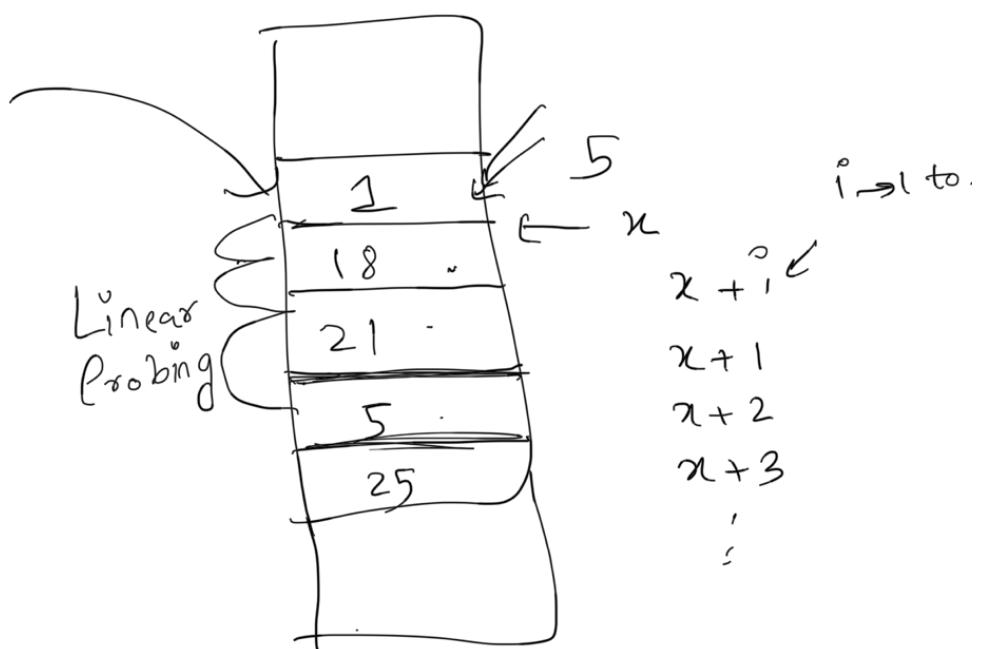
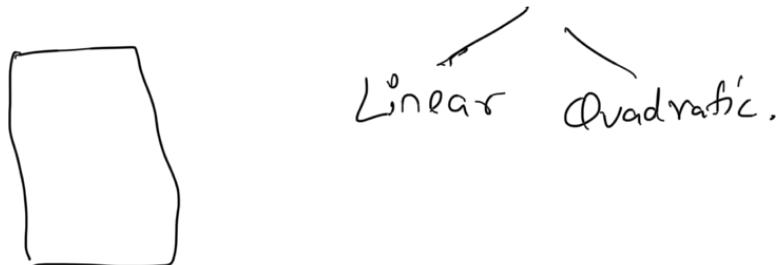
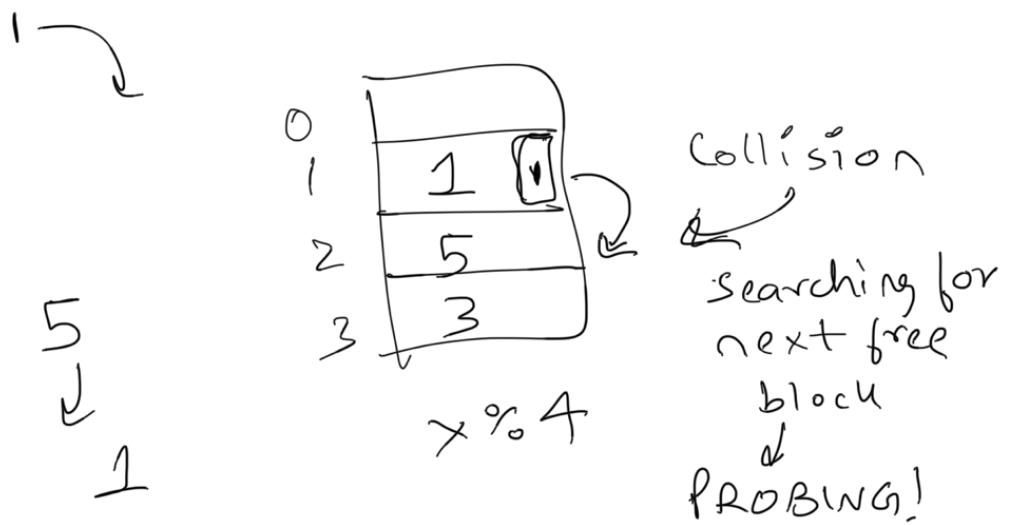
Search("x")

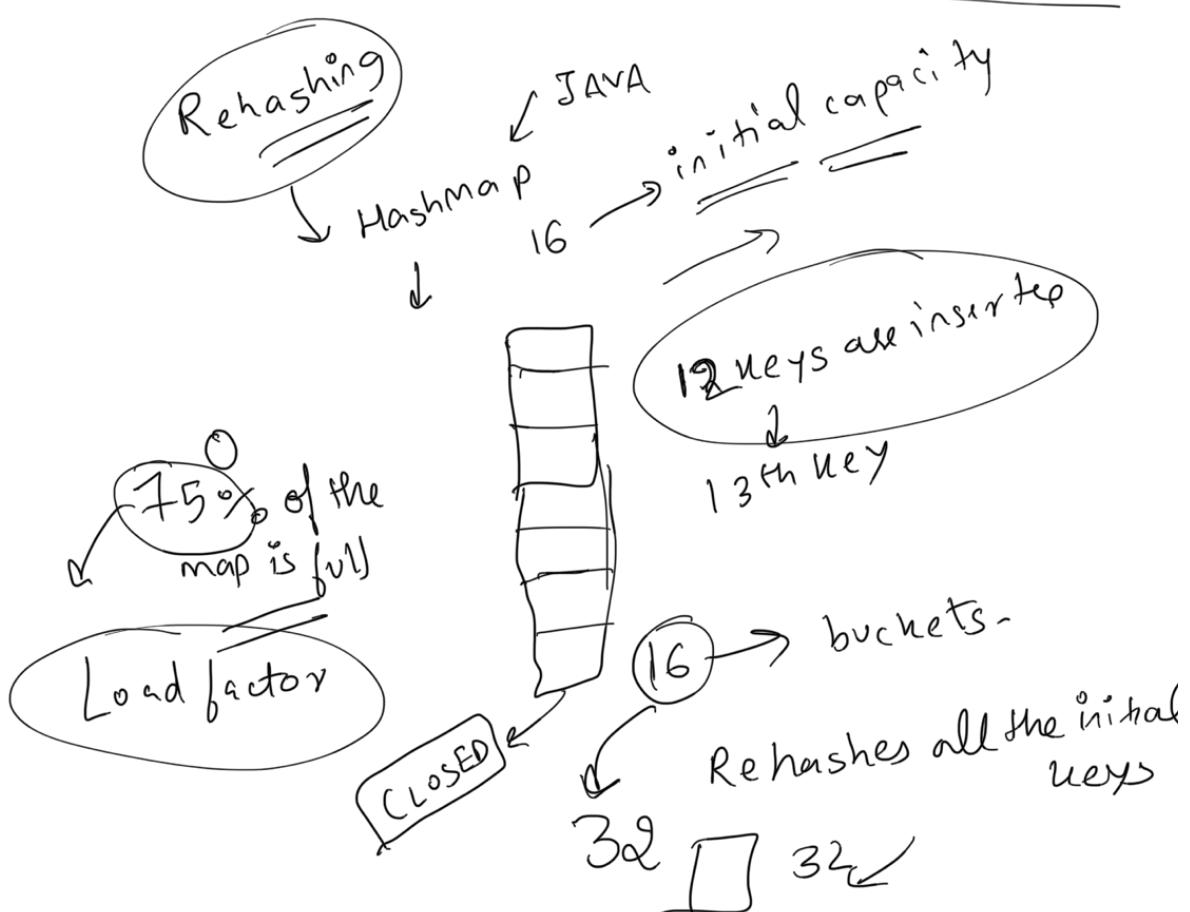
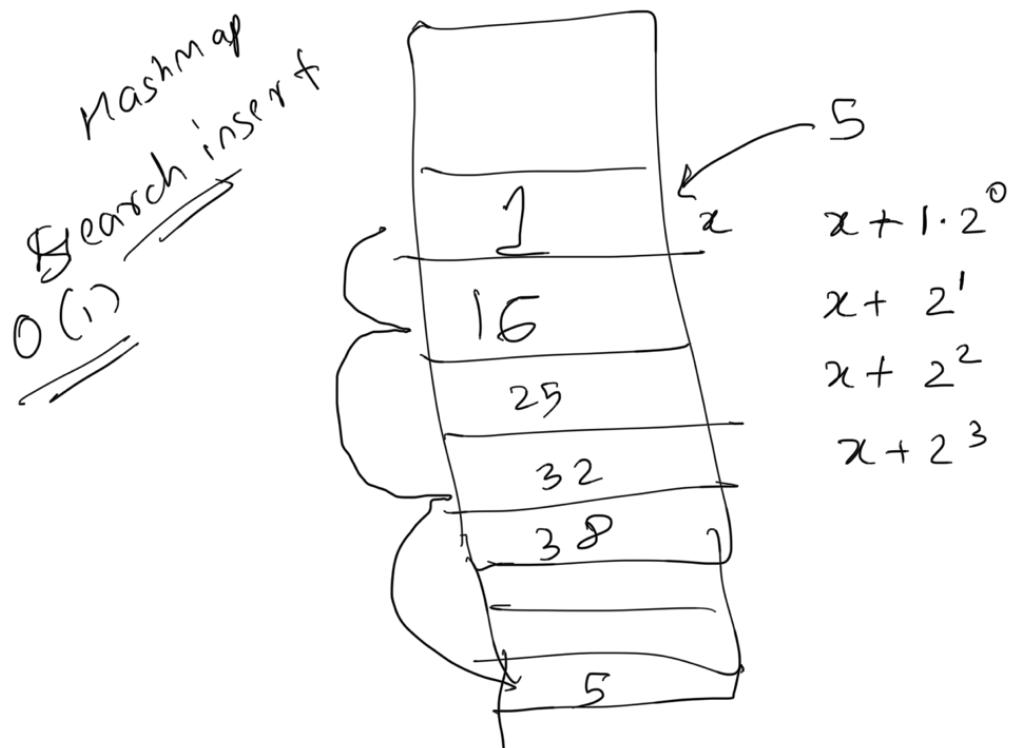
delete("x")

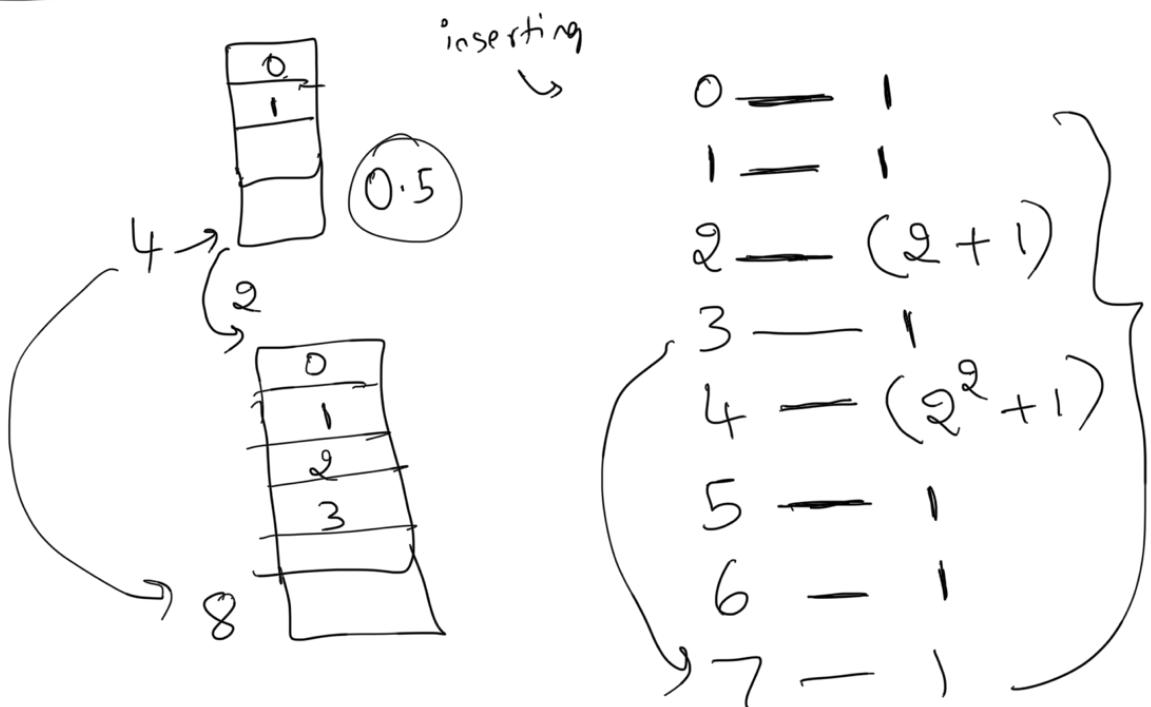
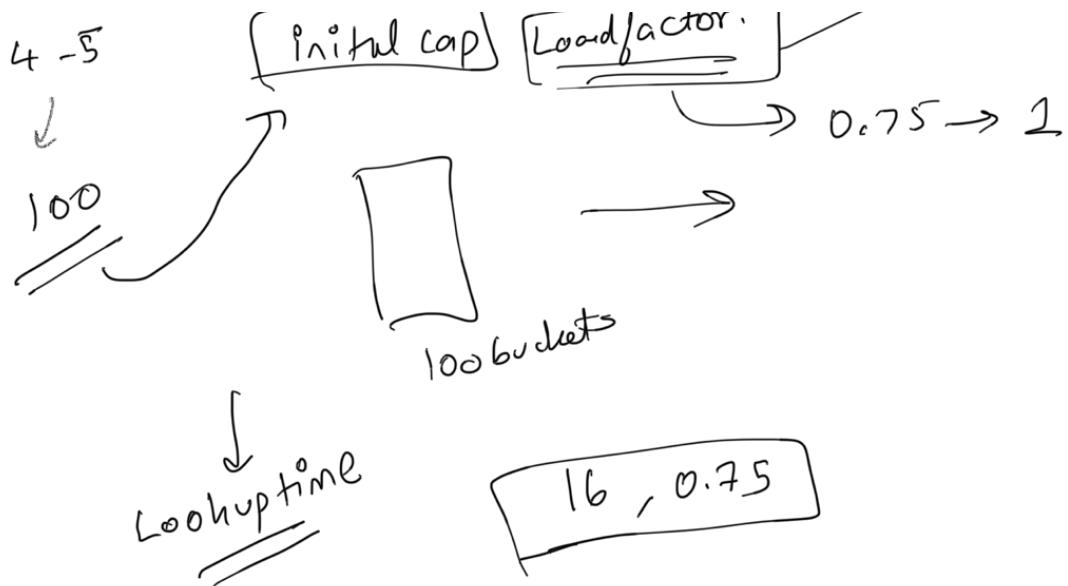
Closed Hashing      Open Addressing



$$h(x \% 16)$$







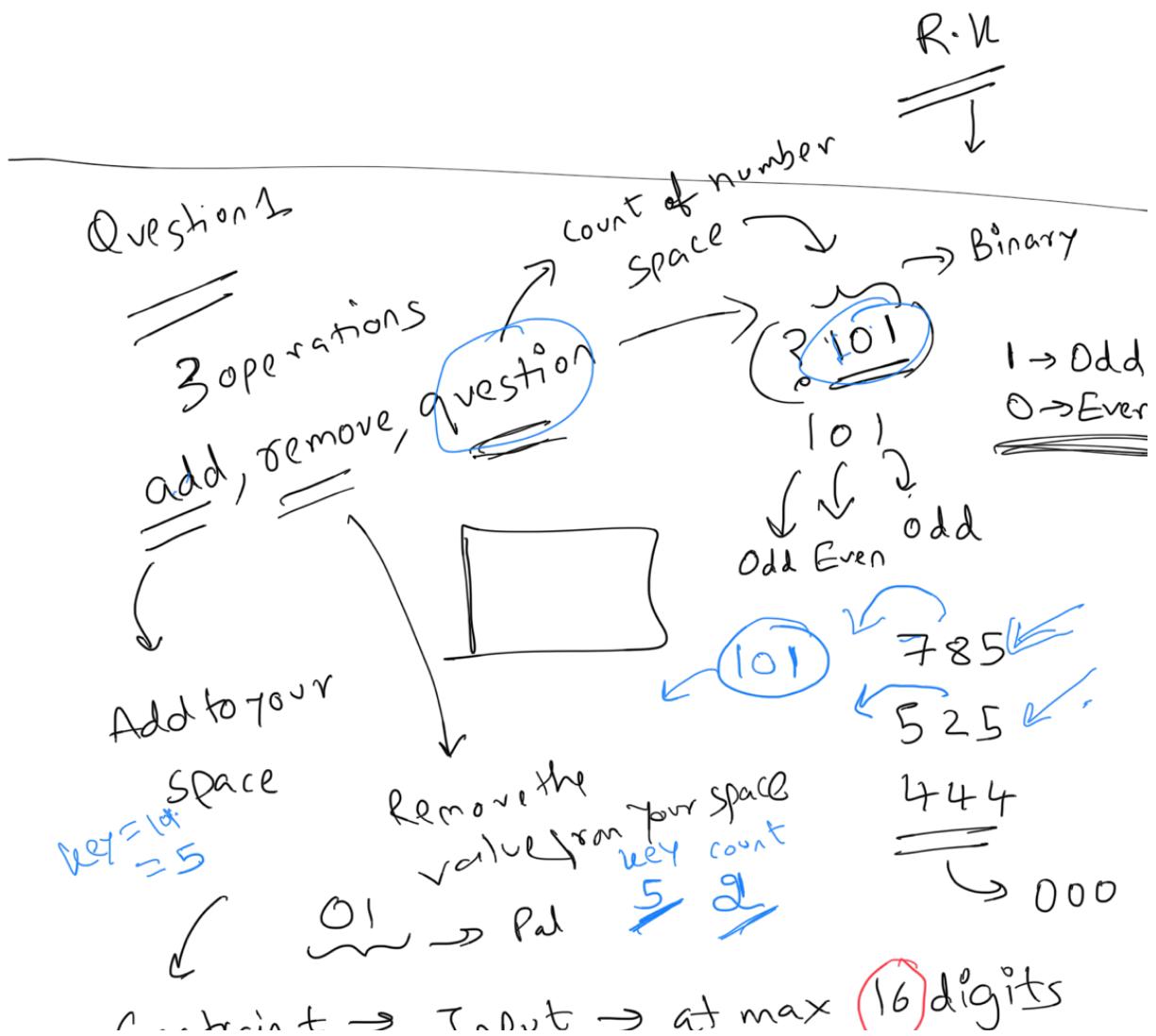
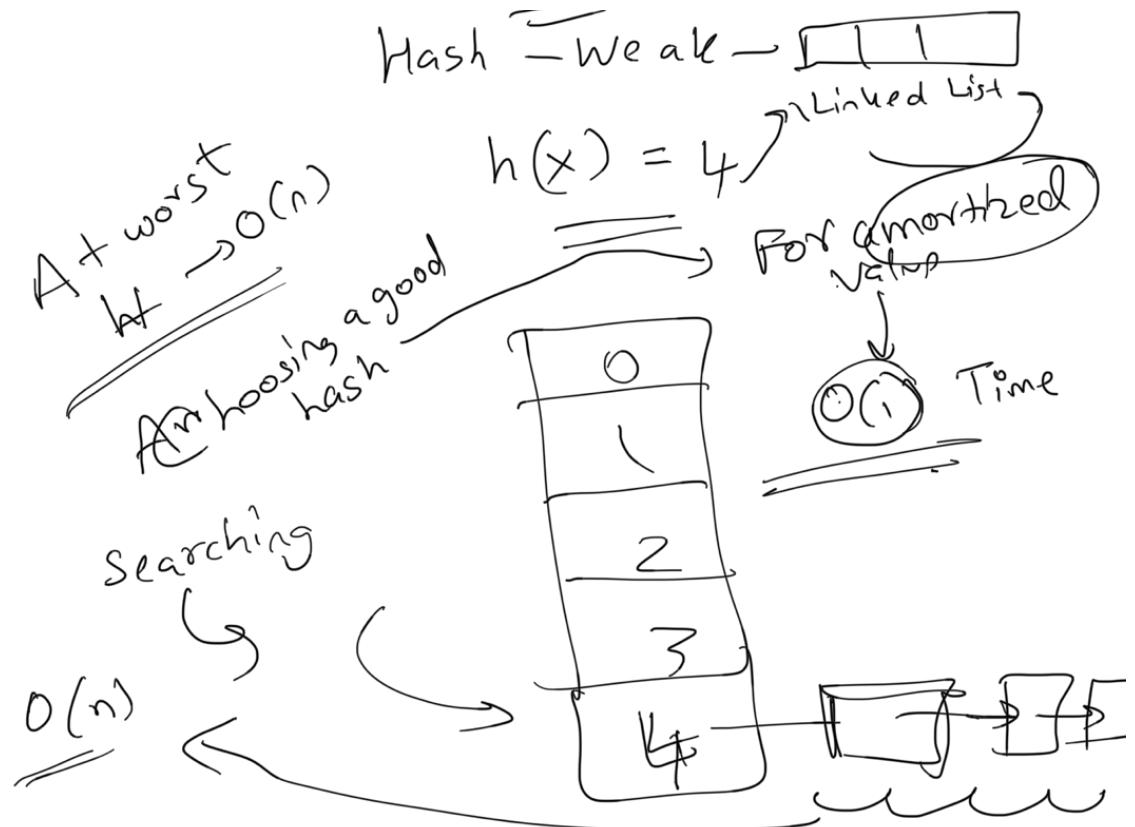
Amortized  $O(1)$  Time complexity

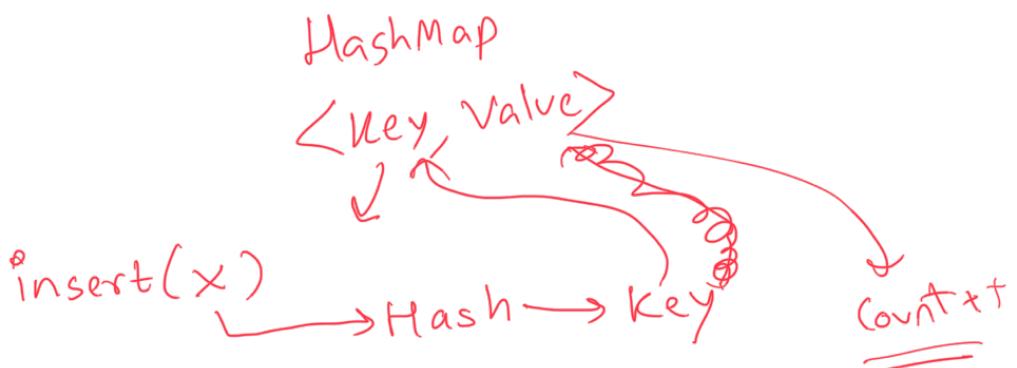
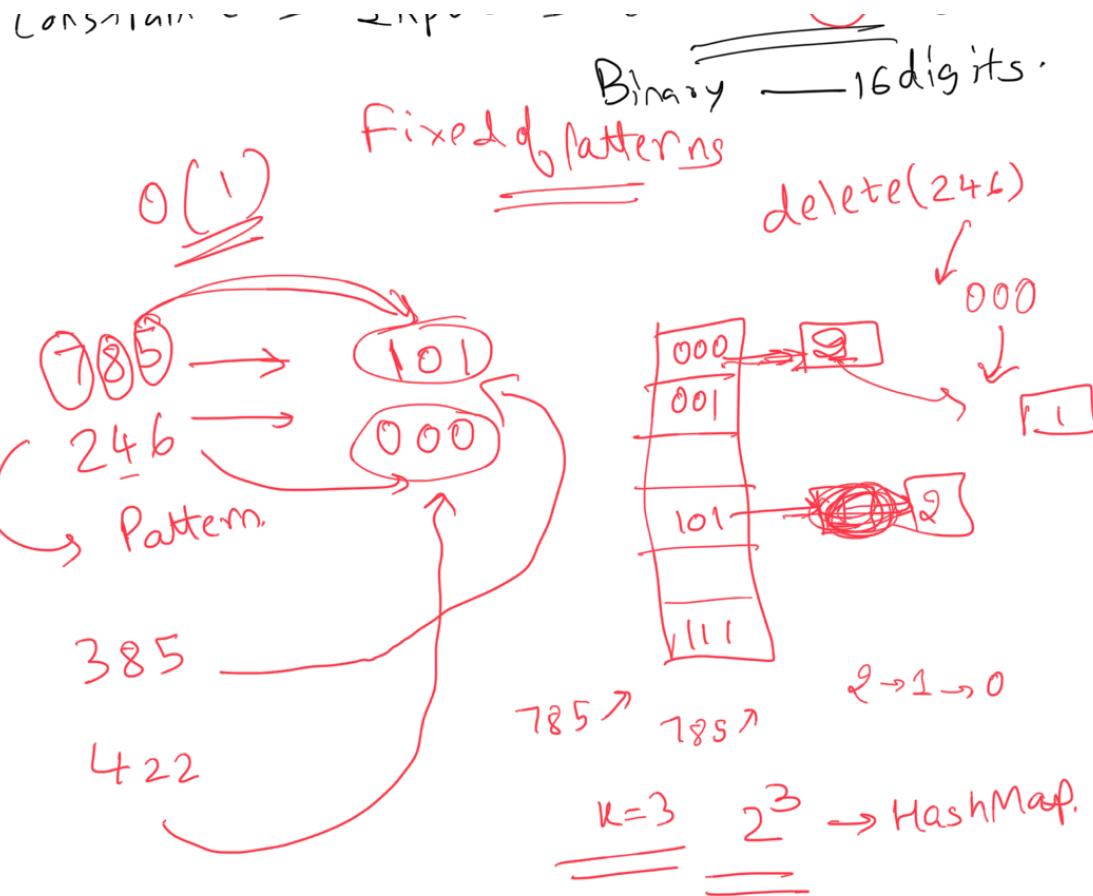
$\sum_{n=1}^{n \text{ such values}} O(1) \leq O(n)$

At worst case

$\underline{\underline{O(n)}}$

open hashing





```

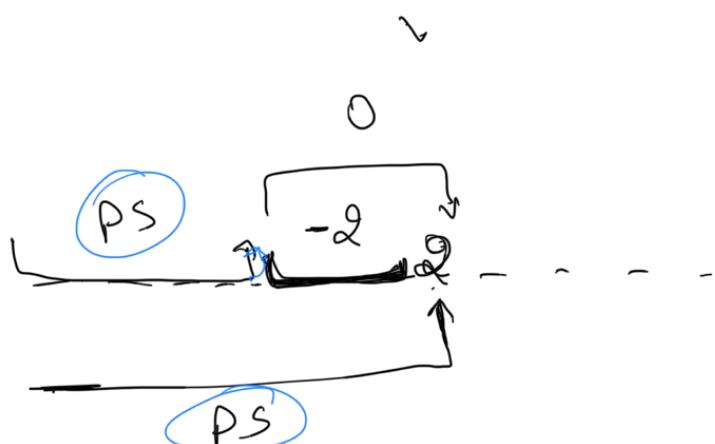
val = map.get(key)
map.put(key, val+1)
    
```

Array  
 $\overbrace{\quad\quad\quad}$  size  $\rightarrow N$   
 $\overbrace{\quad\quad\quad}$  Unsorted  
 $\overbrace{\quad\quad\quad}$  Return true if there is a  
 Subarray of sum 0.  
 else false??

array: 6 -1 2 -1 1  
 $\underbrace{0}_{}$   $\Rightarrow \underline{\underline{N \log N}}$

PS: 6 5 7 6 7

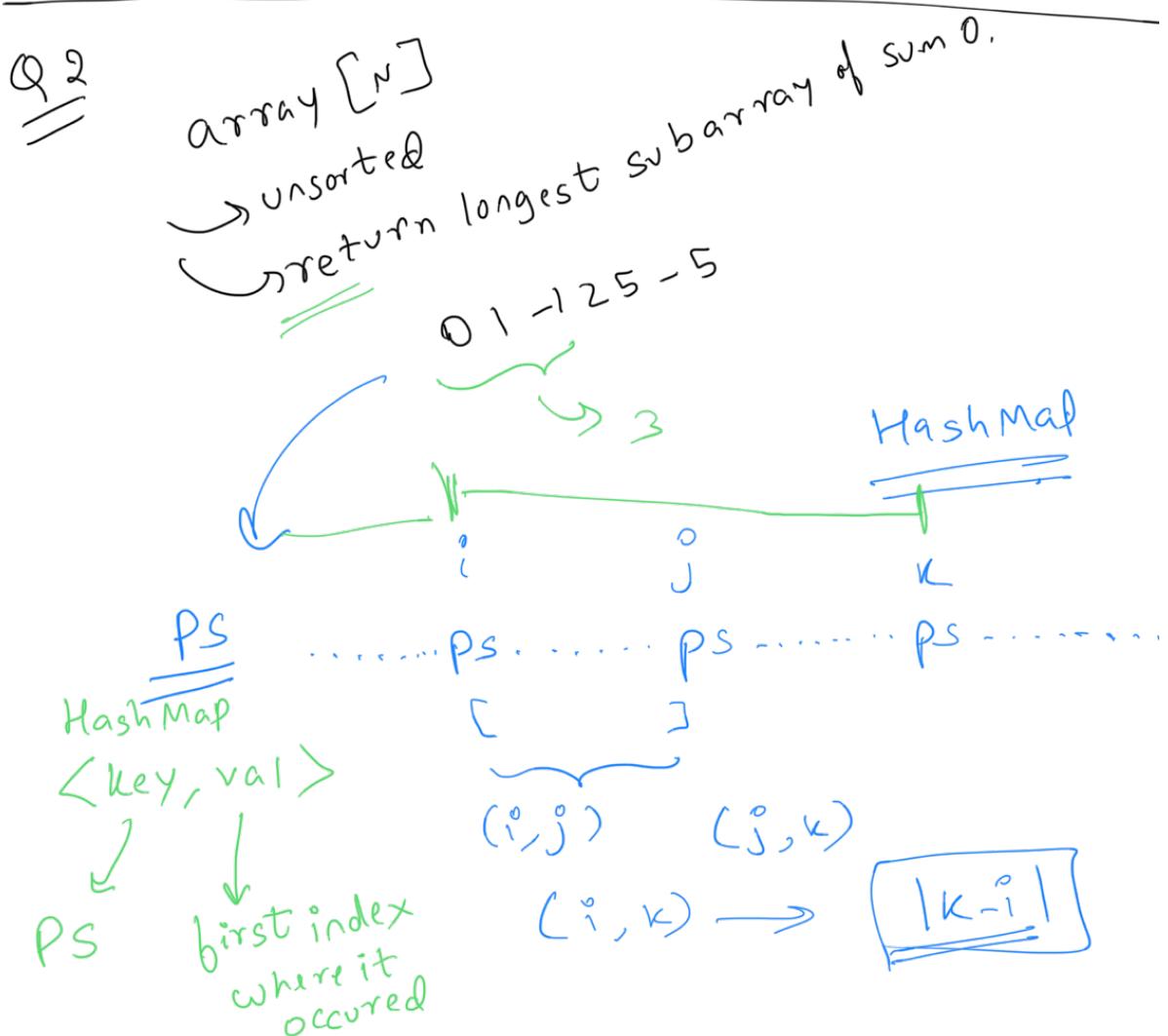
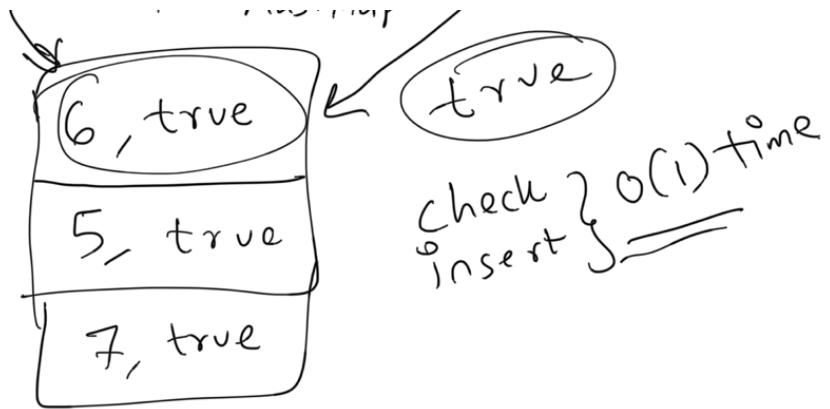
'(key, value)  
 PS ↑ true  
 6, true  
 5, true  
 7, true



$$x - z + z = PS$$

$$\underline{x = PS}$$

6 -1 2 -1 1  
 $\nearrow \nearrow \nearrow \nearrow$   
 $PS=7$   
 $PS=0$        $PS=5$        $PS=6$   
 $PS=6$       }      }  
 Hash Map < >



index 0 1 2 3 4 5 6 7

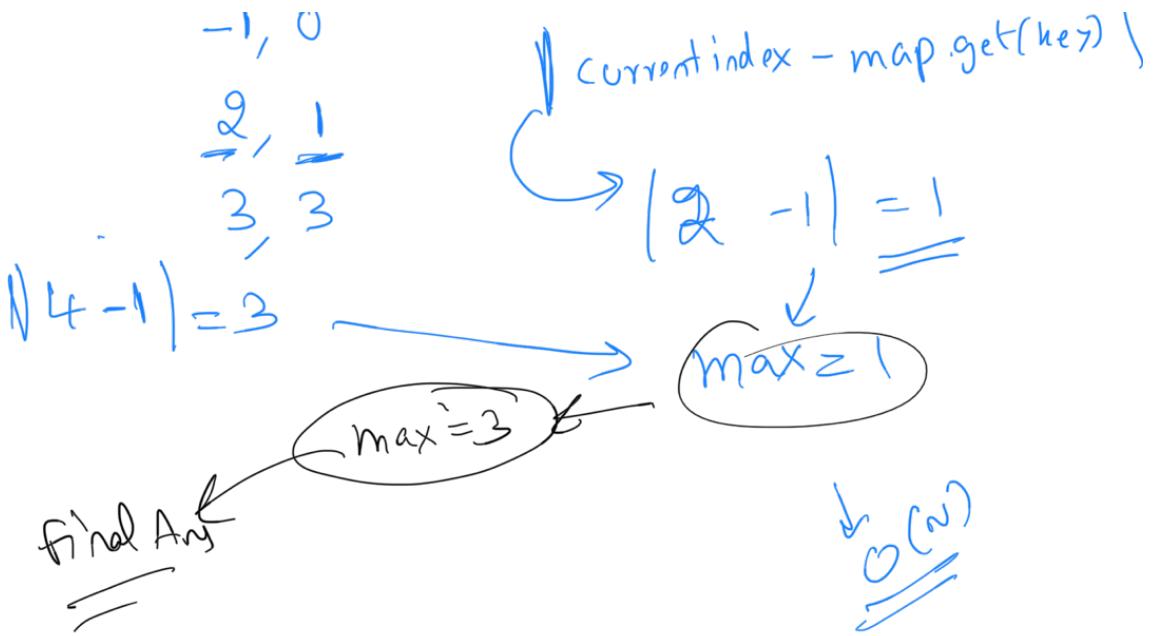
array -1 3 0 1 -1 2 5 -5

PS -1 2 2 3 2 ...

2

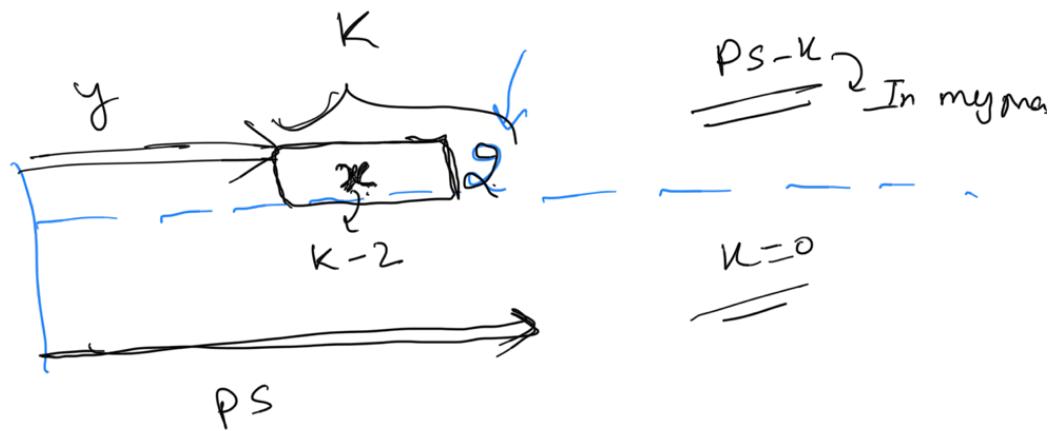
PS

$\langle \text{key}, \text{val} \rangle$  first index occ



Question  
 array( $N$ )  
 unsorted  
 length of longest subarray  
 of sum " $K$ "  
 $\downarrow$   
 $1, -1, 5, -2, 3$   
 $K=3$   
 $\downarrow$   
 $4$

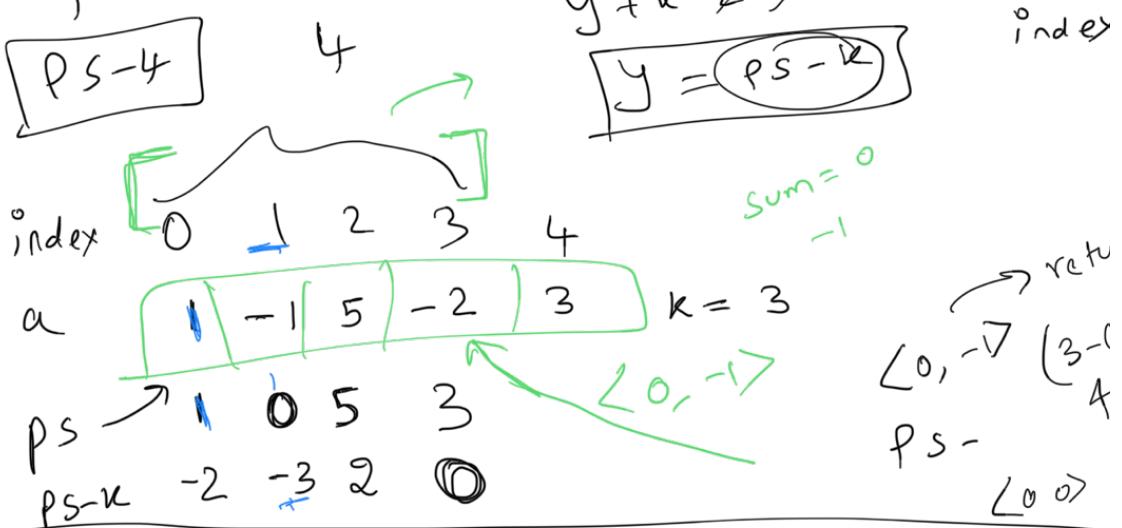
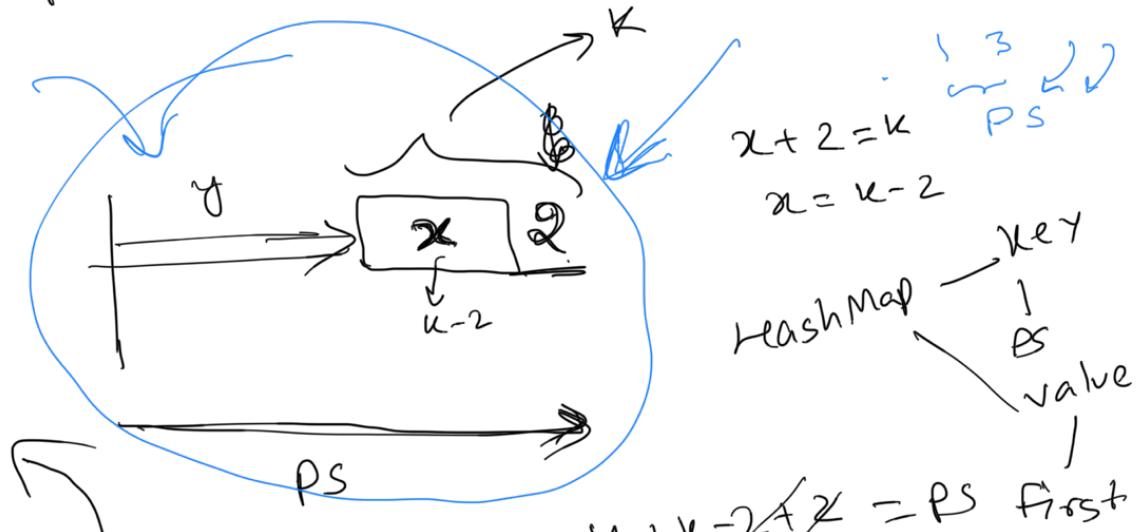
  



$$y + k - z + z = ps$$

$$y = ps - k$$

*(key, value)*  
↓  
ps      first index



$\langle 0, -1 \rangle$

$\langle 1, 0 \rangle$

Kurrrr = 3

first = 0

QA diff = 3 - 0 = 3

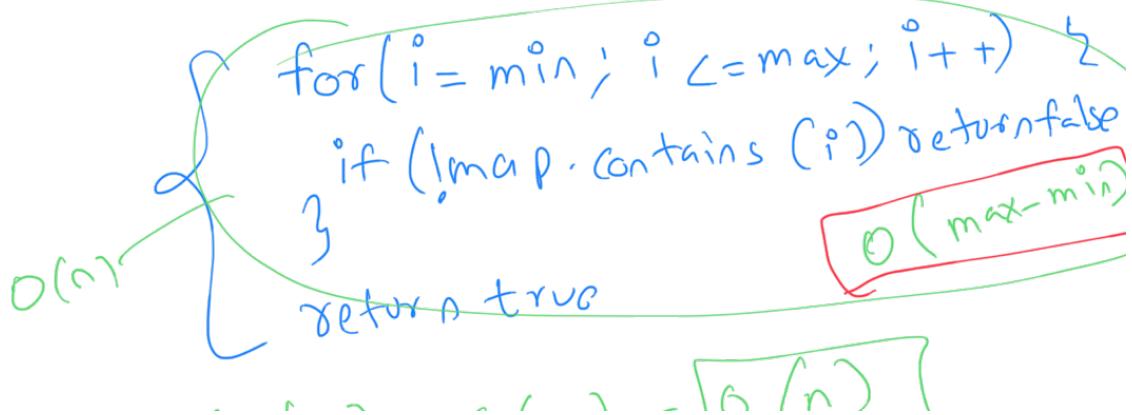
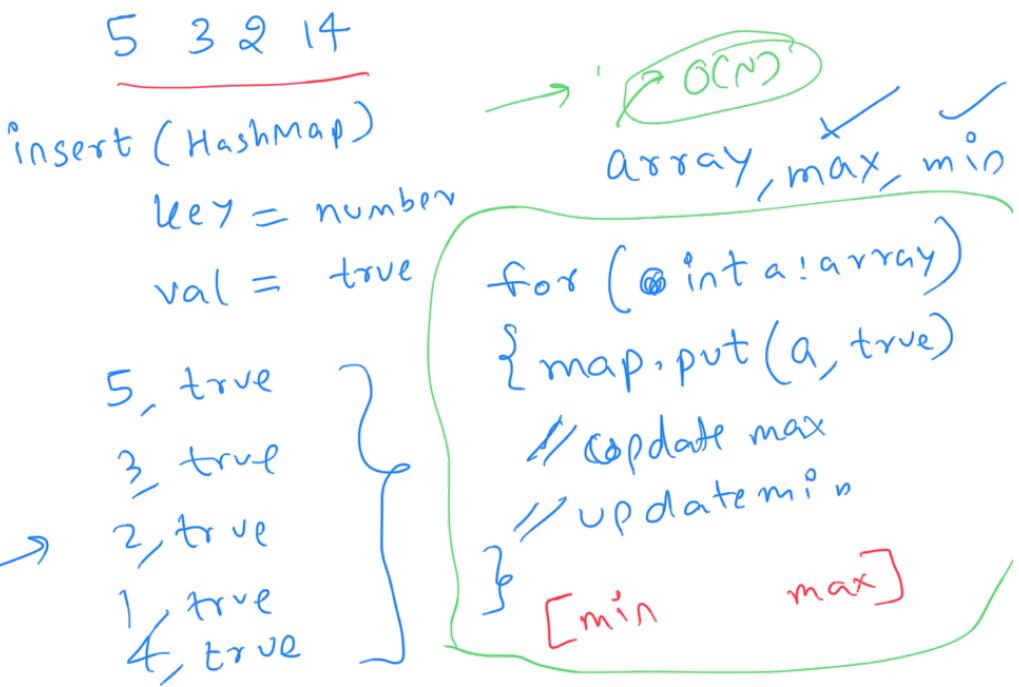
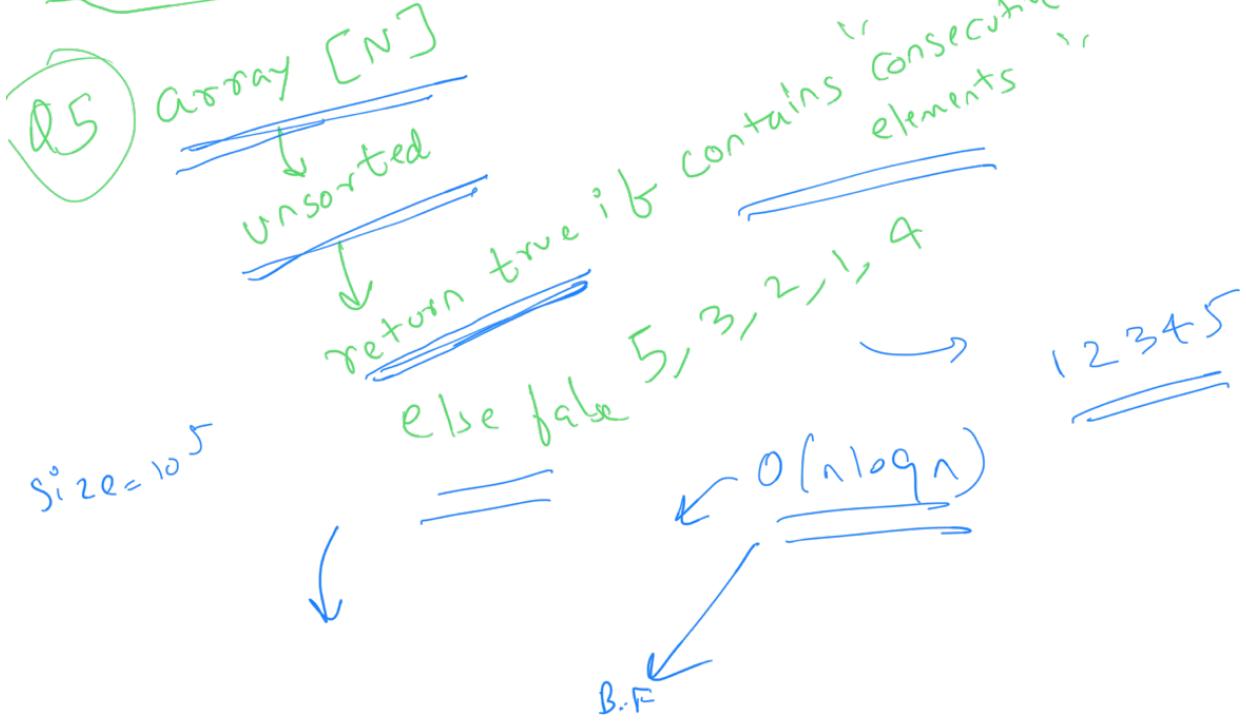
0th index

\*

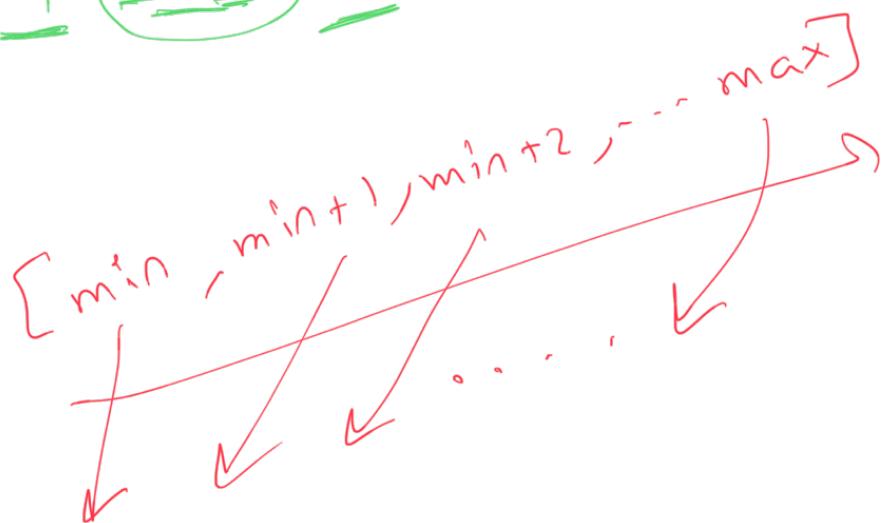
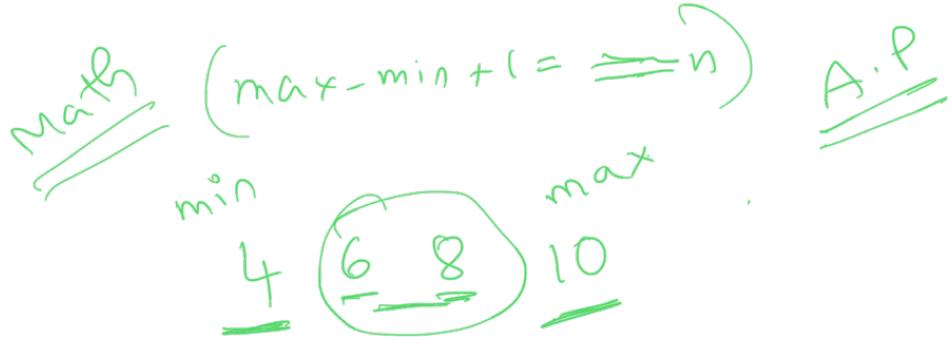
$\langle 0, -1 \rangle$

[ ]

BEGIN



$$\Theta(n) + O(n) \underset{\text{S.C}}{\approx} O(n)$$



Question 7

array [n]  
→ Unsorted

Find out longest length of consecutive numbers that appear in the array in any order &

$n \rightarrow 100, 4, 200, 1, 3, 3, 2$

$4 \rightarrow$   
Insert everything in map  
 $\min = 1$   
 $\max = 4$   
count = 4  
100, true

1234 56...  
100

$O(n)$	<table border="1"> <tr><td>4</td><td>true</td></tr> <tr><td>200</td><td>true</td></tr> <tr><td>1</td><td>true</td></tr> <tr><td>3</td><td>true</td></tr> <tr><td>2</td><td>true</td></tr> </table>	4	true	200	true	1	true	3	true	2	true
4	true										
200	true										
1	true										
3	true										
2	true										

$\max = \leftarrow$

$$\cancel{O(\max - \min)}$$

$\min, \max$  from min to max  
find out contiguous elements

Approach  
 S.C -  $O(n)$   
 T.C -  $O(\max - \min)$

Update max  
array-size n

$$\min = 1$$

$$\max = 10^5$$

$1 2 3 4 5 \dots 10^5 \rightarrow O(10^5)$

$\max$  and  $\min$   $\rightarrow \cancel{O(\max - \min)}$

$\cancel{O(n)}$   
Observation

map

... - - - - - ...  $\max \min$  18920

1 2 3 4  
 true true ...  
 false false ...

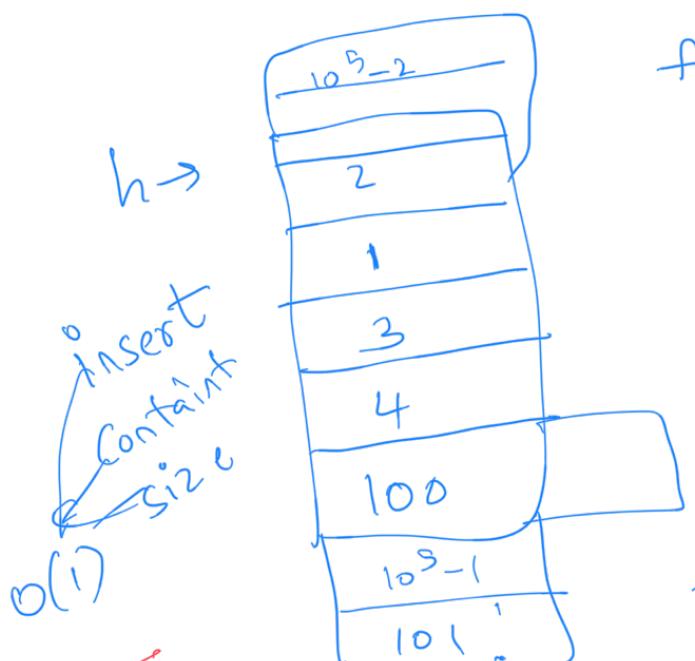
↪ array  $\rightarrow a_1 a_2 a_3 a_4 a_5$ .  
 if  $(a_3 - 1)$  is present in hash map  
 then  $a_3$  cannot be beginning of sequ  
 [  $a_3 - 1$  ]  
 not present map

$a_3 \rightarrow$  start counting

$a_3 + (\dots)$

$T$  max  
 count  
 $O(n)$

$a \rightarrow 1 2 3 4$       100 101       $10^{-2} 10^{-1}$



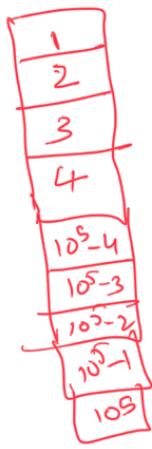
```

for (a:array)
  if (!h.contains(a-1))
    while (true)
      if (h.contains(a))
        count++ a++
        update max
      } break;
    }
  }
}
  
```

All  $\rightarrow O(N)$  TIME

↓ ↙ STEP1 : INSERT

↑  
3  
2  
↙ ↘  
2, 3



STEP-2

$\underline{\underline{O(n)}}$

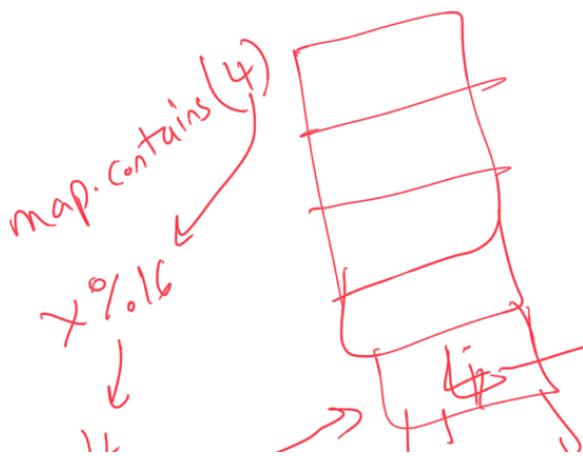
```
for (a:array) {  
    if (!map.contains(a-1))  
        while ( )  
    } count = 4 → max =  
    1 2 3 4 5  $\underline{\underline{x}}$ 
```

$O(10^5)$  →  $\underline{\underline{O(7)}}$

$O(7)$   
map.contains 7 elems.  
map.put  
map.get min <= max =  $10^5$   $O(10^5)$   $\times 0(7)$   
} /

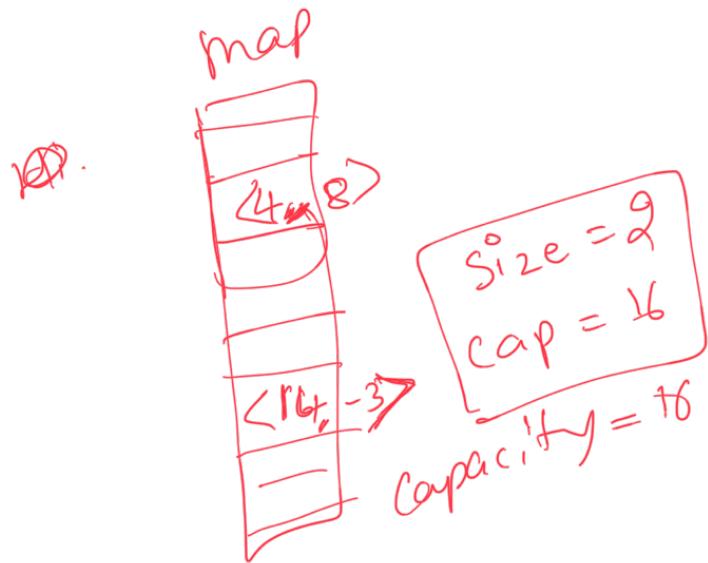
map.contains(?)

$\times \% 16$   
 $\underline{\underline{map.put(4)}}$



$\underline{\underline{O(1)}}$   
Amortized  
hash

~~Y~~ →  ~~==~~ ~~Override~~



---

$$\max = 10$$

$$\min = 1$$

1 -

$O(n)$   3

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Hashing - 2