Hashing

Pre - Storing & fetching

$\rightarrow N$

arr = 5 8 3 1 5 1 1 3 8 7 6 5

5 comes 3 times
8 comes 2 times
3
1
5 comes 3 times

$N \Big\downarrow \quad \begin{array}{l} -N \\ N \\ N \\ N \end{array}$

$\rightarrow N \times N$

$\rightarrow N^2$

7   8   9   1   2 $\rightarrow M$

N   N $O(M \times N)$

arr = 5 8 3 1 5 1 1 3 8 7 6 5   Prestoring

↑

$TC \to O(N)$
$SC \to O(N)$

```
1:  3
3:  2
8:  2
5:  3
```

$TC \to O(m)$ 5 ?   7   8   1   10   100 M
$\to O(M+N)$ ↓ $O(1)$ $O(1)$ (0) $O(1)$ $O(1)$
                  $O(1)$

1→8

arr = 5 8 3 1 5 1 1 3 8 7 6 5   k = 12

(N) → 0 1 2 3 4 5 6 7 8 9 10 11

TC → O(N)

| 0 | 3 | 0 | 2 | 0 | 3 | 1 | 1 | 2 |

SC → O(N)

0 1 2 3 4 5 6 7 8

---

7   3   1   5   4 → M

1   ↓
$O(1)$ $O(1)$

                              TC → O(M)

              TC → O(M+N)

              SC → O(N)

Made with Goodnotes

1-8   i
      j   Number Hashing

      arr = 2 8 3 1 5 1 1 3 8 7 6 5
            0 1 2 3
      hash_list = [0] * 9   [0,0,0,0.....0,0]

      # Pre-compute   2
      for i in range (len(arr)):
          hash_list [arr[i]] += 1
num
~~Al~~ = Enter number =

      print (hash_list [num])

a-z
26

string = "abcddeaabbz"

$\rightarrow$
N

hast_lst = | 3 | 3 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 1 | 1 |
           0   1   2   3   4   5   6   7   ... 24   25

TC → O(N)

↓
m

a → O(N)
z → O(N)
c → O(N)

TC → O(M×N)

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a = 97-97 = 0   O(1)

z =   O(1)   TC → O(M)

c = O(1)

↓
M

TC → O(N+M)

Character Hashing

A-Z, a-z   string = "Azcd12DeZ"

0   1   2   3   · · ·   122

$L = 123$

SET

arr = [55, 105, 95, 5, 35 .]   num%010

hash_list = | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
             0   1   2   3   4   5   6   7   8   9   10

| 0 |
| 1 |
| 2 |
| 3 |
| 4 |
| 5 | → | 55 | → | 105 | → | 95 | → | 5 | → | 35 |
| 6 |
| 7 |
| 8 |
| 9 |
| 10 |

15   59

$O(N)$