§ Given an array of N elements.
Find the majority element!
└→ An element with freq $> N/2$

$N = 6$
$ME = 1$ $freq(1) = 4$
$> 6/2$

A: [1 2 1 6 1 1]

A: [1 2 2 6 1 1]
X ME

$f(x) > N/2$
$f(n) > 6/2$

A: [3 3 4 6 1 3 2 5 3 3 3 3]

ME = 3 !

$N = 12$
> 6
$f(3) = 7$

I) BF
∀ element find the freq.

$TC = O(N^2)$
$SC = O(1)$

II) Sorting

A : [1 3 1 5 3 3 3 5]   8

Sort(A) : [1 1 3 3 3 3 5 5]

2   4   2
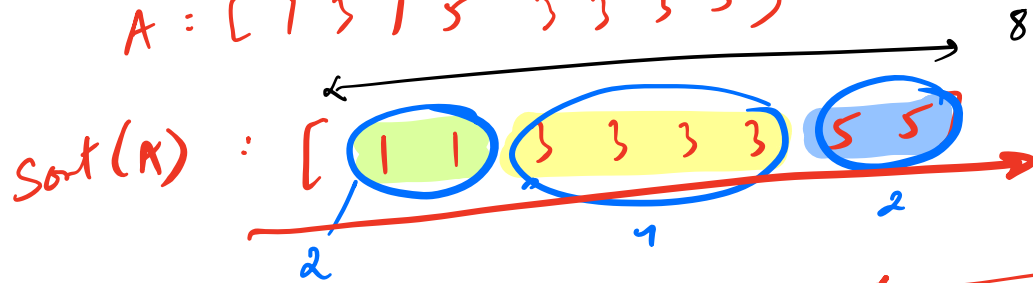
Heap Sort →

TC = $O(N \lg N)$

SC = $O(1)$

III Hash Map

A : [1 3 1 5 3 3 5]

$O(N)$ → ⟨ele, freq⟩

⟨ 1, ② ⟩
⟨ 3, ③ ⟩ $O(N)$
⟨ 5, ② ⟩

TC : $O(N)$

SC : $O(N)$

MOORE'S VOTING ALGORITHM

○ Can there be more than 1 ME?

$$x, y \longrightarrow ME$$

$$f(x) > N/2$$

$$f(y) > N/2$$

$$f(x) + f(y) > N \quad \times$$

$\longrightarrow$ there is ATMOST 1 ME !!!

A: [1 3 1 3 3 3 3]
   NME   ME

[1 3 1 3 3]

N	ME	fr(ME)
7	3	4
5	3	3

-2 ( ) -1

$\frac{S}{N} = $

$\frac{ME}{N/2 + 1}$

A [ ]
  ME$_x$ NME$_x$

[ ]

$N - 2$

$\frac{(N-2)}{2} + 1$

$N/2$ ∤ r

$N/2$
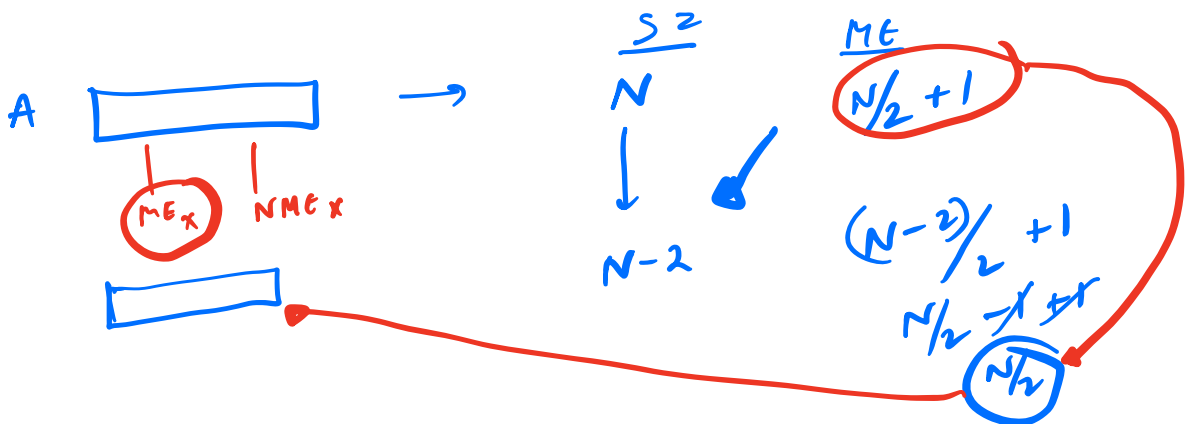
⊙ If I del 1 out of ME
1 ——— NME

→ the ME does not change!

⊙

NME   NME   ME
A: [1 3 3 3 3 3 3] ⟶ 3

A: [1 3 3 3 3] ⟶ 3

→ If I del 2 Diff NME's [1 occ.]

→ the ME does not change!

→ ☑ If I del ANY 2 diff. elements
the ME. Would NOT change!

A: [4 4 3 8 8 4 9 4 4]   ME
                                    4
                          1

A: [4 3 3 2 1 4 4 5 4 4 7]

A: [1 2 4 1 4 5 1 4 4 4]   4→
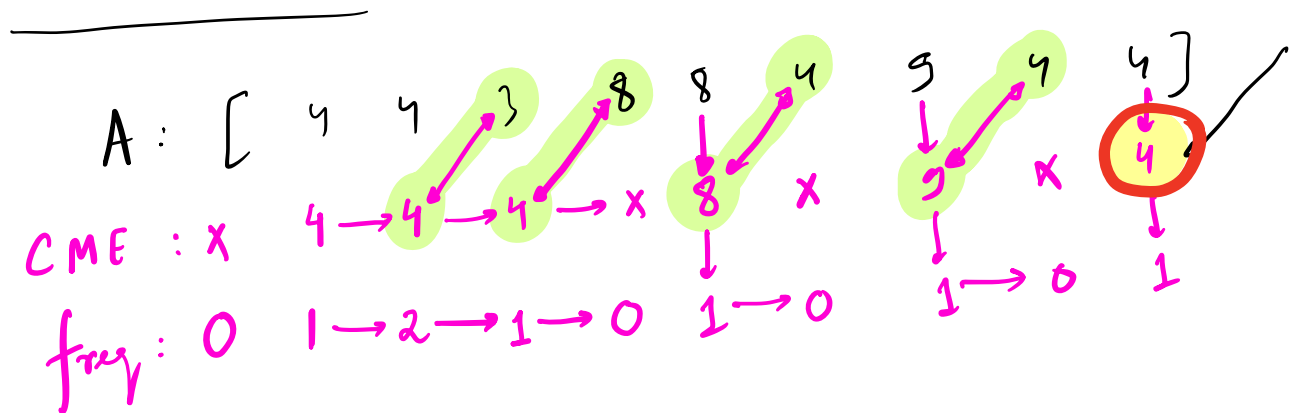
[2 2 2 2 3 3 3 3]

A: [4 4 3 8 8 4 9 4 4]

CME : X   4→4→4→X   8 X   9→4 X   4

freq: 0   1→2→1→0   1→0   1→0   1

Validate: $f(4) = 5 > \frac{9}{2}$

∴ 4 → ME ✓

4

1

A: [1   2   4   2   3   3]

CME: x   1   x   4   x   3   3 →

freq: 0   1→0   1→0   1→2

$$f(3) = 3 \neq \%_2$$

$$3 \longrightarrow N \; ME$$

$$\longrightarrow there \; is \; NO \; ME!$$

A: [1   1   1   3   1   4   2   1]

CME: x   1   1   1 →1   1   1   1   1

fre: 0   1→2→3→2→3→2→1→2
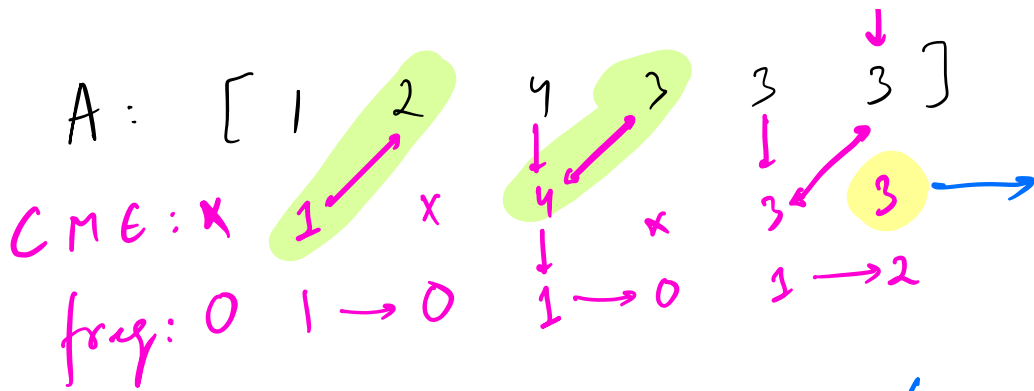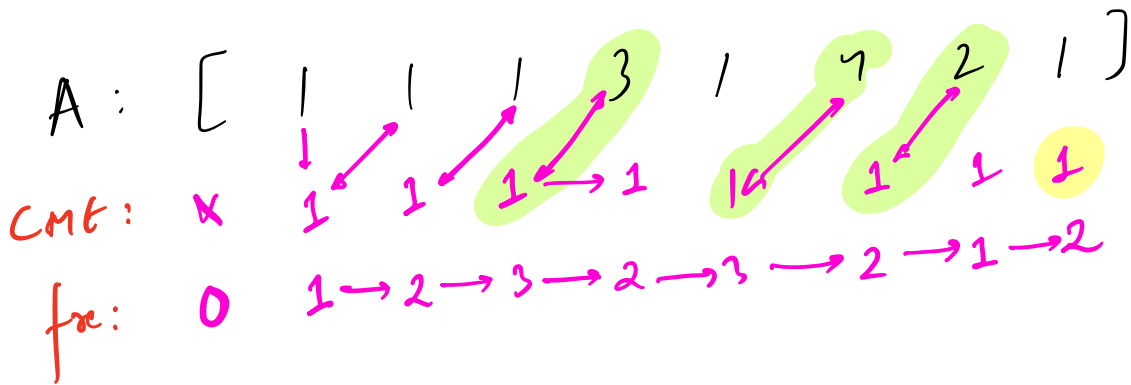
```
cmc = -1 , f = 0;
f ( i = 0; i < N; i++) {
    if ( f == 0) {
        cmc = A[i];
        f = 1;
    }
    else if ( cmc = A[i]) {
        f++;
    }
    else {
        f--;
    }
}
f = 0;
f ( i = 0; i < N; i++) {
    if ( cmc == A[i]) {
        f++;
    }
}
if ( f > N/2) ret cmc
    ret -1;
```

TC = O(N)

SC = O(1)

$t=0$

1   3   4   6   8

L

0

→ After how much time will all the ANTS fall off ?

Speed of ANTS = 1 unit/sec