



Agenda

- ① Employees And Manager
- ② Problem with a given diff.
- ③ Array pair divisible by k
- ④ Pair sum Divisible by k
- ⑤ Largest Subarray with zero sum.

Employees and Manager

obj

Map

key(Emp)

Value(Man)

A

C

B

C

C

F

D

E

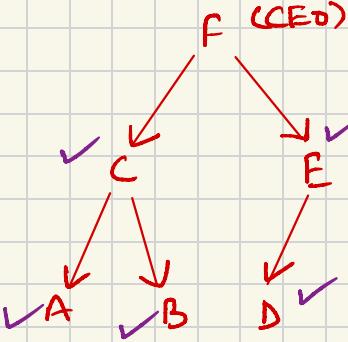
E

F

F

F

org chart



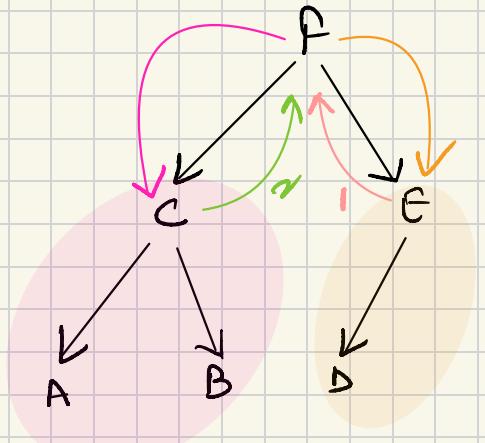
obj Emp

String

Map

	Number of Emp under him
A	0
B	0
C	2
D	0
E	1
F	5

Integer

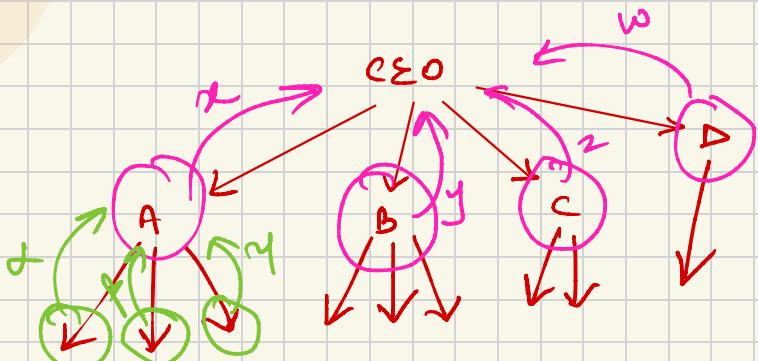


$$\sum_i \text{Emp}_i = (2+1) + (1+1) = 5 \quad \checkmark$$

No. of Empc

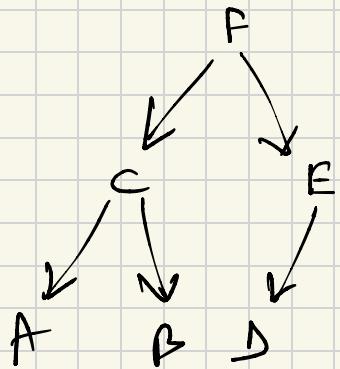
C himself.

How many Emp
Under you



$$\text{CEO} \sum_i = (x+1) + (y+1) + (z+1) + (w+1)$$

$$\sum_i = (\underline{\alpha+1}) + (\underline{\gamma+1}) + (\underline{\beta+1})$$



~~fun()~~ → return No. of Emp under given Emp.

Recursion

$$\left\{ \begin{array}{l} F(F) = (F(C) + 1) + (F(E) + 1) \\ F(C) = (F(A) + 1) + (F(B) + 1) \end{array} \right.$$

✓ int helper(F _____)

fault: return no. of emp under
a given emp

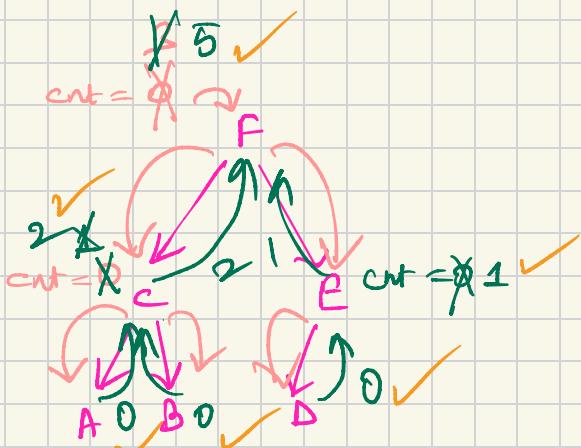
Base
No direct reportee

No. of EmpUnder
 $= 0$

Map

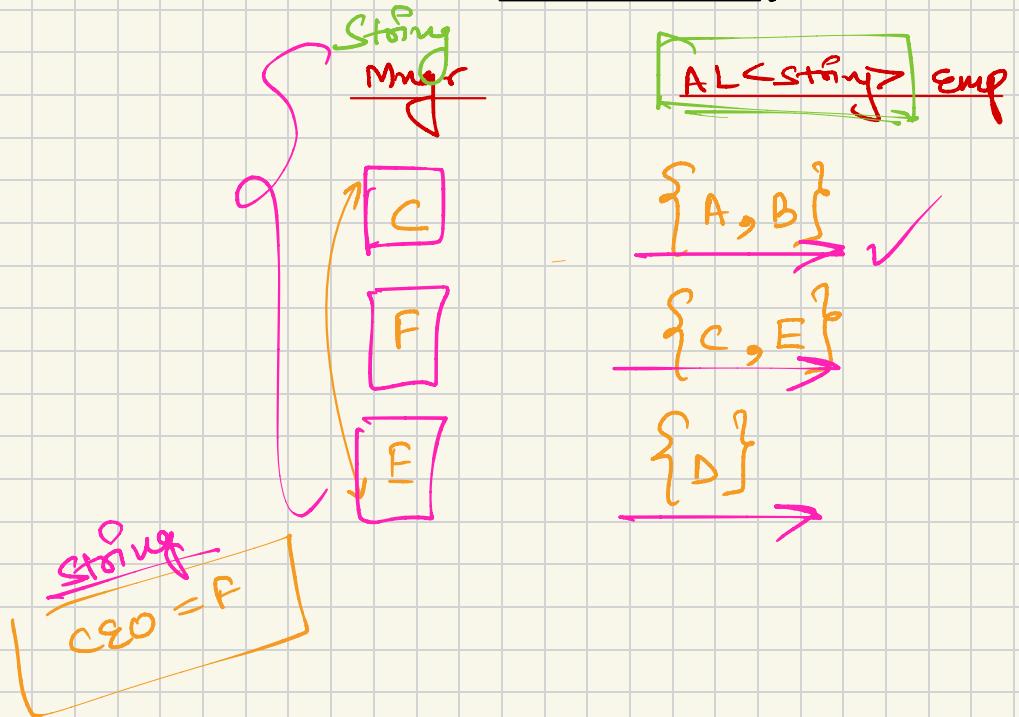
Emp → No. of Reportees

{
 int cnt = 0;
 go to each direct repoter, ask no. of emp under them.
 int p = (a+d);
}
return cnt;



✓ Direct Reportee Map

Emp	Mgr
A	C
B	C
C	F
D	E
E	F
F	F



Problem with a given Difference.

$$\text{int [] arr} = \{ 5, 10, 3, 2, 50, 80 \} \quad B = 78$$

Brute Force.

o Nested loop

→ if ($\text{arr}[i] - \text{arr}[j] == B$ || $\text{arr}[j] - \text{arr}[i] == B$)
return true;

~~int [] arr = { 5, 10, 3, 2, 50, 80 }~~ B = 45

{ 2, 3, 5, 10, 50, 80 }

si

mid

ei

Soorting Work

Case mid < B

~~mid + 1~~

x - y

`int[] arr = { 5, 10, 3, 2, 50, 80 };`

$B = 73$

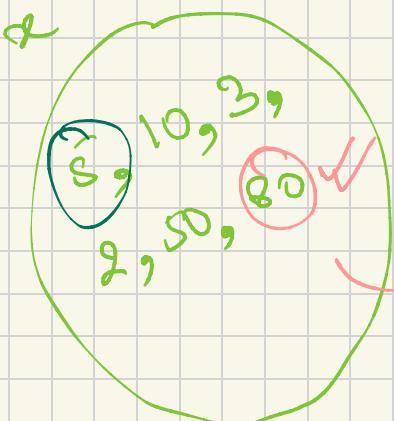


$$x - y = B$$

$$y - x = B$$

$$x = y - B$$

created x y $x-y=B$
 $T C(O(N)) \times T C(O(N)) = O(CN)$



scanning $T C(O(1))$

Array Pair Divisible by K

int [] arr = { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 } K = 5

↓
even length

(N/2) such pairs, sum of each pair is divisible by K

* you can only each ele once.

$\frac{(9,1)}{10}, \frac{(2,8)}{10}, \frac{(3,7)}{10}, \frac{(4,6)}{10}, \frac{(5,10)}{15}$ ✓

True
Can be done or not

$\text{int arr} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ $K = 5$

$(x, y) \in (x+y)$ divisible by K

or

$$x + y = a * K \quad \left. \begin{array}{l} \text{some multiple of} \\ K \end{array} \right\}$$

$$\boxed{x = q * K + r}$$

$K \overline{) x \text{ } q}$
 \downarrow
 \overline{r}

$$x + y = a * k$$

$$(q_1 * k + r_1) + (q_2 * k + r_2) = a * k$$

$$\underline{(q_1 + q_2) * k} + \underline{(r_1 + r_2)} = a * k$$

divisible by k

divisible by k }
or equal zero }

$(x, y) \rightarrow$ divisible by k

$$\left. \begin{array}{l} (r_1 + r_2) = k \\ \text{or} \\ (r_1 + r_2) = 0 \end{array} \right\} \checkmark$$

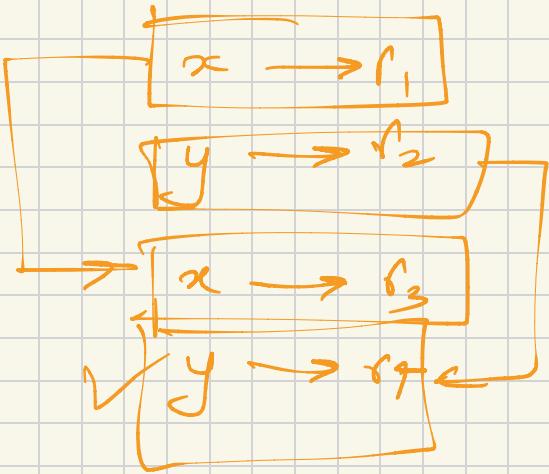
$$\boxed{(r_1 + r_2) = k} \quad \text{or} \quad \boxed{(r_1 + r_2) = 0}$$

$$\left. \begin{array}{l} \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} \\ \downarrow \quad \downarrow \end{array} \right\}$$

rem 1 2 3 4 0 1 2 3 4 0

$$k=5$$

$$(1, 4)(2, 8)(3, 7)(6, 9)$$



$$r_1 + r_3 = k$$

$$r_2 + r_4 = k$$

o freq of each term

o try to match freq

o its comp

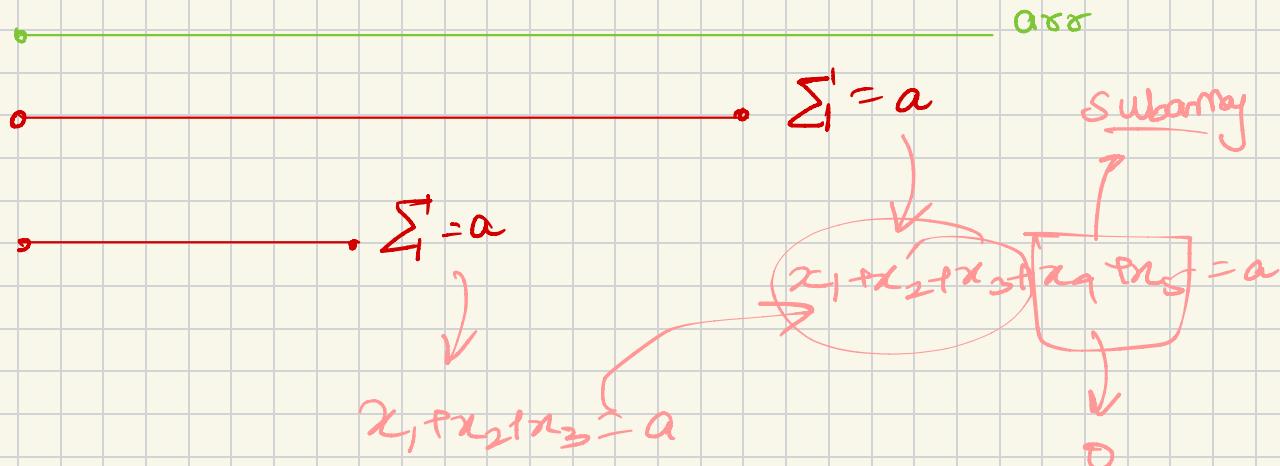
$$r_2 = k - \alpha$$

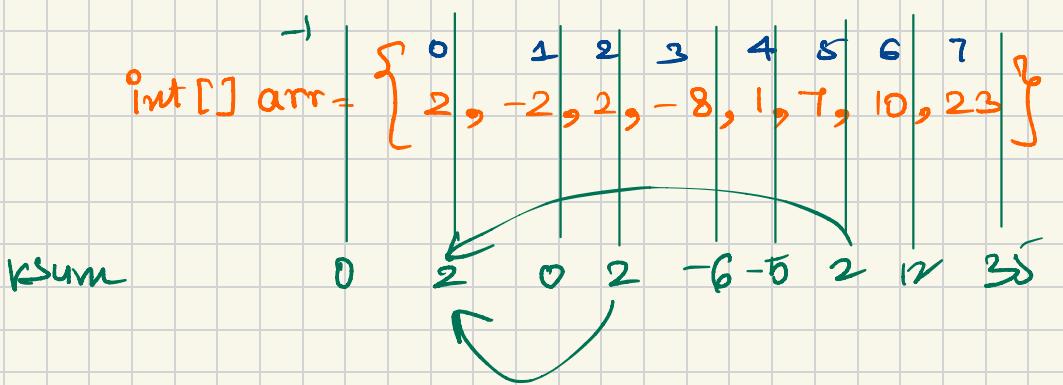
$$\alpha \quad \left\{ \begin{array}{l} r_1 = 0 \\ r_4 = 0 \end{array} \right.$$

freq 0 be even

longest subarray with sum equal to zero

int arr = { 2, -2, 2, -8, 1, 7, 10, 23 };





Map
 rsum
 2 → idarr

$$\text{len} = \cancel{5}$$