

Todays Content

1. Re-arrange arr[]
2. Count freqency of all elements.

Few Basics:

Say $a \geq 0$: $\forall a \in M$:

$$1. a \% M = a$$

$$5 \% 7 = 5$$

$$6 \% 10 = 6$$

$$2. a / M = 0$$

$$6 / 10 = 0$$

$$3 / 5 = 0$$

Modular:

Given an $ar[N]$ re-arrange array value, such that $ar[i] = ar[ar[i]]$

Note: all array elements are unique.

Constraints:

$$1 \leq N \leq 10^5$$

$$0 \leq ar[i] \leq N$$

0 1 2 3 4 5 6 7

#Exn, $ar[N] = \{ 6 4 2 1 7 0 3 5 \}$

$ar[i] = ar[ar[i]]$

$\{ 3 7 2 4 5 6 1 0 \}$

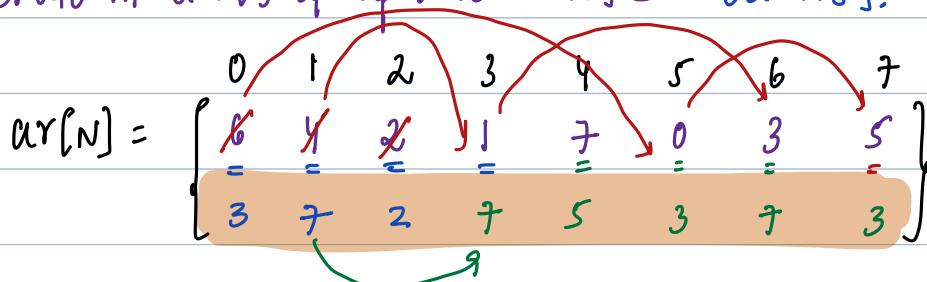
Ideal: Using Extra Space $Tc: O(N+N) = O(N)$ $Sc: O(N)$

$i=0; i < N; i++\}$

$\{ b[i] = ar[ar[i]] \}$

$i=0; i < N; i++\}$
 $\{ ar[i] = b[i] \}$

Ideal2: Iterate in $ar[]$ & update $ar[i] = ar[ar[i]]$.



Issue: If we update array we lose old data.

Con: We should store old & new data at same place?

#deaz:

#firs Since Bing Bang Days Time

100 hrs 4D $4 \text{ hrs} = 4 \text{ am}$

40 hrs 1D $16 \text{ hrs} = 4 \text{ pm}$

78 hrs 3D $6 \text{ hrs} = 6 \text{ am}$

n hrs $\frac{n}{24}$ $n \% 24$

obs: In n , we are able to see both days of Time

hint: $0 \leq ar[i] < N$: If we divide $\frac{n}{N} = [0..N-1]$

Dividend = Divisor + Quotient + Remainder

$$ar[i]/N = \text{old} = Q$$

$$ar[i] = N * \text{old} + \text{new}$$

$$ar[i]\%N = \text{new} = R$$

$$\begin{aligned} \underline{ar[i]/N} &= (N * \text{old} + \text{new})/N \\ &= (\cancel{N * old}/N + \cancel{new}/N) \\ &= (\text{old} + 0) \\ \rightarrow &= \text{old}, \end{aligned}$$

$$\begin{aligned} \underline{ar[i]\%N} &= (N * \text{old} + \text{new})\%N \\ &= ((\cancel{N * old})\%N + \cancel{new}\%N)\%N \\ &= (0 + \cancel{new}\%N)\%N \\ &= \cancel{new}\%N = \text{new} \end{aligned}$$

$$\begin{aligned} ar[i]: & \quad ar[i]\%N = \text{old} = R \\ & \quad ar[i]/N = \text{new} = Q \end{aligned}$$

$$ar[i] = N * \text{new} + \text{old}$$

$$\begin{aligned} ar[i]/N &= (N * \text{new} + \text{old})/N \\ &= (\cancel{N * new}/N + \cancel{\text{old}}/N) \\ &= (\text{new} + 0) \\ \rightarrow &= \text{new} \end{aligned}$$

$$\begin{aligned} ar[i]\%N &= (N * \text{new} + \text{old})\%N \\ &= (\cancel{N * new}\%N + \cancel{\text{old}}\%N)\%N \\ &= (0 + \cancel{\text{old}}\%N)\%N \\ &= (\cancel{\text{old}}\%N) = \text{old} \end{aligned}$$

Approach : $\text{ar}[i] = \boxed{N + \text{old}} + \boxed{\text{new}}$

0	1	2	3	4	5	6	7
ar[N] = { 6 }	4	2	1	7	0	3	5 }

#Step1: Iterate in arr[] & multiply by N.

0	1	2	3	4	5	6	7
ar[N] = { 6*8 }	4*8	2*8	1*8	7*8	0*8	3*8	5*8 }

#Step2: Iterate in arr[] & add new value

0	1	2	3	4	5	6	7
ar[N] = { $\underset{i}{\overrightarrow{6*8+3}}$ } $\underset{i}{\overrightarrow{4*8+7}}$ $\underset{i}{\overrightarrow{2*8+2}}$ $\underset{i}{\overrightarrow{1*8+4}}$ $\underset{i}{\overrightarrow{7*8+5}}$ $\underset{i}{\overrightarrow{0*8+6}}$ $\underset{i}{\overrightarrow{3*8+1}}$ $\underset{i}{\overrightarrow{5*8+0}}$ }							

$$0 \ ar[0]_i = ar[\ar[0]/8] = ar[6]/8 = 3 \quad ar[0] = ar[\ar[0]]$$

$$1 \ ar[1]_i = ar[\ar[1]/8] = ar[4]/8 = 7$$

$$2 \ ar[2]_i = ar[\ar[2]/8] = ar[2]/8 = 2$$

$$3 \ ar[3]_i = ar[\ar[3]/8] = ar[1]/8 = 4$$

$$i \ ar[i]_i = ar[\ar[i]/N]$$

#Step3: Iterate in arr[] & apply %N

0	1	2	3	4	5	6	7
ar[N] = { $\underset{i}{\overrightarrow{6*8+3}}$ } $\underset{i}{\overrightarrow{4*8+7}}$ $\underset{i}{\overrightarrow{2*8+2}}$ $\underset{i}{\overrightarrow{1*8+4}}$ $\underset{i}{\overrightarrow{7*8+5}}$ $\underset{i}{\overrightarrow{0*8+6}}$ $\underset{i}{\overrightarrow{3*8+1}}$ $\underset{i}{\overrightarrow{5*8+0}}$ }							

0	1	2	3	4	5	6	7
ar[N] = { 3 } 7 2 4 5 6 1 0 }							

TODD

restraints re-arrange(restraints raw) {
TC: $O(N+N+N) = O(N)$
SC: $O(1)$

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Noted: Expected SC O(1)

Constraints:

$$0 \leq \text{arr}[i] \leq N$$

0 1 2 3 4

$$\text{Ex: } \text{arr}[5] = \{2, 4, 4, 0, 3\}$$

Output:

0: 1

1: 0

2: 1

3: 1

4: 2

Idea: For every element from $[0..N-1]$:

Iterate & calculate frequency
point frequency.

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

Hint: $0 \leq \text{arr}[i] \leq N$: If $\forall i, N = [0..N-1]$

Idea: Store freq of each element & do at same time

Dividend = Divisor * Quotient + Remainder

$$\text{arr}[i]/N = \text{old} = Q$$

$$\text{arr}[i] = N * \text{old} + \text{freq}$$

$$\text{arr}[i] \% N = \text{freq} = R$$

$$\text{arr}[i]/N = (N * \text{old} + \text{freq})/N$$

$$= (\underline{N * \text{old}}/N + \underline{\text{freq}}/N)$$

$$= (\text{old} + 1)$$

$$= \underline{\text{old}} + 1 \rightarrow \text{if all arr[i] elements are exactly same freq} == N$$

→ We are not able to exactly extract old value.

$$ar[i] / N = freq = \theta$$

$$ar[i] := ar[i] \% N = old = r$$

$$ar[i] = N * freq + old$$

$$ar[i] / N = (N * freq + old) / N$$

$$= (\cancel{N * freq} / N + \cancel{old / N})$$

$$= (freq + 0)$$

$$= freq$$

$$ar[i] \% N = (N * freq + old) \% N$$

$$= (\cancel{N * freq \% N} + \cancel{old \% N}) \% N$$

$$= (0 + old \% N) \% N$$

$$= (old \% N) = old$$

#Dry Run $ar[i] = \underline{N * freq} + \underline{old}$

$$\begin{array}{cccccccccc} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \text{En: } ar[8] = \{ & 2 & 4 & 4 & 5 & 2 & 3 & 5 & 2 \} \end{array}$$

Step1: Iterate w/ total frequency

$$\begin{array}{cccccccccc} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \text{En: } ar[8] = \{ & \xrightarrow{2} & \xrightarrow{4} & \xrightarrow{4+3N} & \xrightarrow{5+N} & \xrightarrow{2+2N} & \xrightarrow{3+2N} & \xrightarrow{5} & \xrightarrow{2} \} \\ i \end{array}$$

$$0 \quad ar[ar[0]] += N_j$$

$$1 \quad ar[ar[1]] += N_j$$

$$2 \quad ar[ar[2]] \% N_j += N_j$$

$$3 \quad ar[ar[3]] \% N_j += N_j$$

$$4 \quad ar[ar[4]] \% N_j += N_j$$

:

$$i \quad \underline{ar[ar[i]] \% N_j += N_j} \rightarrow$$

Step2: Iterate m arr[] q / N_j

$$\begin{array}{cccccccccc} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \text{En: } ar[8] = \{ & \cancel{x} & \cancel{y} & \xrightarrow{4+3N} & \xrightarrow{5+N} & \xrightarrow{2+2N} & \xrightarrow{3+2N} & \cancel{s} & \cancel{y} \} \\ ar[8] = \{ & \xrightarrow{0} & \xrightarrow{0} & \xrightarrow{3} & \xrightarrow{1} & \xrightarrow{2} & \xrightarrow{2} & \xrightarrow{0} & \xrightarrow{0} \} \end{array}$$

TODD

void printOcc(vect<int> &arr) { TC: O(N) SC: O(1)}

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