Q Given N array elements
Check if there exists a pair (i, j)
s.t. $A[i] + A[j] = K$ $(i \neq j)$

2-SUM

	0	1	2	3	4	5	6	7	8	9
A :	8	3	1	-2	4	5	11	-6	7	5

$K = 11 \rightarrow (4, 8) : 4 + 7 = 11 \rightarrow$ true!

$K = 22 \rightarrow$ false!

1) BF

```
f(i: 0 → N-1){
    f(j: i+1 → N-1){
        if (A_i + A_j == k){
            ret true;
        }
    }
}
ret false;
```

$\boxed{TC = O(N^2)}$

$\boxed{SC = O(1)}$

2) HM →

	0	1	2	3	4	5	6	7	8	9
						j				
A :	8	3	1	−2	4	5	11	−6	7	5

$K - A_j$

$11 - 5$

$= 6$

$A_i + \boxed{A_j} = K$

$\boxed{A_i = K - A_j}$

$K = 11$

```
HashSet < int > hs;
f(i:0 ⟶ N-1){                      → N
    find = K - A[i];                → O(1)
    if(hs.contains(find)==true){
            ret true;
    }
    hs.insert(A[i]);                → O(1)
}
ret false;
```

$\boxed{TC = O(N)}$

$\boxed{SC = O(N)}$

Q Given an arr. Find the no. of pairs (i, j)

: $\boxed{A_i + A_j = K}$ (i<j)

I) BF

$\boxed{\begin{array}{l} TC : O(N^2) \\ \hline SC : O(1) \end{array}}$

II) HM

+2

	0	1	2	3	4	5	6	7	8	9
A :	0	5	2	5	5	8	8	6	10	5

K = 10

<0 : 1>
<2 : 1>
<5 : 3>

10 − 5
= 5

```
HashMap< int, int > hm;        ANS = 0
f(i:0 ⟶ N-1) {  ⟶ N
    find = K - A[i];            }
    ANS += hm[find];            } — O(1)
    hm[A[i]]++;                 }

}
ret ANS;
```

7

f(3)

K = 10

$\boxed{TC = O(N)}$

$\boxed{SC = O(N)}$

	0	1	2	3	4	5	6	7	8	9
A :	0	5	2	5	5	8	8	6	10	5

K = 10

HM

<0, 1>
<5, 3>
<2, 1>

ANS

~~∅~~ ~~1~~ 3

N

5 5 5 5 5 —— 5

K = 10

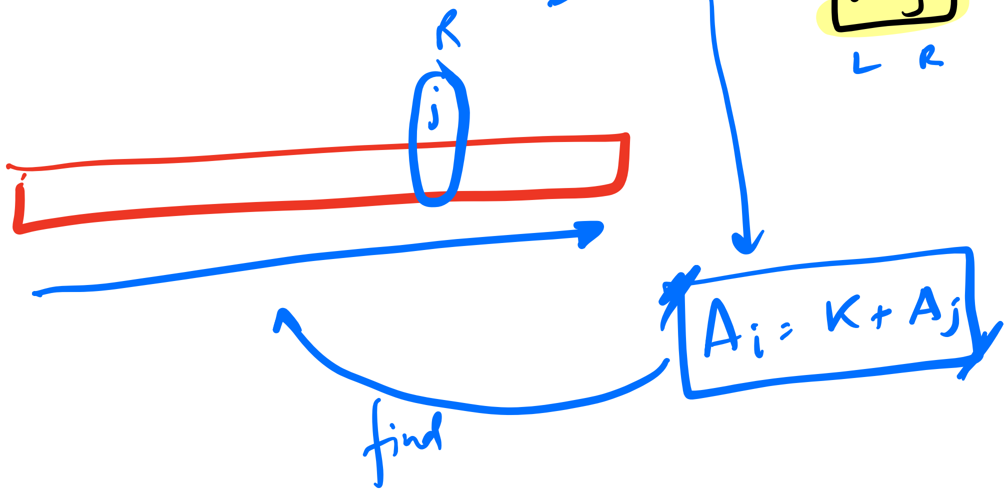
$^{N}C_{2}$ MAX ANS

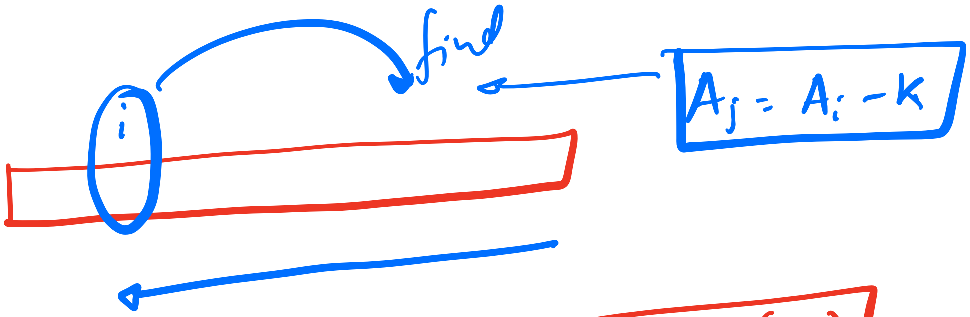
$N(N-1)/2$

Q Given an Array.

Find # pair (i, j) : $\boxed{A_i - A_j = k}$ $\boxed{i<j}$

L R

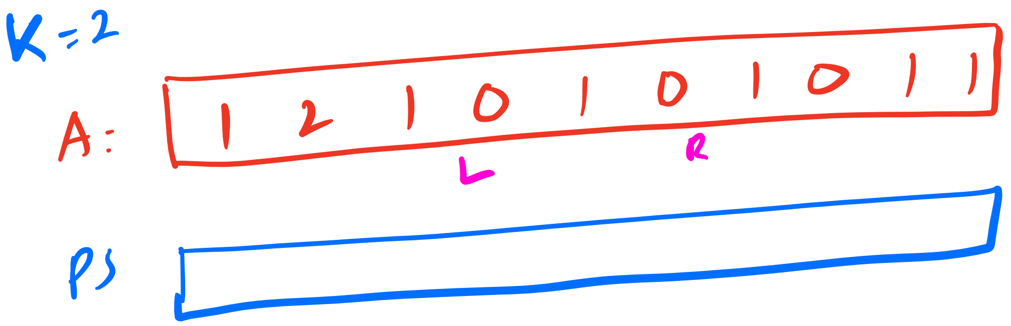




$\boxed{TC = O(N)}$

$\boxed{SC = O(N)}$

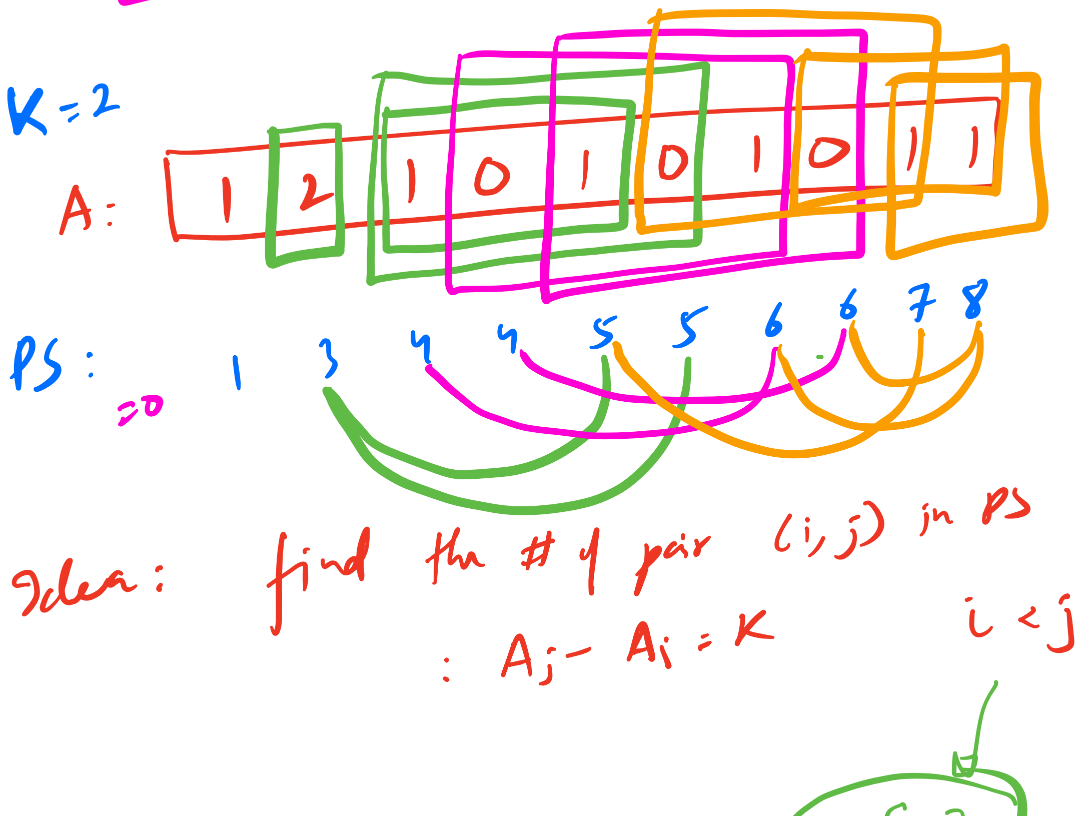
Q Given an Array. find the # of Sub-Arrays whose sum == K



$$\boxed{sum(L, R)} = K$$

$$\downarrow$$

$$\boxed{ps[R] - ps[L-1) = K}$$



Idea: find the # of pair (i, j) in PS

: $A_j - A_i = K$ $i < j$

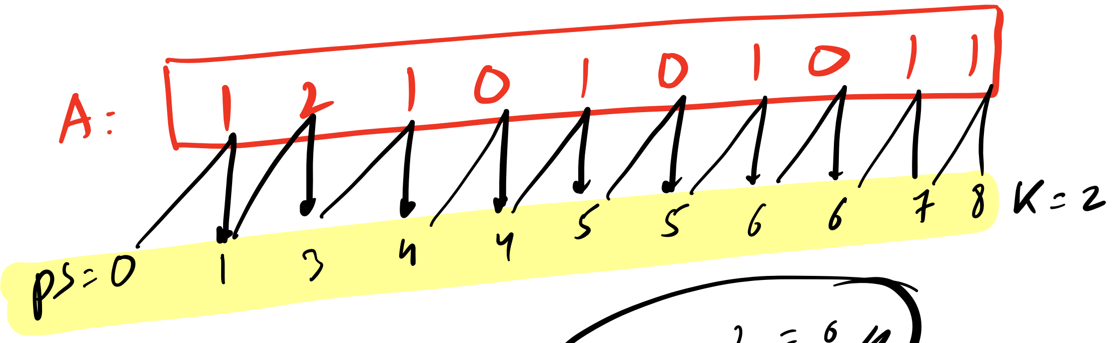
$R \rightarrow \boxed{ps[R]}$

Corner → Case →

0

$\boxed{2}$ 1 $\boxed{2}$ 1 0

ps: 0 2 3 5 6 6



8 − 2 = 6 //

HM

<0, 1>
<1, 1>
<3, 1>
<4, 2>
<5, 2>
<6, 2>
<7, 1>
<8, 1>

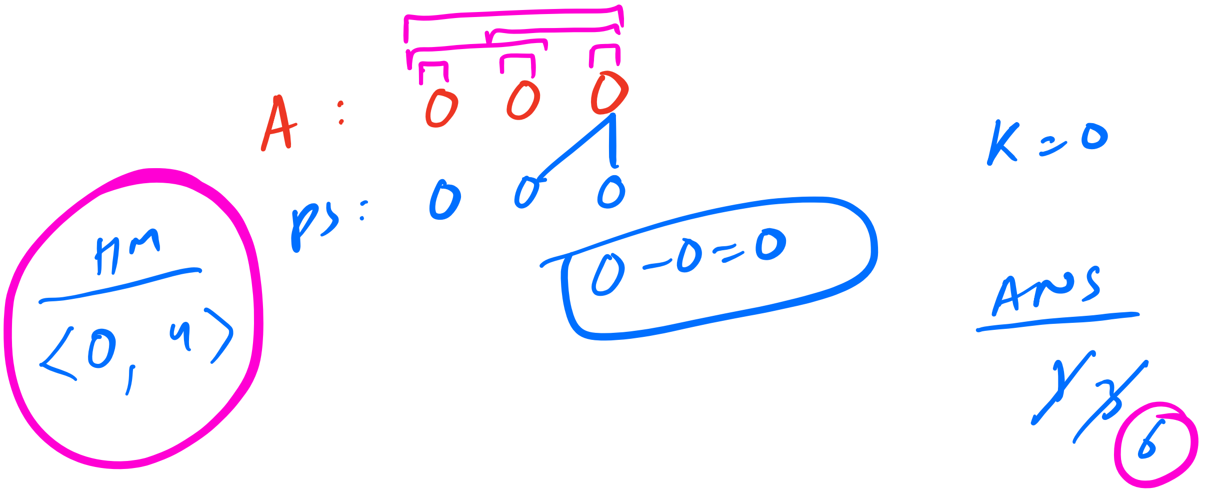
ANS

~~1~~ ~~2~~ ~~3~~ ~~5~~ ~~7~~ ~~9~~
11

A : $\boxed{2}$ 1 5

ps 0 2 3 8

K = 2



Q Given an array. Calculate the no. of **DISTINCT** elements in every subarray of size K.

	0	1	2	3	4	5	6	7	8	9
A :	2	4	3	8	3	5	4	9	4	10

K = 4

$\boxed{\#SA \text{ of size } k = N-K+1}$

1) BF

$\forall$ S.A → (N-K+1)

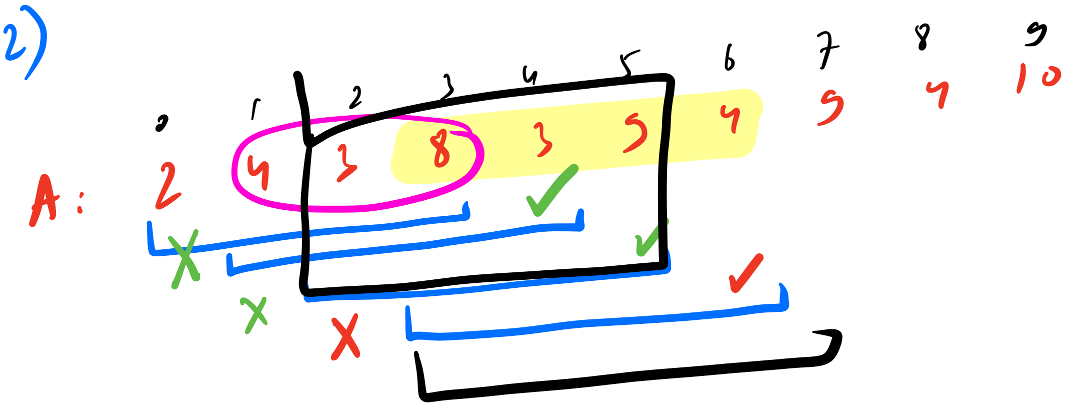
insert in HS find size! → O(K)

$\boxed{SC = O(K)}$

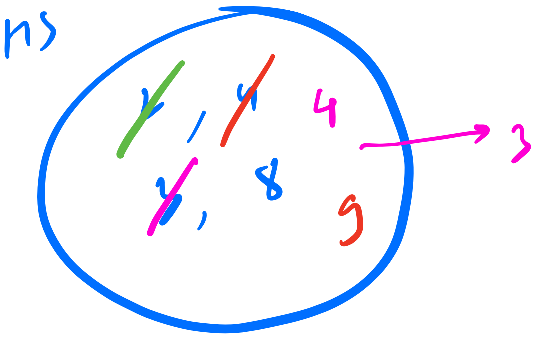
$\boxed{TC = O(K(N-K))}$

$K = N/2$ $\approx O(N^2)$

2)



MS



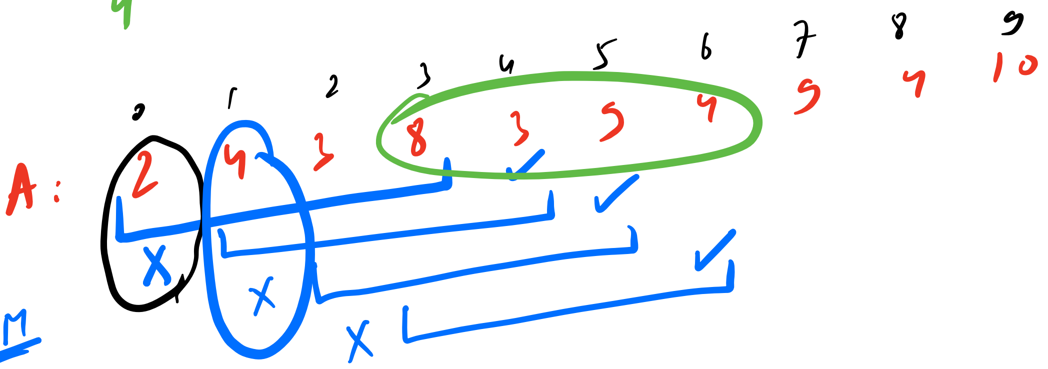
WRONG APPROACH

freq of element MATTERS!

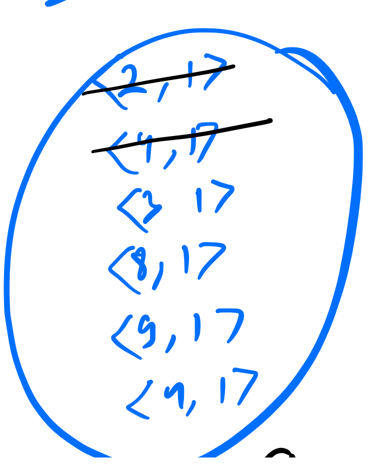
S2

4

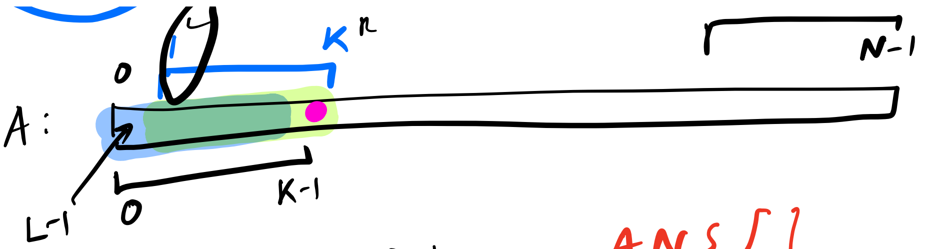
II



MM



S2: 4, 3, 3, 4



ANS [ ]

```
HashMap<int,int> hm;
f(i=0 → K-1){        → O(K)
    hm[A[i]]++;

}
ANS.add(hm.size());

L=1, R=K;
while(R<N){          → O(N-K)
   //[L,R] → S.A
     hm[A[R]]++;
     if(hm[A[L-1]] == 1){
          hm.remove(A[L-1]);        } → O(1)

     }
     else → hm[A[L-1]]--;
      ANS.add(hm.size());
      L++, R++;
  }
  ret ANS;
```

$O(K+N-K)$

$\boxed{TC = O(N)}$

$\boxed{SC = O(K)}$