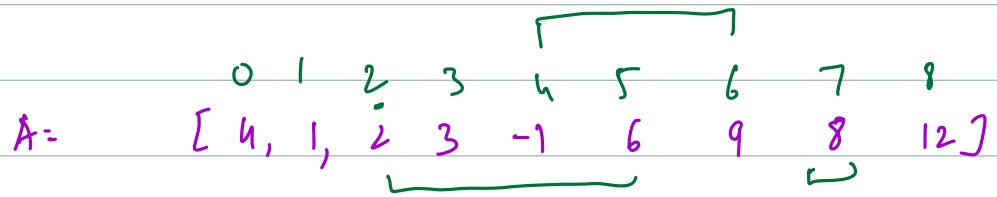
Definition

A subarray is a contiguous part of an array, defined by a starting index and an ending index. It represents a subset of elements within the array.

Note:

- Single element is also considered as subarray.
- Complete array is also considered as subarray.
- Subarray is considered from left to right.



[2 3 -1 6] => (2, 5)

[4, 2] => X

[1, 2, 6] => X

[-1, 6, 9] => (4, 6)

[8] => (7, 7)

[8, 9, 6] => X

[4, 1, 2, 3, -1, 6, 9, 8, 12] => (0, 8)

[2, 3, 6] => X

A = [3, -1, 6, 9, 8]
0 1 2 3 4

(2, 4) => {6, 9, 8}

Question: Given start & end index of a subarray, print the subarray

```
void printSubarray(int[] A, int s, int e){
    for(i=s; i<=e; i++){
        print(A[i]);
    }
    return;
}
```

T.C: O(N), S.C: O(1)

Can we ever print an array in less than O(N) => NO!

Question: Given start index and length of the subarray, print the subarray

A = [4 1 2 3 -1 6 9 8 12]
    0 1 2 3 4 5 6 7 8

	Start	Length			
=>	2	4	=>	{2, 3, -1, 6}	=> (2, 5) (2+4, -1)
	4	3	=>	{-1, 6, 9}	=> {4, 6} (4+3-1)
	1	6	=>	{1, 2, 3, -1, 6, 9}	=> (1, 6) (1+6-1)
	4	3			=> (4, 6) (4+3-1)

s l (s, s+l-1)

[s, e] => e-s+1 = l => e = s+l-1

[a, b] => b-a+1

```
void printSubarray(int[] A, int s, int l){
    int e = s+l-1;
    for(i=s; i<=e; i++){
        print(A[i]);
    }
    return;
}
```

Question: Find total no. of subarrays

Ex: N=3

A = [1, 2, 3]

[1] [1,2] [1,2,3]
[2] [2,3]
[3]

} 6 subarrays

A = [1,2]

[1] [1,2]
[2]

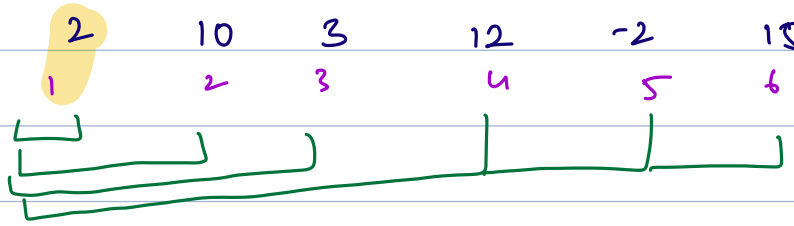
} 3 subarrays

Quiz4: No. of subarrays starting from index 1

N = 7

A : 4 2 10 3 12 -2 15

0 1 2 3 4 5 6



s	e	subarray
1	1	[2]
1	2	
1	3	

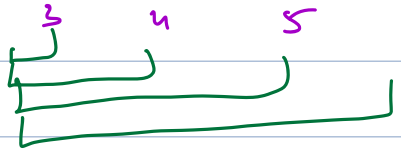
s = 1, e = [1, 2, 3 ..... 6] ⇐

[1, 6] => 6 - 1 + 1 = 6 ⇐

Quiz5: i = 3

A : 4 2 10 3 12 -2 15

0 1 2 3 4 5 6



s	e
3	3
3	4
3	5
3	6

s = 3

e = [3, 4, 5, 6]

= [3, 6] => 6 - 3 + 1 = 4

subarrays starting at index i ?

$s = i$; $e : [i, i+2, i+2 \ldots N-1]$

$[\overset{a}{i}, \overset{b}{N-1}] \Rightarrow N-1-i+1 = \boxed{N-i}$

$[a, b] : b-a+1$

$i : N-i$

# of subarrays = # subarrays starting at index $0 = N$
+
subarrays starting at index $1 = N-1$
+
subarrays starting at index $2 = N-2$
+
subarrays starting at index $3 = N-3$
+
⋮
+
subarrays starting at index $N-1 = 1$

subarrays $= N + (N-1) + (N-2) + \ldots + 3 + 2 + 1$

$= \boxed{\frac{N(N+1)}{2}}$

Question: Given an array, print all the subarrays

A : 2 8 9 4
0 1 2 3

N = 4

$\frac{N(N+1)}{2} = \frac{4 \times 5}{2} = 10$

S	E	Subarrays
0	0	[2] ✓
0	1	[2, 8] ✓
0	2	[2, 8, 9] ✓
0	3	[2, 8, 9, 4] ✓
1	1	[8]
1	2	[8, 9]
1	3	[8, 9, 4]
2	2	[9]
2	3	[9, 4]
3	3	[4]

(0, 0) (0, 1) (0, 2) (0, 3)