Prefix sum

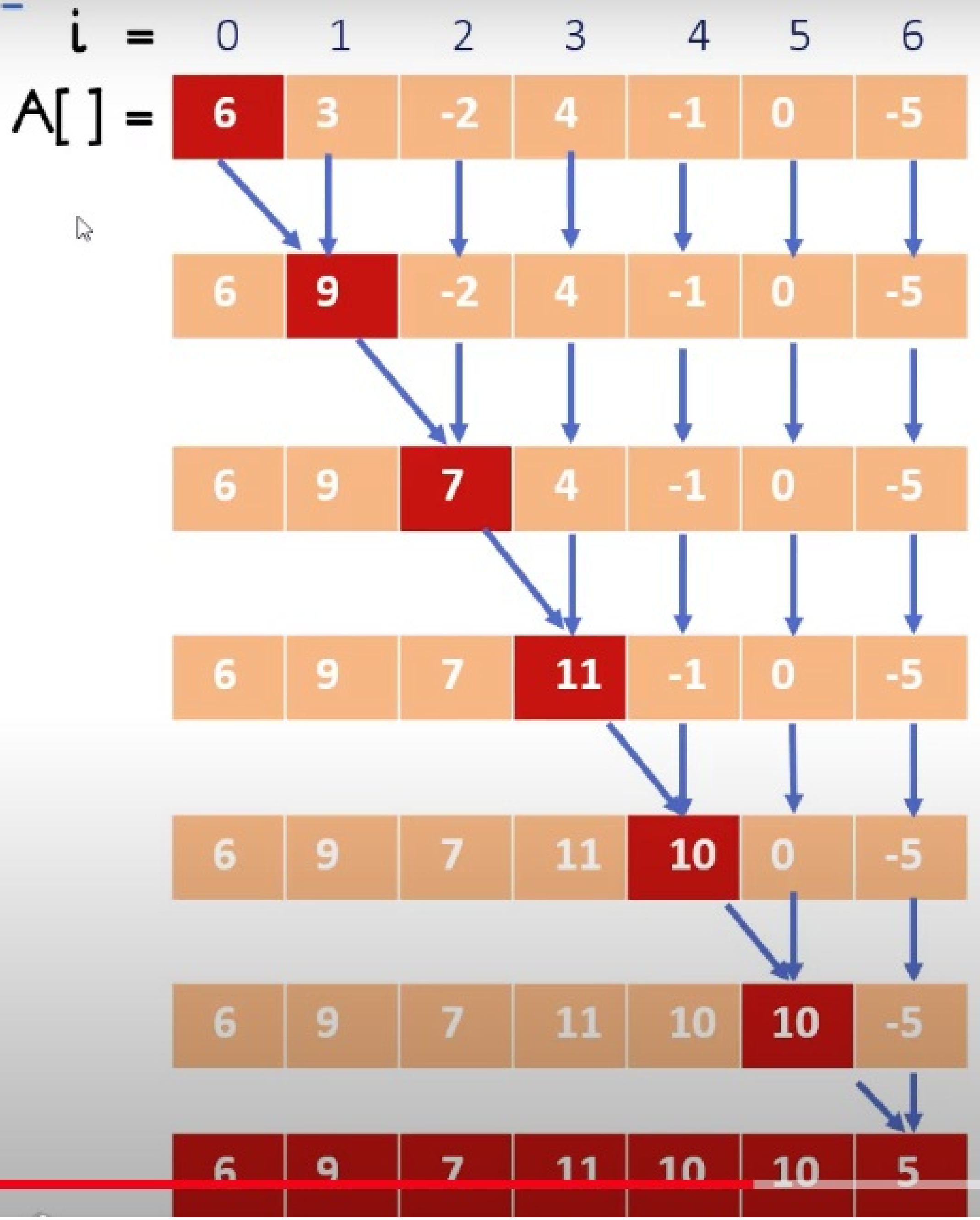
It is a simple yet powerful technique that allows to perform fast calculation on the sum of elements in a given range (called contiguous segments of array).

Example -

i =	0	1	2	3	4	5	6
A[ ] =	6	3	-2	4	-1	0	-5

Prefix Sum Array - A[ ] =	6	9	7	11	10	10	5

Example -



CODE

A[i] = A[i-1] + A[i]

```
for( int i=1; i<n; i++ ){
    A[i] = A[i]+A[i-1];
}
```

n

Prefix sum

Example –

i =	0	1	2	3	4	5	6
A[ ] =	6	3	-2	4	-1	0	-5

Prefix Sum Array –

i =	0	1	2	3	4	5	6
A[ ] =	6	9	7	11	$\boxed{10}$	10	5

Calculate the sum between range [0, 4] ?

Note :- Time taken is constant (O(1))

Yes :- A[4] gives us same

Calculate the sum between range [2, 6] ?

sum between range [0, 6]

sum between range [0, 6] =

sum between range [0, 1] +
sum between range [2, 6]

A[6] = A[1] + sum between range [2, 6]

A[6] - A[1] = sum between range [2, 6]

sum between range [2, 6] = A[6] - A[1]

Analysis of Algorithm -

- To calculate prefix sum array of n size array

  Time complexity - $O(n)$

- Time taken to perform range sum query is -

  Time complexity - $O(1)$

- Total time taken to pre process the n size array and to perform range query is -

  Time complexity - $O(n) + O(1)$

  $\sim O(n)$

Key takeaway from this lesson -

- Range sum query formula- $A[i, j] = A[j] - A[i-1]$
- It takes $O(n)$ time to calculate prefix sum array of n size array.
- It takes $O(1)$ time to perform range sum query on n size array.