Quick Sort

Quick Sort

This sorting algorithm uses the idea of divide and conquer.

It finds the element called **pivot** which divides the array into two halves in such a way that elements in the left half are smaller than pivot and elements in the right half are greater than pivot.

Quick Sort

Three steps

- Find pivot that divides the array into two halves.
- Quick sort the left half.
- Quick sort the right half.

Example

Consider an array having 6 elements

5 2 6 1 3 4

Arrange the elements in ascending order using quick sort algorithm

This is our unsorted array

Array index	0	1	2	3	4	5
Array element	**5**	**2**	**6**	**1**	**3**	**4**

This is our unsorted array

Array index	0	1	2	3	4	5
Array element	**5**	**2**	**6**	**1**	**3**	**4**

Left

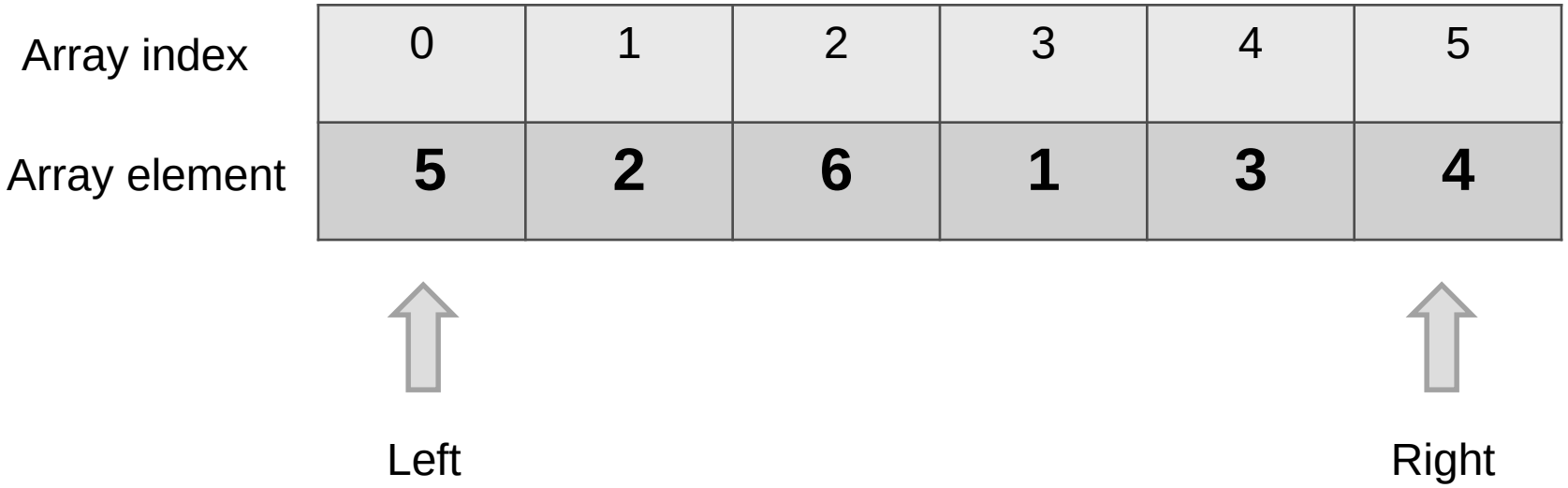
This is our unsorted array

Array index	0	1	2	3	4	5
Array element	**5**	**2**	**6**	**1**	**3**	**4**

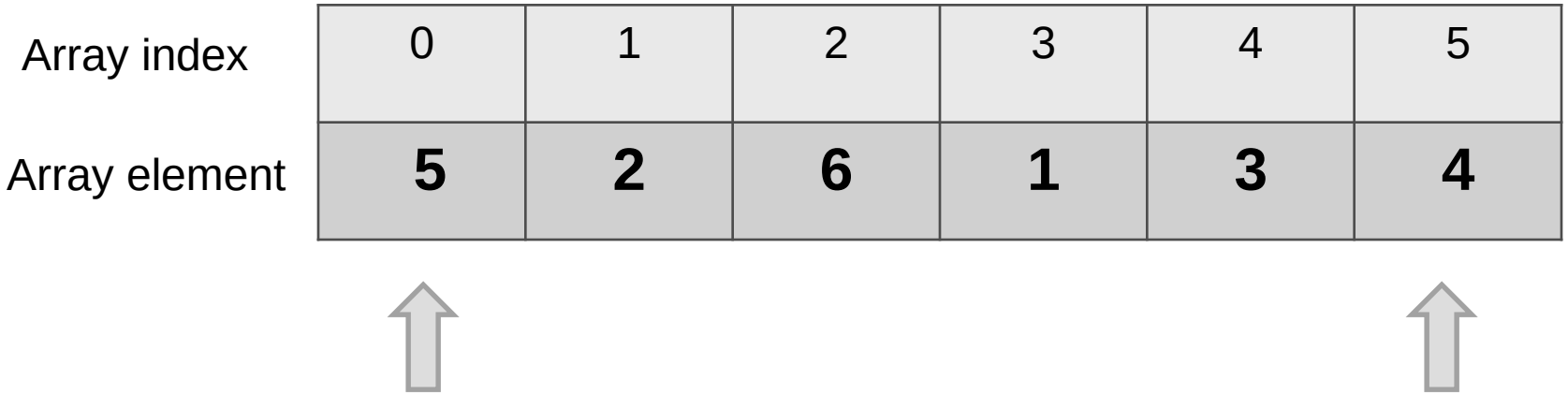
Left

Initially pointing to the
First element of the array

This is our unsorted array



This is our unsorted array

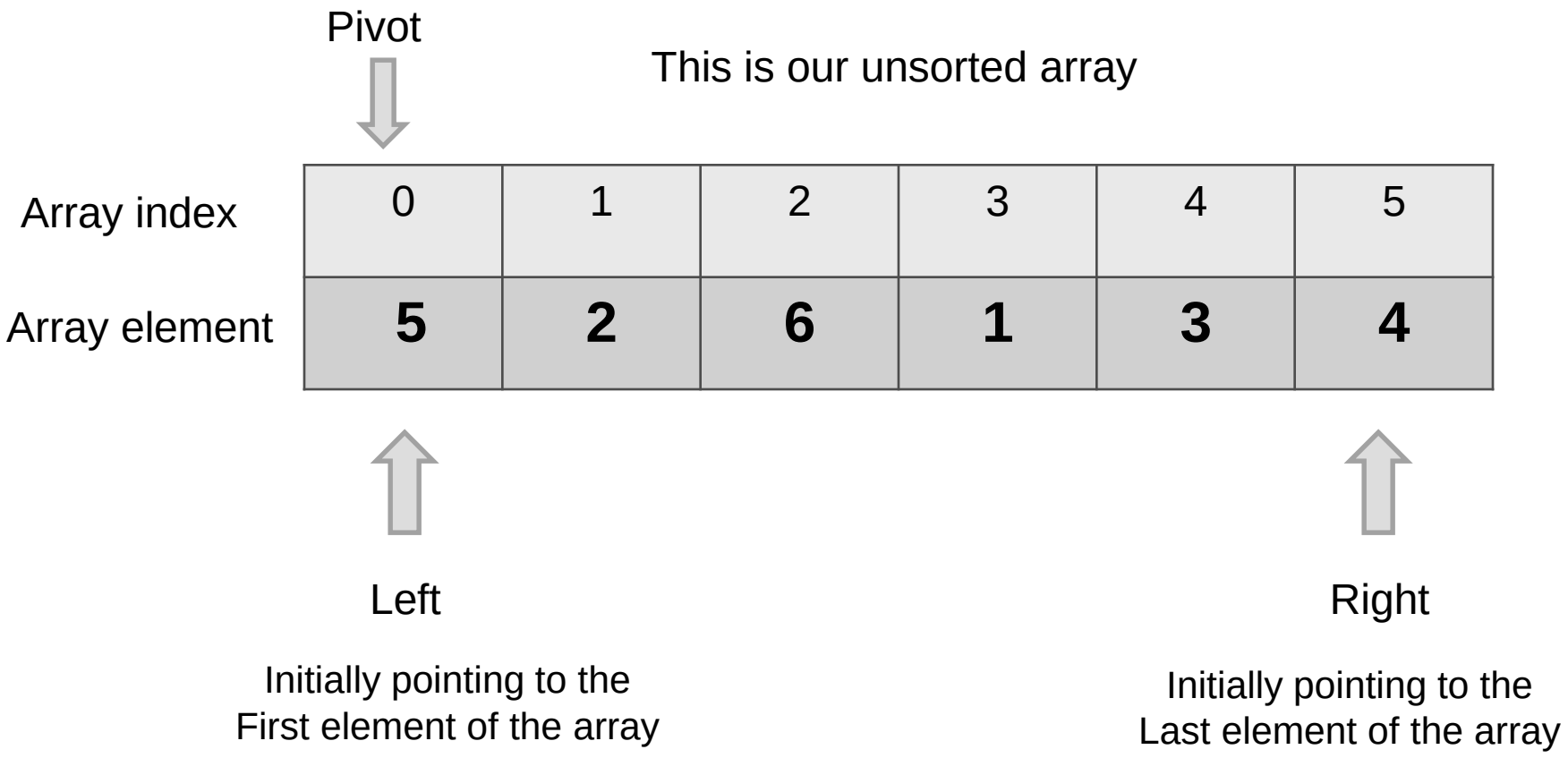


Left

Initially pointing to the
First element of the array

Right

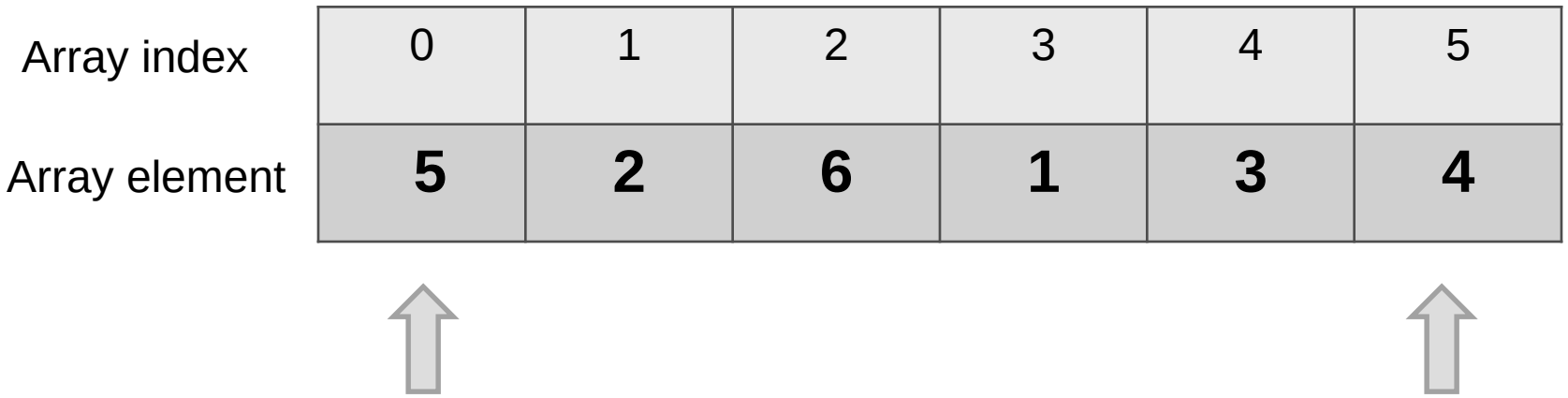
Initially pointing to the
Last element of the array


Pivot
This is our unsorted array
Array index
0
1
2
3
4
5
Array element
5
2
6
1
3
4
Left
Initially pointing to the
First element of the array
Right
Initially pointing to the
Last element of the array

Initially pointing to the
First element

Pivot

This is our unsorted array



Left

Initially pointing to the
First element of the array

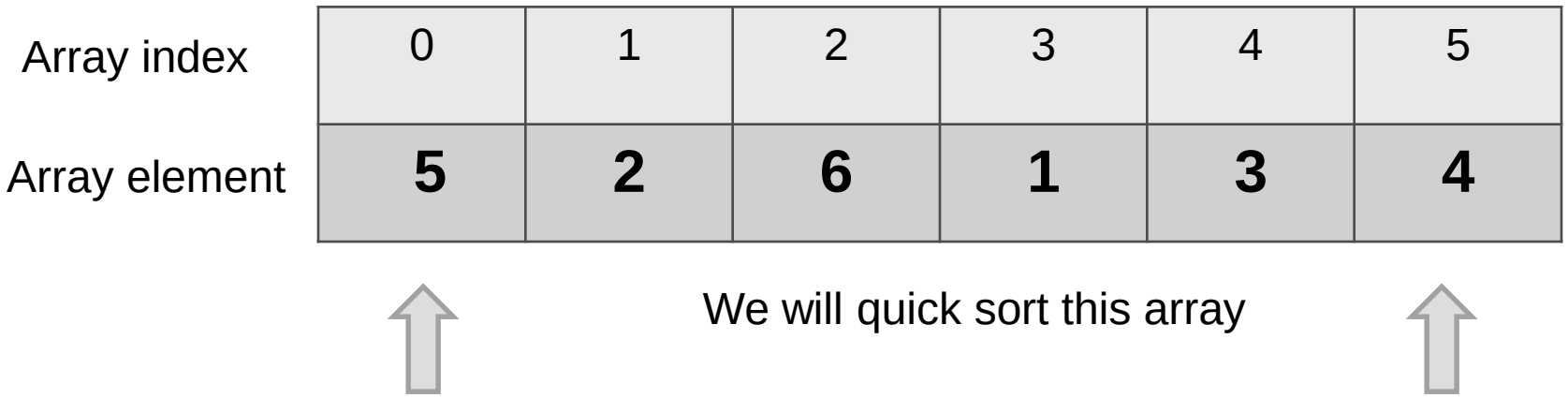
Right

Initially pointing to the
Last element of the array

Initially pointing to the
First element

Pivot

This is our unsorted array



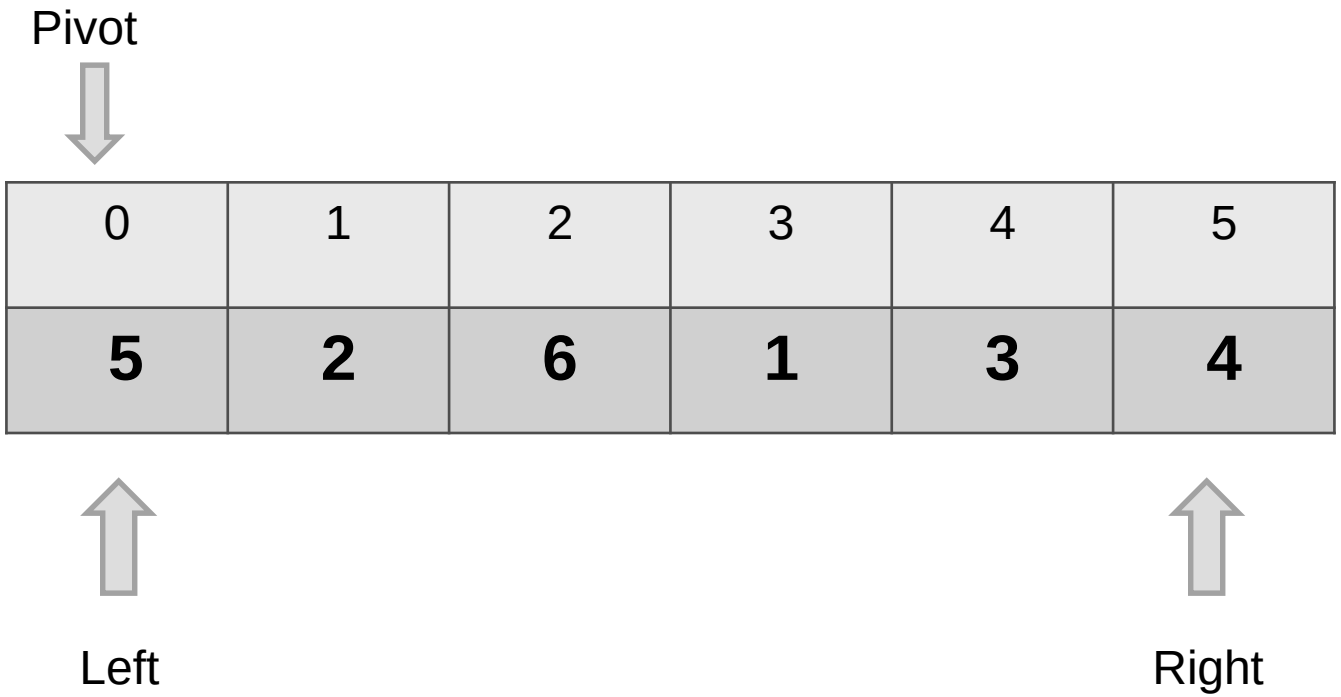
We will quick sort this array

Left

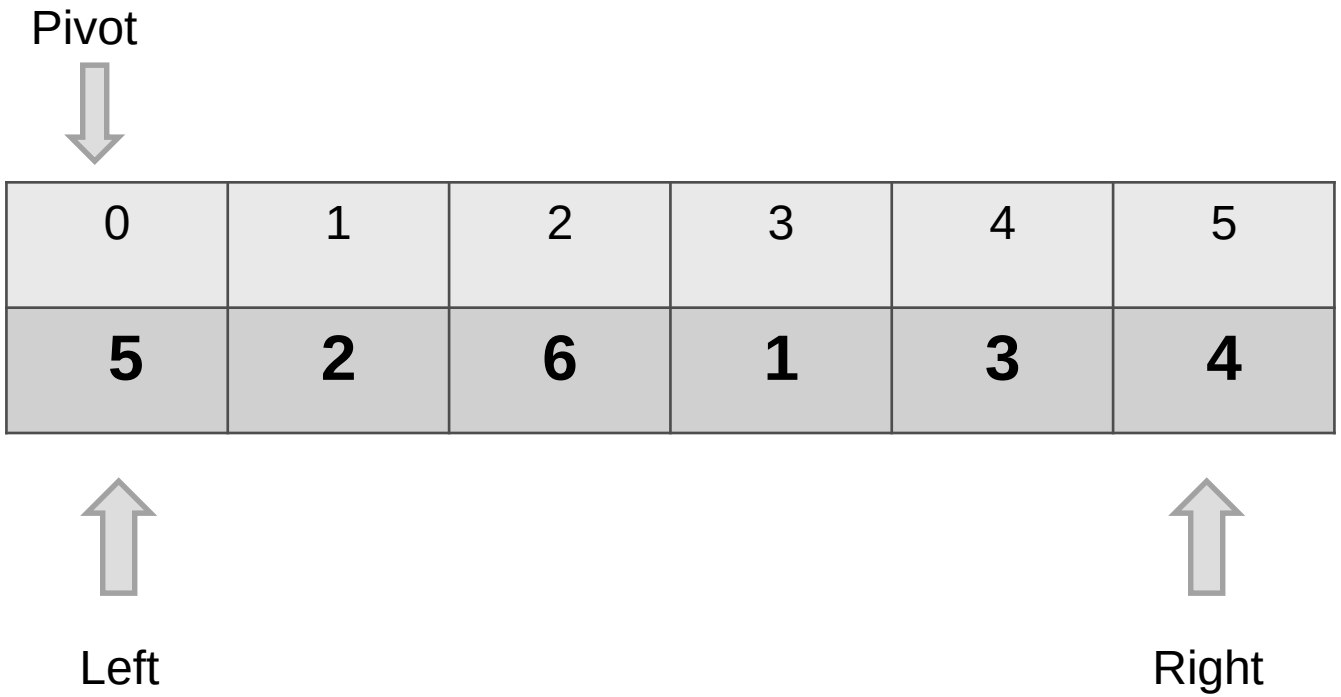
Right

Initially pointing to the
First element of the array

Initially pointing to the
Last element of the array

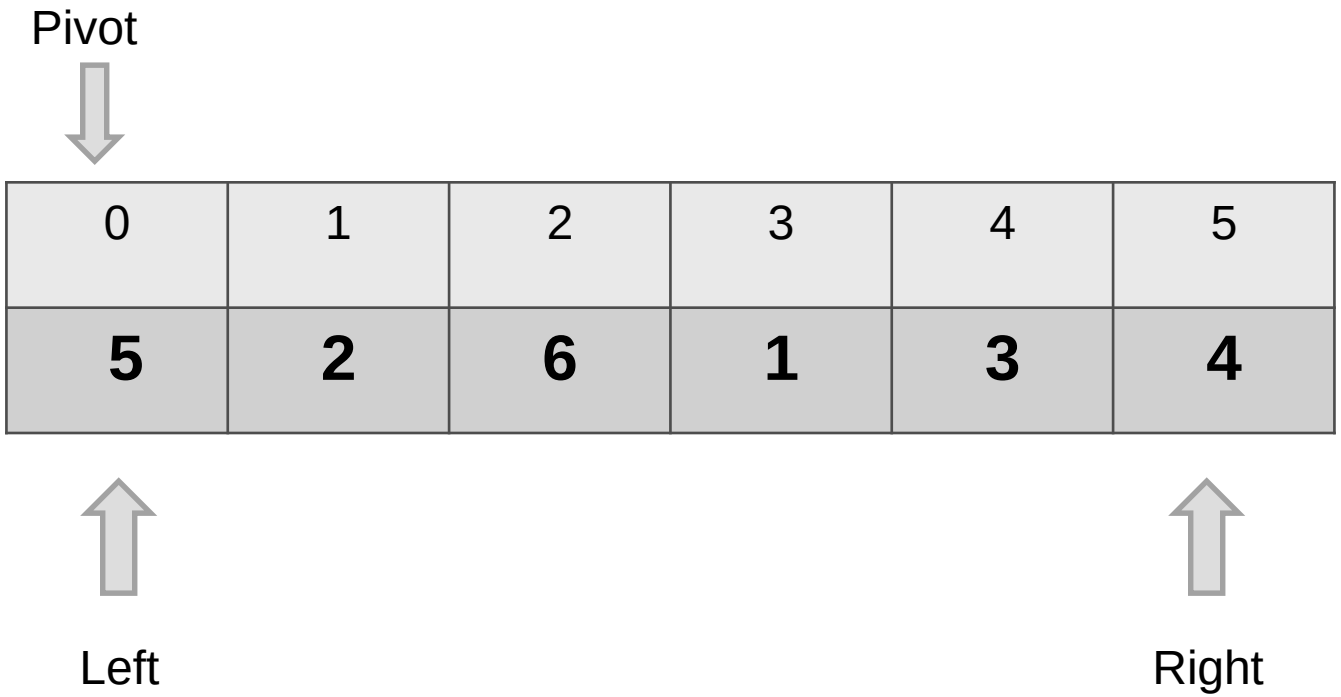

Pivot
0
1
2
3
4
5
5
2
6
1
3
4
Left
Right

Remember this rule:



Remember this rule:

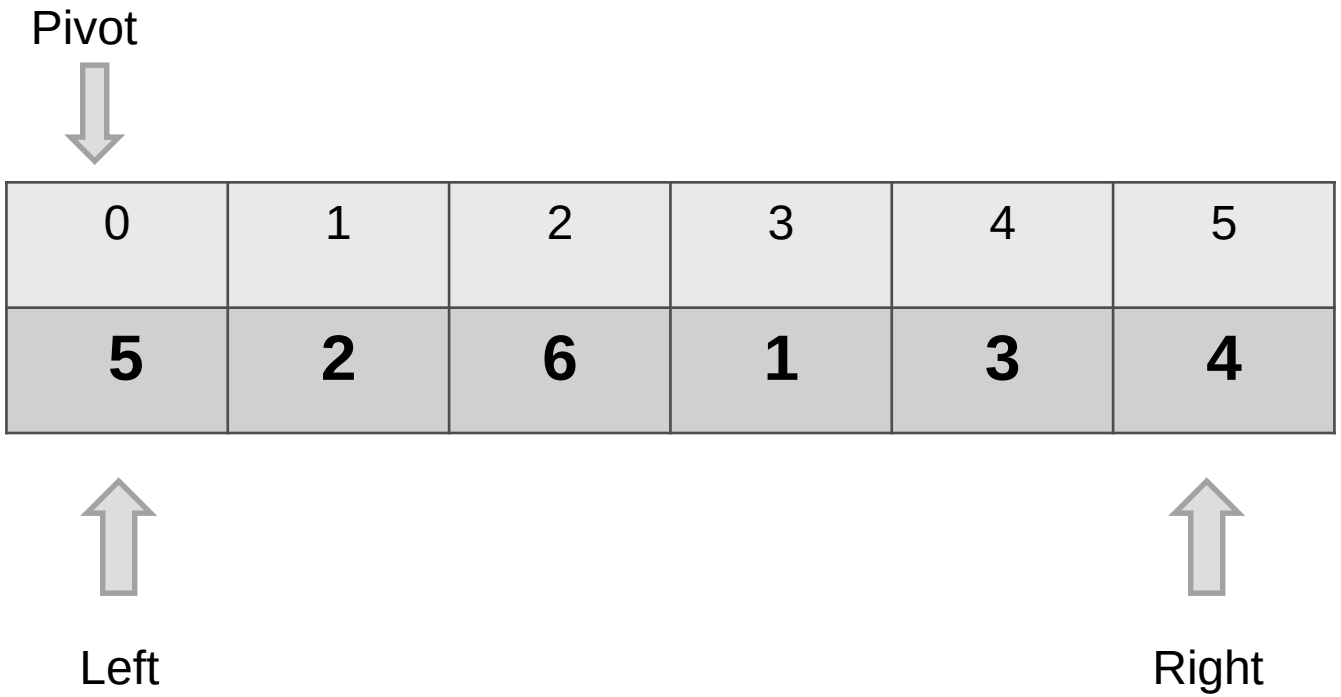
All element to the **RIGHT** of pivot be **GREATER** than pivot.



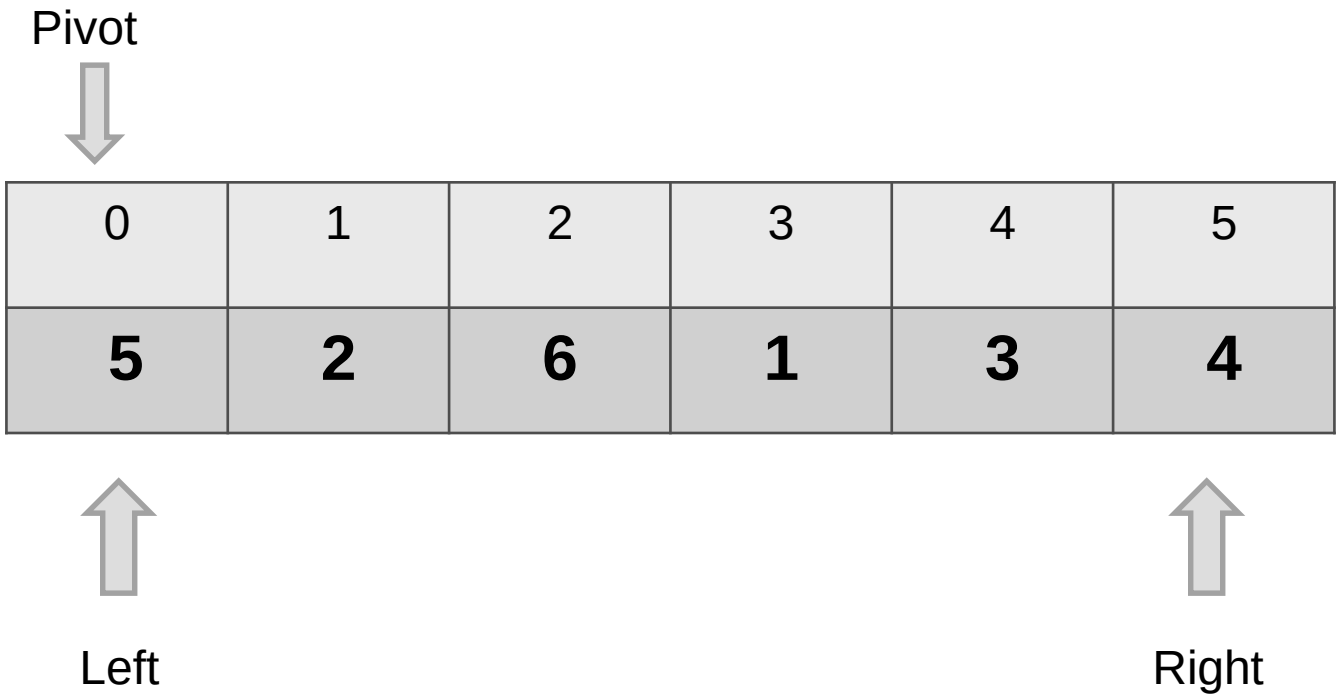
Remember this rule:

All element to the **RIGHT** of pivot be **GREATER** than pivot.

All element to the **LEFT** of pivot be **SMALLER** than pivot.



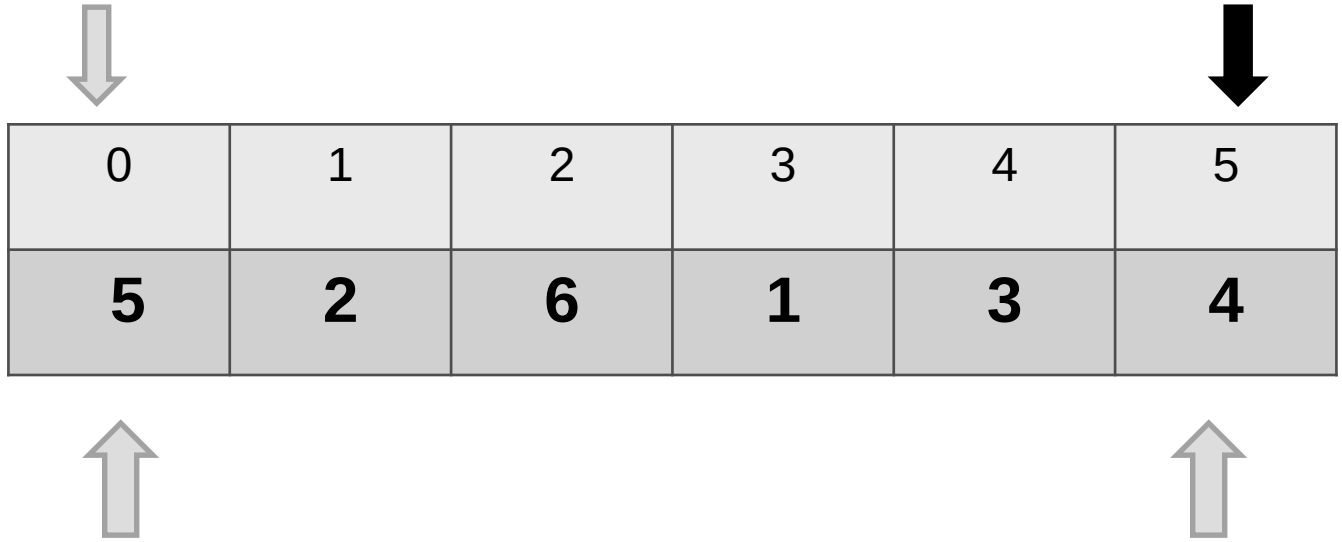
As the pivot is pointing at left

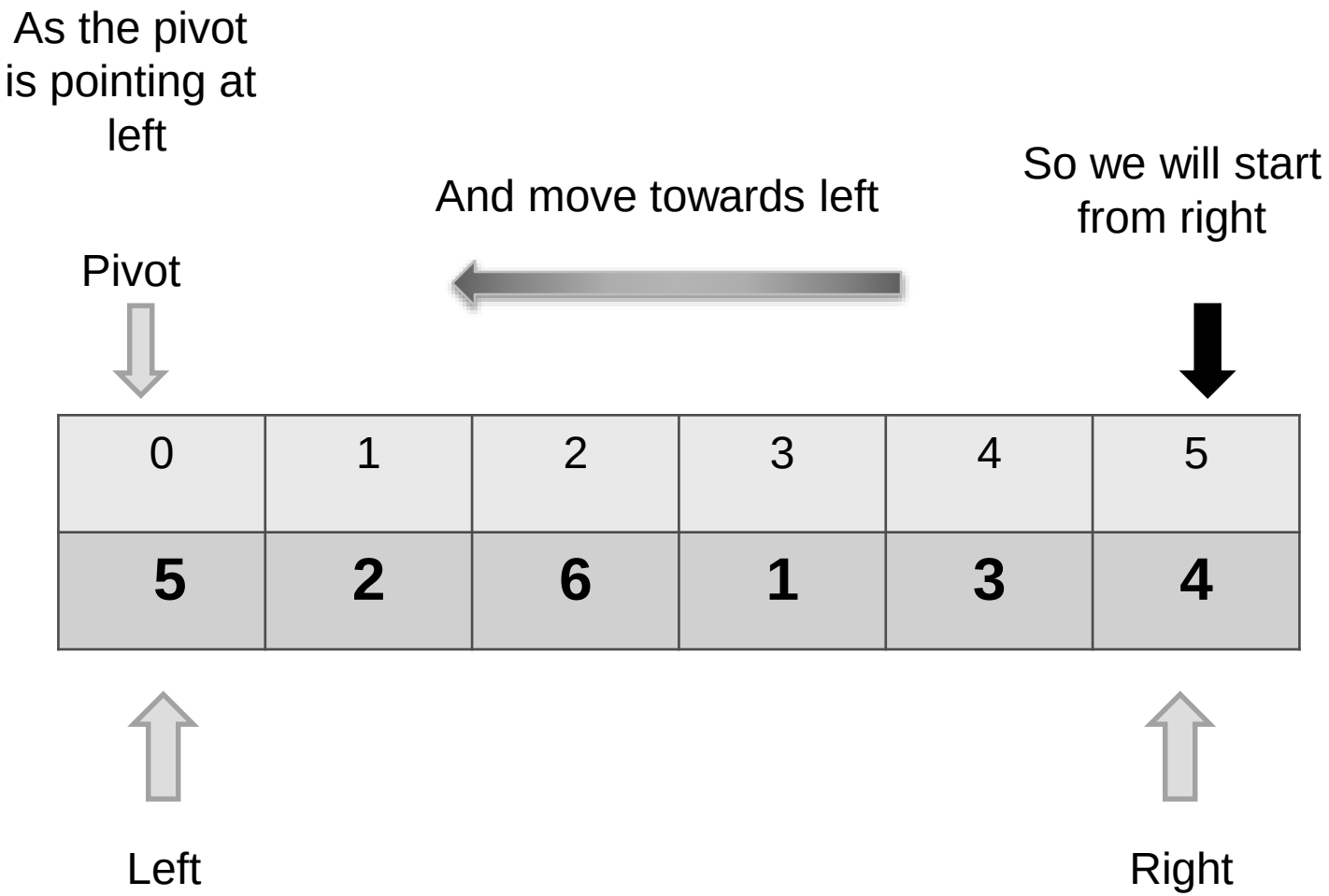


As the pivot is pointing at left

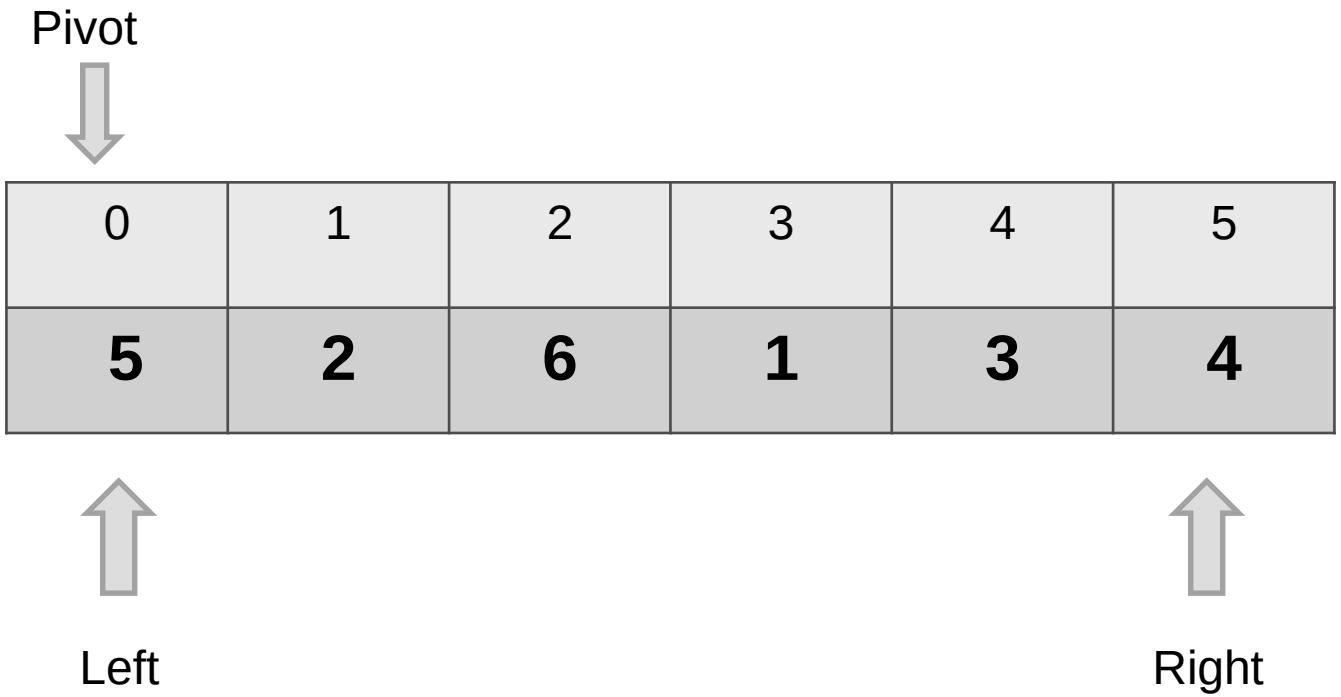
So we will start from right

Pivot




As the pivot is pointing at left
And move towards left
So we will start from right
Pivot
0
1
2
3
4
5
5
2
6
1
3
4
Left
Right

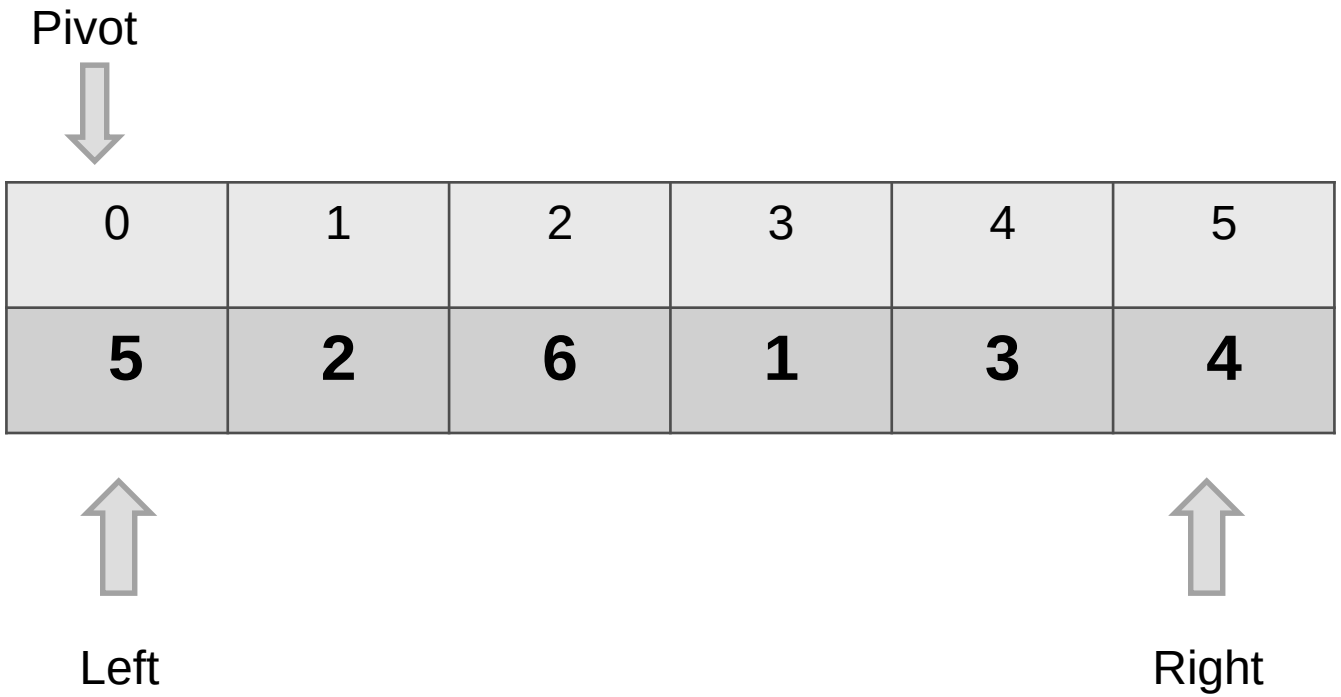
Pivot = 5
Right =4



Is Pivot < Right

(5 < 4)

Pivot = 5
Right =4

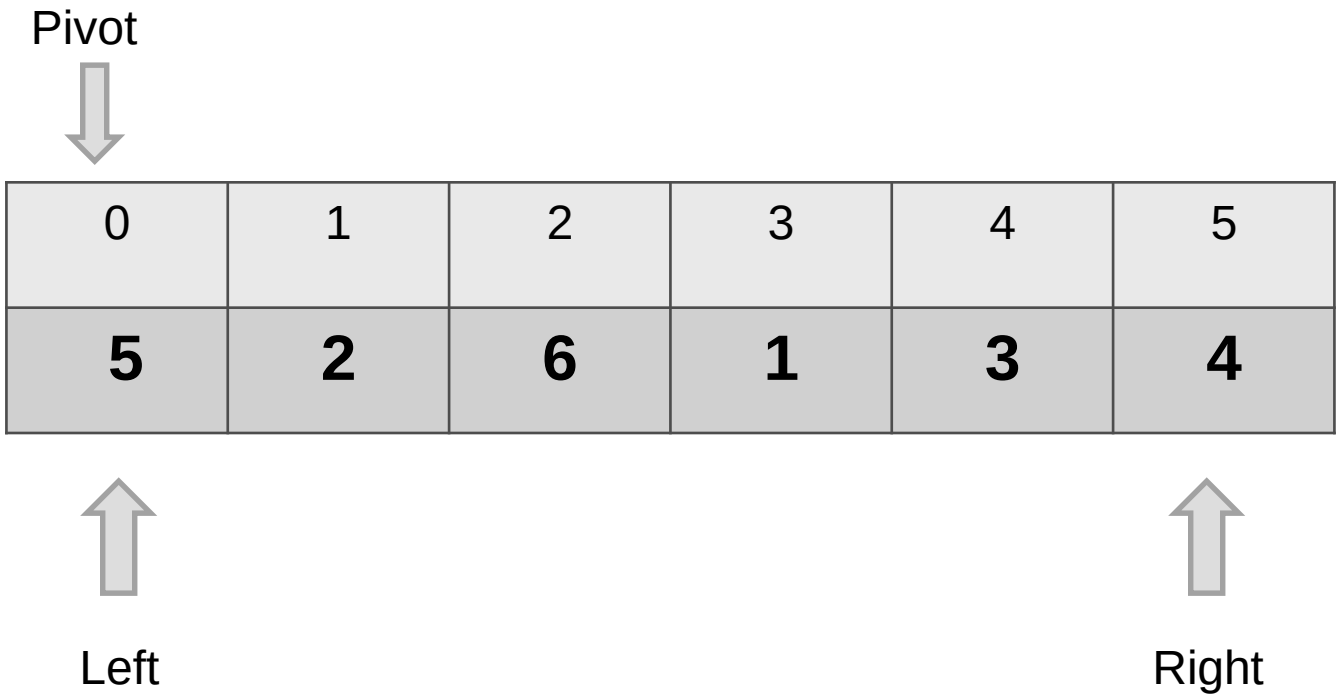


Is Pivot < Right

(5 < 4)

NO

Pivot = 5
Right =4



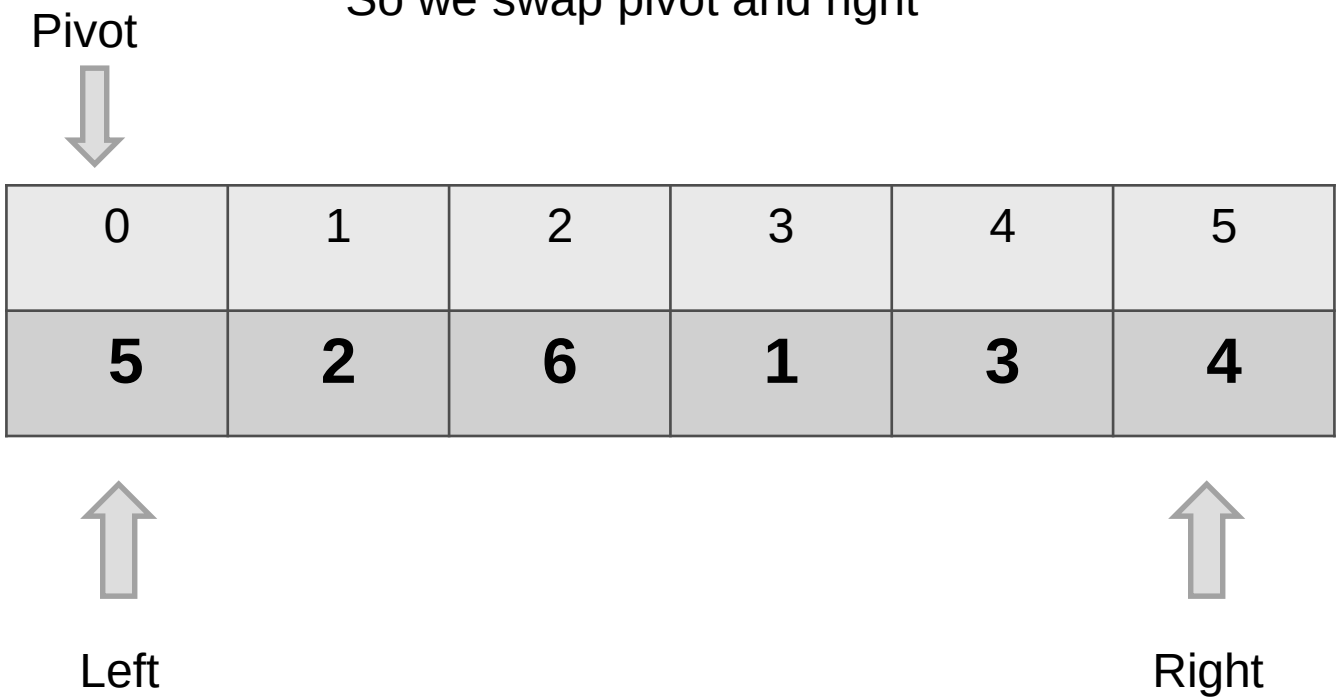
Is Pivot < Right

(5 < 4)

Pivot = 5
Right =4

NO

So we swap pivot and right



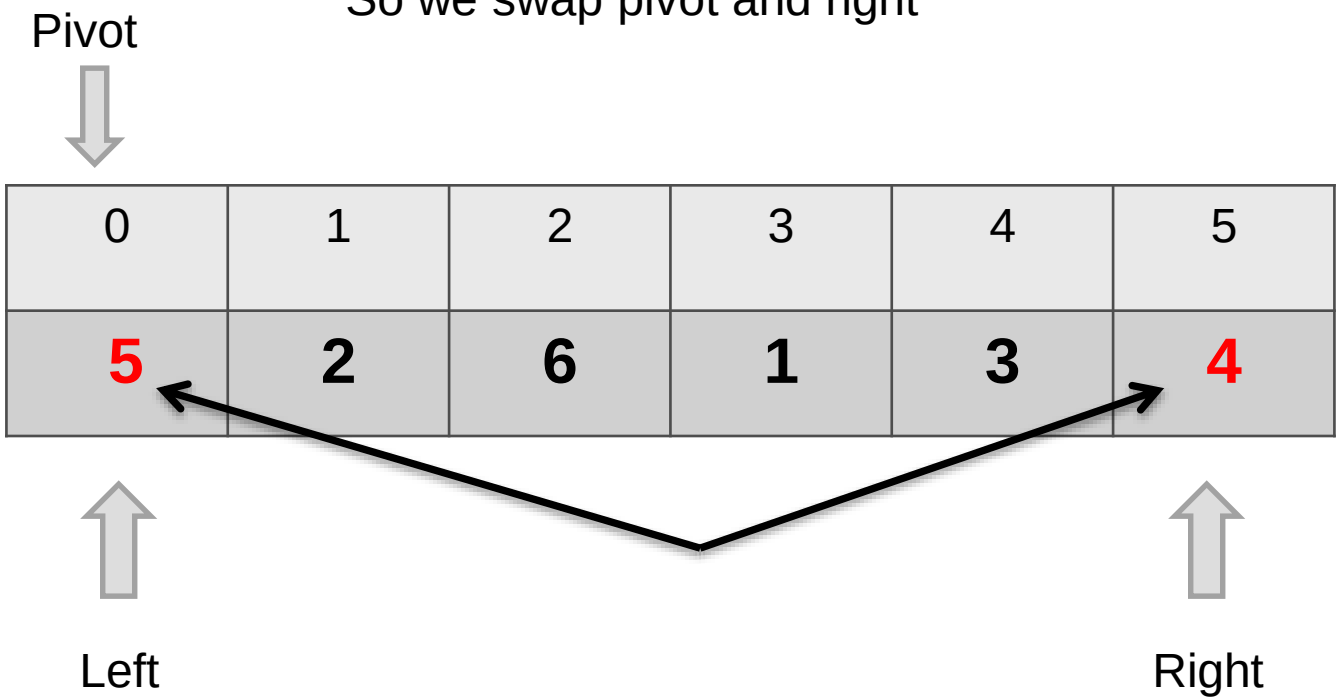
Is Pivot < Right

(5 < 4)

Pivot = 5
Right =4

NO

So we swap pivot and right



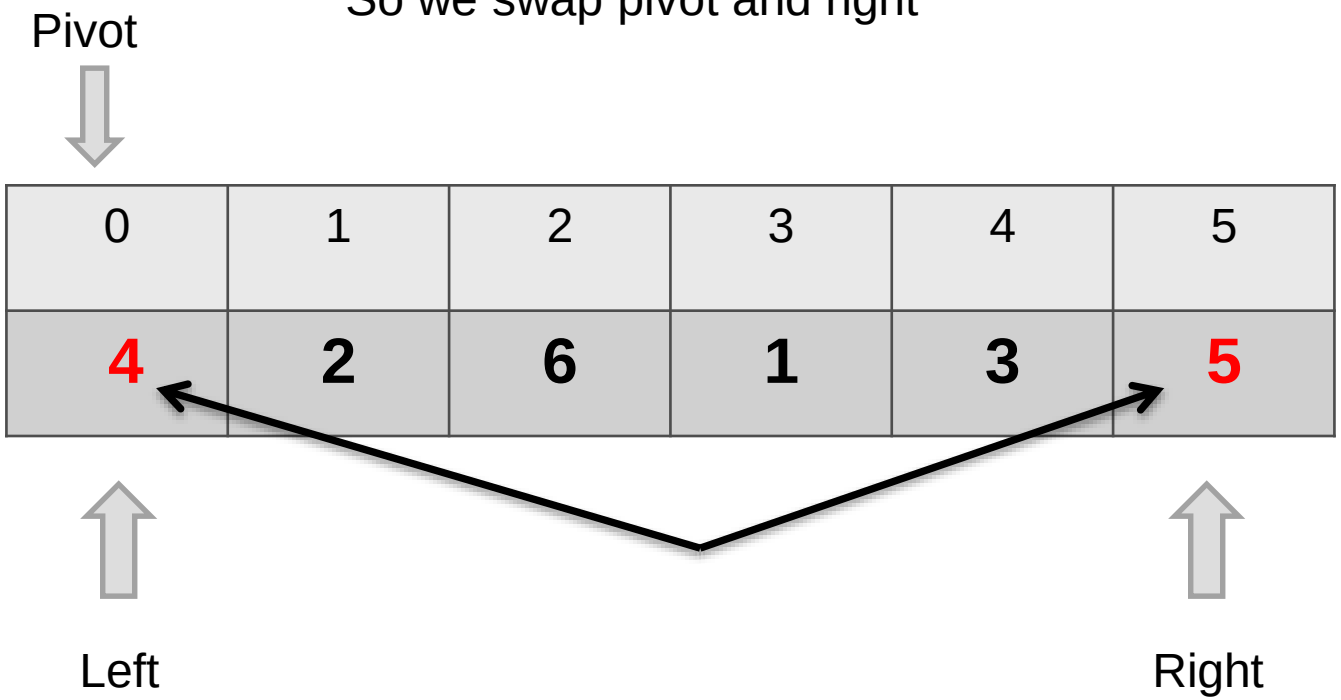
Is Pivot < Right

(5 < 4)

Pivot = 5
Right =4

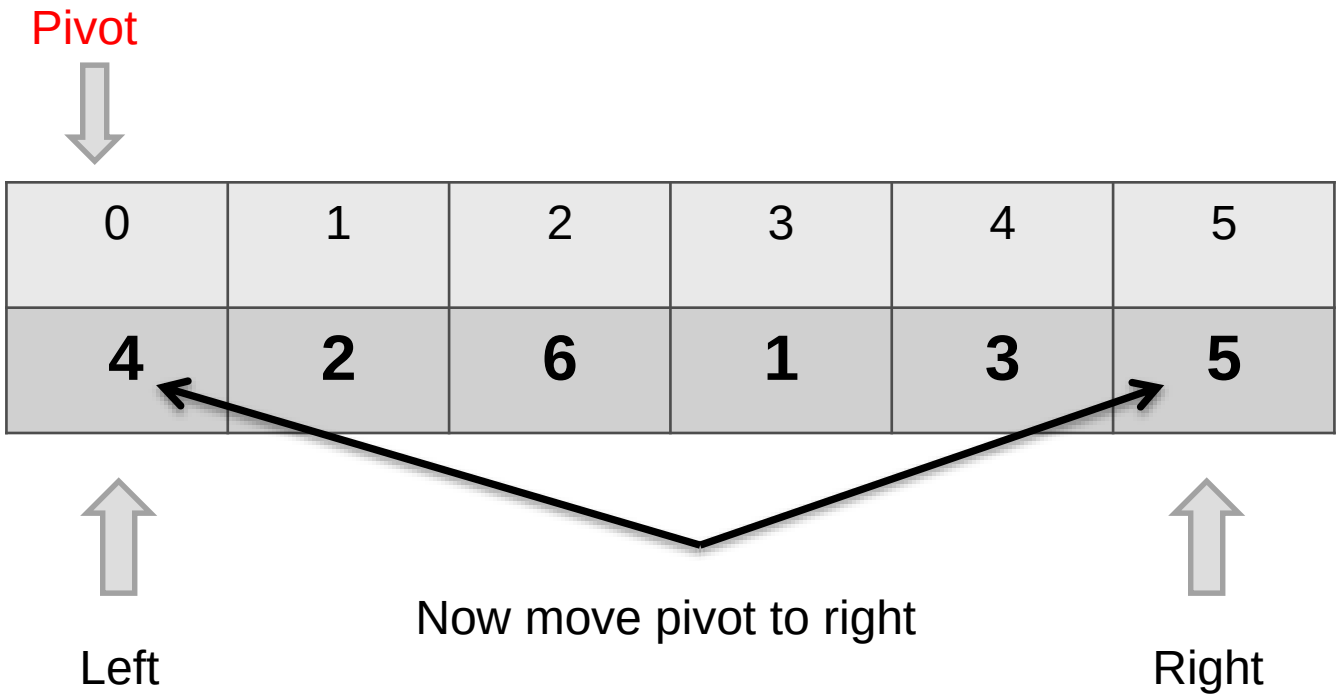
NO

So we swap pivot and right



Is Pivot < Left

Pivot = 5
Left =4

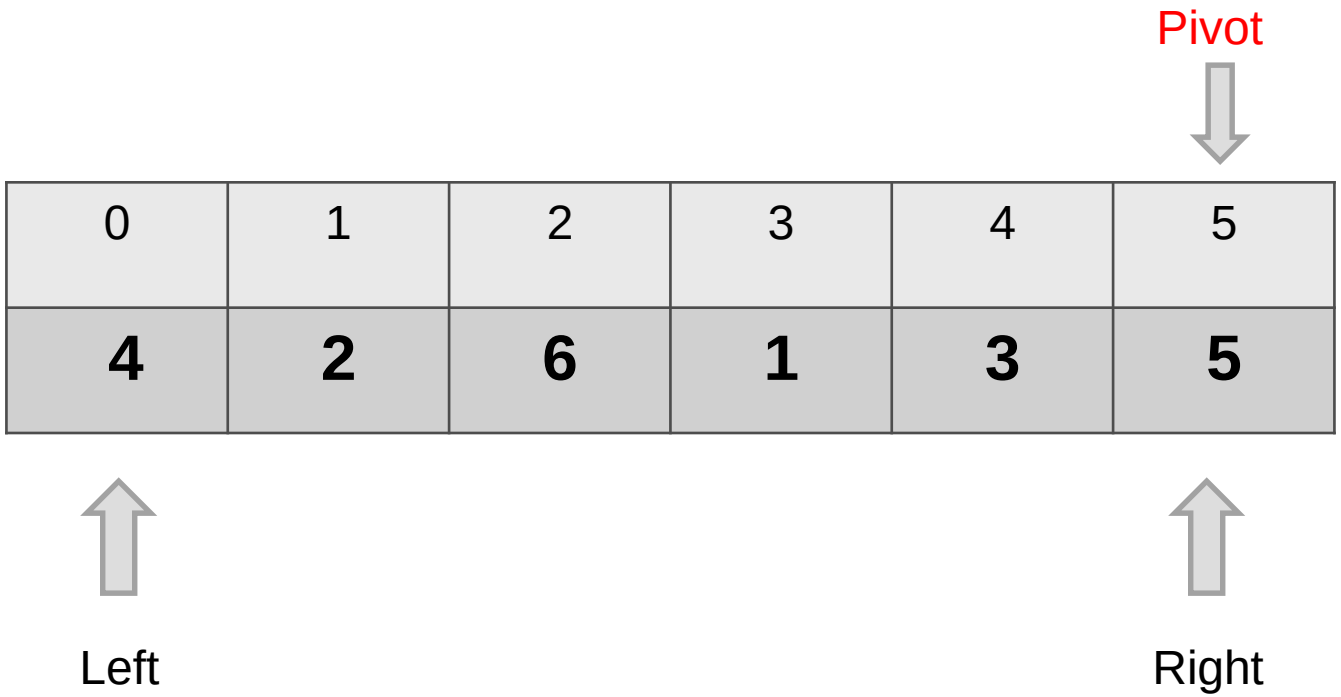


Is Pivot < Left

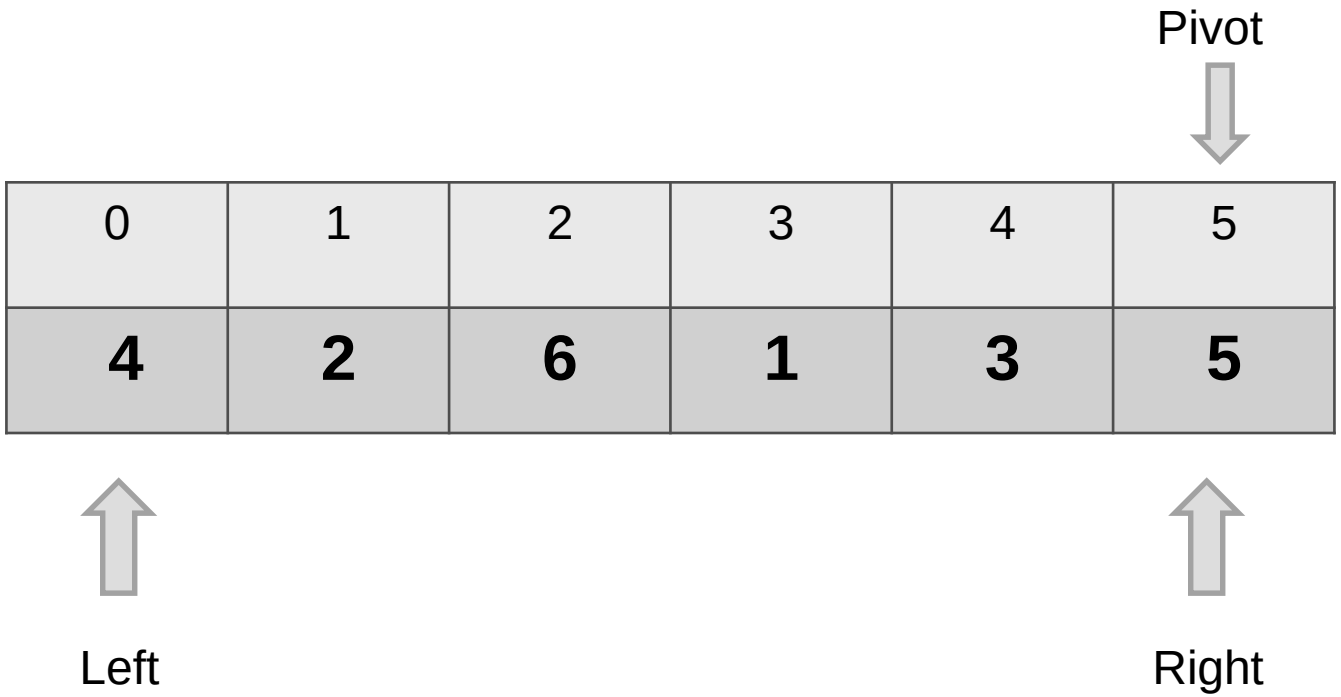
NO

Pivot = 5
Left =4

So we swap pivot to the right

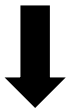


Now the pivot is pointing at right



Now the pivot is pointing at right

So we will start from left

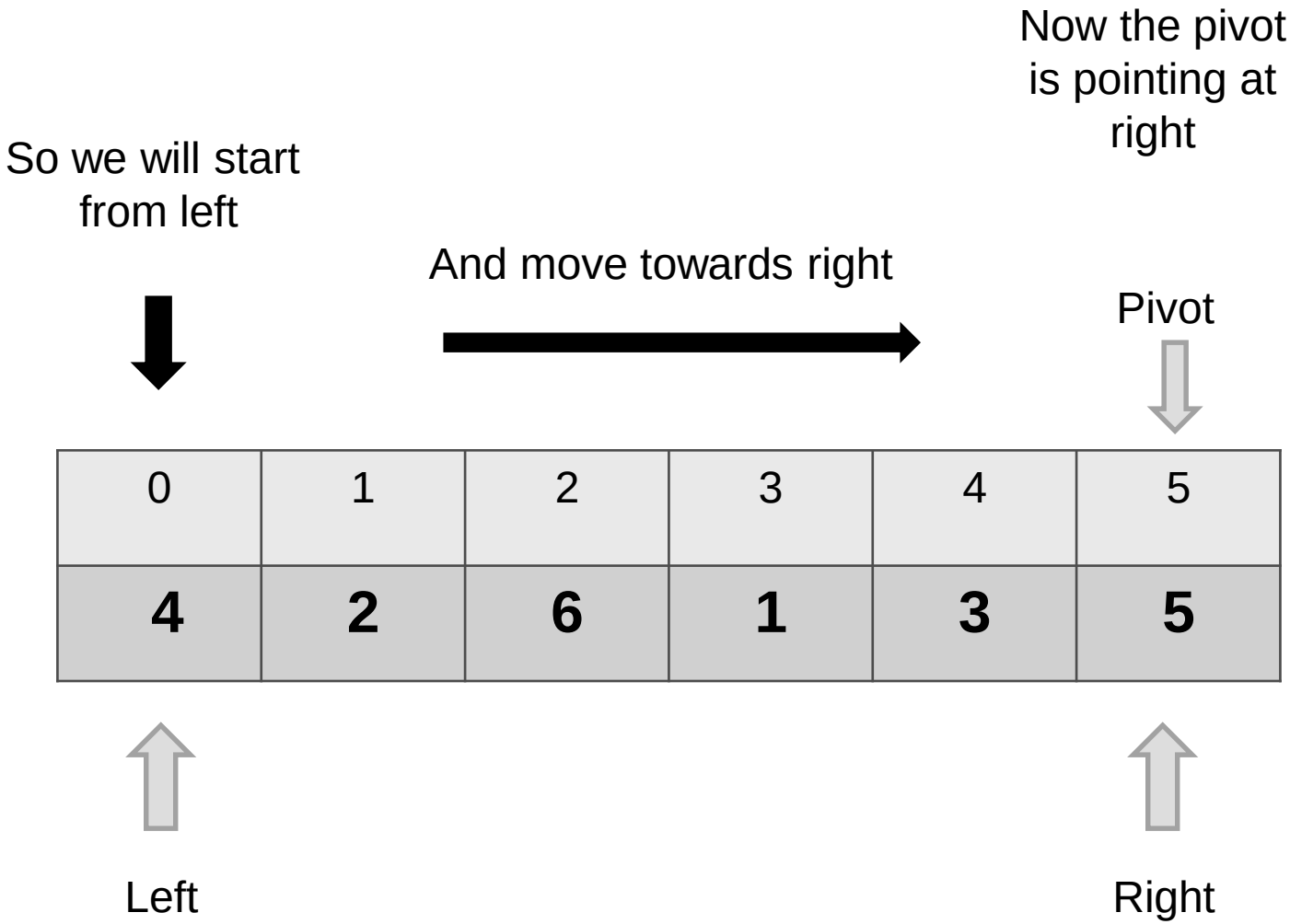


Pivot

0	1	2	3	4	5
4	**2**	**6**	**1**	**3**	**5**

Left

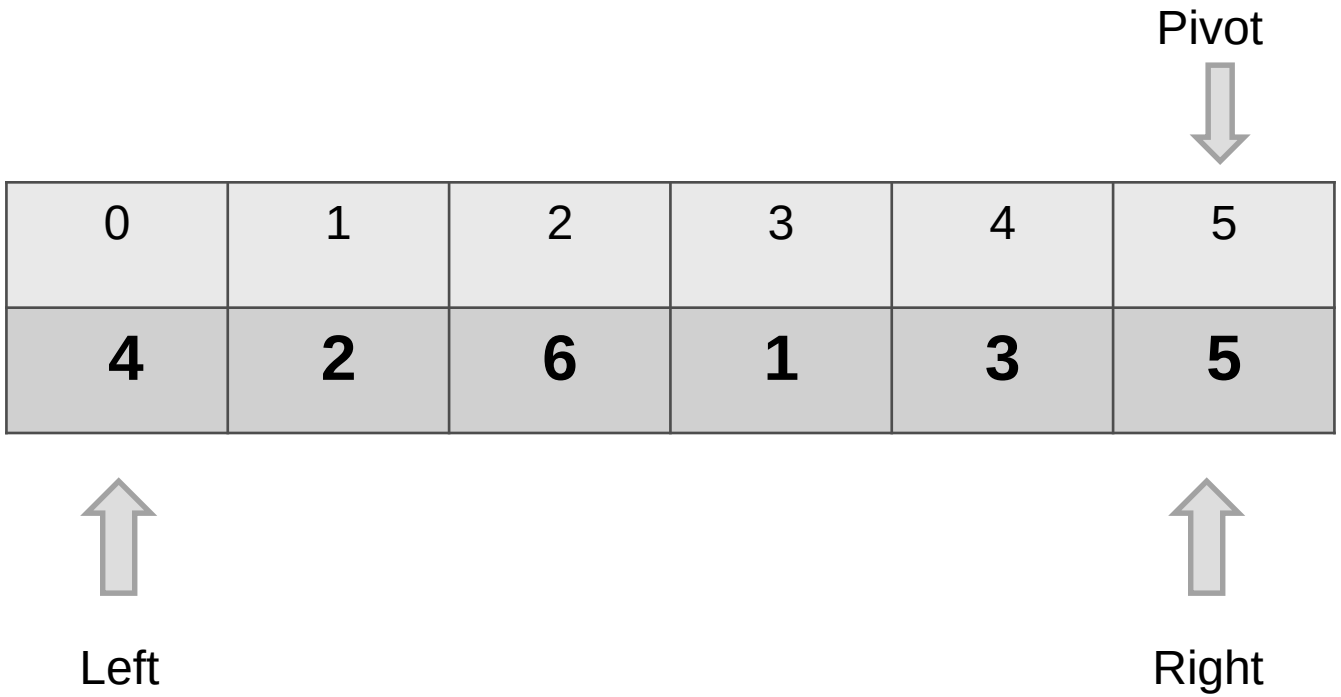
Right


Now the pivot is pointing at right
So we will start from left
And move towards right
Pivot
0
1
2
3
4
5
4
2
6
1
3
5
Left
Right

Is Pivot > Left

(5 > 4)

Pivot = 5
Left =4

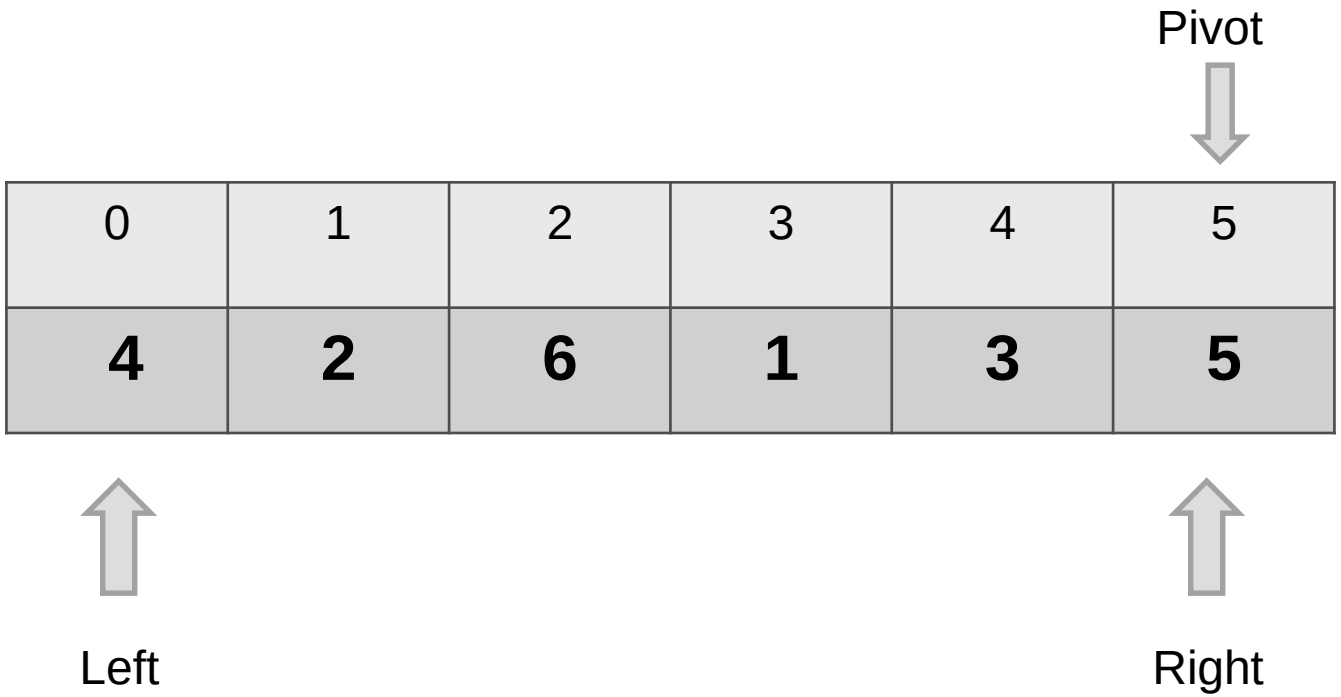


Is Pivot > Left

(5 > 4)

Pivot = 5
Left =4

YES



Is Pivot > Left

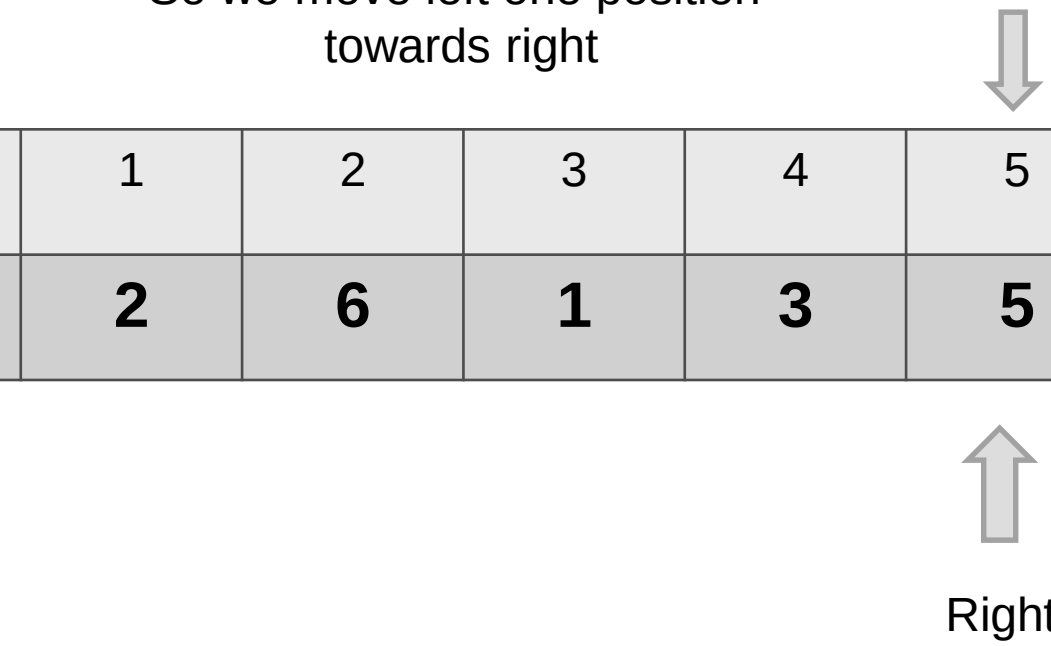
(5 > 4)

Pivot = 5
Left =4

YES

So we move left one position towards right

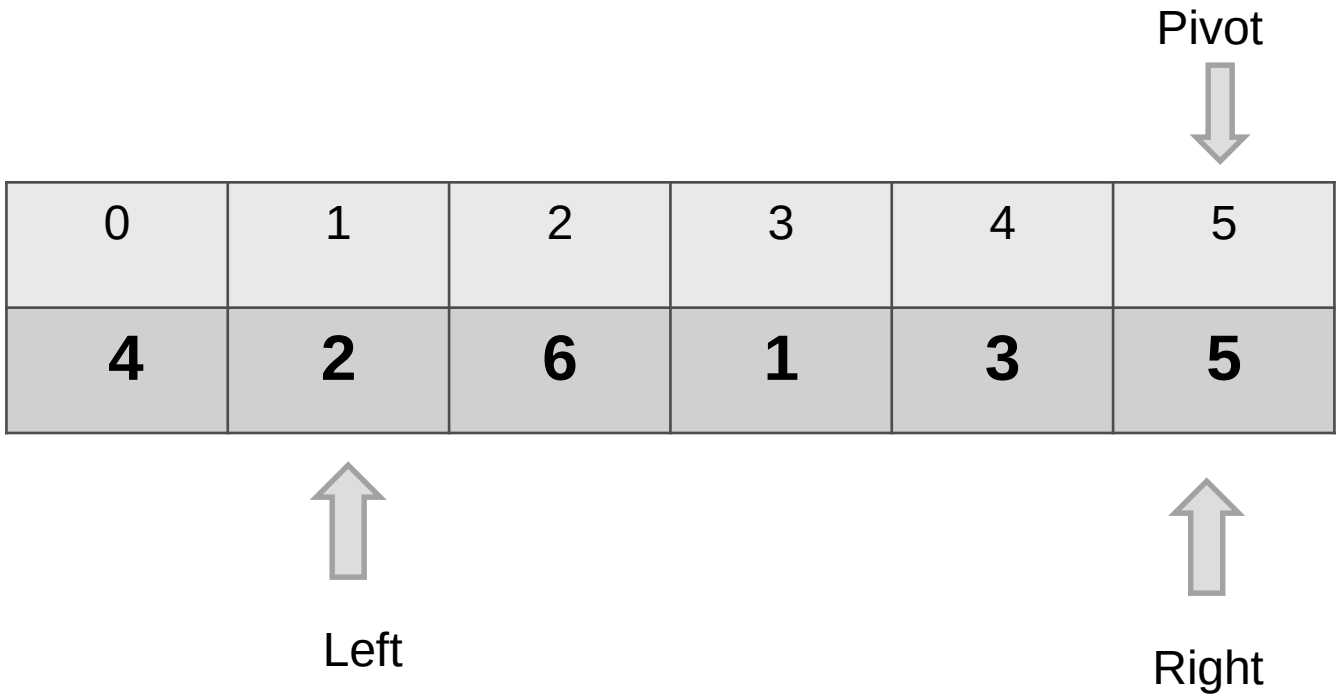
Pivot



Is Pivot > Left

(5 > 2)

Pivot = 5
Left =2

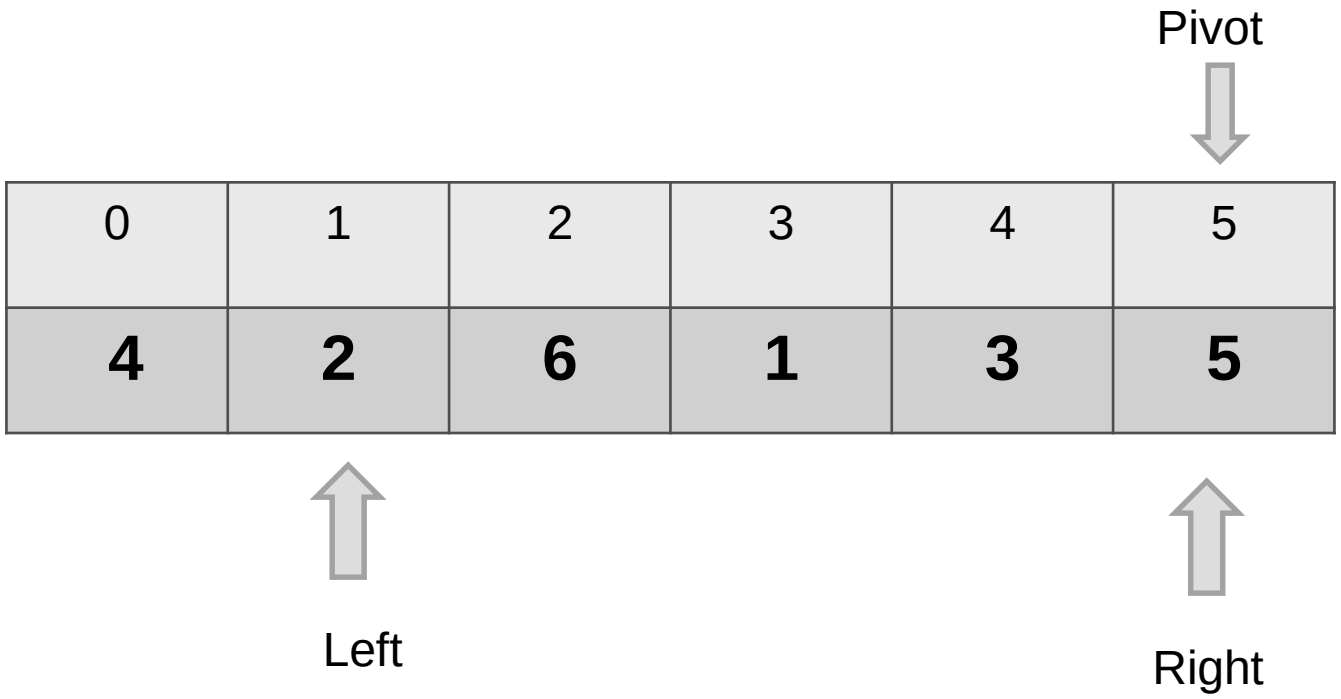


Is Pivot > Left

(5 > 2)

Pivot = 5
Left =2

YES



Is Pivot > Left

(5 > 2)

Pivot = 5
Left =2

YES

So we move left one position towards right

Pivot

0	1	2	3	4	5
4	**2**	**6**	**1**	**3**	**5**

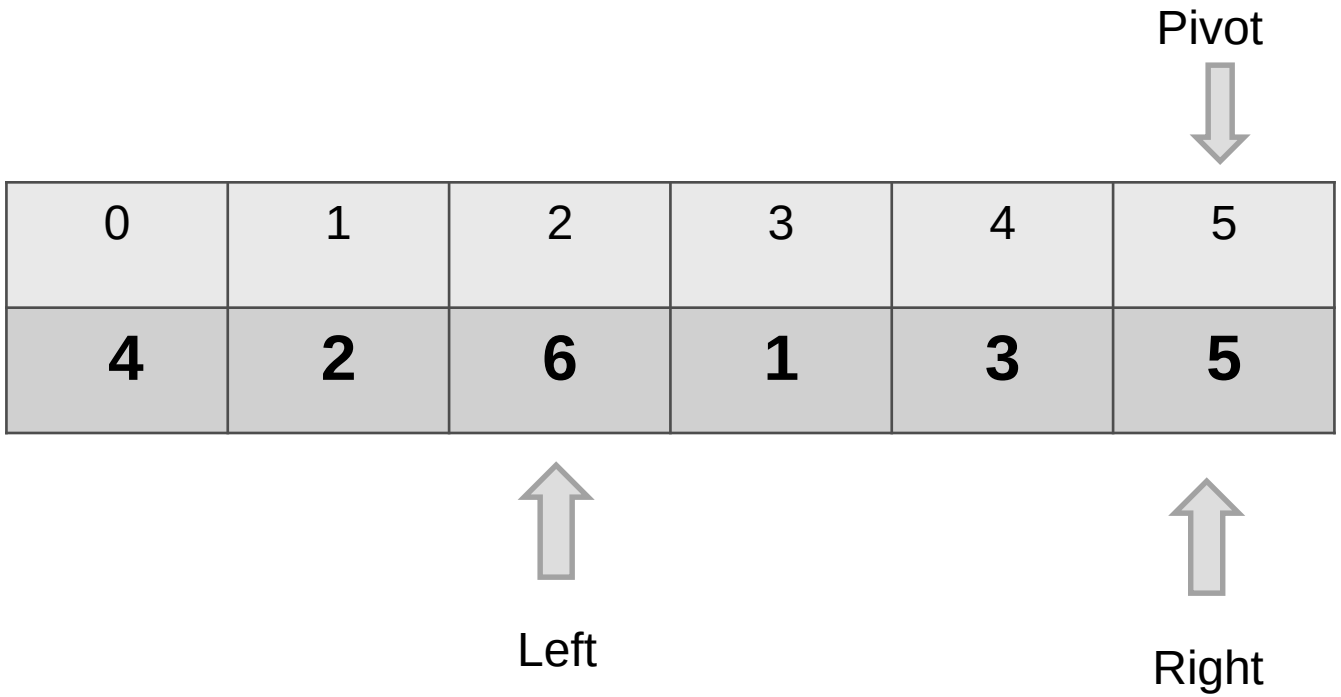
Left

Right

Is Pivot > Left

(5 > 6)

Pivot = 5
Left =6

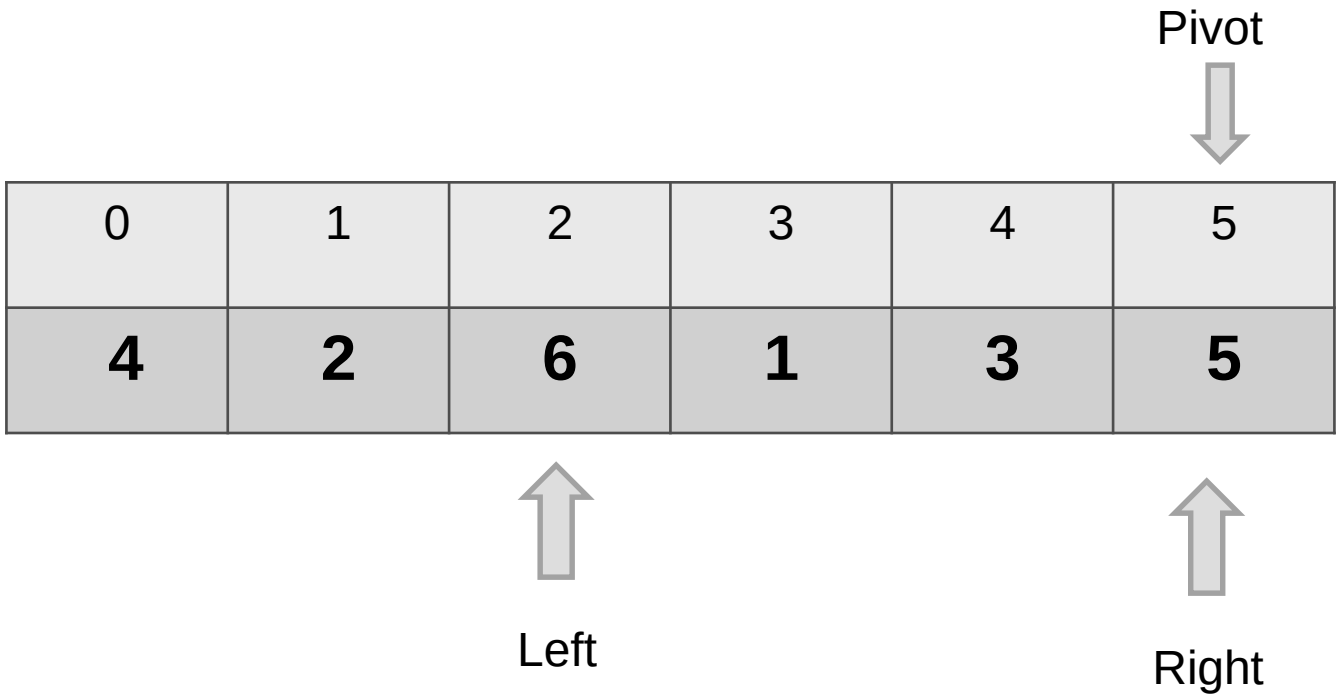


Is Pivot > Left

(5 > 6)

NO

Pivot = 5
Left =6



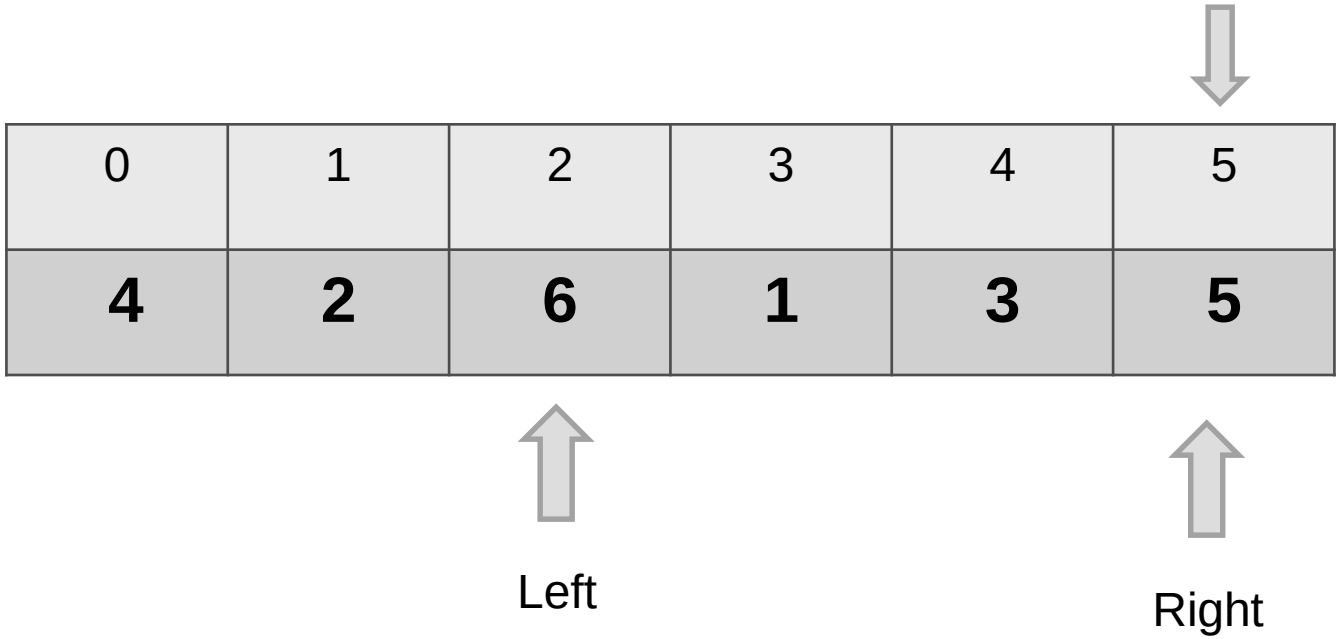
Is Pivot > Left

(5 > 6)

Pivot = 5
Left =6

NO

So we swap pivot and left



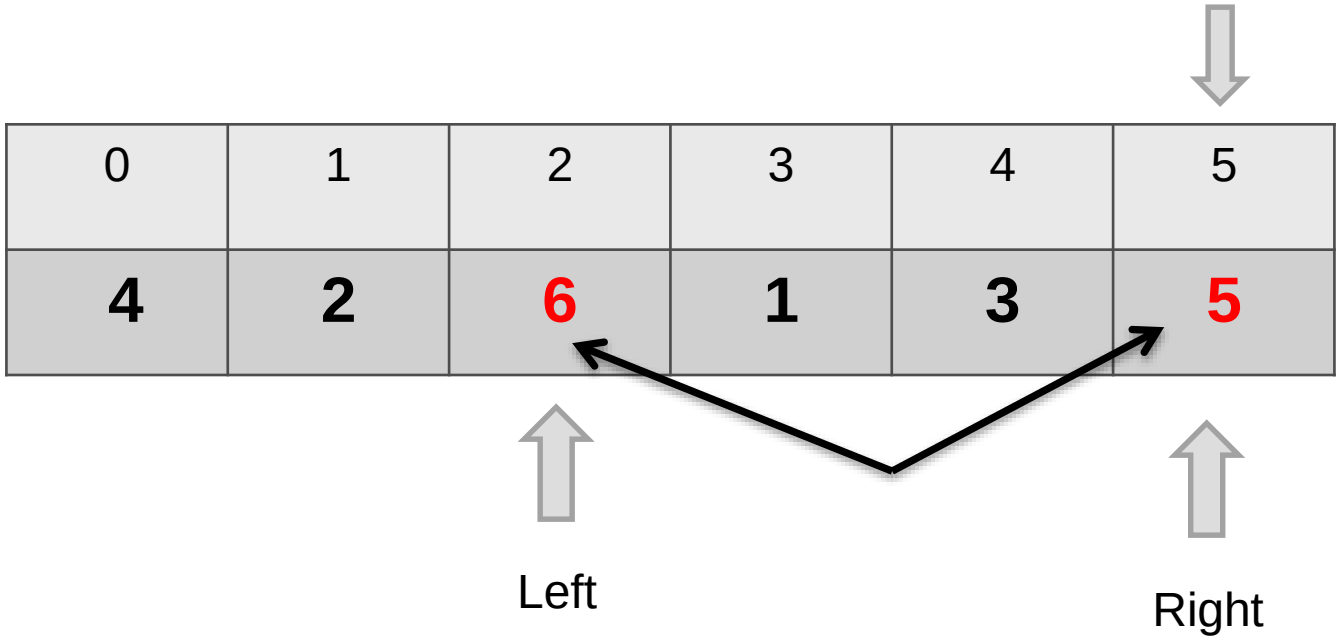
Is Pivot > Left

(5 > 6)

Pivot = 5
Left =6

NO

So we swap pivot and left



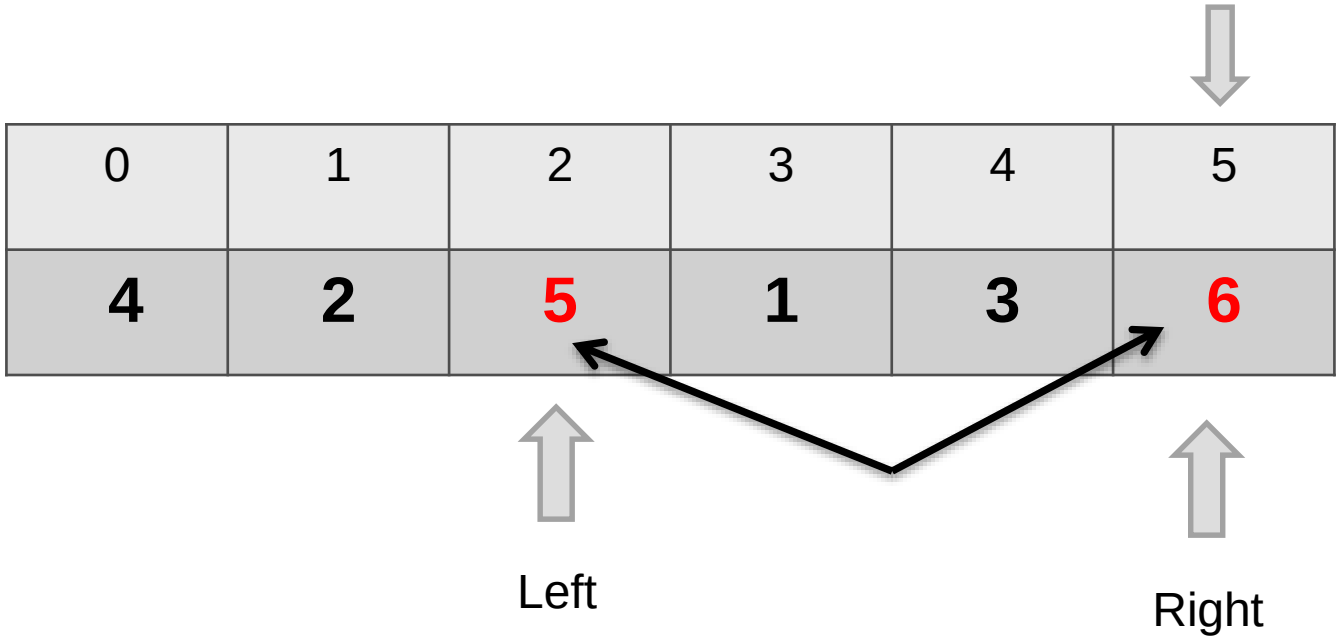
Is Pivot > Left

(5 > 6)

Pivot = 5
Left =6

NO

So we swap pivot and left



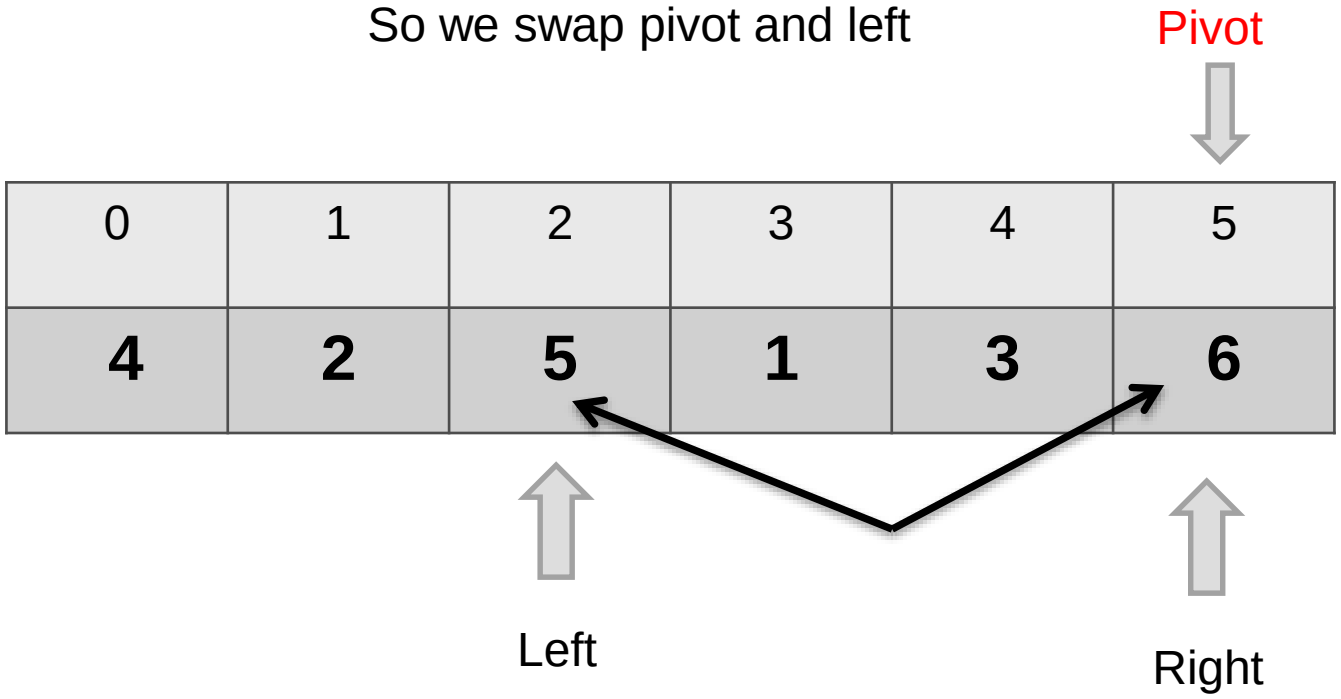
Is Pivot > Left

(5 > 6)

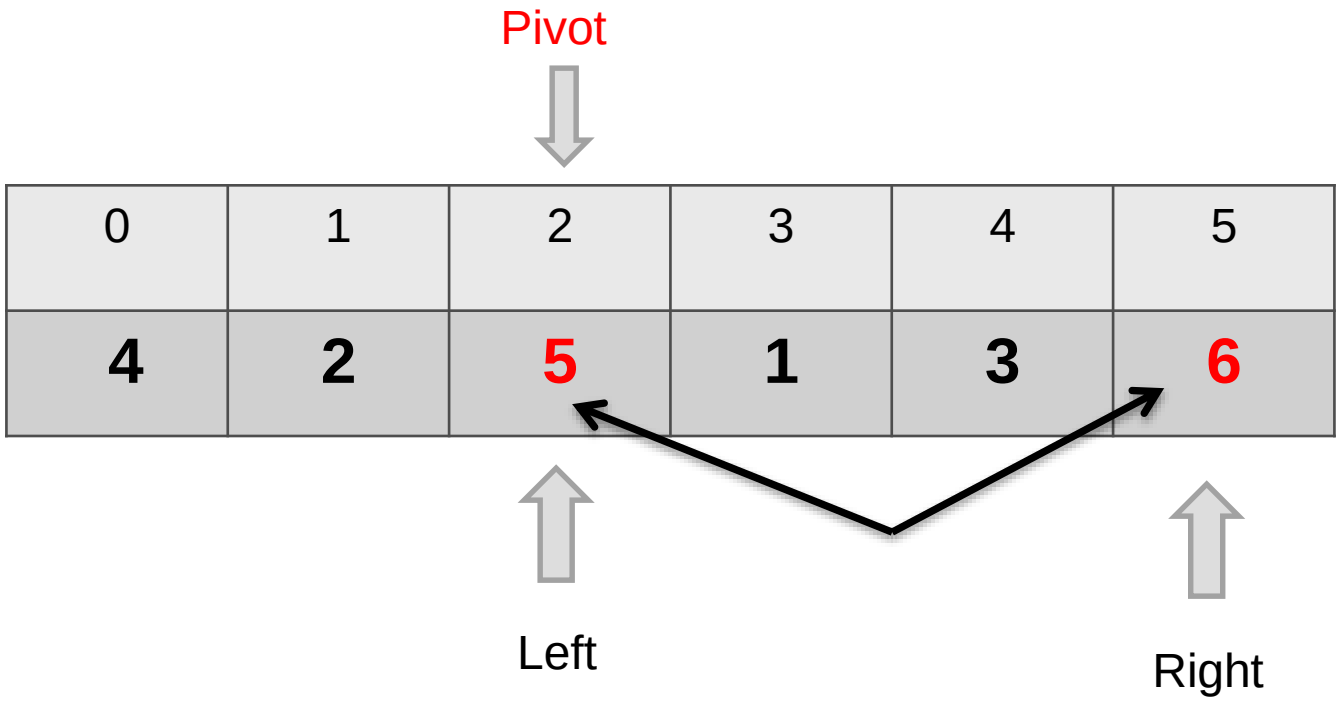
Pivot = 5
Left =6

NO

So we swap pivot and left



And move the pivot to left


Pivot
0
1
2
3
4
5
4
2
5
1
3
6
Left
Right

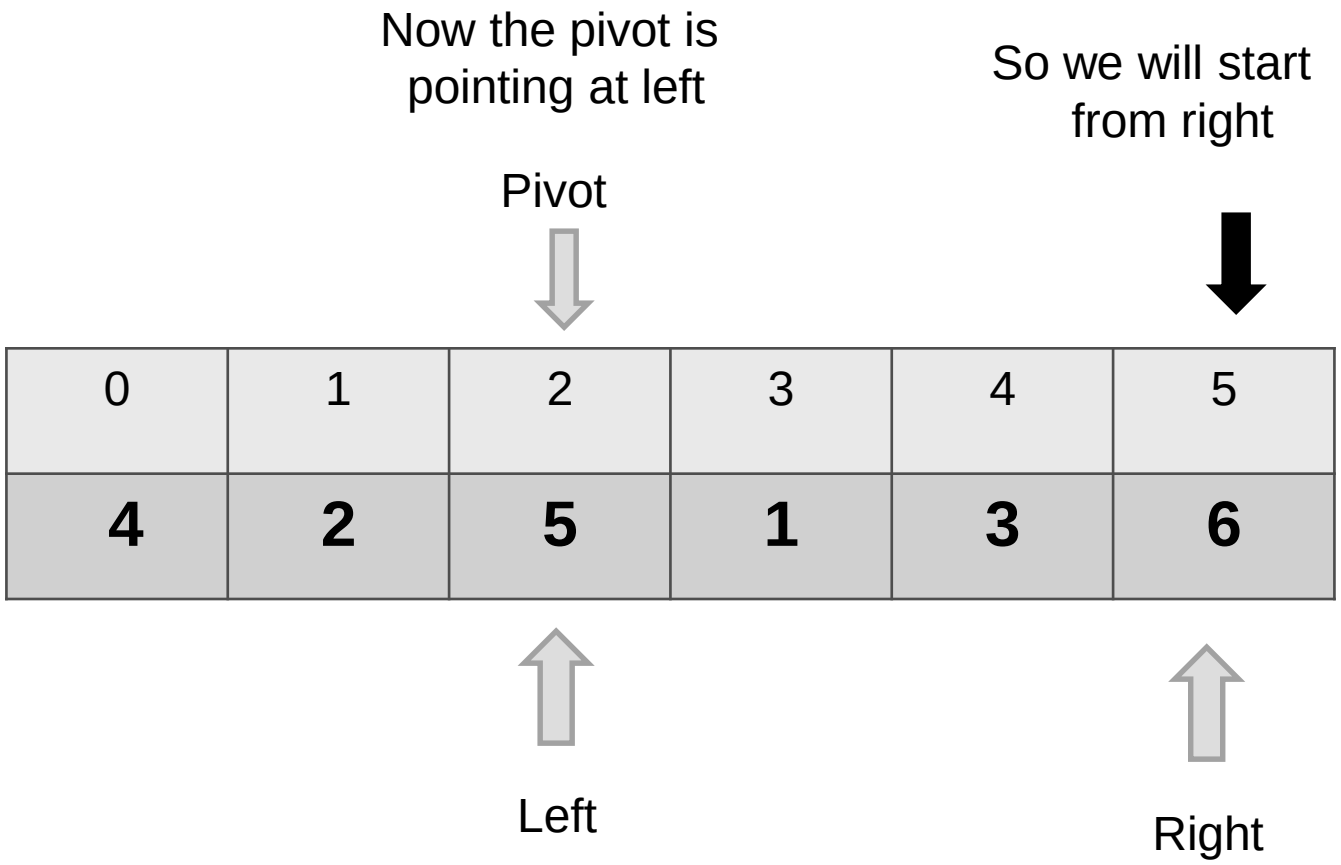
Now the pivot is pointing at left

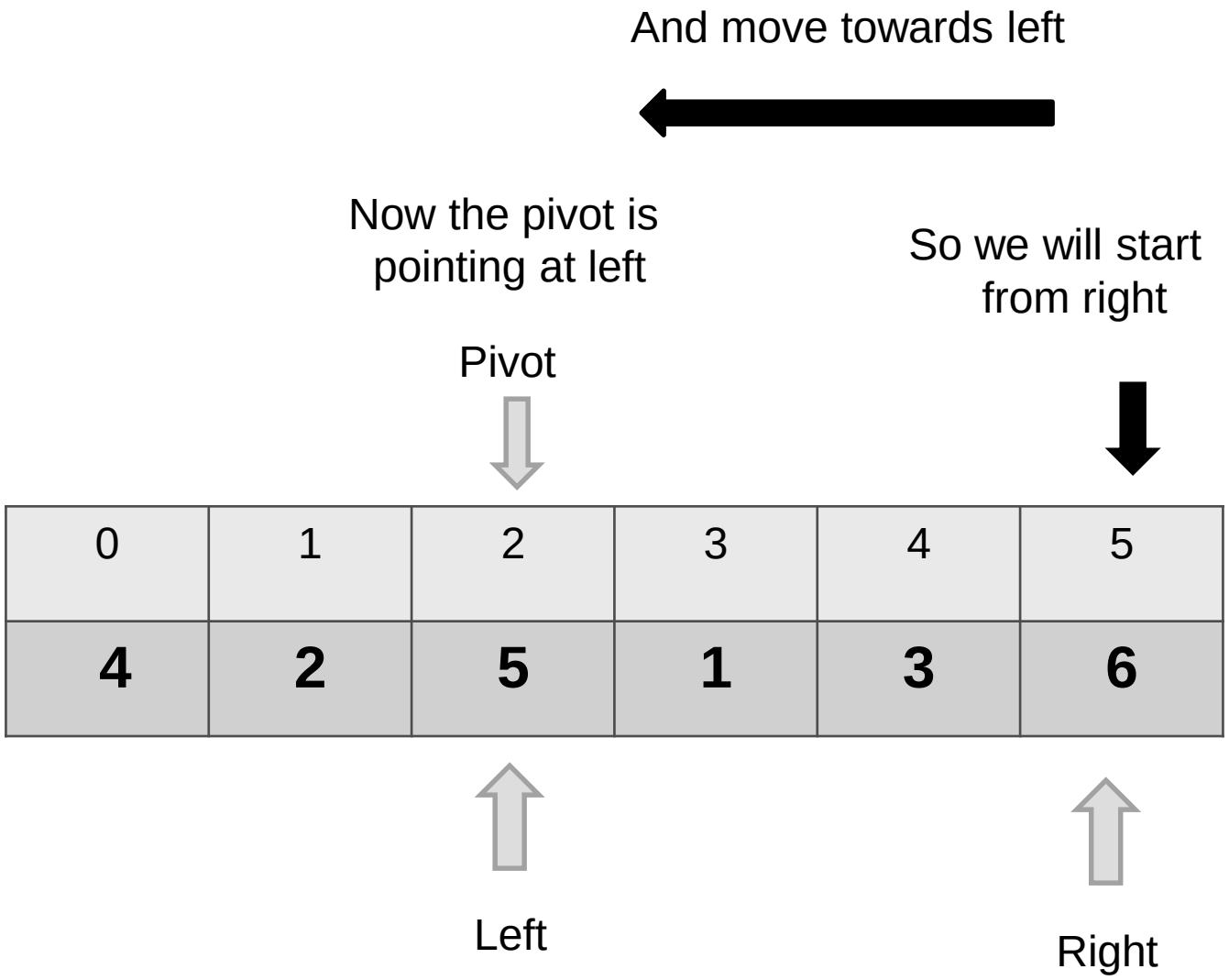
Pivot

0	1	2	3	4	5
4	**2**	**5**	**1**	**3**	**6**

Left

Right

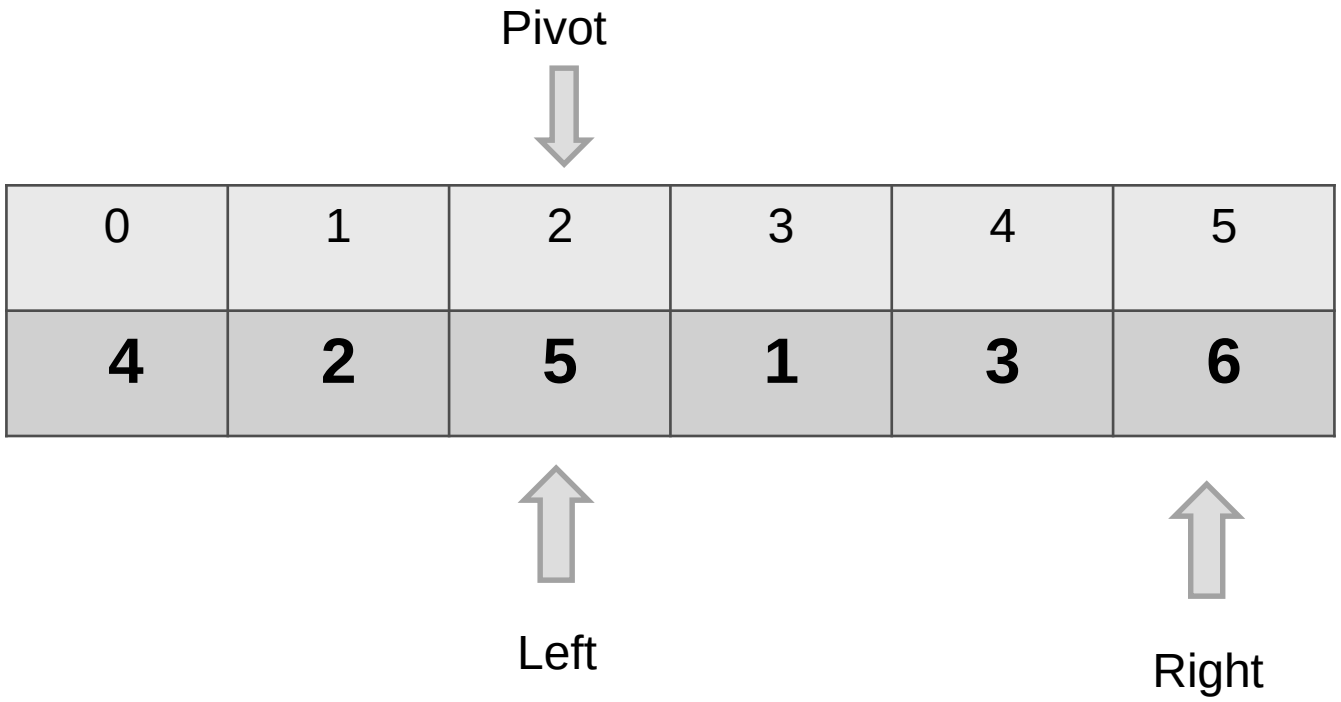

Now the pivot is pointing at left
So we will start from right
Pivot
0
1
2
3
4
5
4
2
5
1
3
6
Left
Right


And move towards left
Now the pivot is pointing at left
So we will start from right
Pivot
0
1
2
3
4
5
4
2
5
1
3
6
Left
Right

Is Pivot < Right

(5 < 6)

Pivot = 5
Right =6

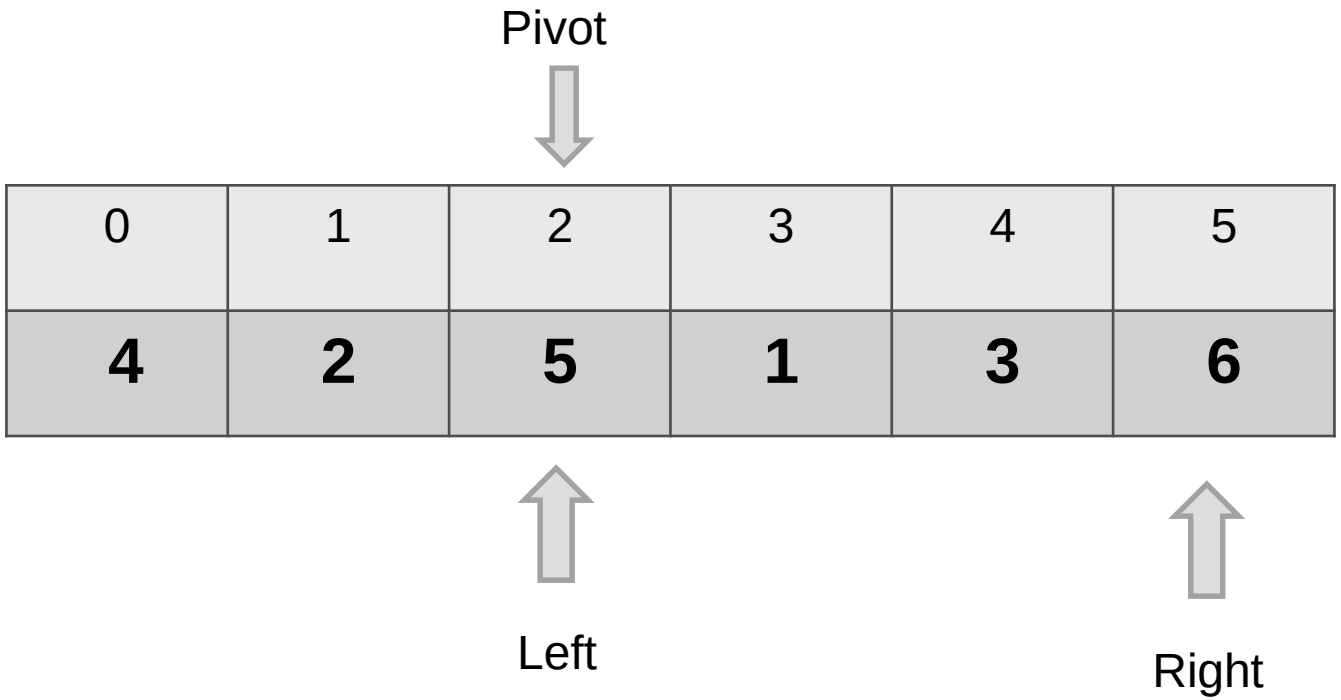


Is Pivot < Right

(5 < 6)

YES

Pivot = 5
Right =6



Is Pivot < Right

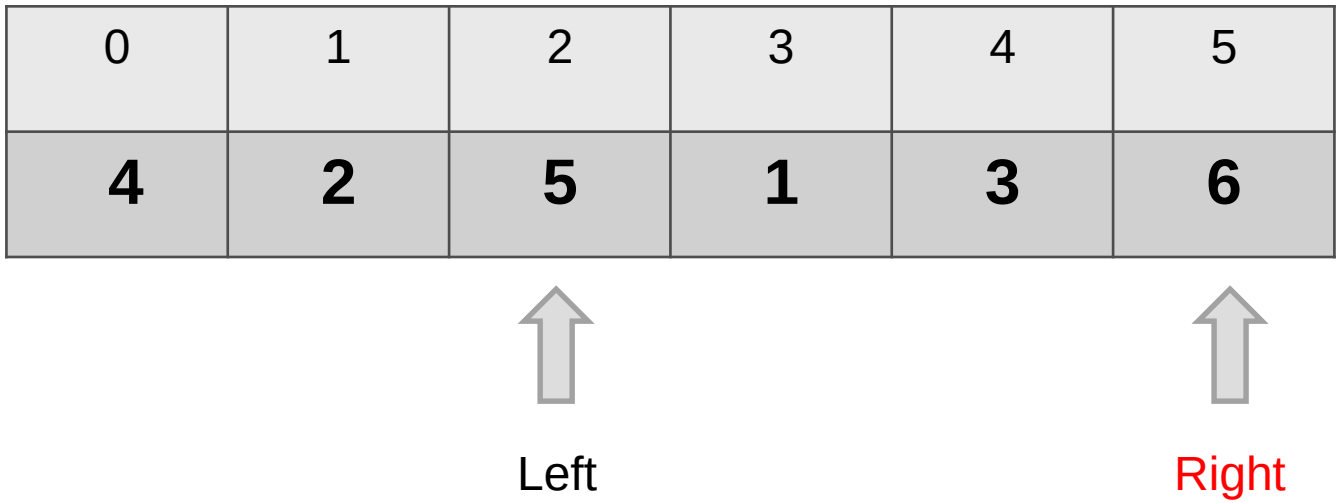
(5 < 6)

YES

Pivot = 5
Right =6

Pivot

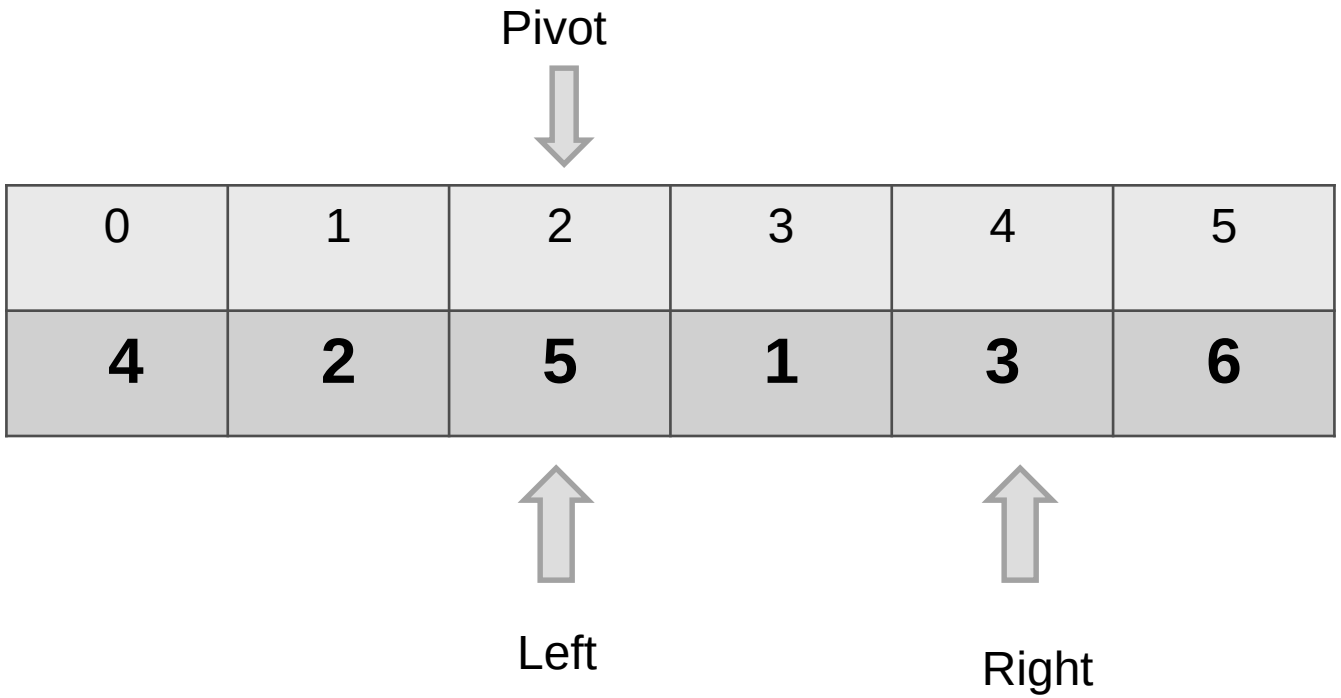
So we move right one position towards left



Is Pivot < Right

(5 < 3)

Pivot = 5
Right =3

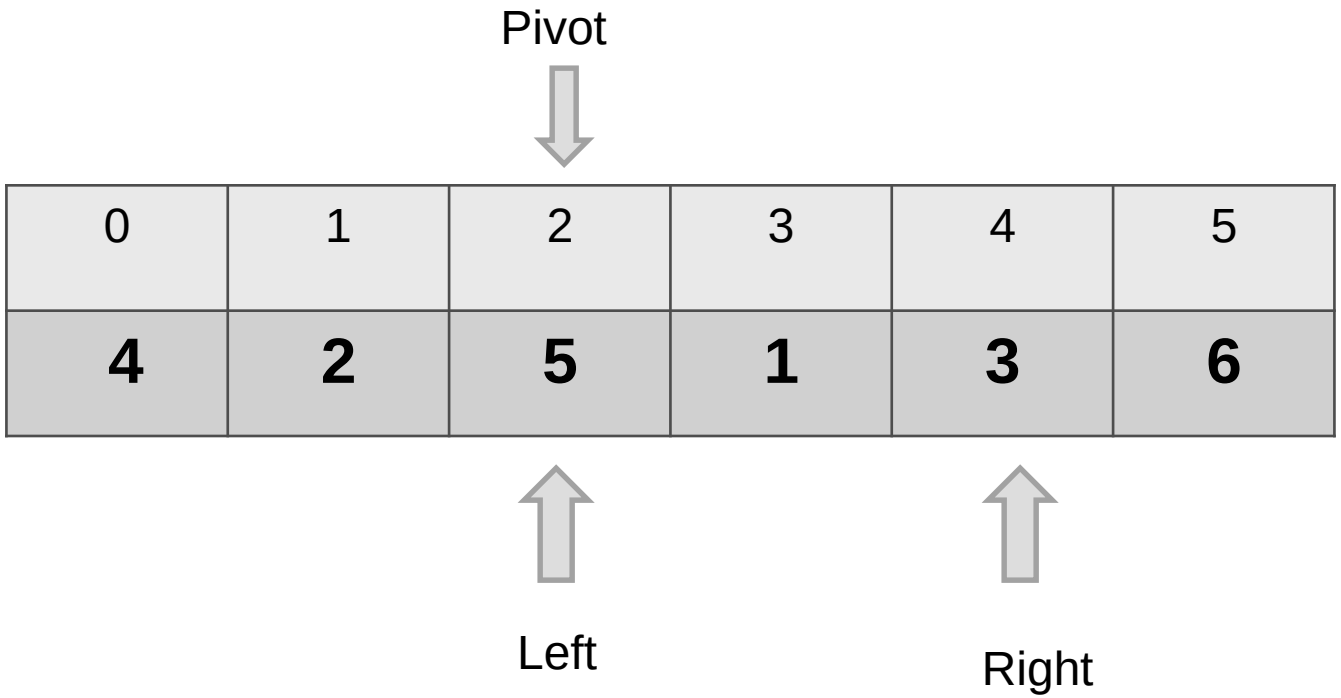


Is Pivot < Right

(5 < 3)

NO

Pivot = 5
Right =3



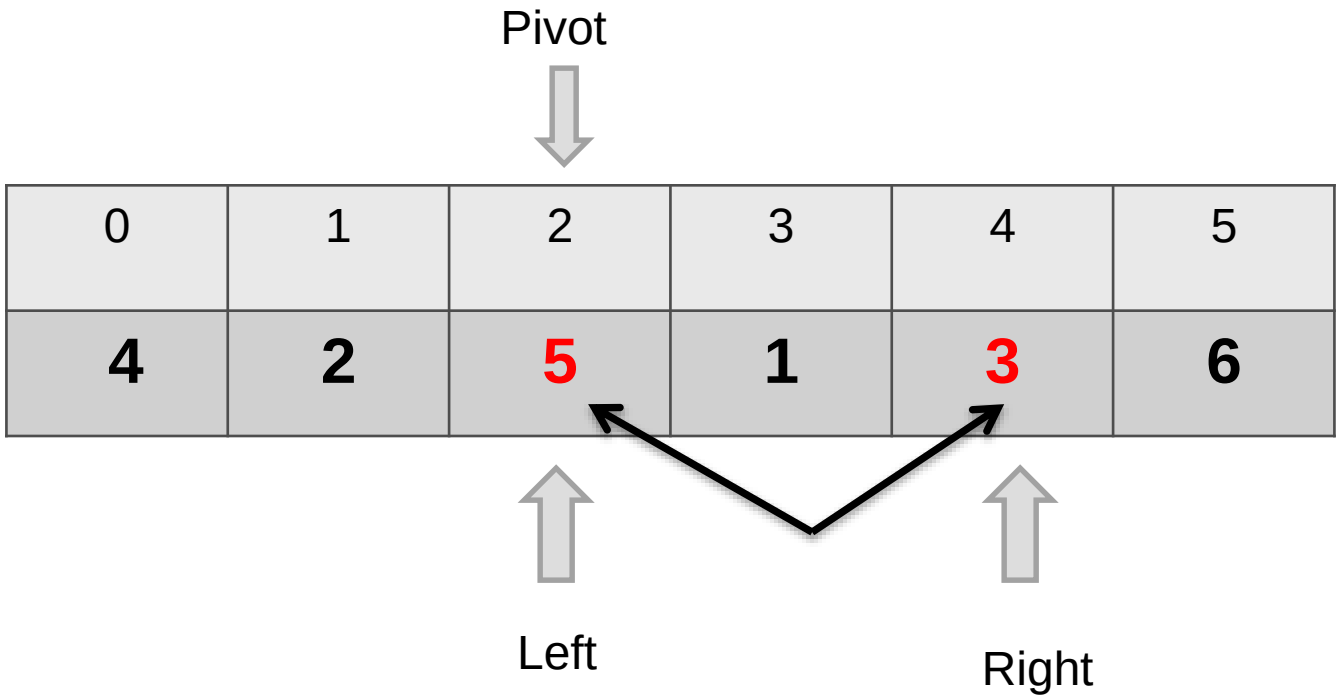
Is Pivot < Right

(5 < 3)

NO

Pivot = 5
Right =3

So we swap pivot and right



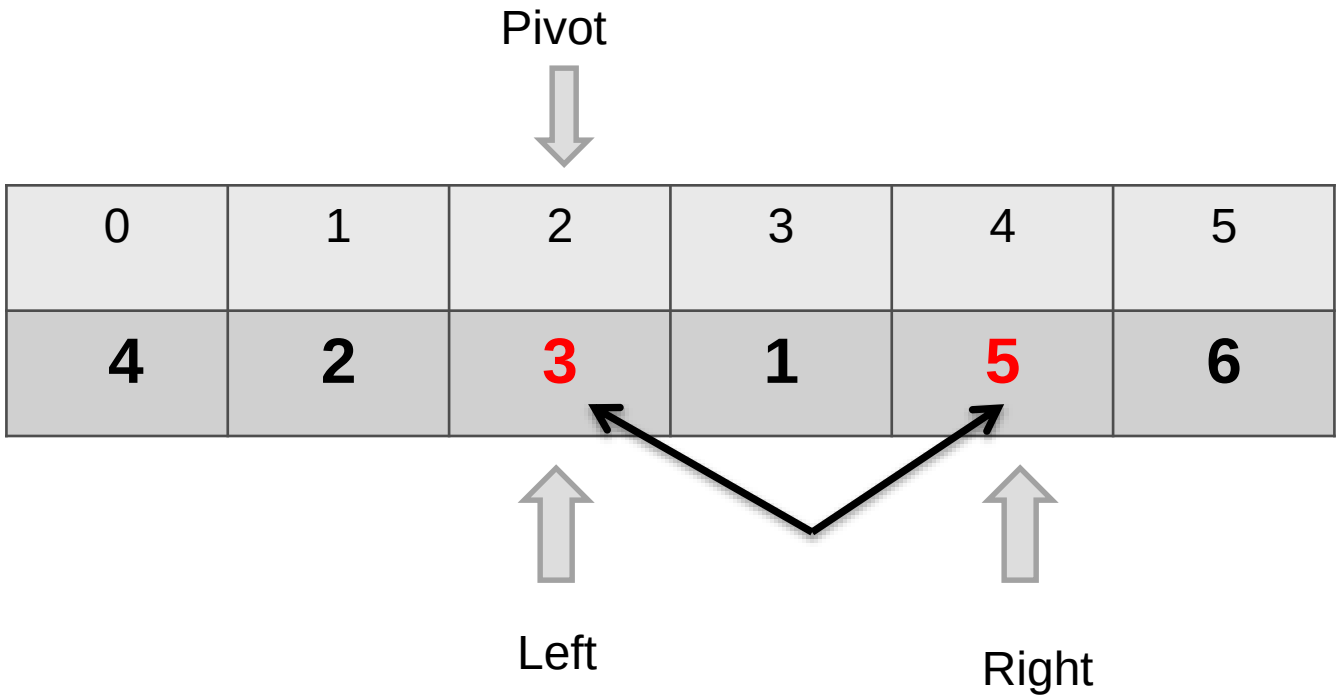
Is Pivot < Right

(5 < 3)

NO

Pivot = 5
Right =3

So we swap pivot and right



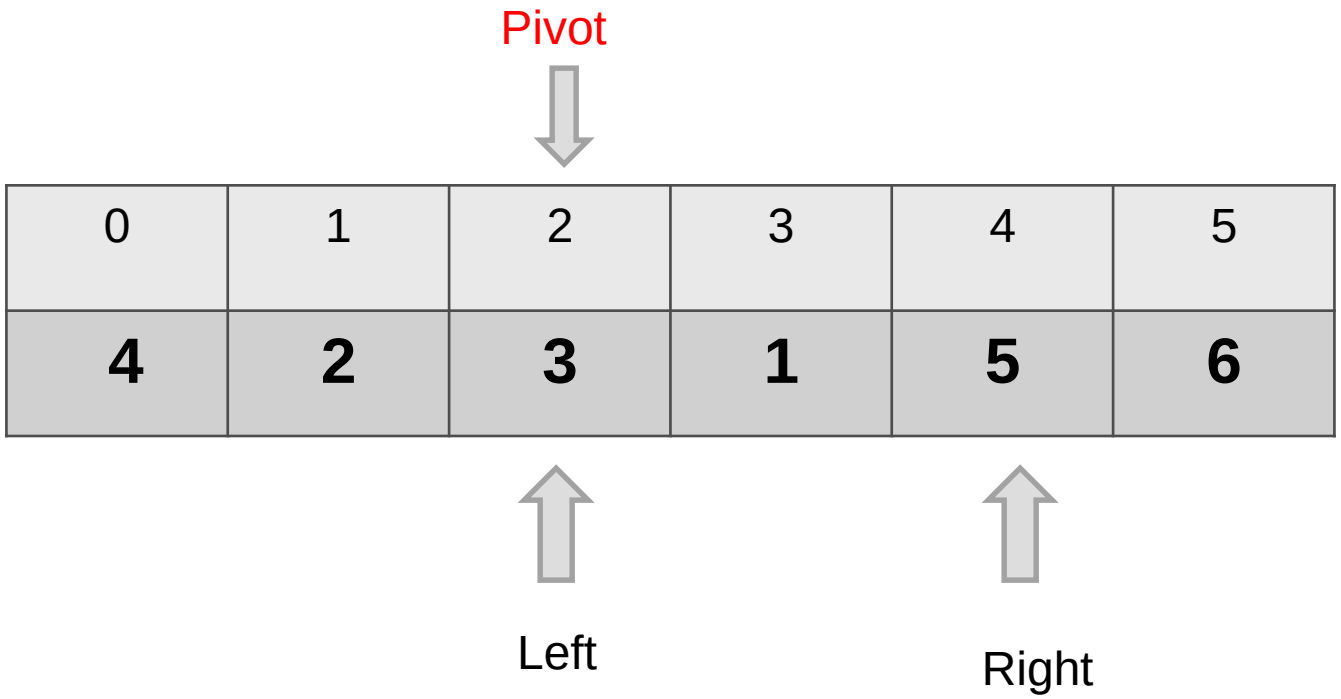
Is Pivot > Right

(5 > 3)

NO

Pivot = 5
Right =3

So we swap pivot and right

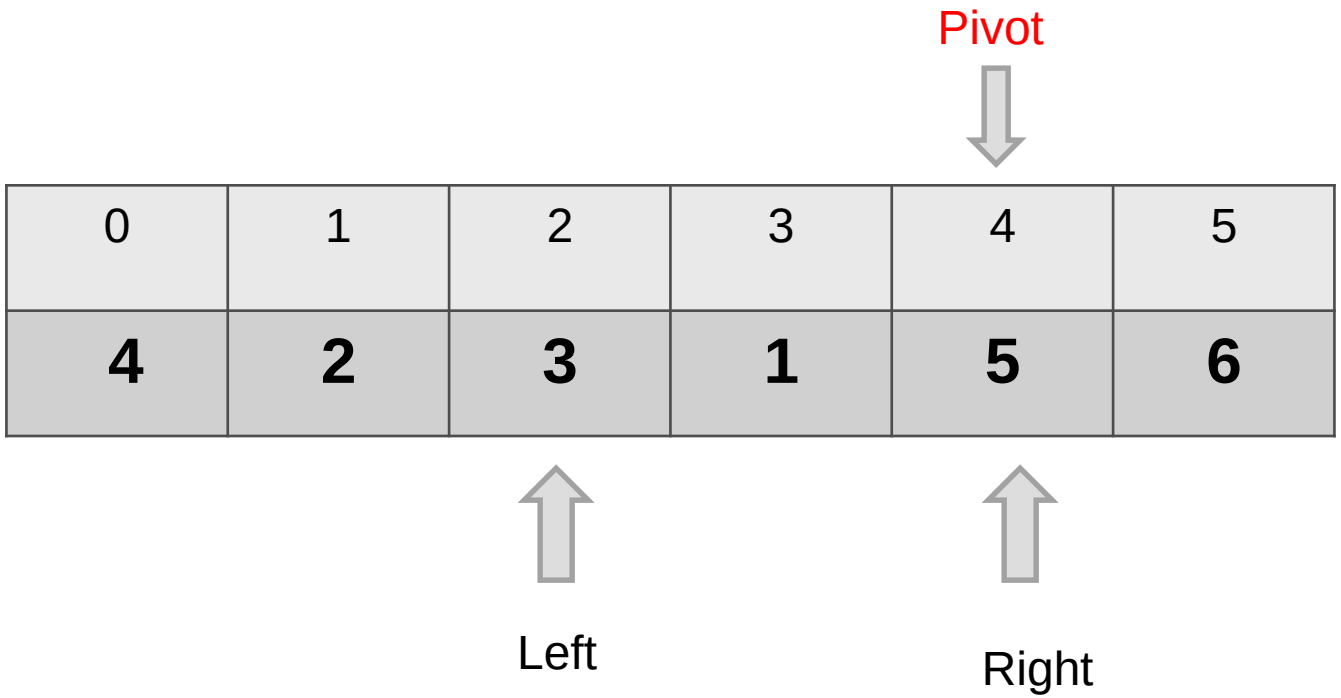


And move the pivot to right

Is Pivot > Left

(5 > 3)

Pivot = 5
Left =3

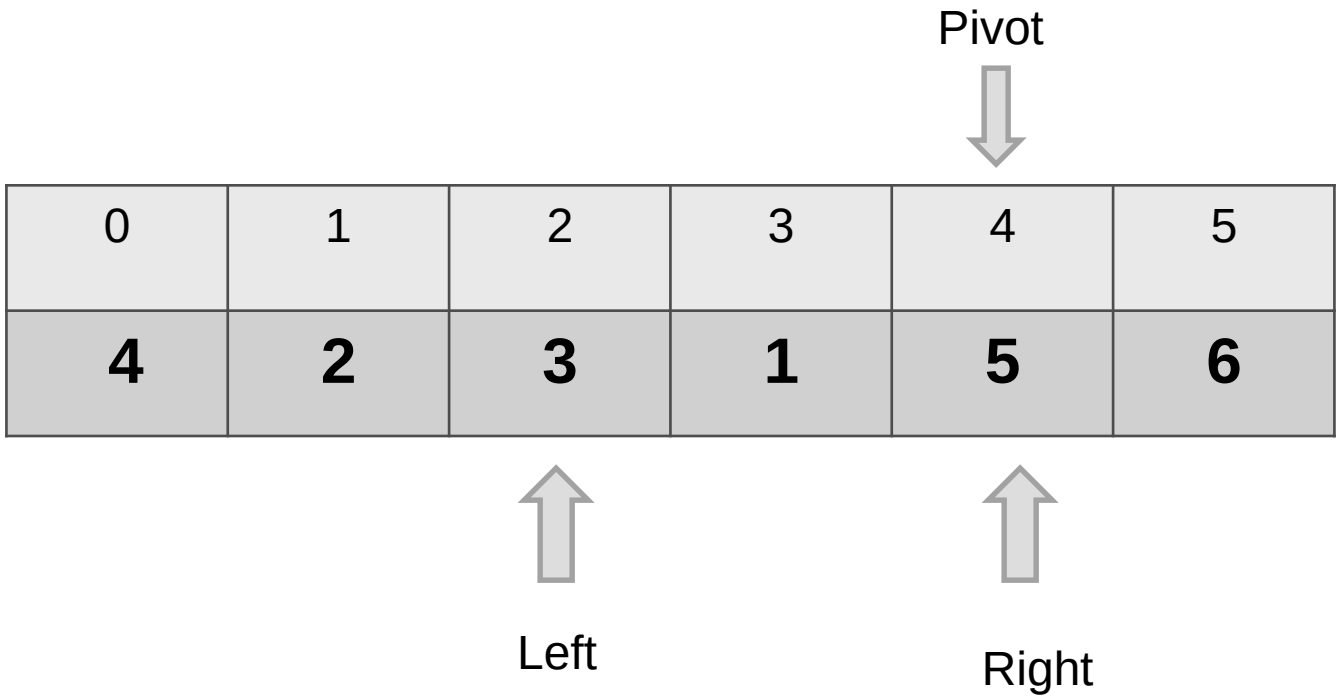


Is Pivot > Left

(5 > 3)

YES

Pivot = 5
Left =3



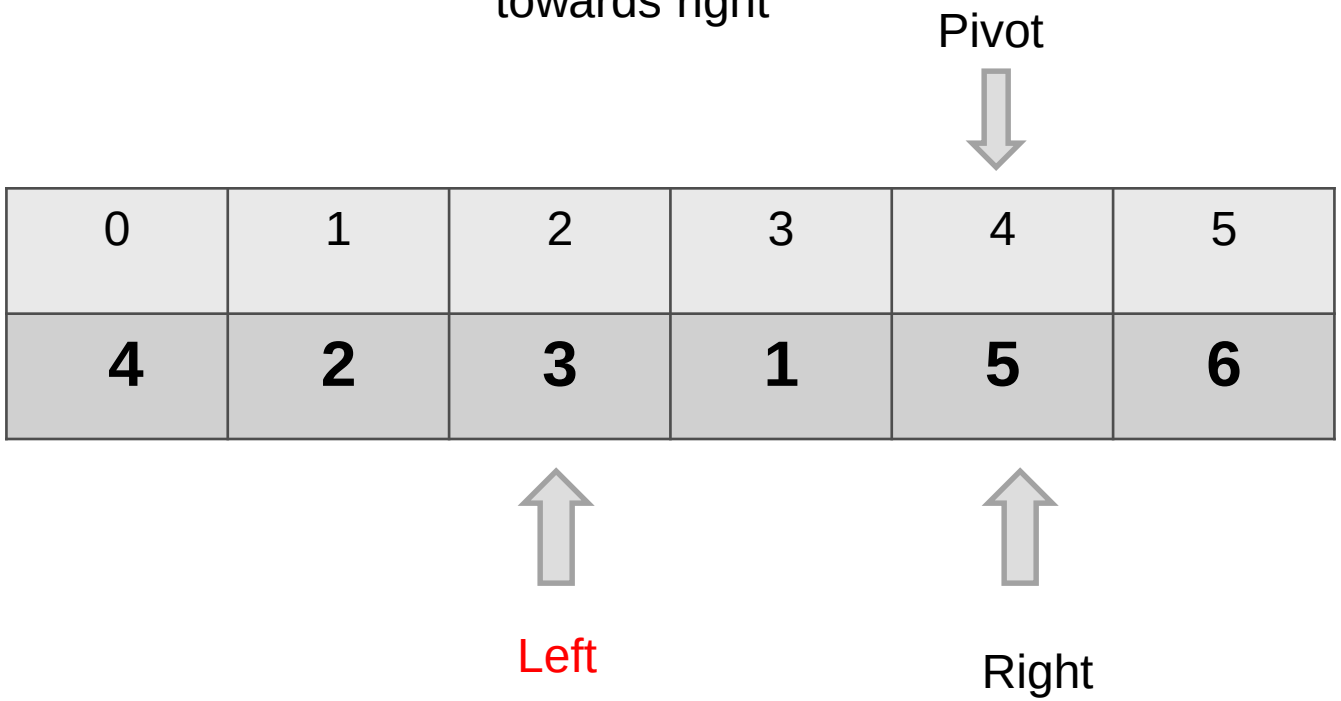
Is Pivot > Left

(5 > 3)

YES

So we move left one position towards right

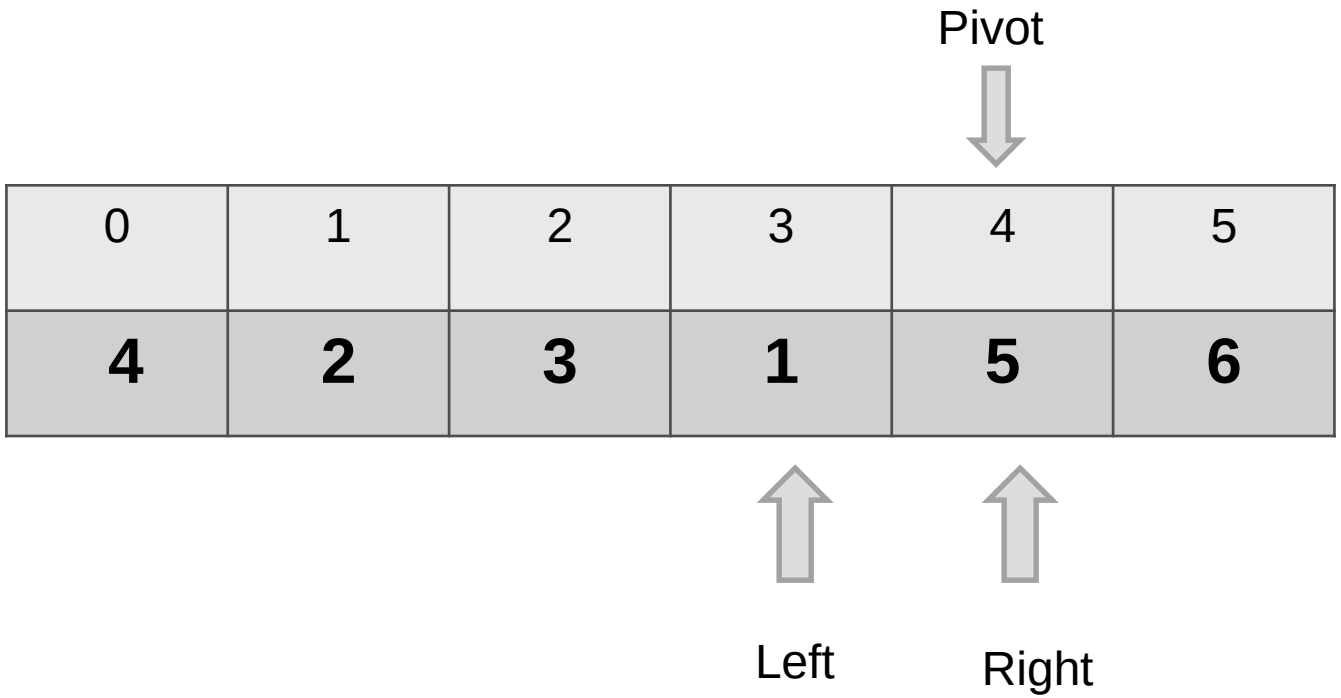
Pivot = 5
Left =3

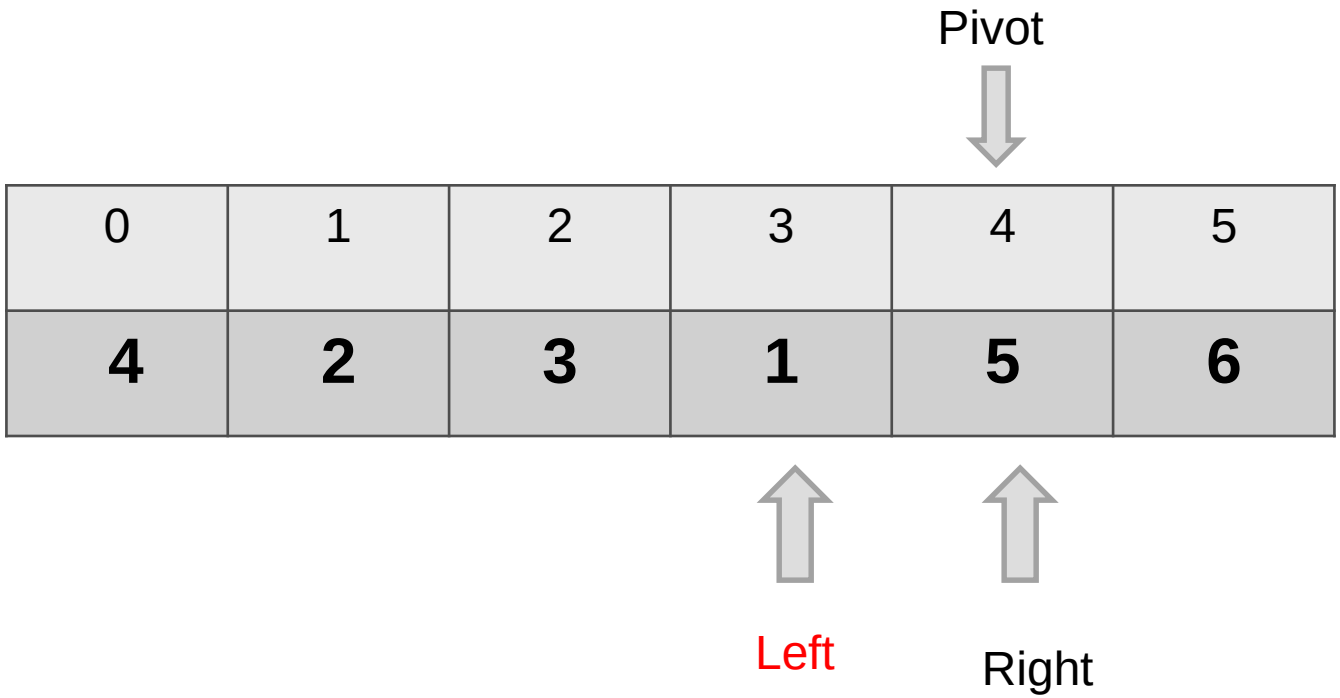


Is Pivot > Left

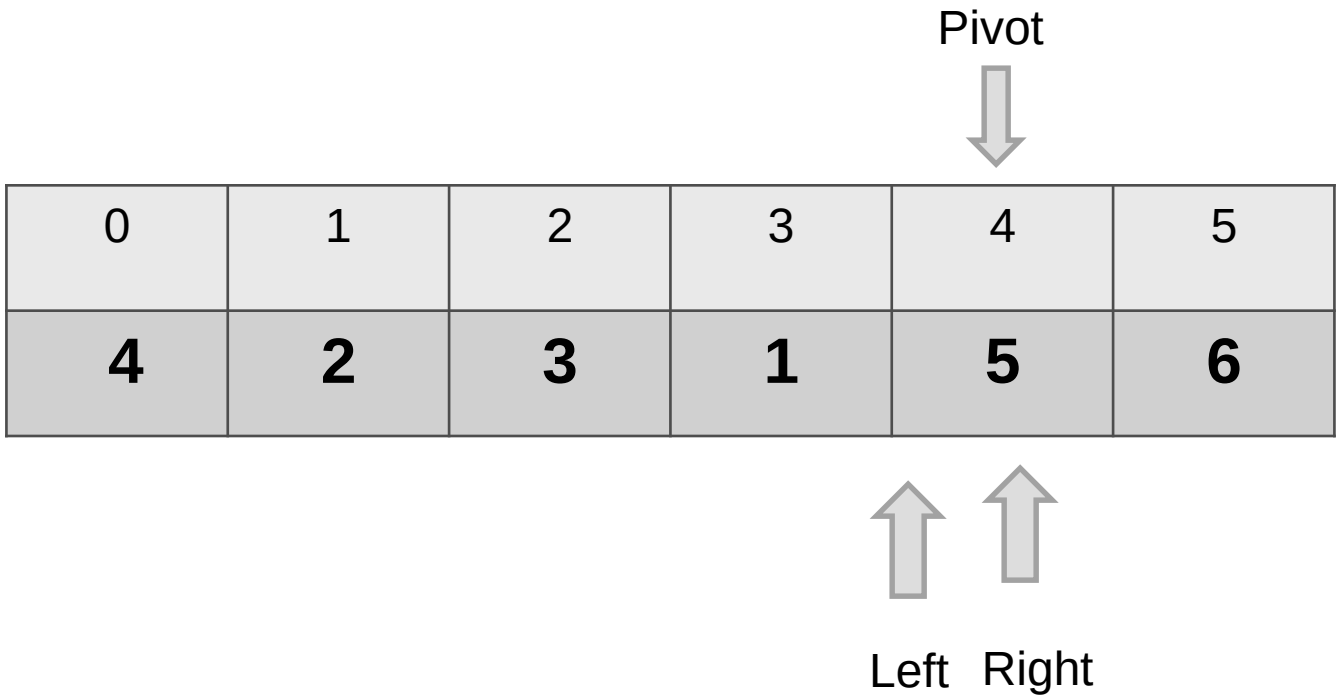
(5 > 1)

Pivot = 5
Left = 1



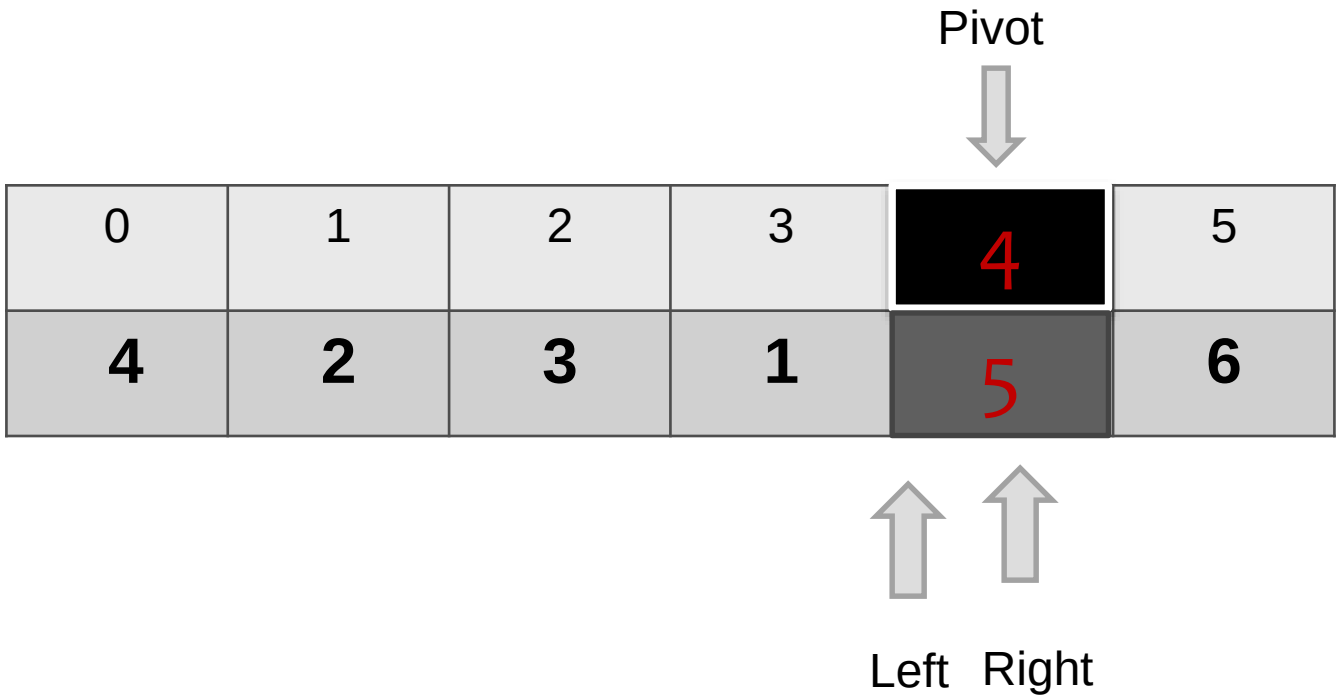

Pivot
0
1
2
3
4
5
4
2
3
1
5
6
Left
Right

Now both left and right are pointing at the same element of the array



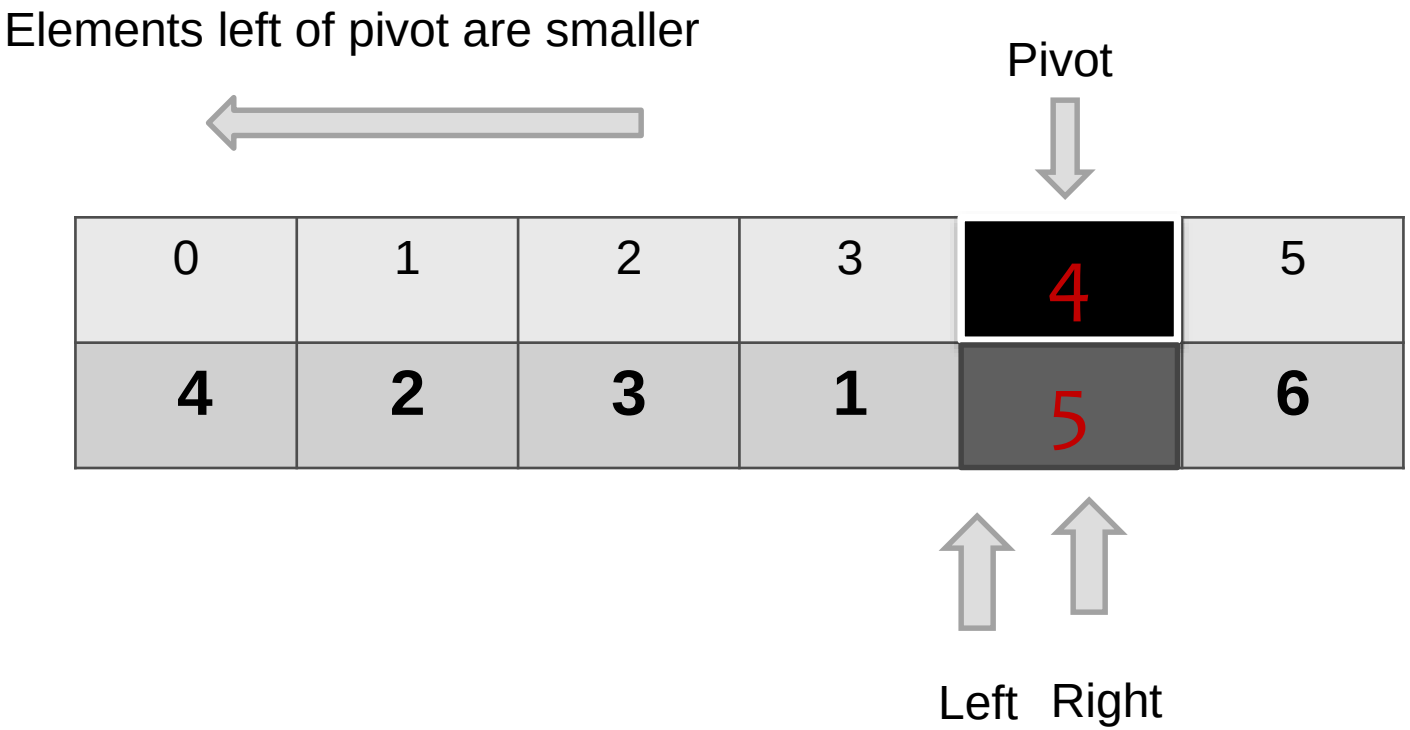
Now both left and right are pointing at the same element of the array

This time 5 is the pivot and it is at the sorted position



Now both left and right are pointing at the same element of the array

This time 5 is the pivot and it is at the sorted position



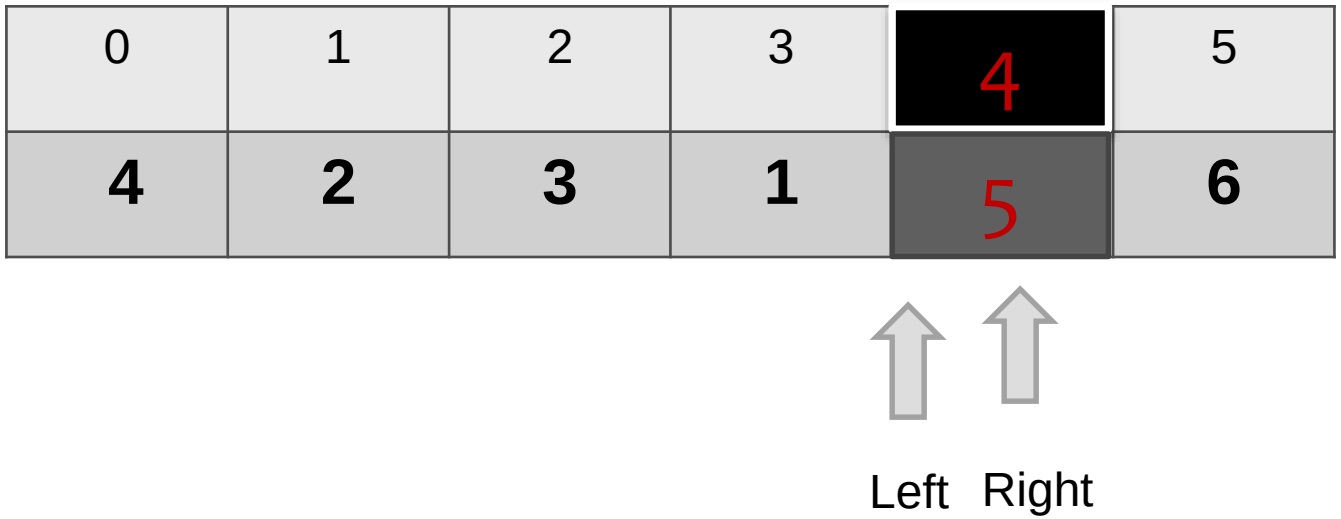
Now both left and right are pointing at the same element of the array

This time 5 is the pivot and it is at the sorted position

Elements left of pivot are smaller

Pivot

Elements right of pivot are greater



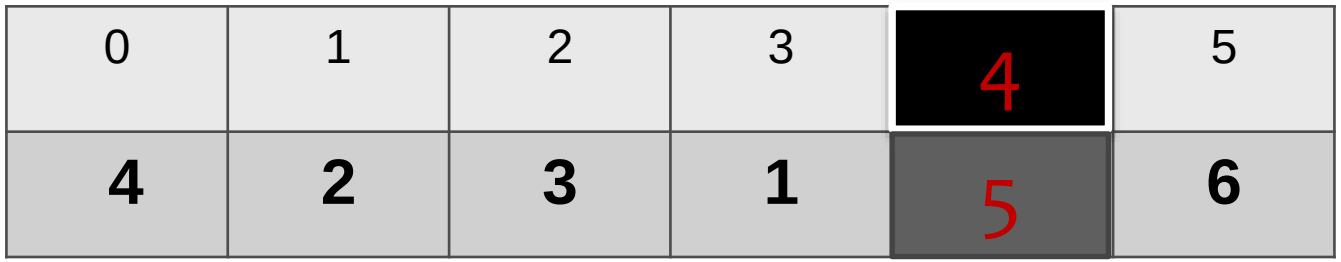
Now both left and right are pointing at the same element of the array

This time 5 is the pivot and it is at the sorted position

Elements left of pivot are smaller

Pivot

Elements right of pivot are greater



Left Right

So pivot has divided the array into two sub array

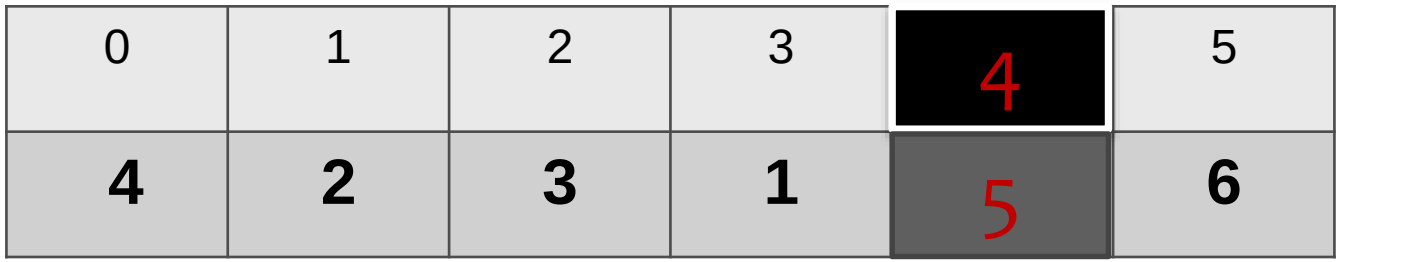
Now both left and right are pointing at the same element of the array

This time 5 is the pivot and it is at the sorted position

Elements left of pivot are smaller

Pivot

Elements right of pivot are greater



Left sub array

Right sub array

Left

Right

So pivot has divided the array into two sub array

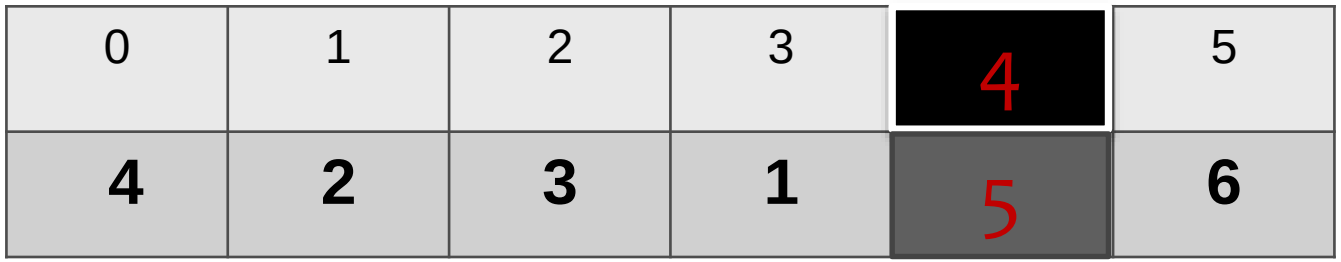
Now both left and right are pointing at the same element of the array

This time 5 is the pivot and it is at the sorted position

Elements left of pivot are smaller

Elements right of pivot are greater

Pivot



Left sub array

Right sub array

Left

Right

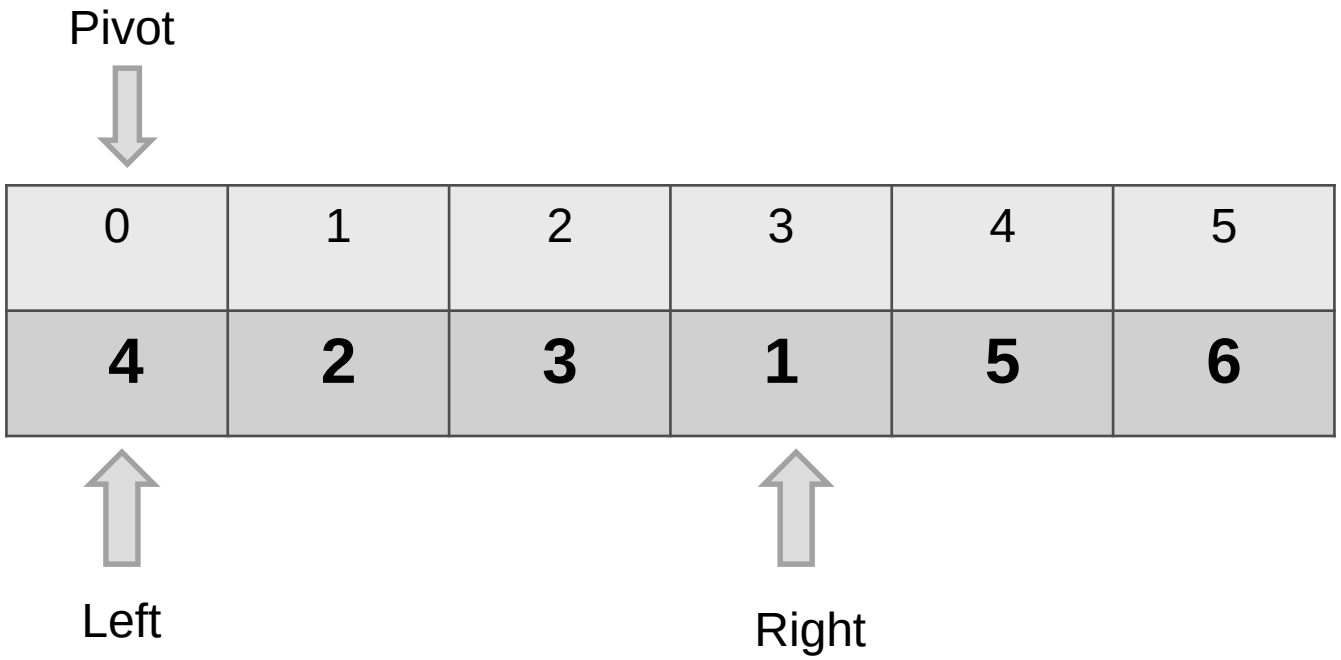
So pivot has divided the array into two sub array

We will now quick sort the left sub array

Is Pivot < Left

(4 < 1)

Pivot = 4
Left =1

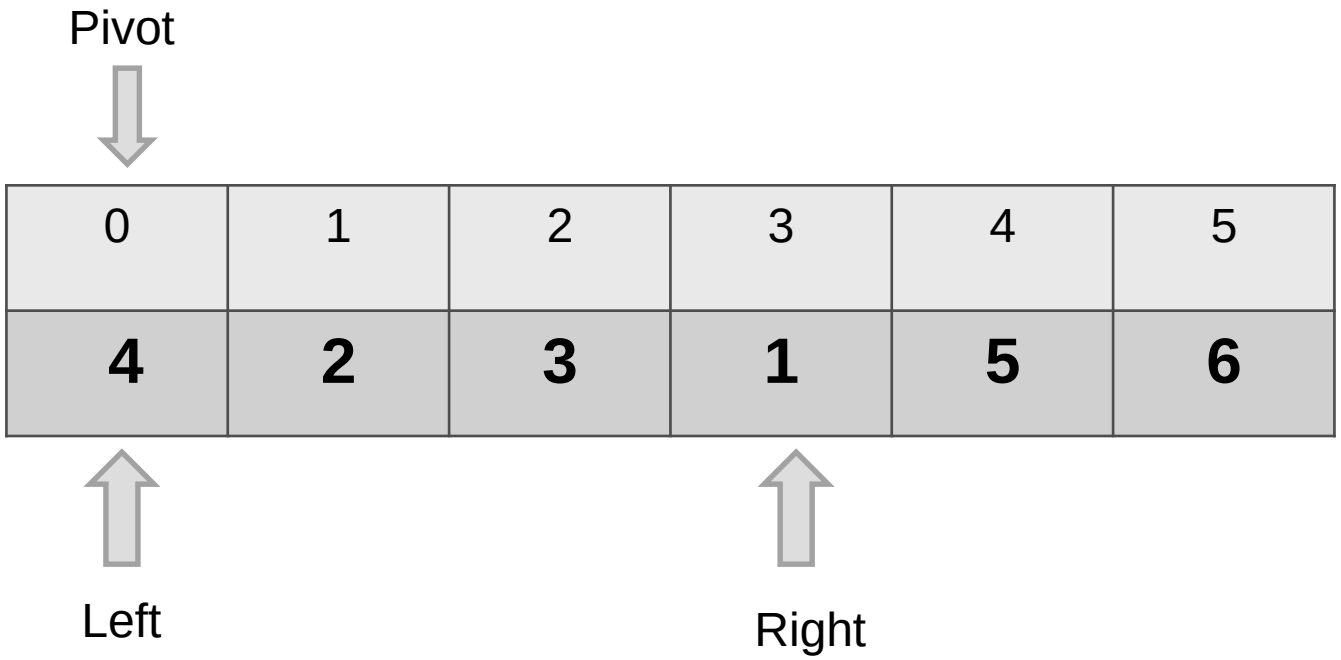


Is Pivot < Left

(4 < 1)

NO

Pivot = 4
Left =1



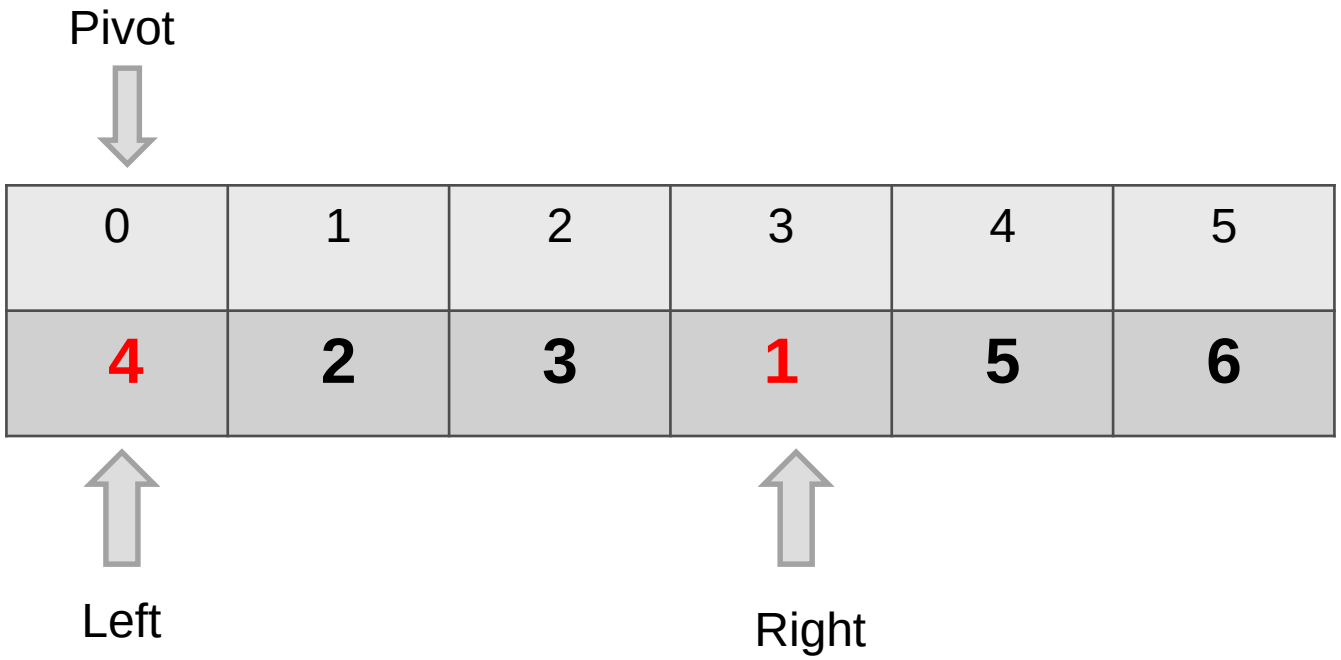
Is Pivot < Left

(4 < 1)

NO

Pivot = 4
Left =1

So we swap pivot and right



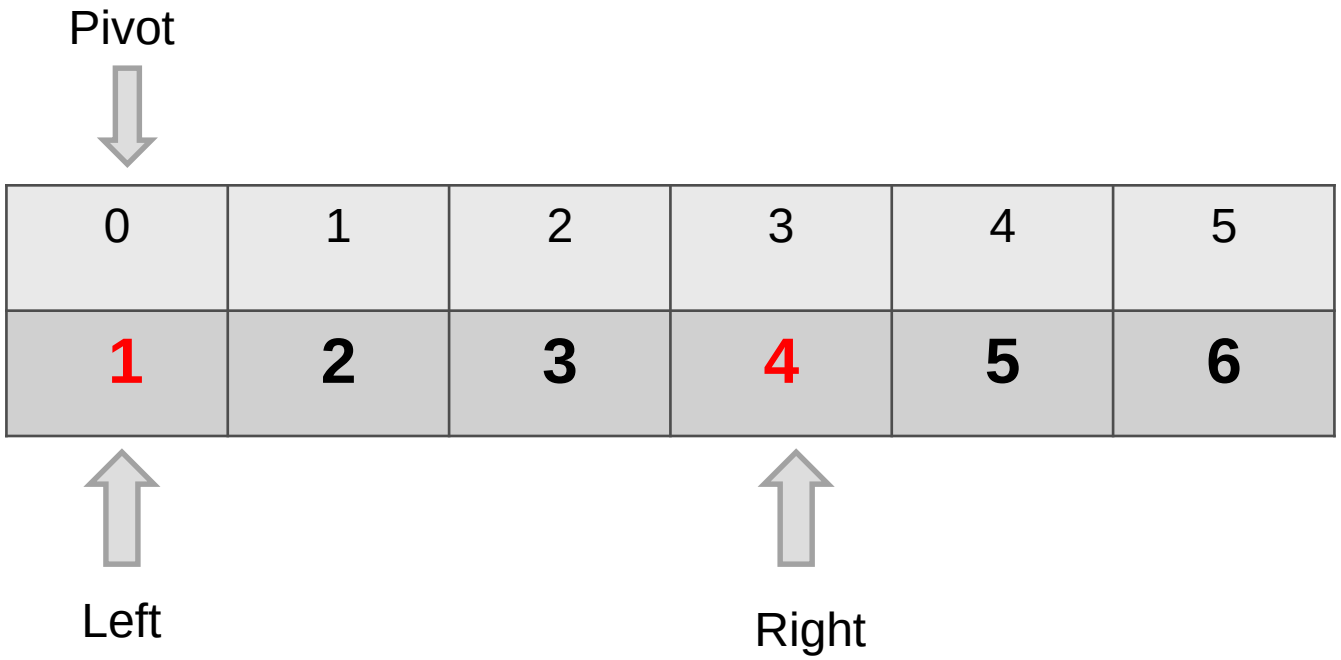
Is Pivot < Left

(4 < 1)

NO

Pivot = 4
Left =1

So we swap pivot and right



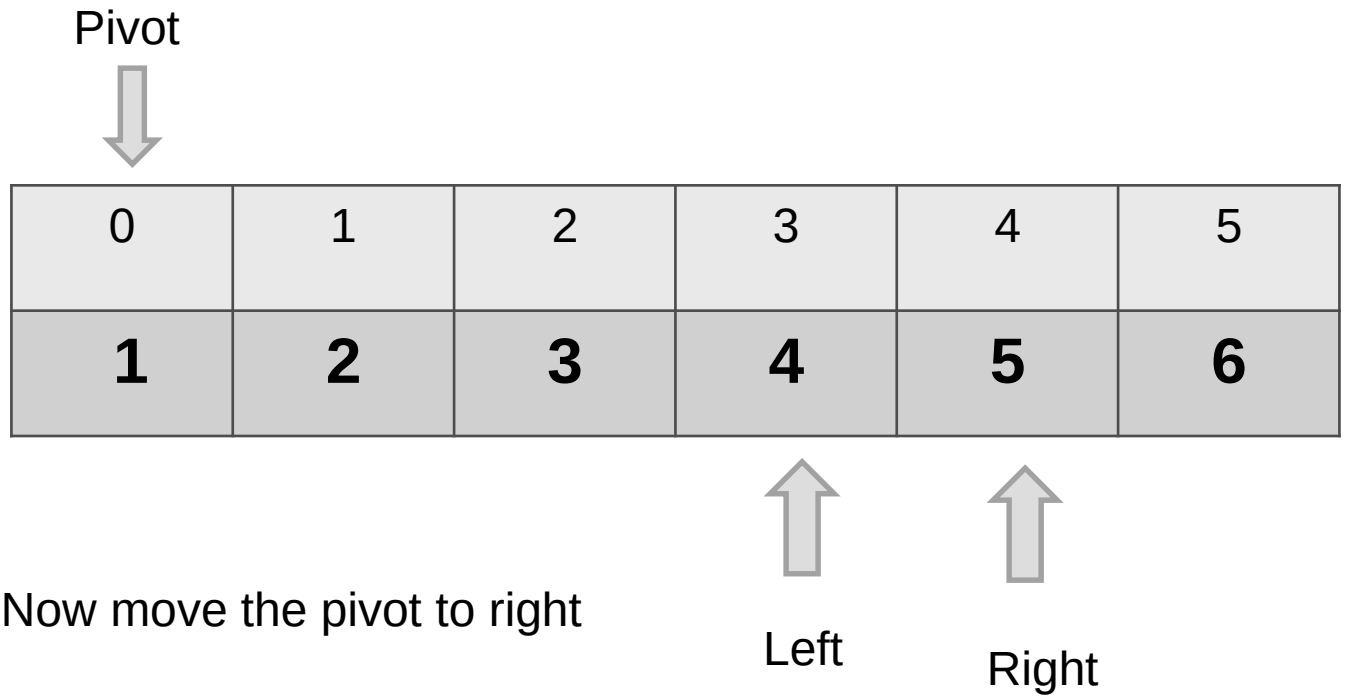
Is Pivot < Left

(4 < 1)

NO

Pivot = 4
Left =1

So we swap pivot and right



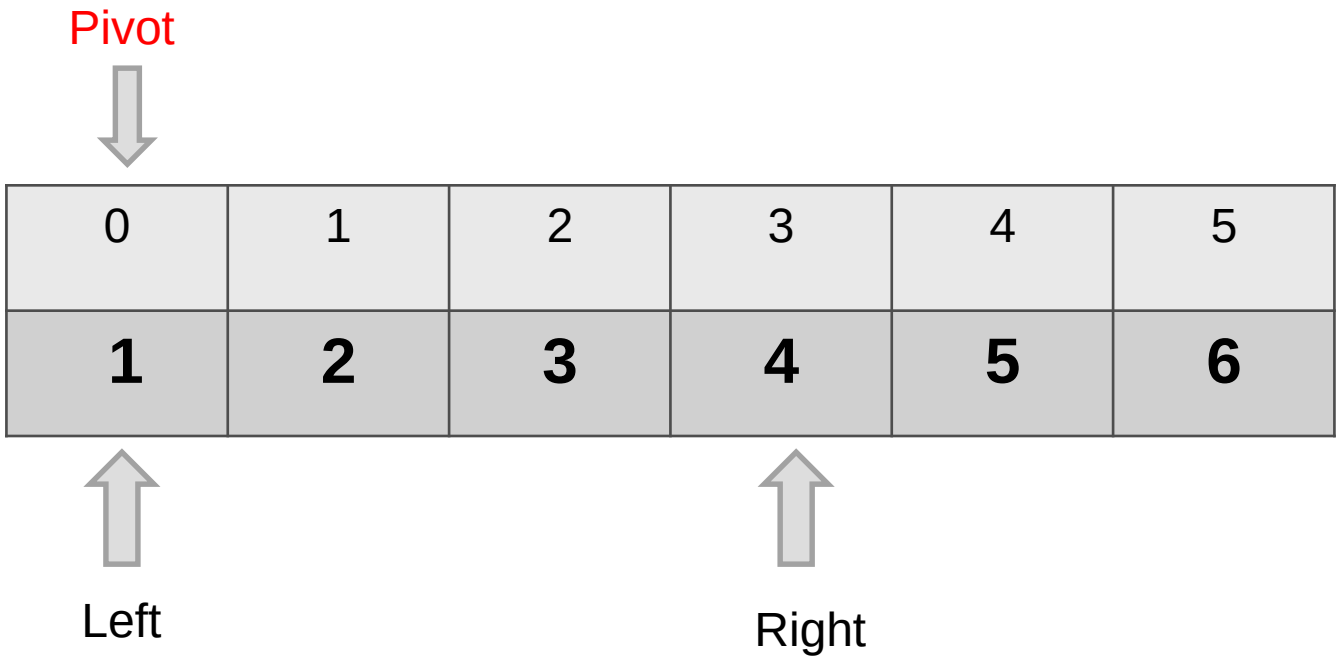
Is Pivot < Left

(4 < 1)

NO

Pivot = 4
Left =1

So we swap pivot and right



The Array is Sorted

0	1	2	3	4	5
1	**2**	**3**	**4**	**5**	**6**

Jeanie Lyn Arnoco