EXAMPLE 1

Sort the following list of items using counting sort:

$$A = \{6, 0, 2, 0, 1, 3, 4, 6\}.$$

SOLUTION

The temporary array C is of size K = 6, as this is the largest element in array A.

$$n = \text{length}[A] = 8$$

Array A is:

6	0	2	0	1	3	4	6	
1	2	3	4	5	6	7	8	

Step-1: for $i \leftarrow 0$ to k

$$C[i] \leftarrow 0$$

So, array C is:

0	0	0	0	0	0	0	0
1	2	3	4	5	6	. 7	8

Step-2: Now the elements of C are updated according to the repetition of elements in A. for $j \leftarrow 1$ to n

$$C[A[j]] \leftarrow C[A[j]] + 1$$

For each occurrence of the same element C[A[j]] is incremented by 1.

For
$$j = 1$$
,

$$C[A[1]] = C[6] = C[6] + 1 = 0 + 1 = 1$$

For
$$j = 2$$
,

$$C[A[2]] = C[0] = C[0] + 1 = 0 + 1 = 1$$

For
$$j=3$$
,

$$C[A[3]] = C[2] = C[2] + 1 = 0 + 1 = 1$$

For
$$j = 4$$
,

$$C[A[4]] = C[0] = C[0] + 1 = 1 + 1 = 2$$

For
$$j = 5$$
,

$$C[A[5]] = C[1] = C[1] + 1 = 0 + 1 = 1$$

For
$$j = 6$$
,

$$C[A[6]] = C[3] = C[3] + 1 = 0 + 1 = 1$$

For
$$j = 7$$
,

$$C[A[7]] = C[4] = C[4] + 1 = 0 + 1 = 1$$

For
$$j = 8$$
,

$$C[A[8]] = C[6] = C[6] + 1 = 1 + 1 = 2$$

So, the updated array, C is as follows:-

	2	1	1	1	1	0	2	6
•	0	1	2	3	4	5	6	

This shows that there are 2 occurrences of elements 0, 6 and 1 occurrence each of elements 1, 2, 3, 4 and zero occurrence of element 5.

Step-3: For each element we have to determine how many elements are less than that element.

for
$$i \leftarrow 1$$
 to k

$$C[i] \leftarrow C[i] + C[i-1]$$

For i = 1,

$$C[1] = C[1] + C[0] = 1 + 2 = 3$$

That is, the element i = 1 is at the 3^{rd} position and there are 2 elements less than that i. Similarly, we will do for other values of i and updated array C is as follows:

Step-4: Now the output array B is to be put with the elements in A in sorted order.

for $j \leftarrow n$ down to 1

do
$$B[C[A[j]]] \leftarrow A[j]$$

and
$$C[A[j]] \leftarrow C[A[j]] - 1$$

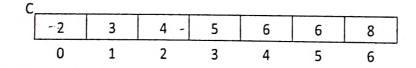
As we know that the position of A[j] through array position C[A[j]], it is put in array B at that very position.

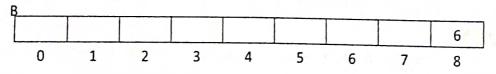
For
$$j = 8$$
,

$$B[C[A[8]]] = B[C[6]] = B[8] = A[j] = A[8]$$

So,
$$B[8] = A[8] = 6$$

And
$$C[A[8]] = 8 - 1 = 7 = C[6]$$



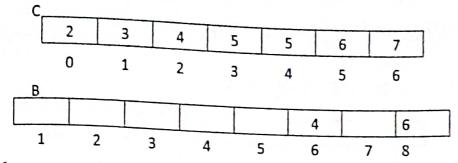


For
$$j = 7$$
,

$$B[C[4]] = B[6] = A[j] = A[7]$$

So,
$$B[6] = A[7] = 4$$

And
$$C[A[7]] = C[4] = C[4] - 1 = 6 - 1 = 5$$



For j = 6,

$$B[C[A[j]]] = B[C[3]] = B[5] = A[6]$$

So,

$$B[5] = 3$$

And

$$C[A[3]]] = C[3] = C[3] - 1 = 5 - 1 = 4$$

C	·							
	2	3	4	5	5	6	1.7	
	0	1	2	:3	4	5	6	

B	· · ·			_					
					3	4		6	
	1.	2	3	4	5	6	7	8	

For j = 5,

$$B[C[A[j]]] = B[C[1]] = B[3] = A[5]$$

So,

$$B[3] = 1$$

And

$$C[1] = C[1] = C[1] - 1 = 3 - 1 = 2$$

C.								
	2	2	4	4	5	6	7	
	0		2				201.00	
В								

B.									
			1		3	4		6	
	1	2	3	4	5	6	7	8	

For j = 4,

$$B[C[A[j]]] = B[C[0]] = B[2] = A[4]$$

So,

$$B[2]=0$$

And

$$C[0] = C[0] - 1 = 2 - 1 = 1$$

C	1,42		4 4 5 6 7 2 3 4 5 6				
	1	2	4	4	5	6	7
	0	1	2	3	4	5	6

В	0	1		3	4		6	
1111	2	3	4	5	6	7	8	

For
$$j = 3$$
,

$$B[C[A[j]]] = B[C[2]] = B[4] = A[3]$$

So,

$$B[4] = 2$$

And

$$C[2] = C[2] - 1 = 4 - 1 = 3$$

C	1	2	3	4	5	6	7	
	0	1	2	3	4	5	6	

B		0	1	2	3	4	, , , , , , , , , , , , , , , , , , ,	6	
_	1	2	3	4	5	6	7	8	

For j = 2,

$$B[C[A[j]]] = B[C[0]] = B[1] = A[2]$$

So,

$$B[1] = 2$$

And

$$C[0] = C[0] - 1 = 1 - 1 = 0$$

C	0	2	3	4	5	6	7
	0	1	2	3	4	5	6

В	0	0	1	2	3	4		6	1
	1	2	3	4	5	6	7	8	

For j = 1,

$$B[C[A[j]]] = B[C[6]] = B[7] = A[1]$$

So,

$$B[7] = 6$$

And

$$C[6] = C[6] - 1 = 7 - 1 = 6$$

CL								_
	0	2	3	4	5	6	6	
	0	1	2	3	4	5	6	4

Br			,						
	0	0	1	2	3	4	6	6	
	1	2	3	4	5	6	7	8	