

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
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 3rd 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:

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

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

C

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

B

								6
0	1	2	3	4	5	6	7	8

For $j = 7$,

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

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

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

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

B							
					4		6
1	2	3	4	5	6	7	8

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	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	1	2	3	4	5	6	

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

B							
	0	1		3	4		6
1	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

B	0	0	1	2	3	4		6
	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 $C[6] = C[6] - 1 = 7 - 1 = 6$

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

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