ساختمان داده ها

مثالی کامل از اجرای الگوریتم مرتب سازی شمارشی (Counting Sort)

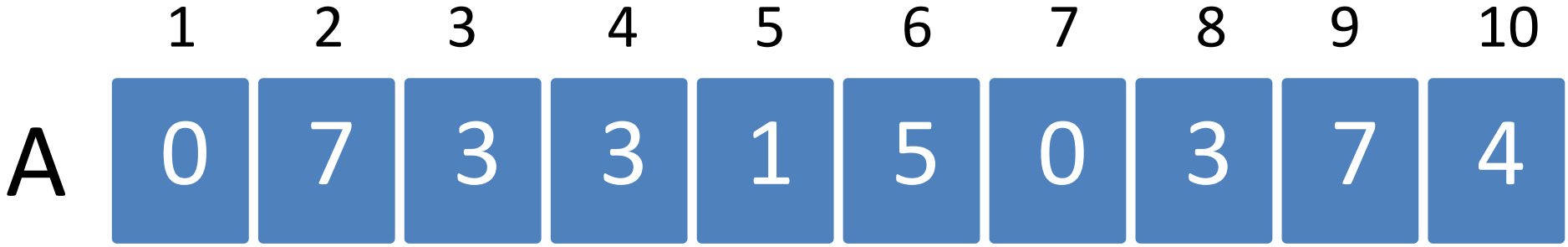
تهیه شده توسط: حسین تقی زاده

مدرس: غیاثی‌شیرازی

دانشگاه فردوسی مشهد

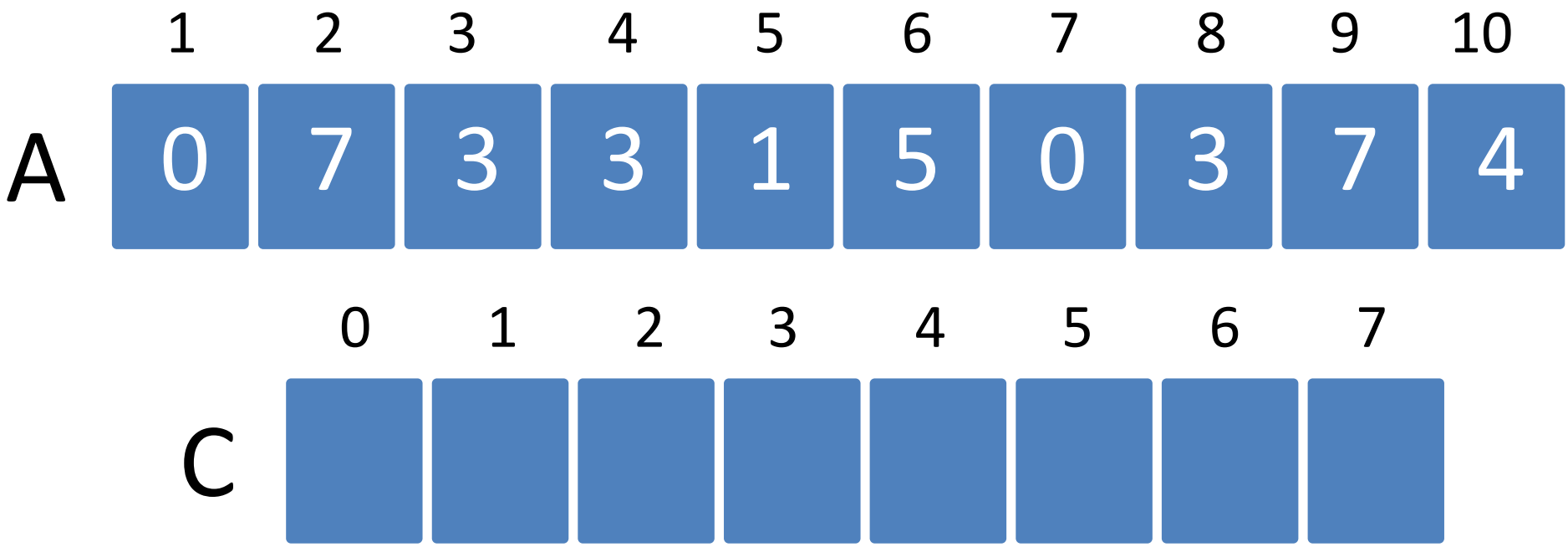
الگوریتم مرتب سازی شمارشی

```
COUNTING-SORT(A, B, k)
 1  let C[0..k] be a new array
 2  for i = 0 to k
 3      C[i] = 0
 4  for j = 1 to A.length
 5      C[A[j]] = C[A[j]] + 1
 6  // C[i] now contains the number of elements equal to i.
 7  for i = 1 to k
 8      C[i] = C[i] + C[i − 1]
 9  // C[i] now contains the number of elements less than or equal to i.
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] − 1
```


1 2 3 4 5 6 7 8 9 10
A
0 7 3 3 1 5 0 3 7 4

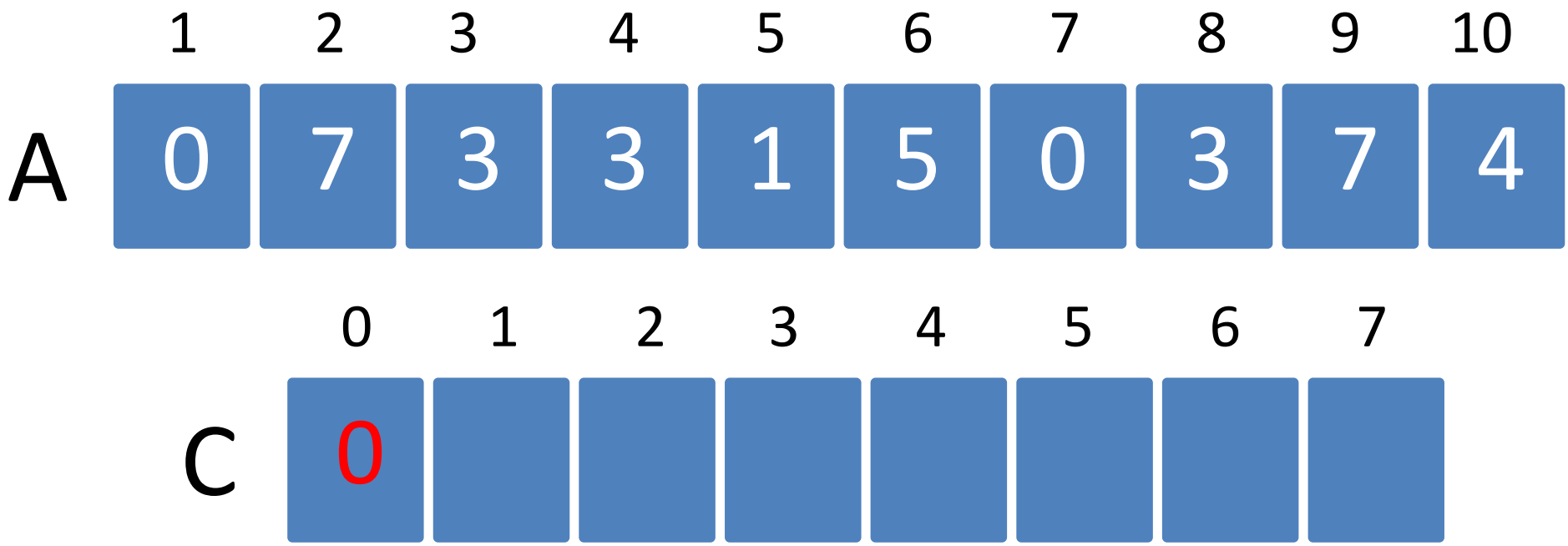
COUNTING-SORT(A, B, k)

1 let $C[0..k]$ be a new array



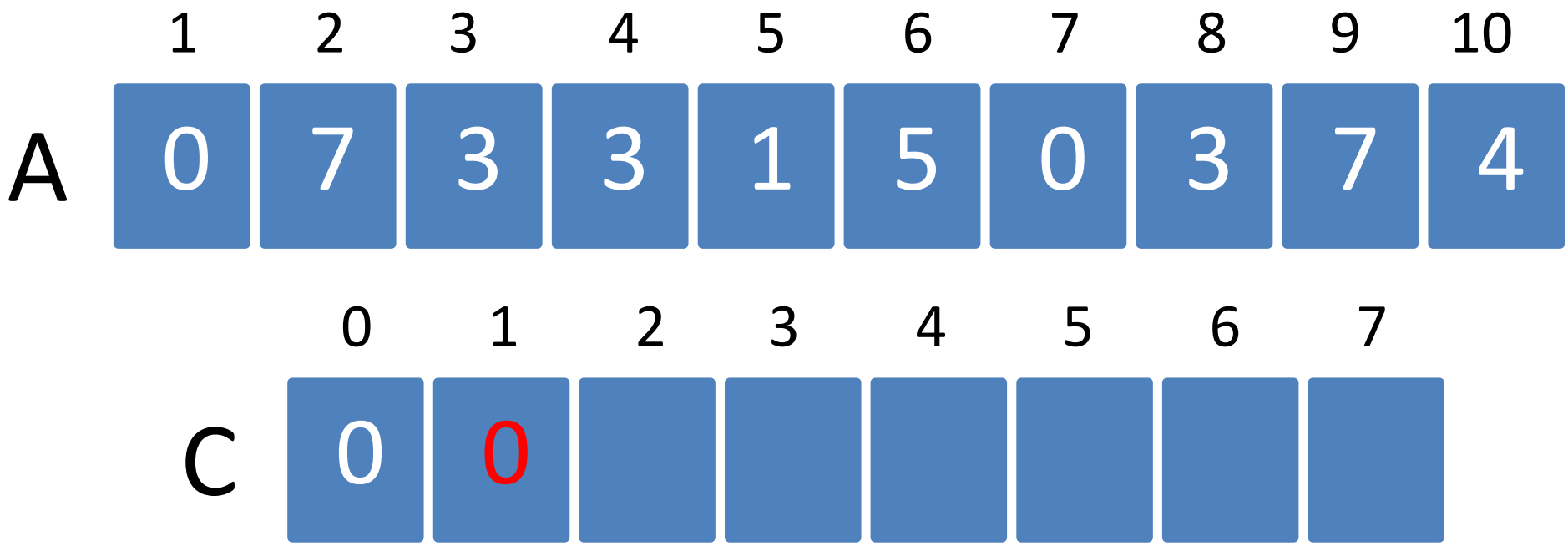
2 **for** $i = 0$ **to** k
3 $C[i] = 0$

i = 0 k = 7



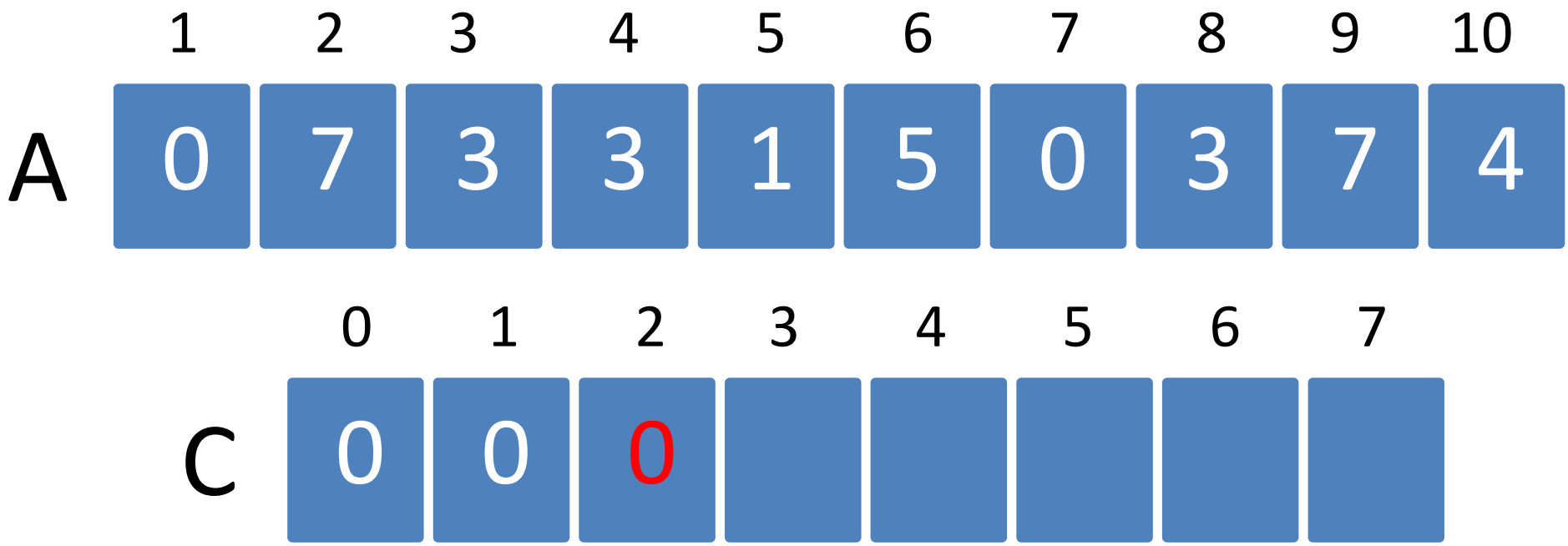
2 **for** $i = 0$ **to** k
3 $C[i] = 0$

i = 1 k = 7



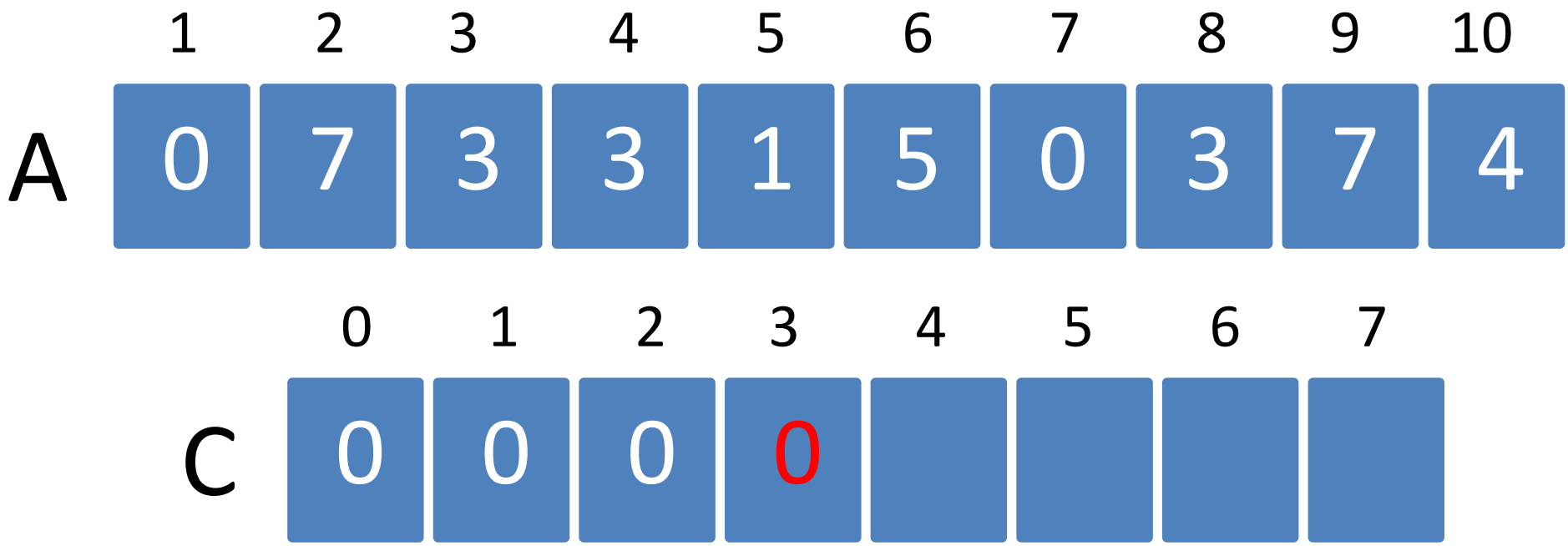
2 **for** $i = 0$ **to** k
3 $C[i] = 0$

i = 2 k = 7



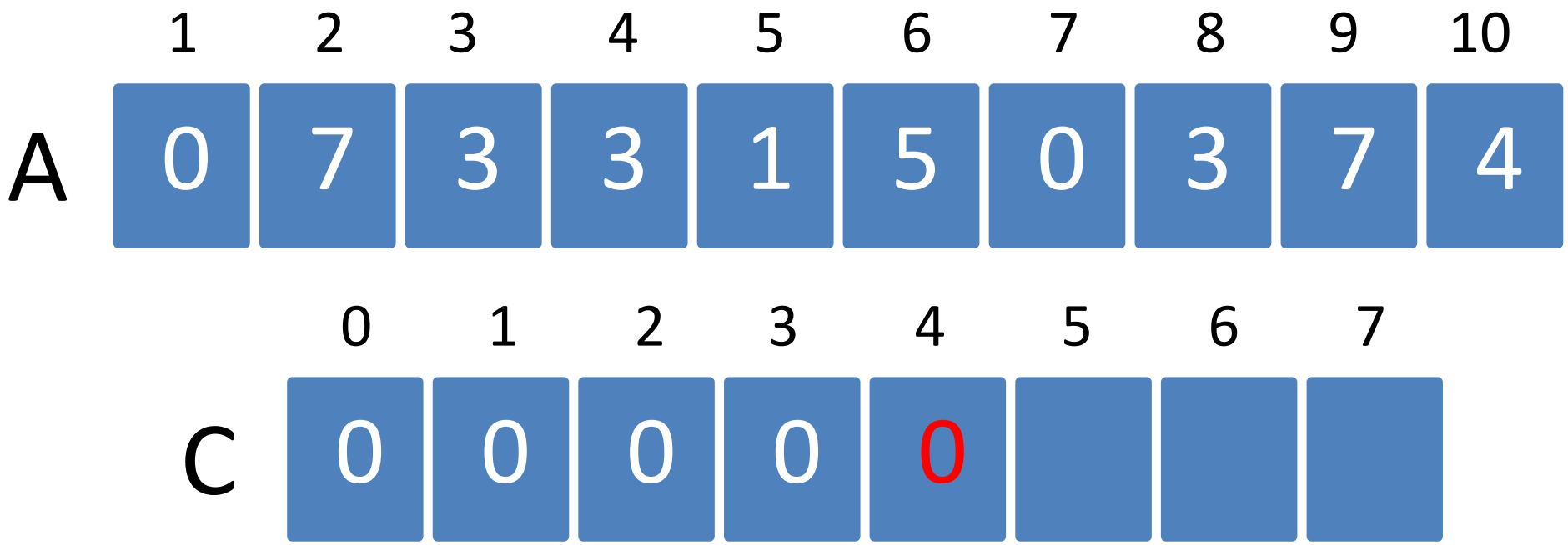
2 **for** $i = 0$ **to** k
3 $\quad C[i] = 0$

i = 3 k = 7



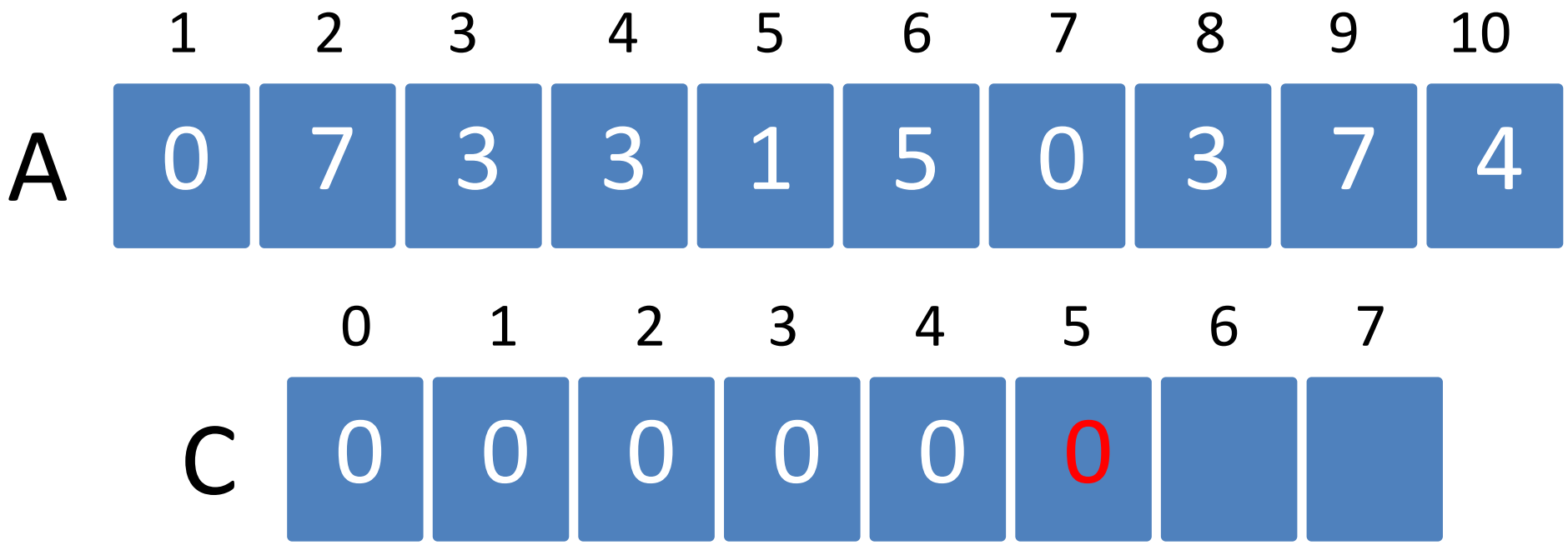
2 **for** $i = 0$ **to** k
3 $C[i] = 0$

i = 4 k = 7



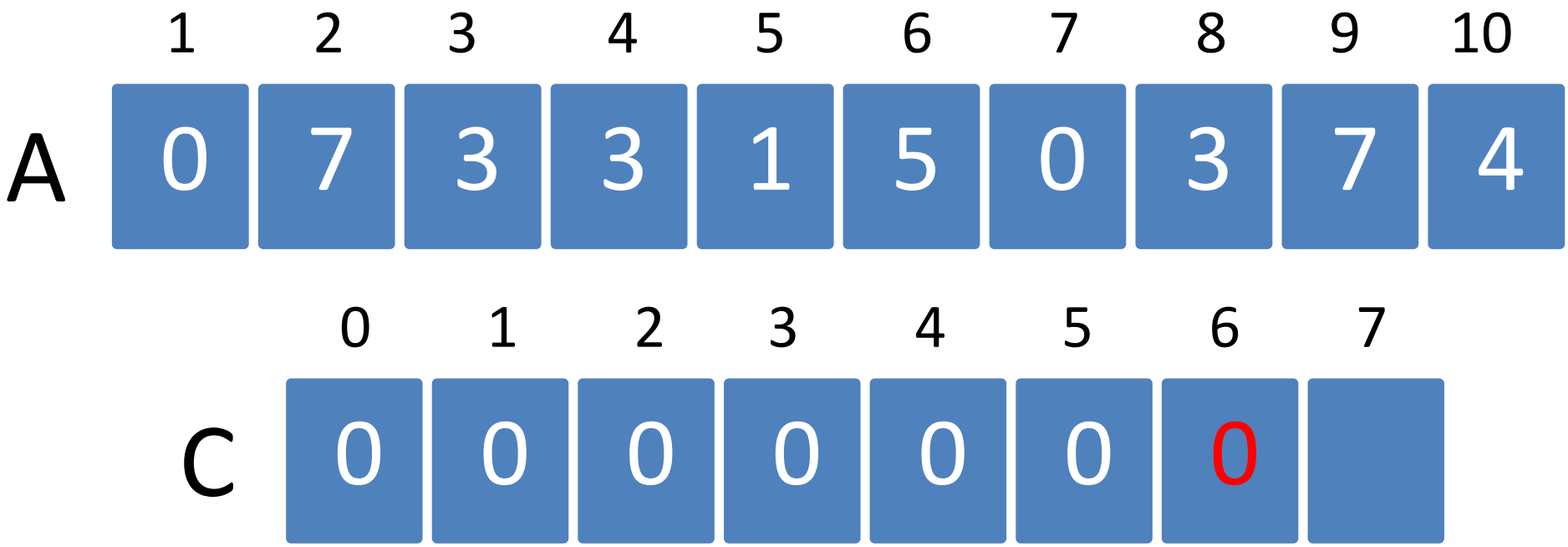
2 **for** $i = 0$ **to** k
3 $C[i] = 0$

i = 5 k = 7



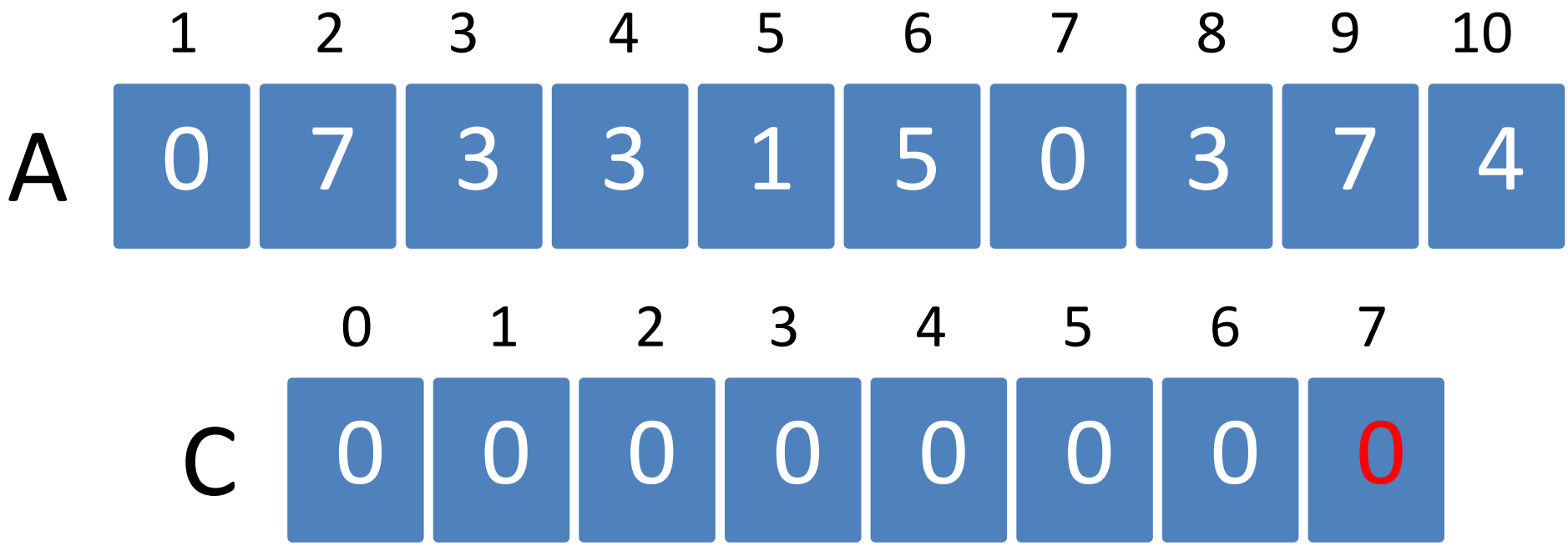
2 **for** $i = 0$ **to** k
3 $C[i] = 0$

i = 6 k = 7



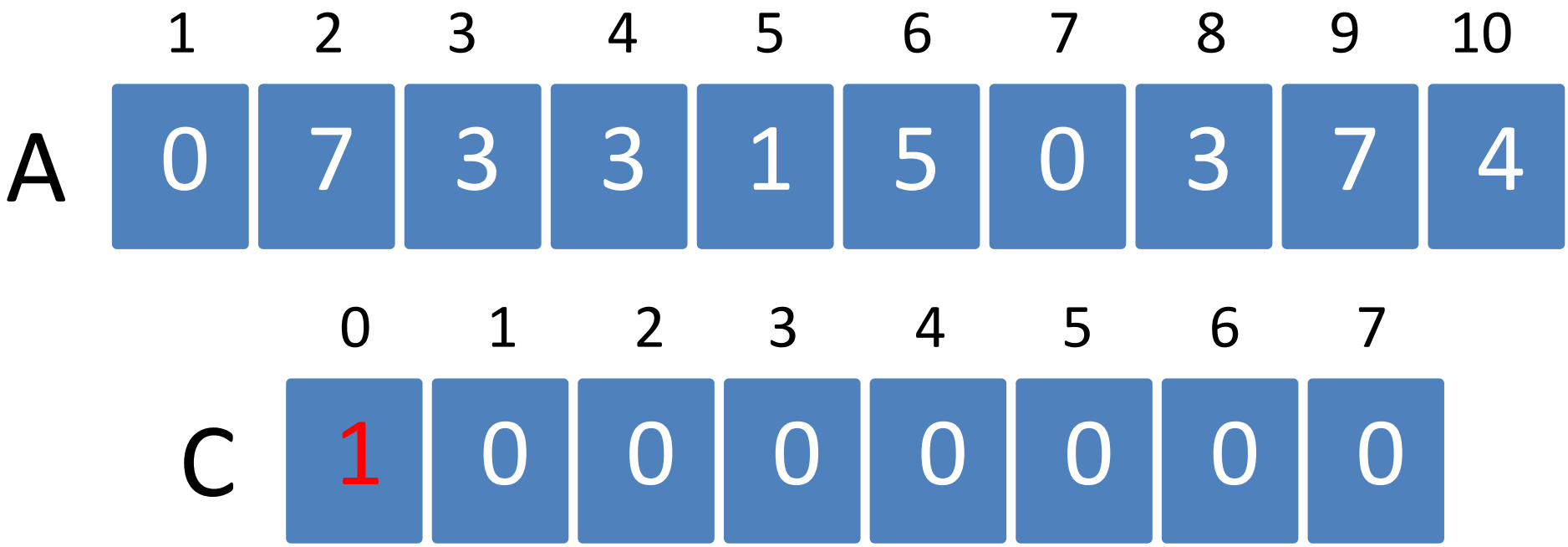
2 **for** $i = 0$ **to** k
3 $C[i] = 0$

i = 7 k = 7



```
4  for j = 1 to A.length
5      C[A[j]] = C[A[j]] + 1
```

j = 1 A.length = 10



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4  for j = 1 to A.length
5      C[A[j]] = C[A[j]] + 1
```

j = 2 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

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

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4  for j = 1 to A.length
5      C[A[j]] = C[A[j]] + 1
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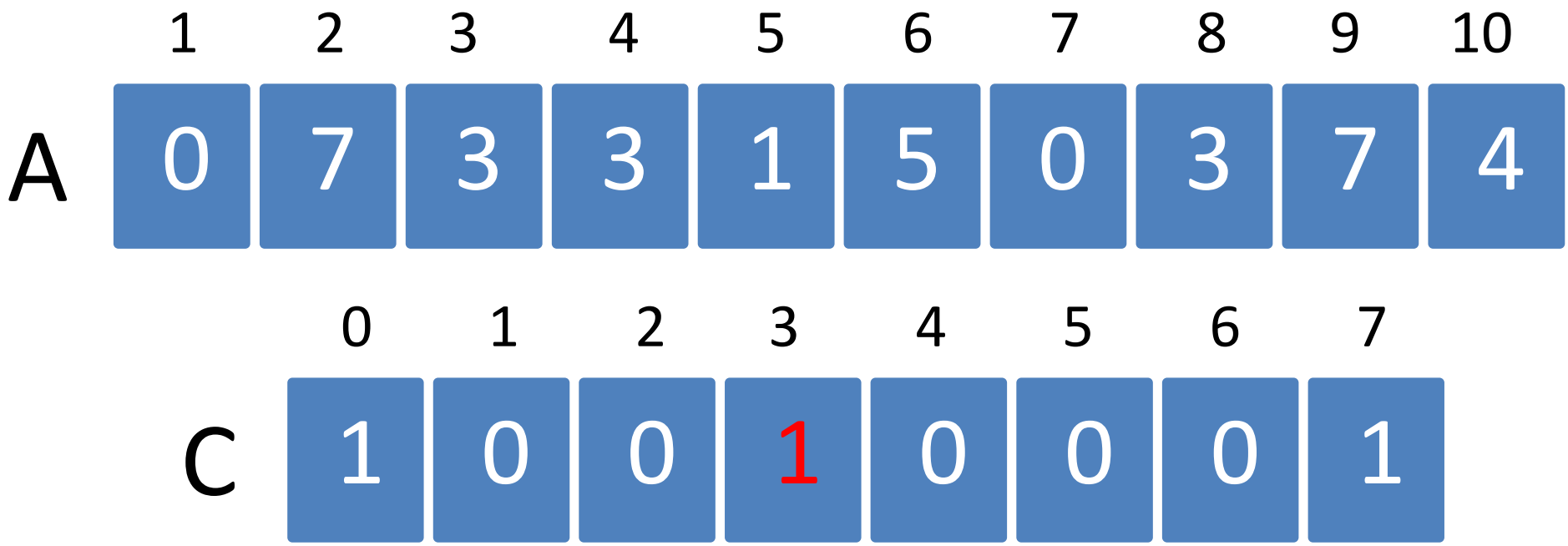
j = 3 A.length = 10



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4  for j = 1 to A.length
5      C[A[j]] = C[A[j]] + 1
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j = 4 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

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

```
4  for j = 1 to A.length
5      C[A[j]] = C[A[j]] + 1
```

j = 5 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

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

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j = 6 A.length = 10

	1	2	3	4	5	6	7	8	9	10
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	0	1	2	3	4	5	6	7
C	1	1	0	2	0	1	0	1

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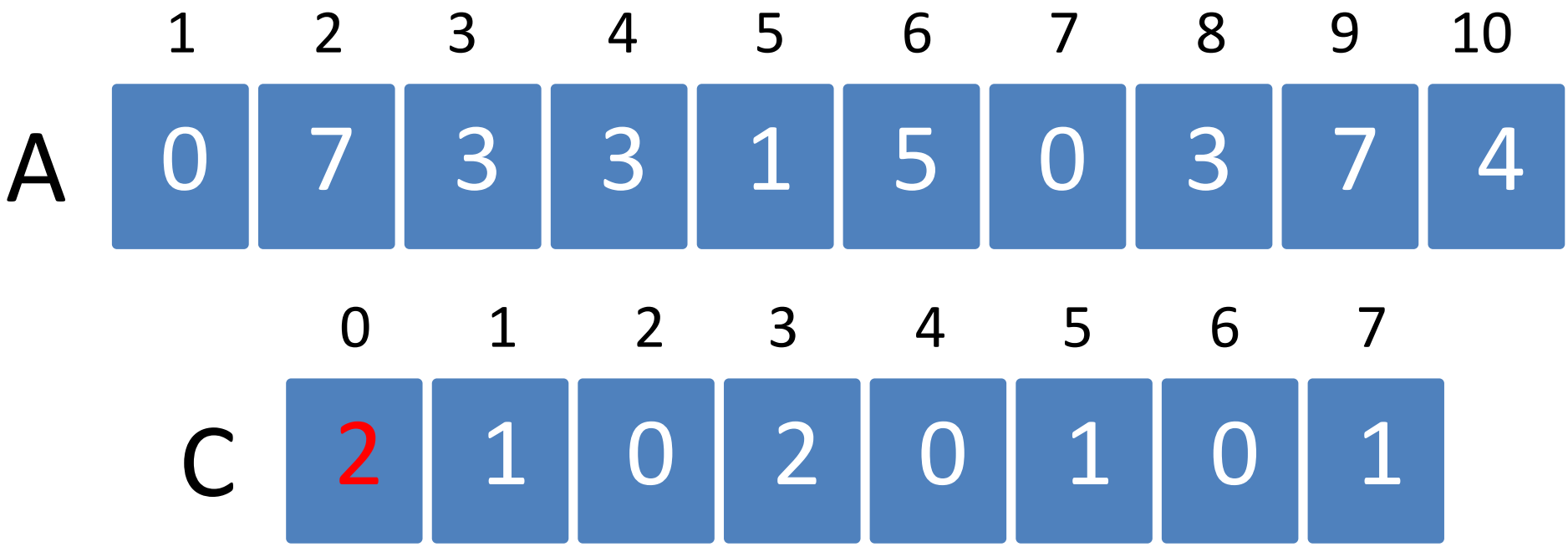
j = 7 A.length = 10



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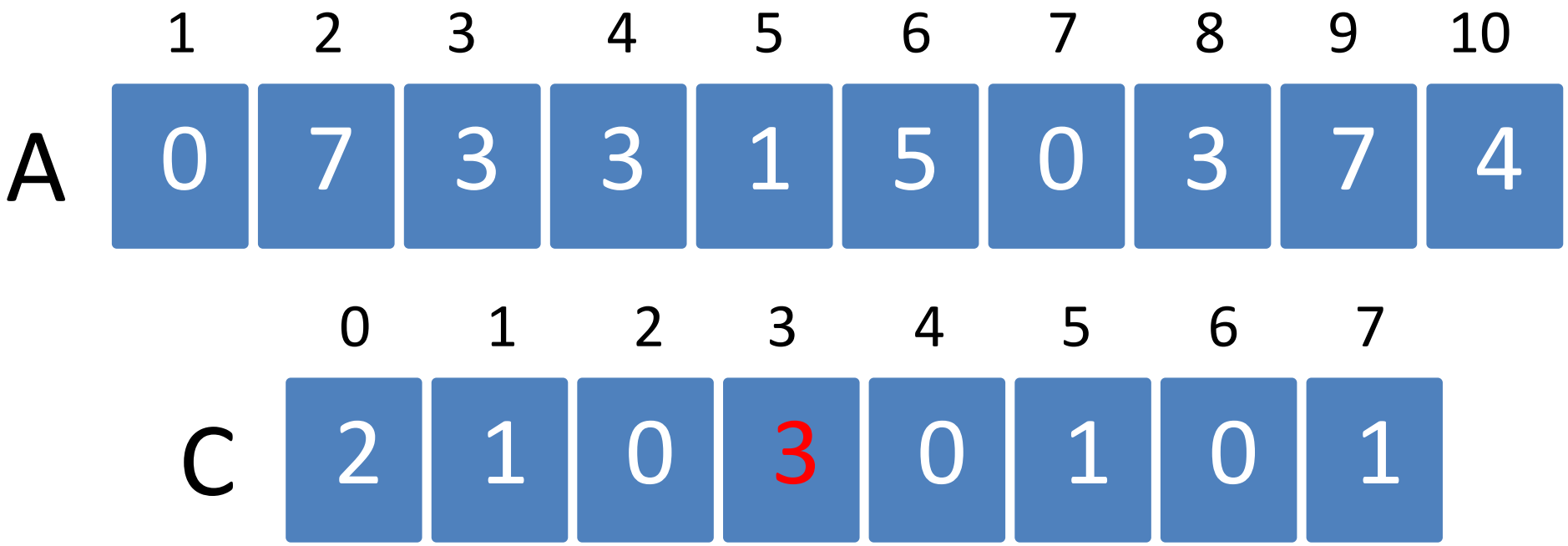
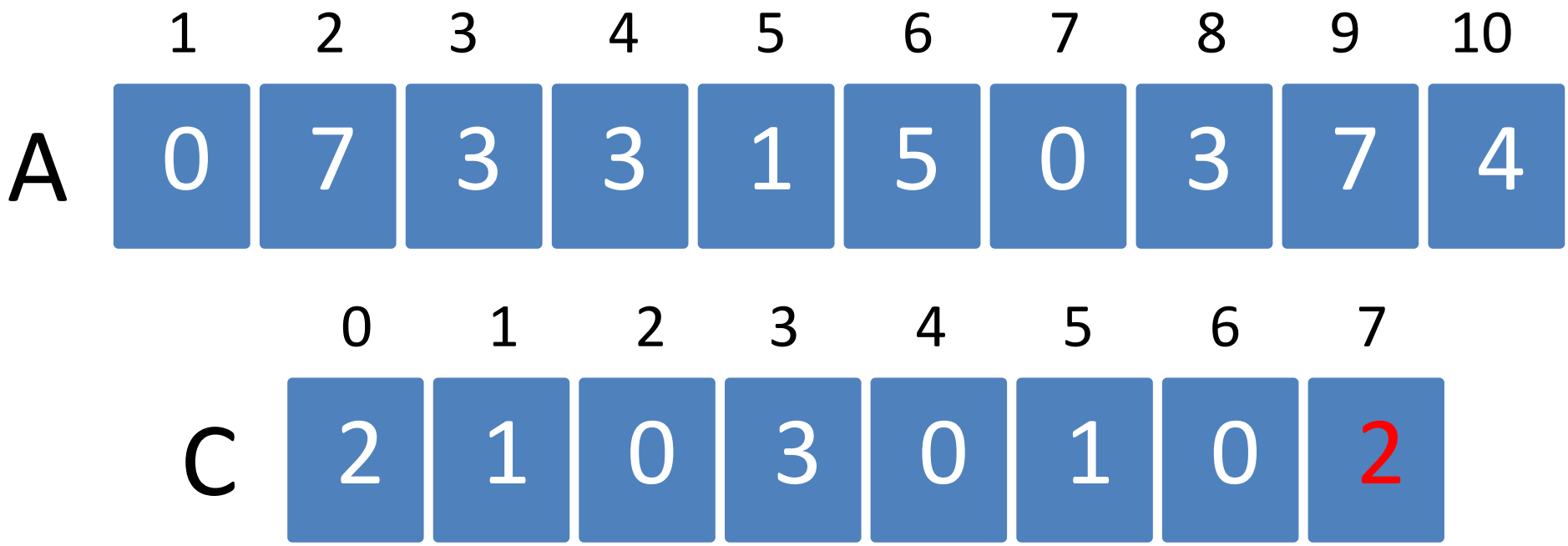
4  for j = 1 to A.length
5      C[A[j]] = C[A[j]] + 1
```

j = 8 A.length = 10



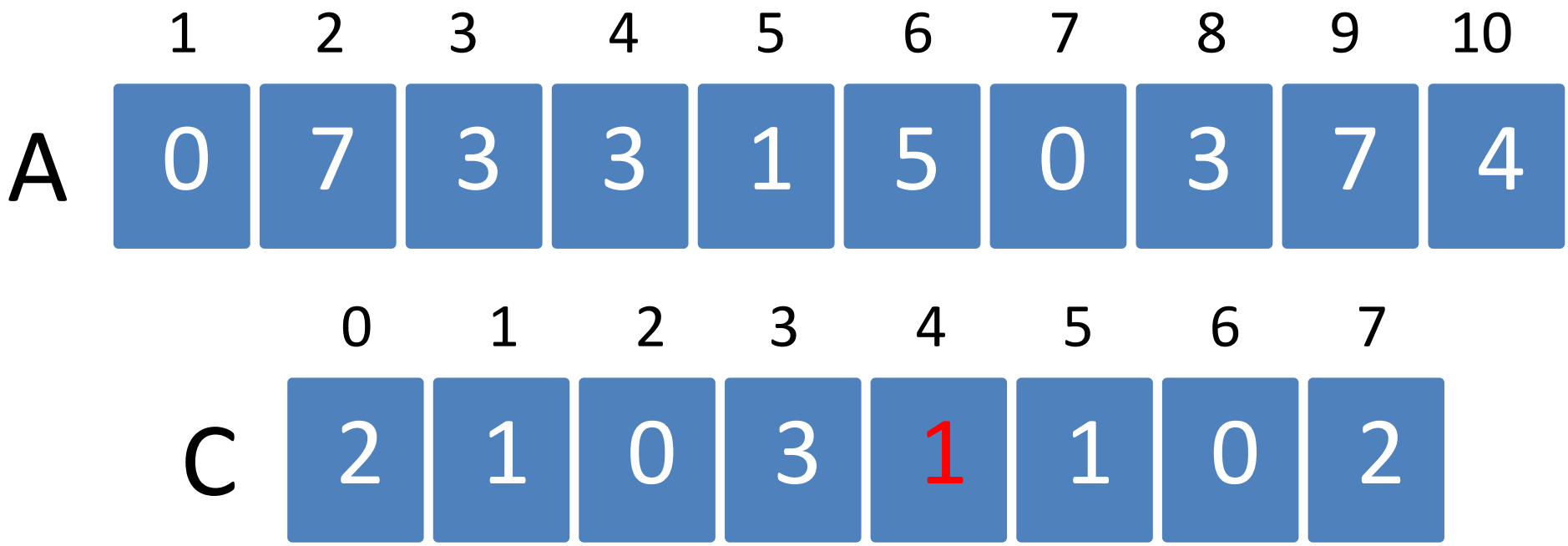
```
4  for j = 1 to A.length
5      C[A[j]] = C[A[j]] + 1
```

j = 9 A.length = 10

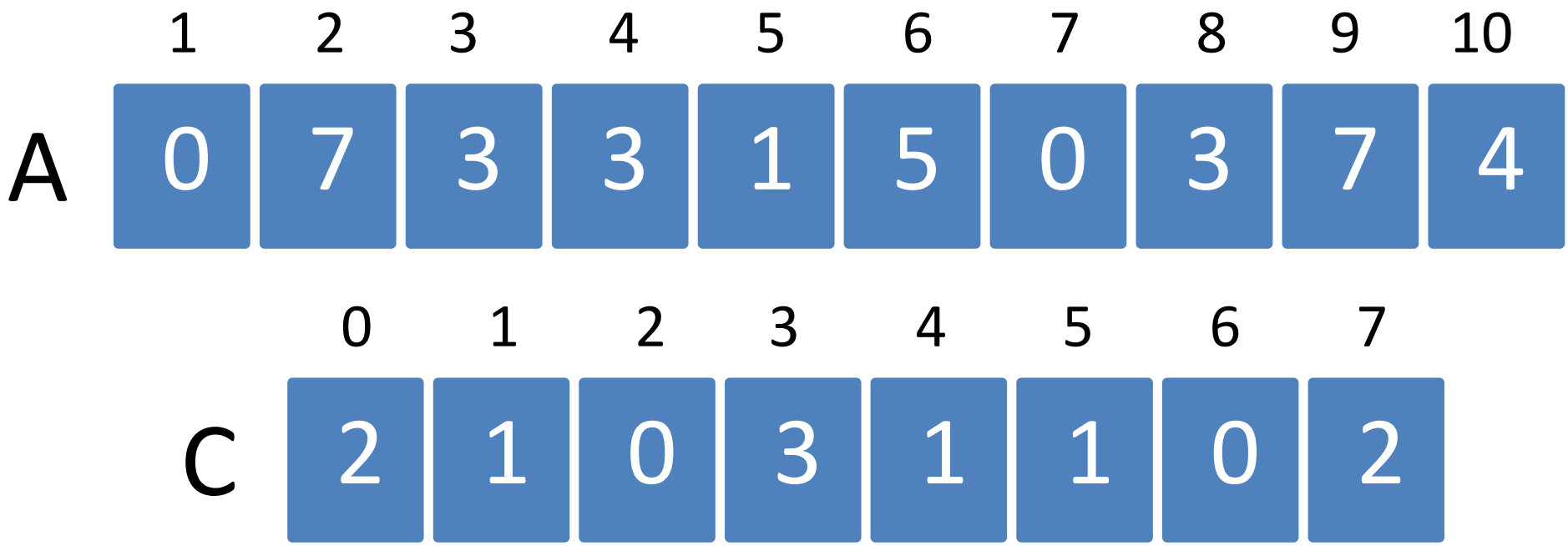


```
4  for j = 1 to A.length
5      C[A[j]] = C[A[j]] + 1
```

j = 10 A.length = 10



```
6   // C[i] now contains the number of elements equal to i.
7   for i = 1 to k
8       C[i] = C[i] + C[i − 1]
```



```
6   // C[i] now contains the number of elements equal to i.
7   for i = 1 to k                                          i = 1   k = 7
8       C[i] = C[i] + C[i − 1]
```

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

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

```
6   // C[i] now contains the number of elements equal to i.
7   for i = 1 to k                                          i = 2   k = 7
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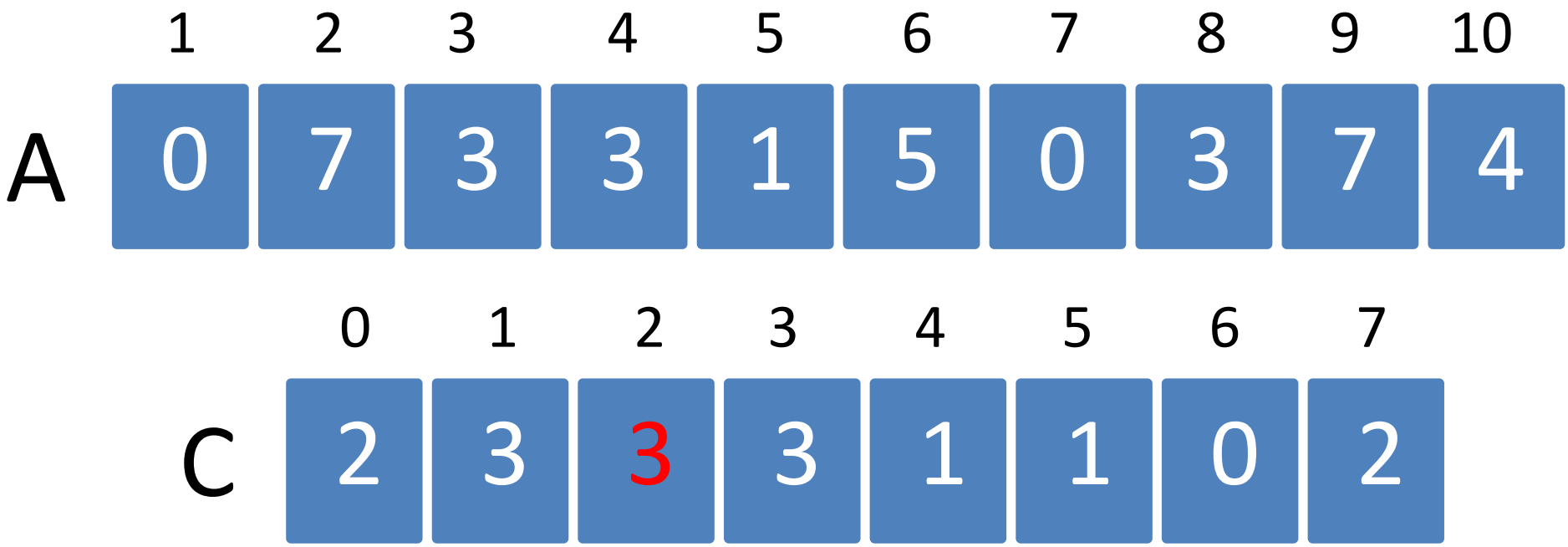

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6   // C[i] now contains the number of elements equal to i.
7   for i = 1 to k                                          i = 3   k = 7
8       C[i] = C[i] + C[i − 1]
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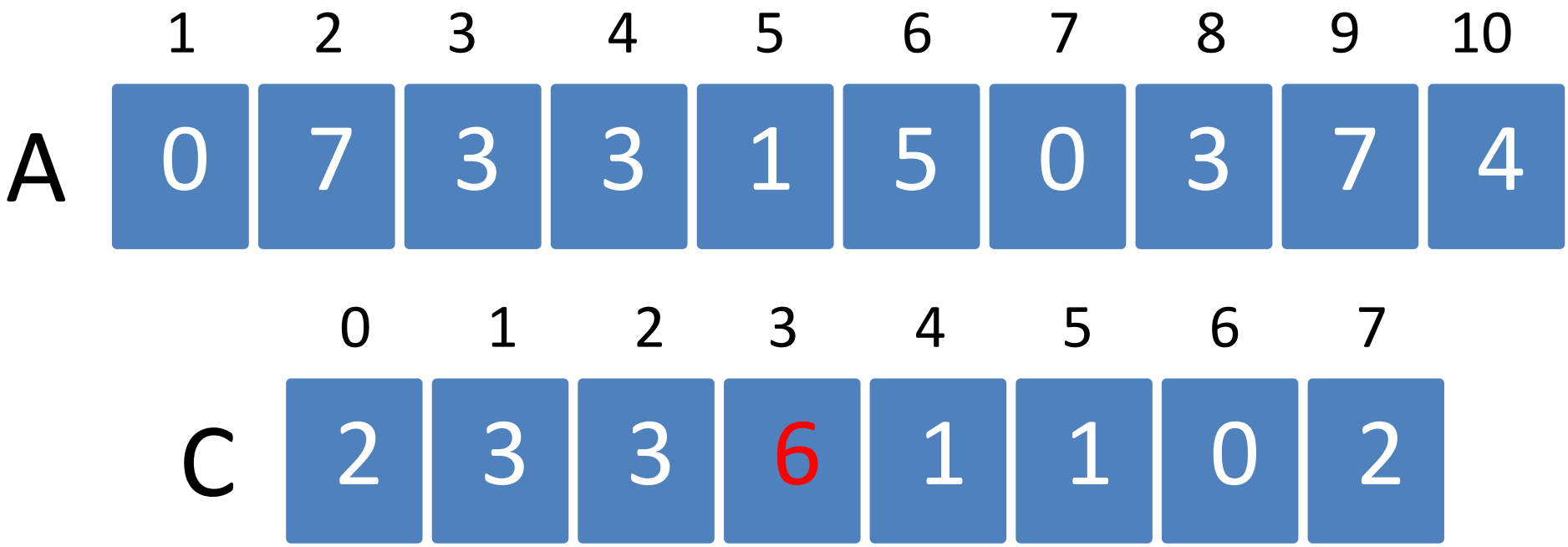

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i = 4 k = 7

	1	2	3	4	5	6	7	8	9	10
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	0	1	2	3	4	5	6	7
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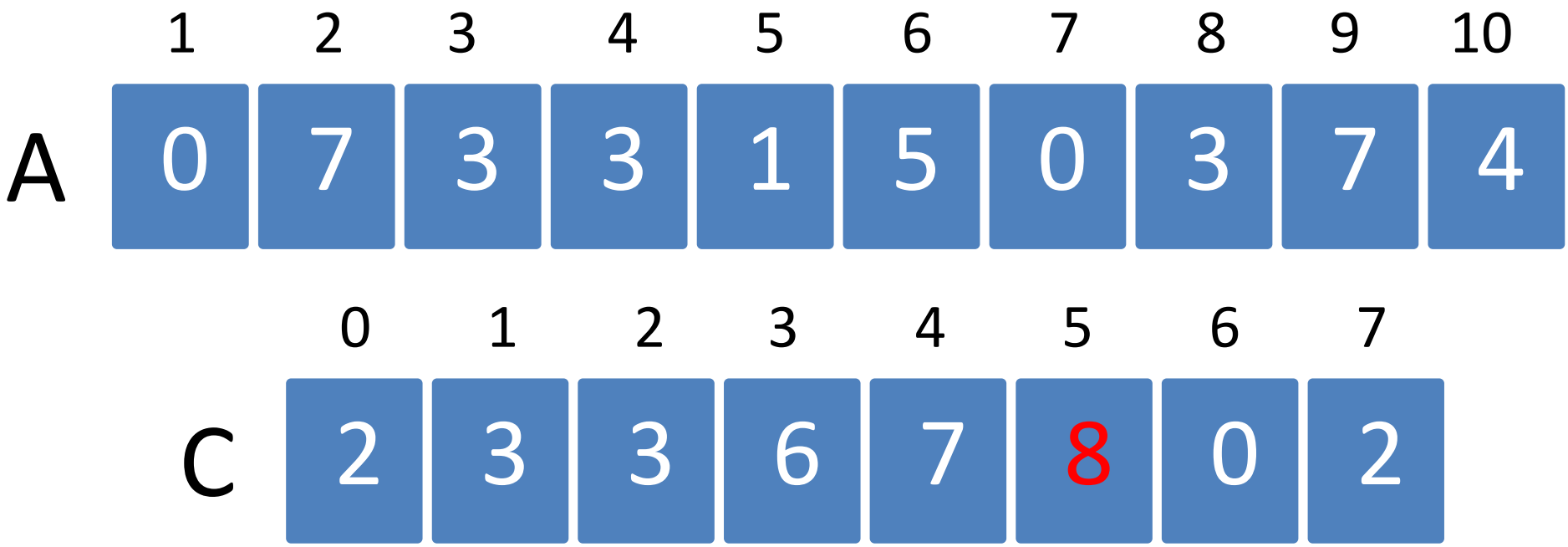
6   // C[i] now contains the number of elements equal to i.
7   for i = 1 to k                                          i = 5   k = 7
8       C[i] = C[i] + C[i − 1]
```



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7   for i = 1 to k                                          i = 6   k = 7
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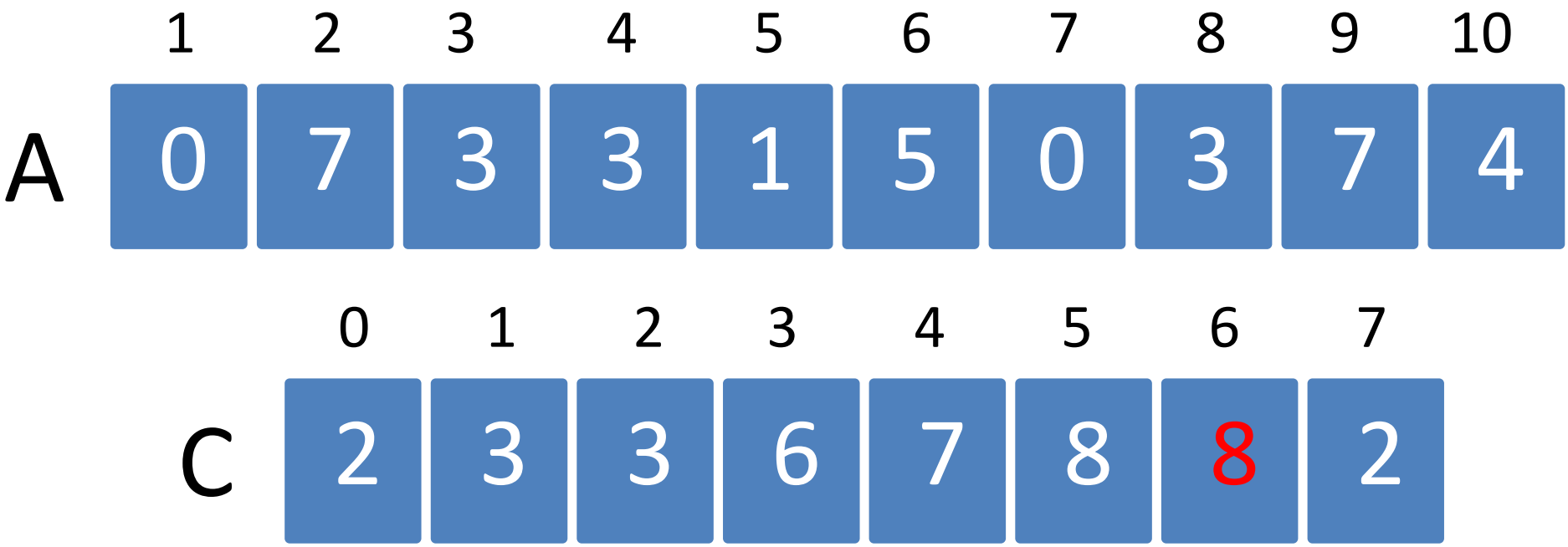

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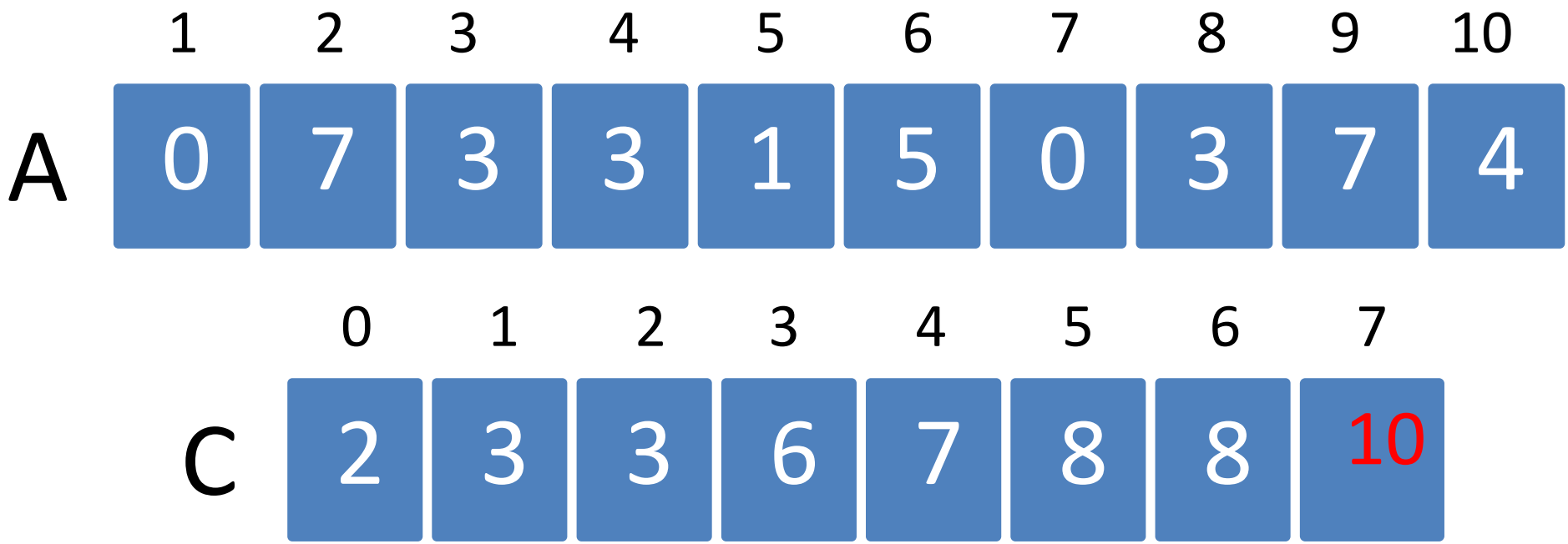

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9   // C[i] now contains the number of elements less than or equal to i.
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
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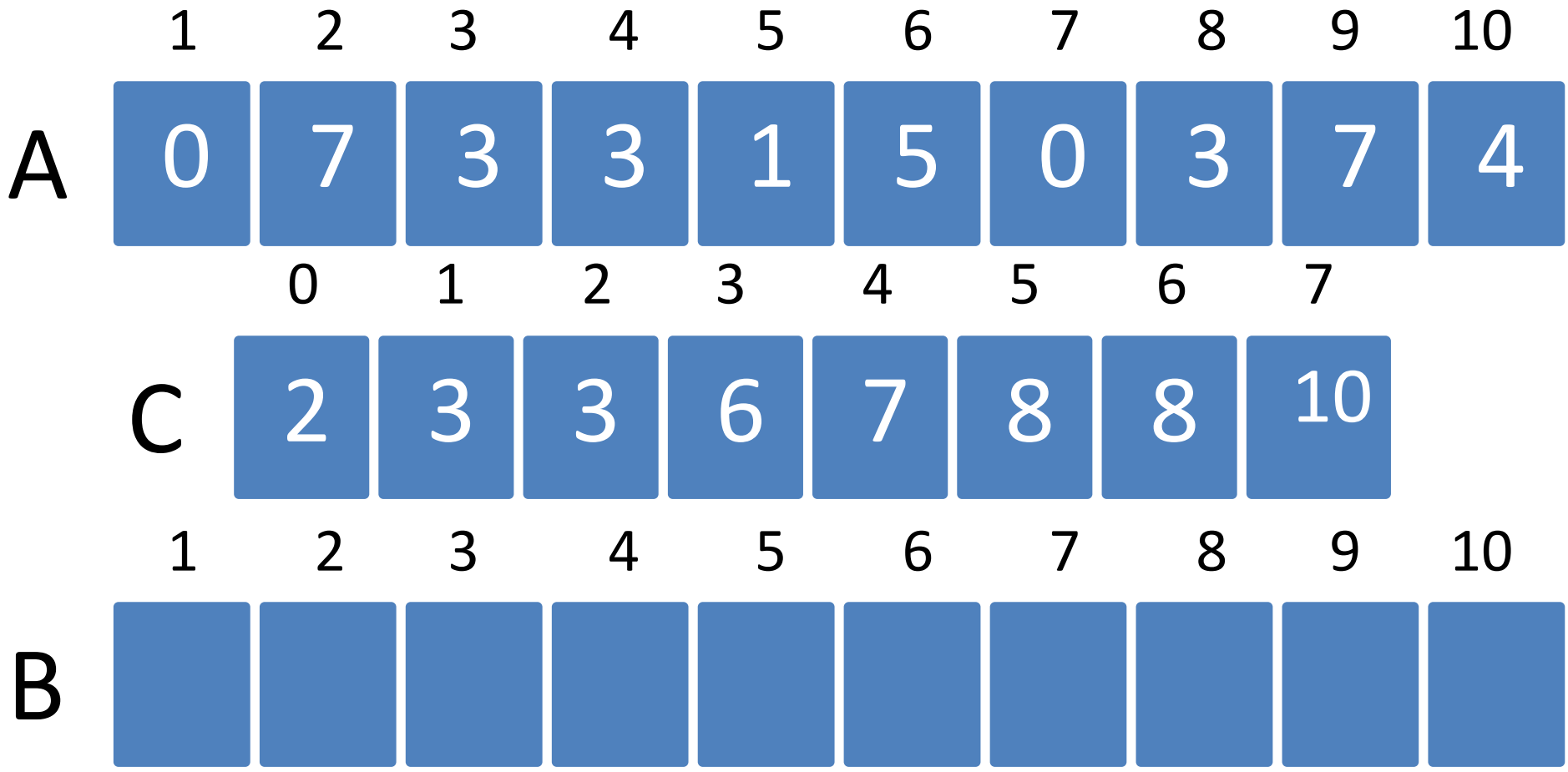

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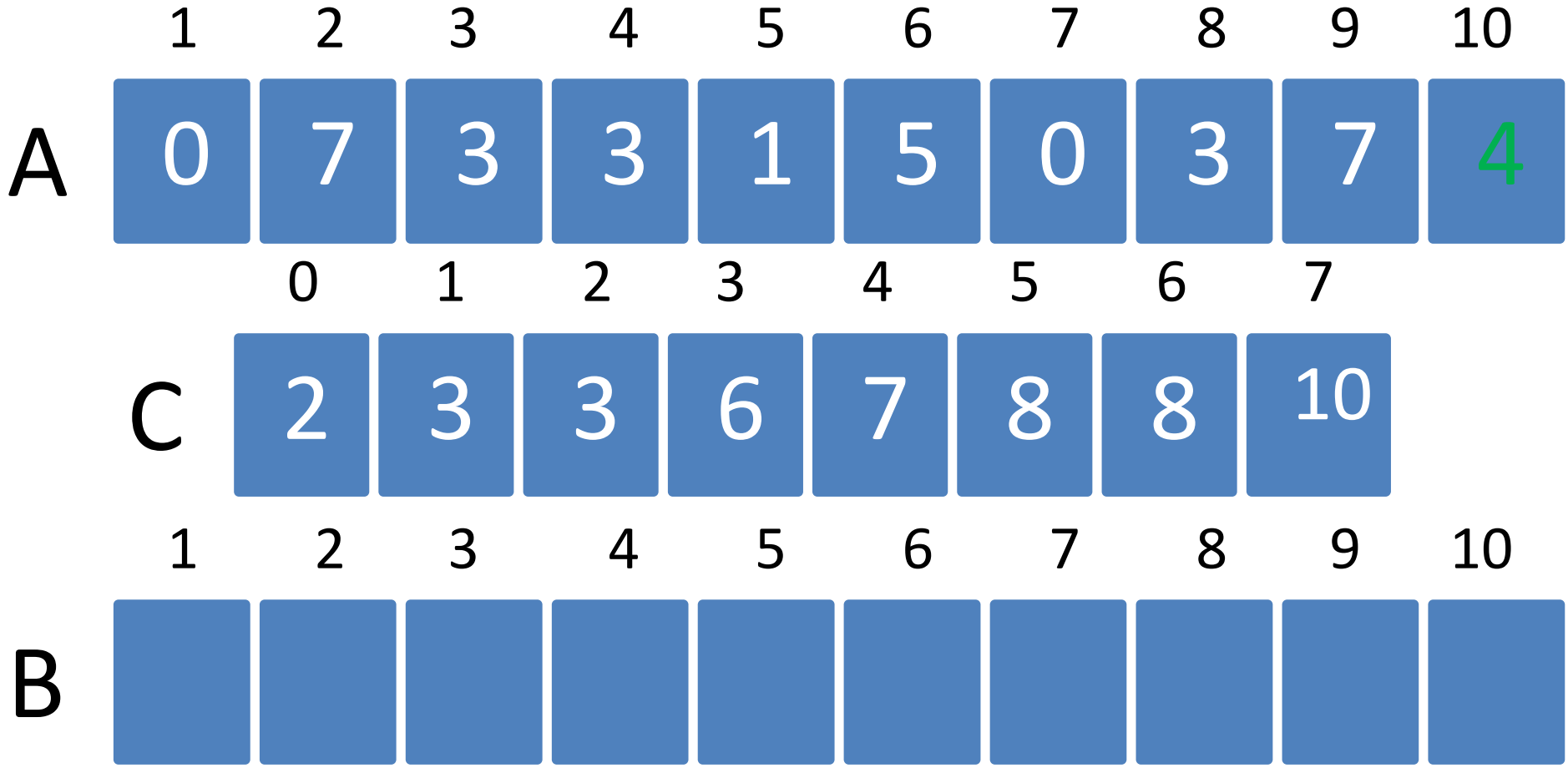
j = 10 A.length = 10



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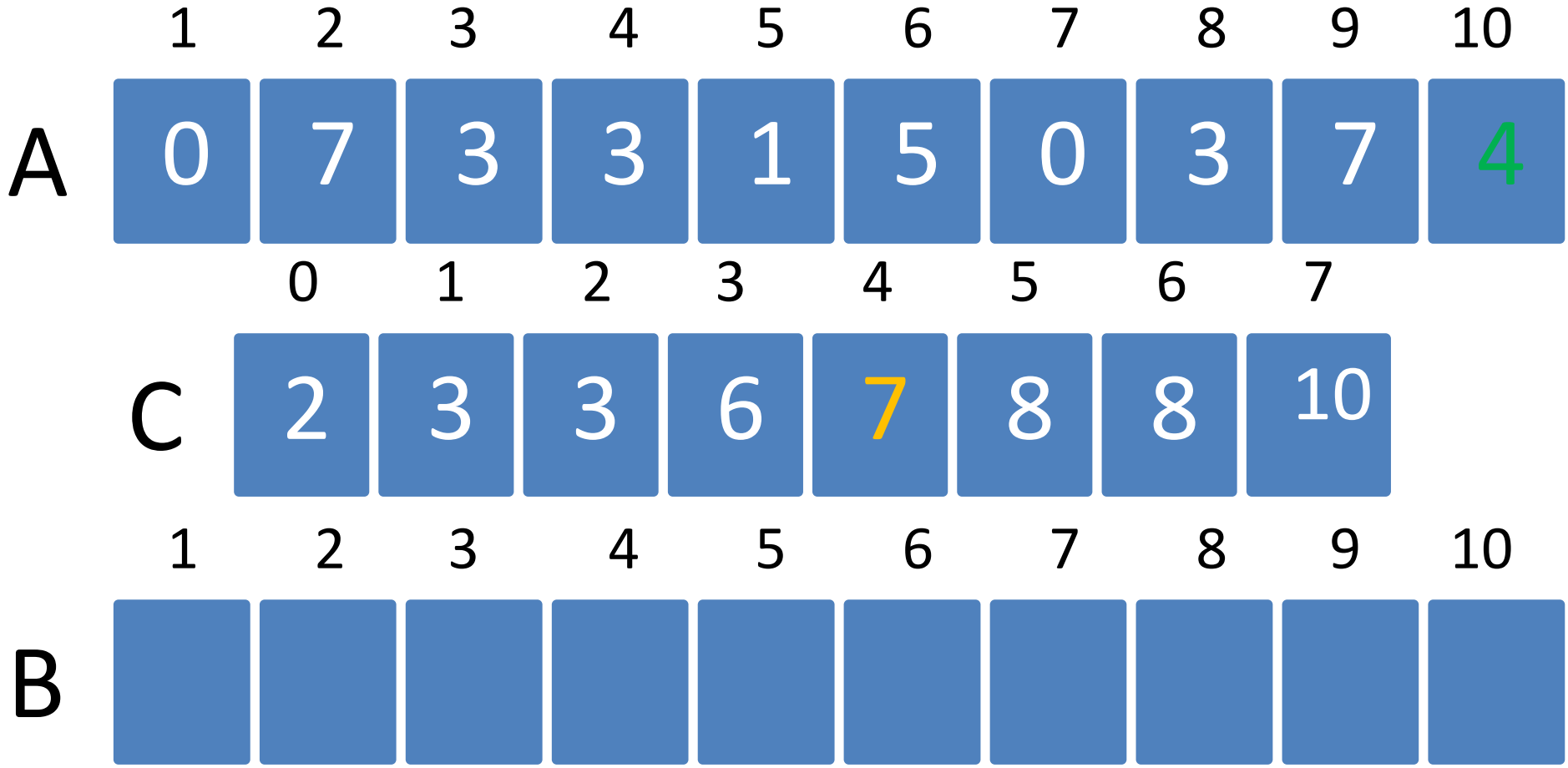

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	0	1	2	3	4	5	6	7
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B							4			

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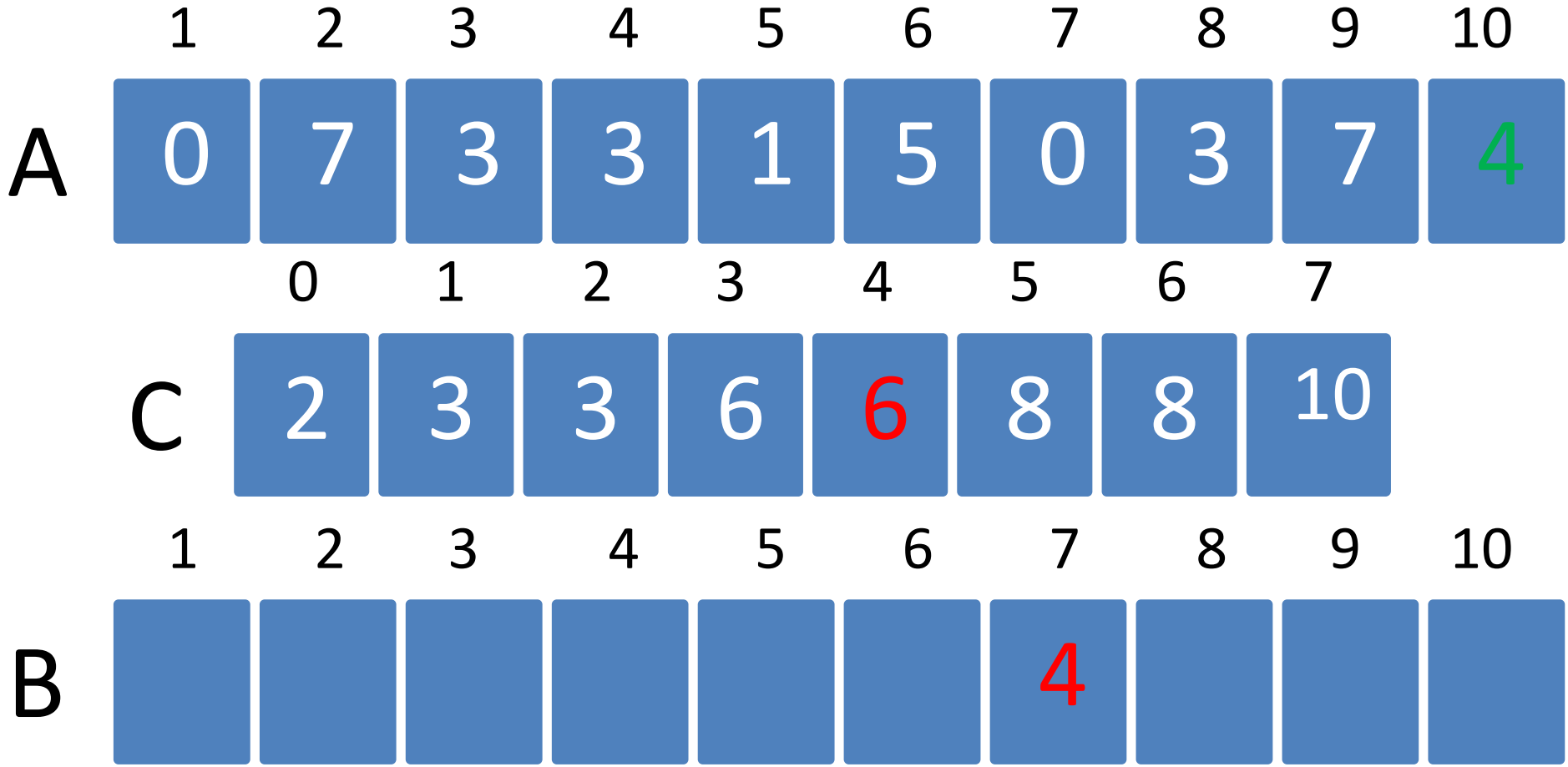

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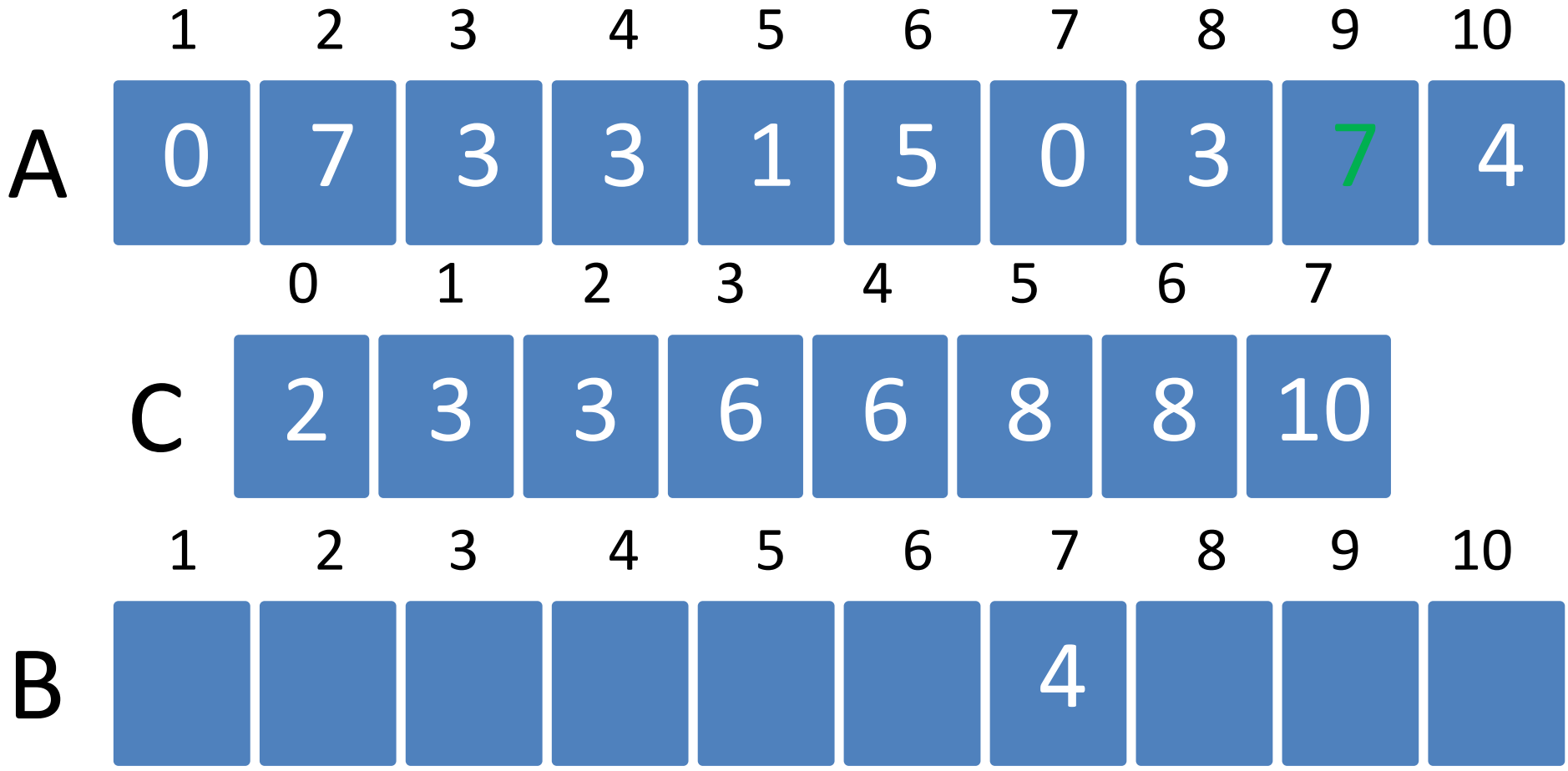

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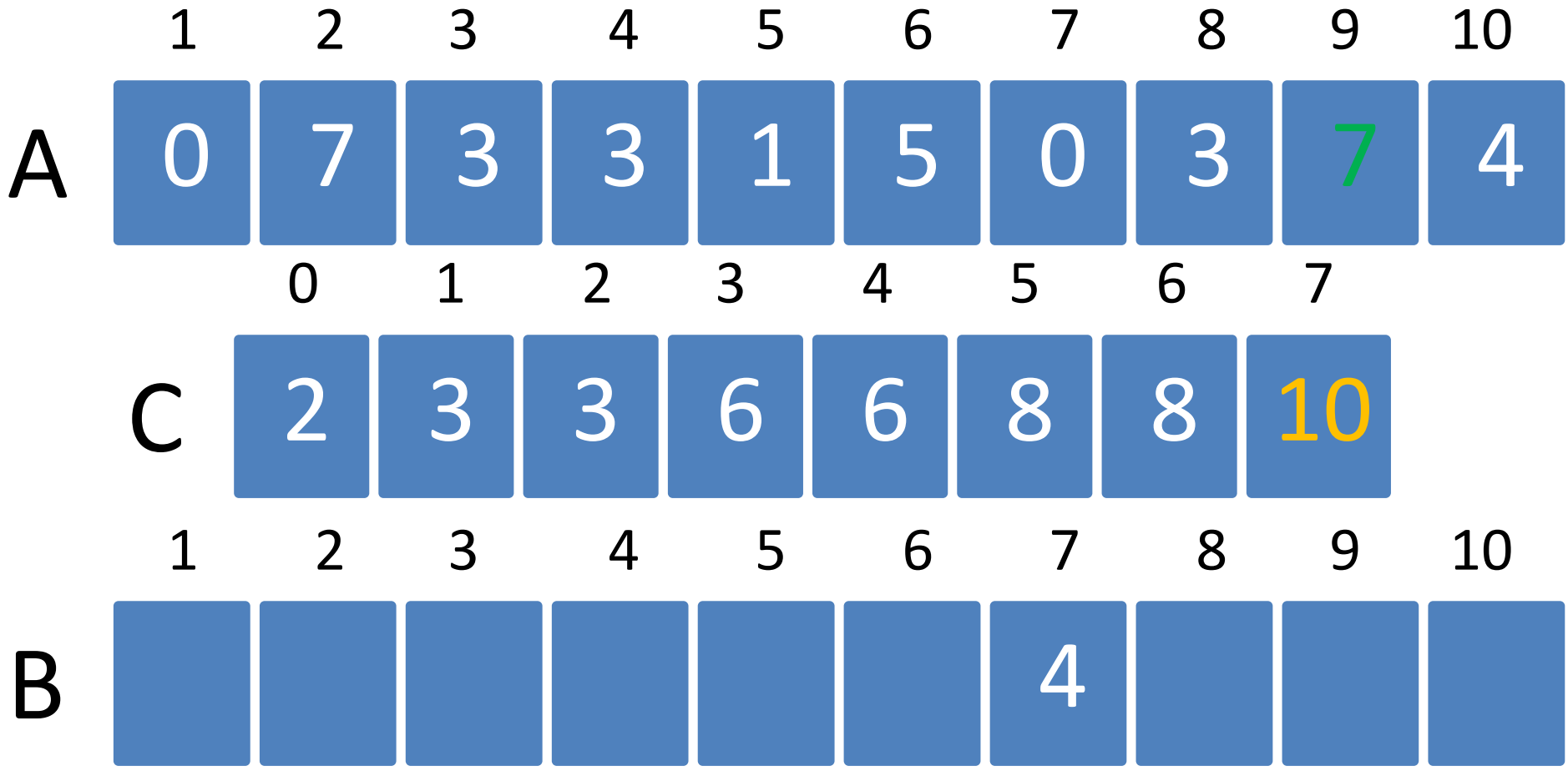

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C	2	3	3	6	6	8	8	10

	1	2	3	4	5	6	7	8	9	10
B							4			7

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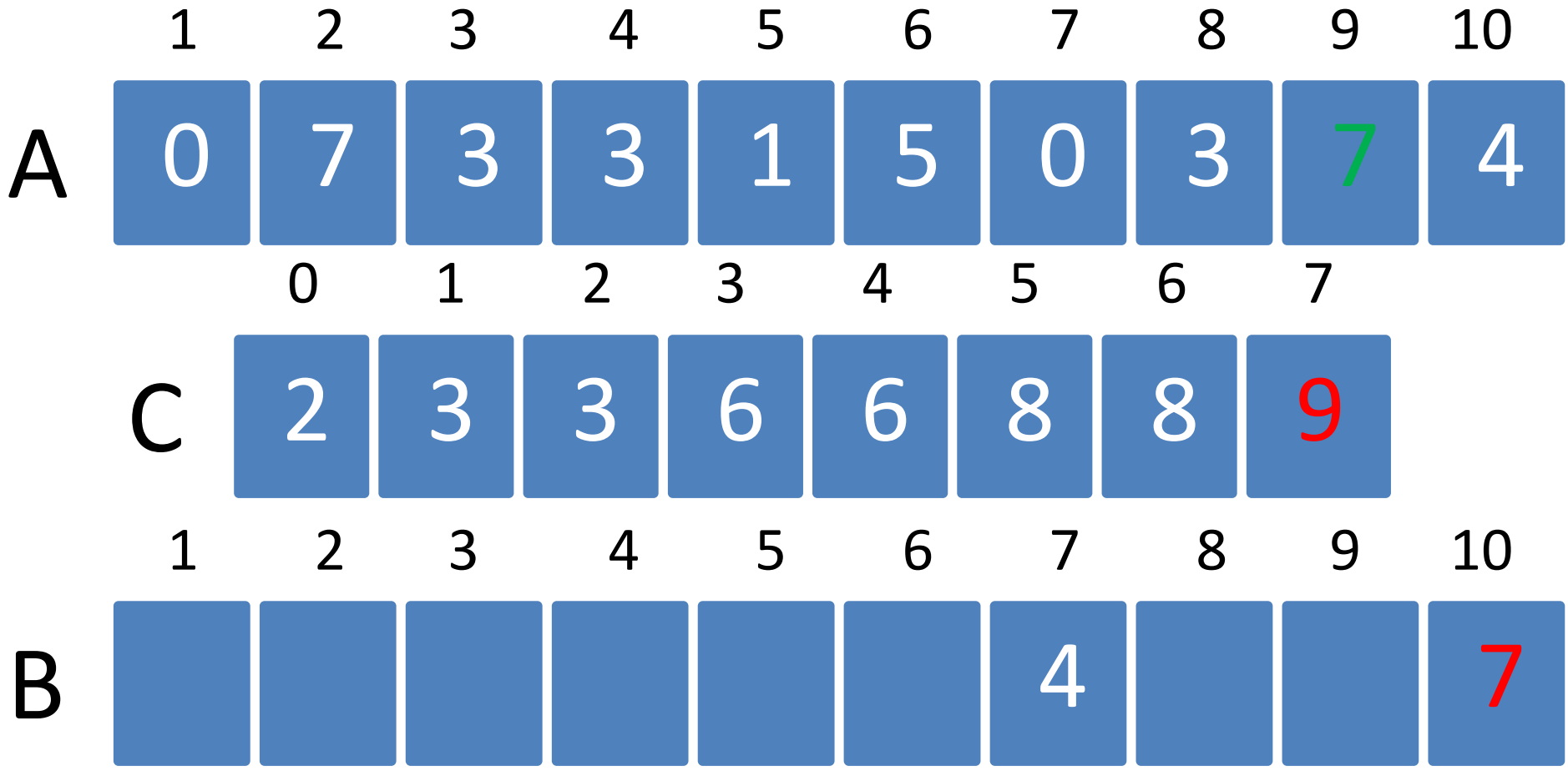

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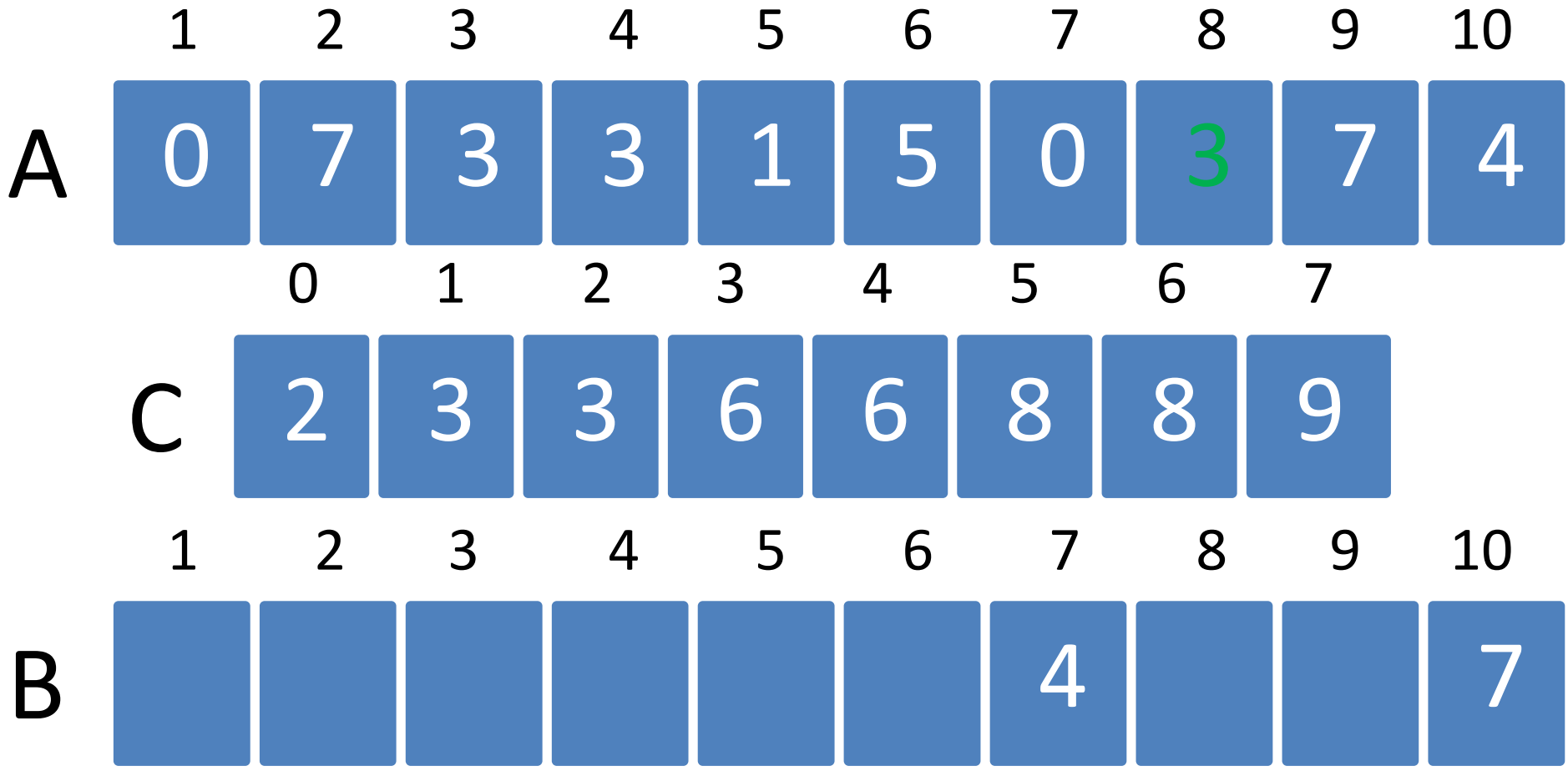

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	0	1	2	3	4	5	6	7
C	2	3	3	6	6	8	8	9

	1	2	3	4	5	6	7	8	9	10
B							4			7

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j = 8 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

	0	1	2	3	4	5	6	7
C	2	3	3	6	6	8	8	9

	1	2	3	4	5	6	7	8	9	10
B						3	4			7

```
9   // C[i] now contains the number of elements less than or equal to i.
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] − 1
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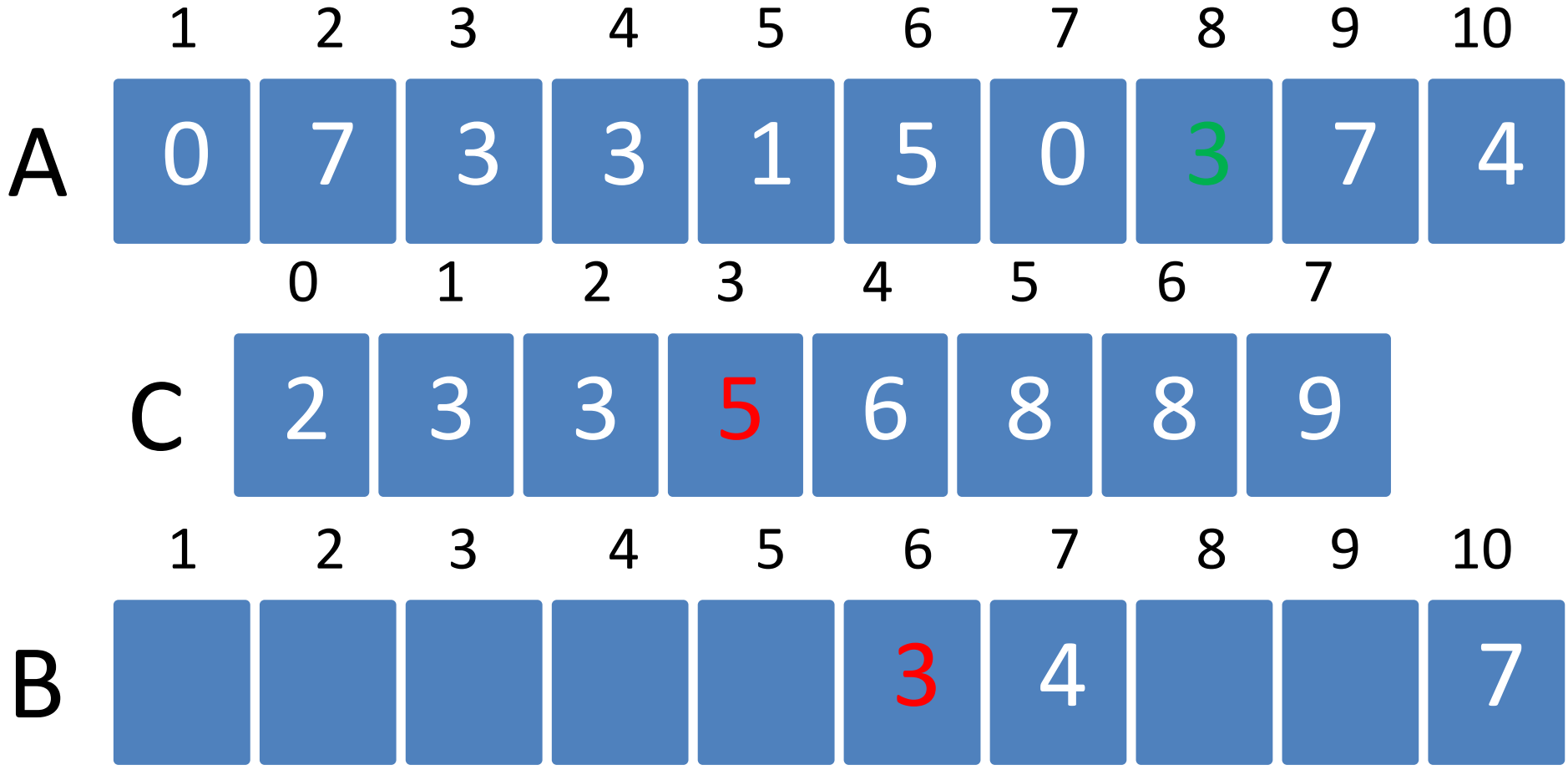
j = 8 A.length = 10



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9   // C[i] now contains the number of elements less than or equal to i.
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] − 1
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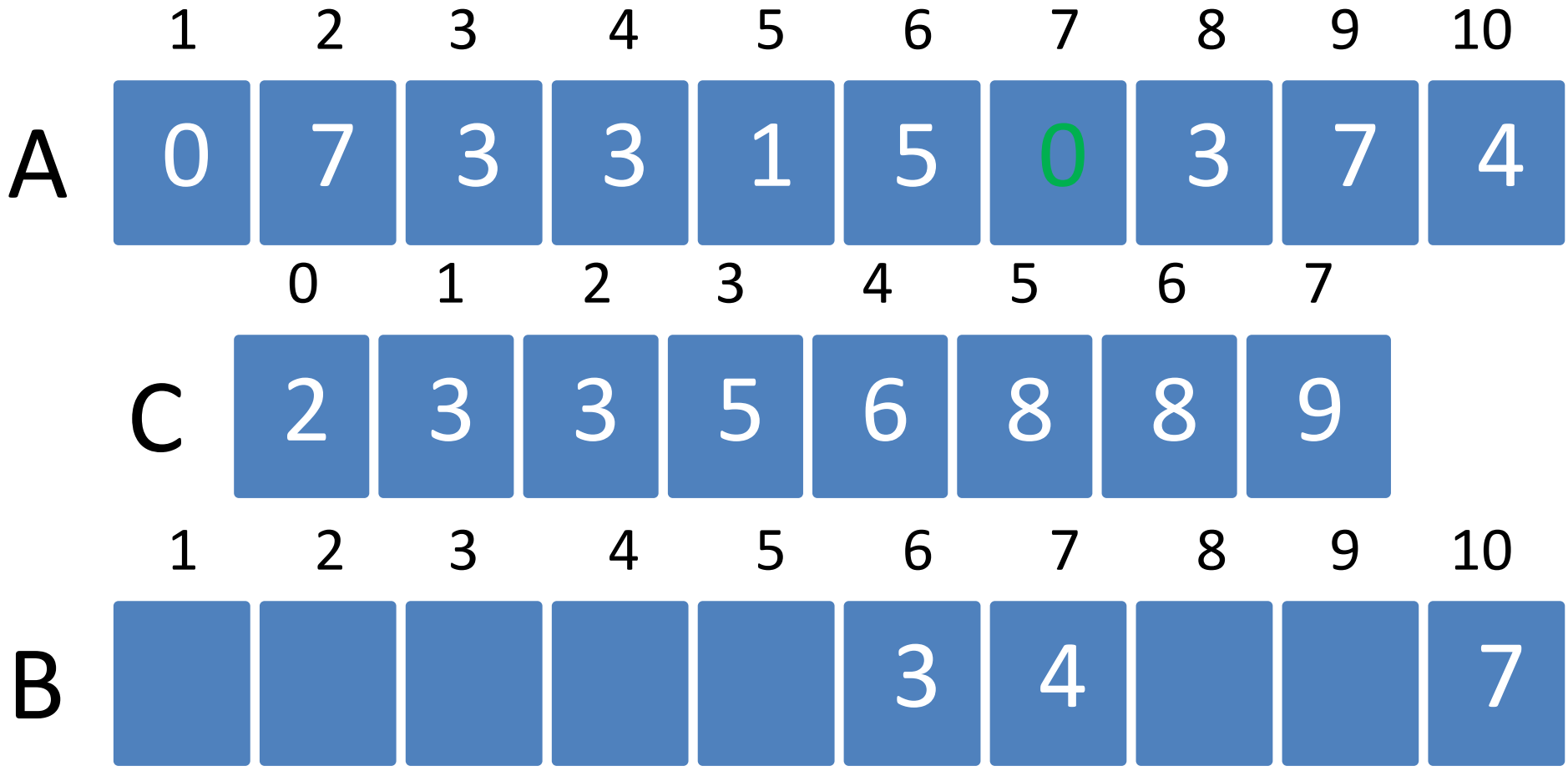
j = 7 A.length = 10



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9   // C[i] now contains the number of elements less than or equal to i.
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] - 1
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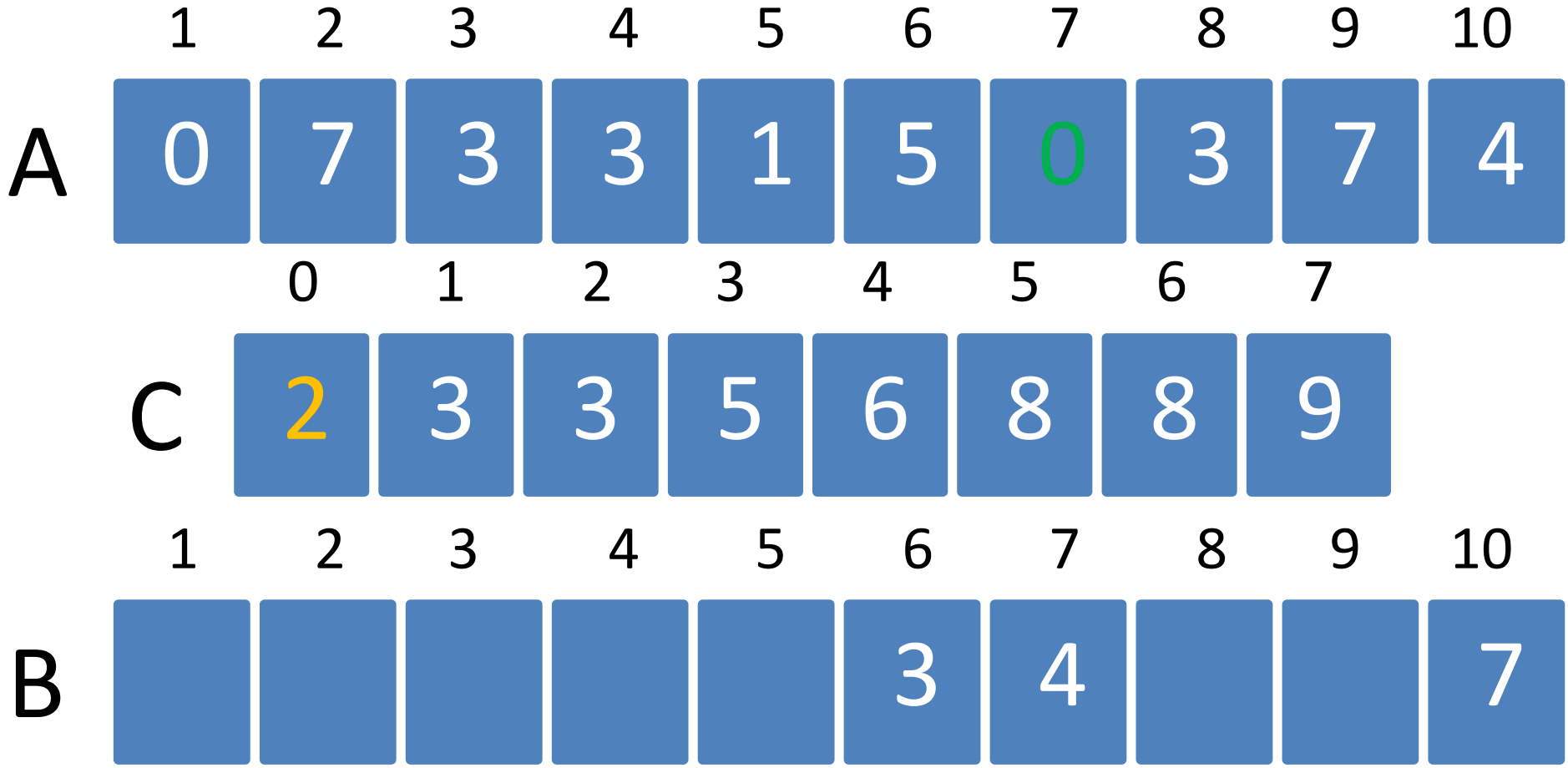
j = 7 A.length = 10



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11      B[C[A[j]]] = A[j]
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	0	1	2	3	4	5	6	7
C	2	3	3	5	6	8	8	9

	1	2	3	4	5	6	7	8	9	10
B		0				3	4			7

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	0	1	2	3	4	5	6	7
C	1	3	3	5	6	8	8	9

	1	2	3	4	5	6	7	8	9	10
B		0				3	4			7

```
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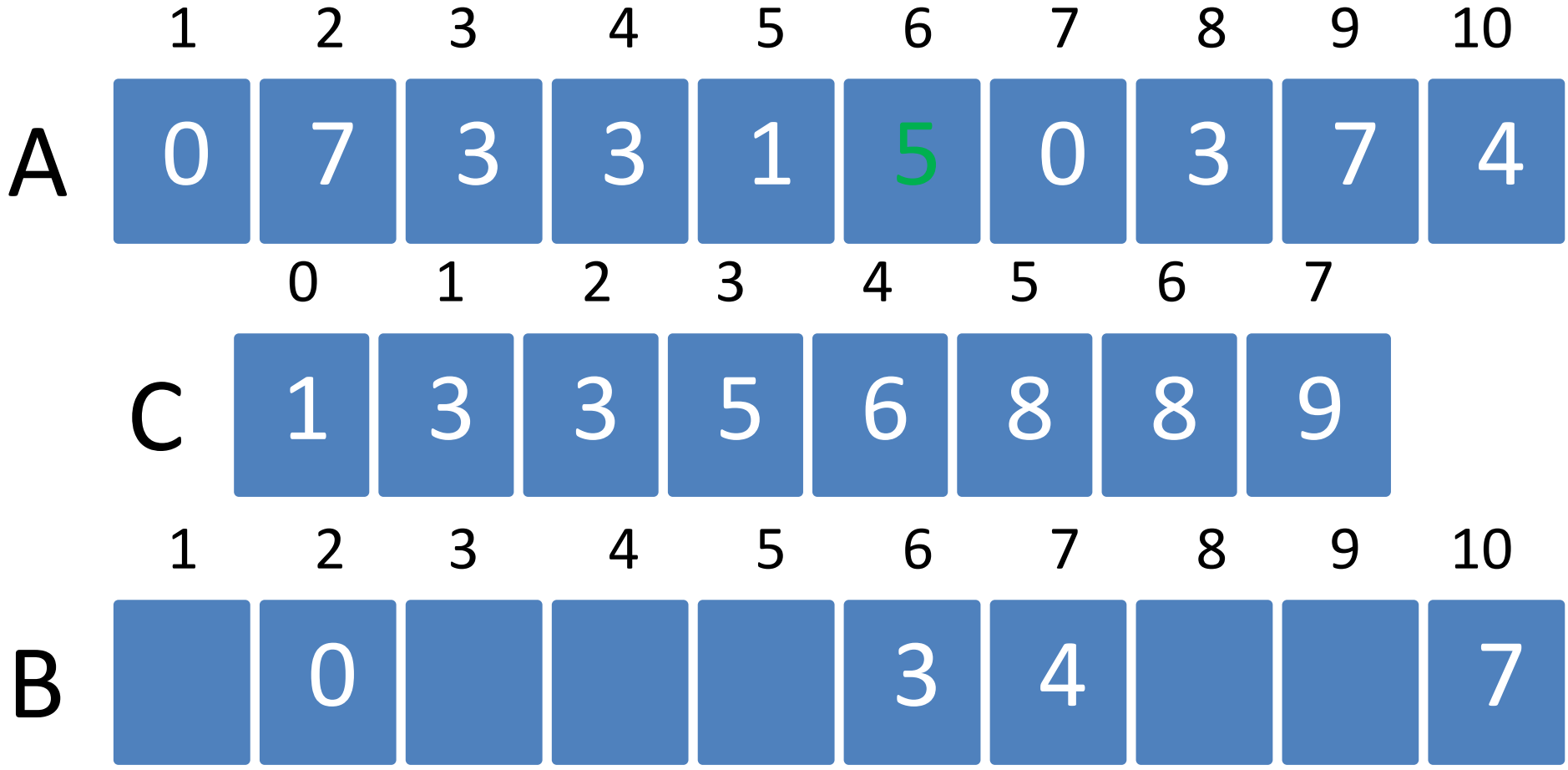
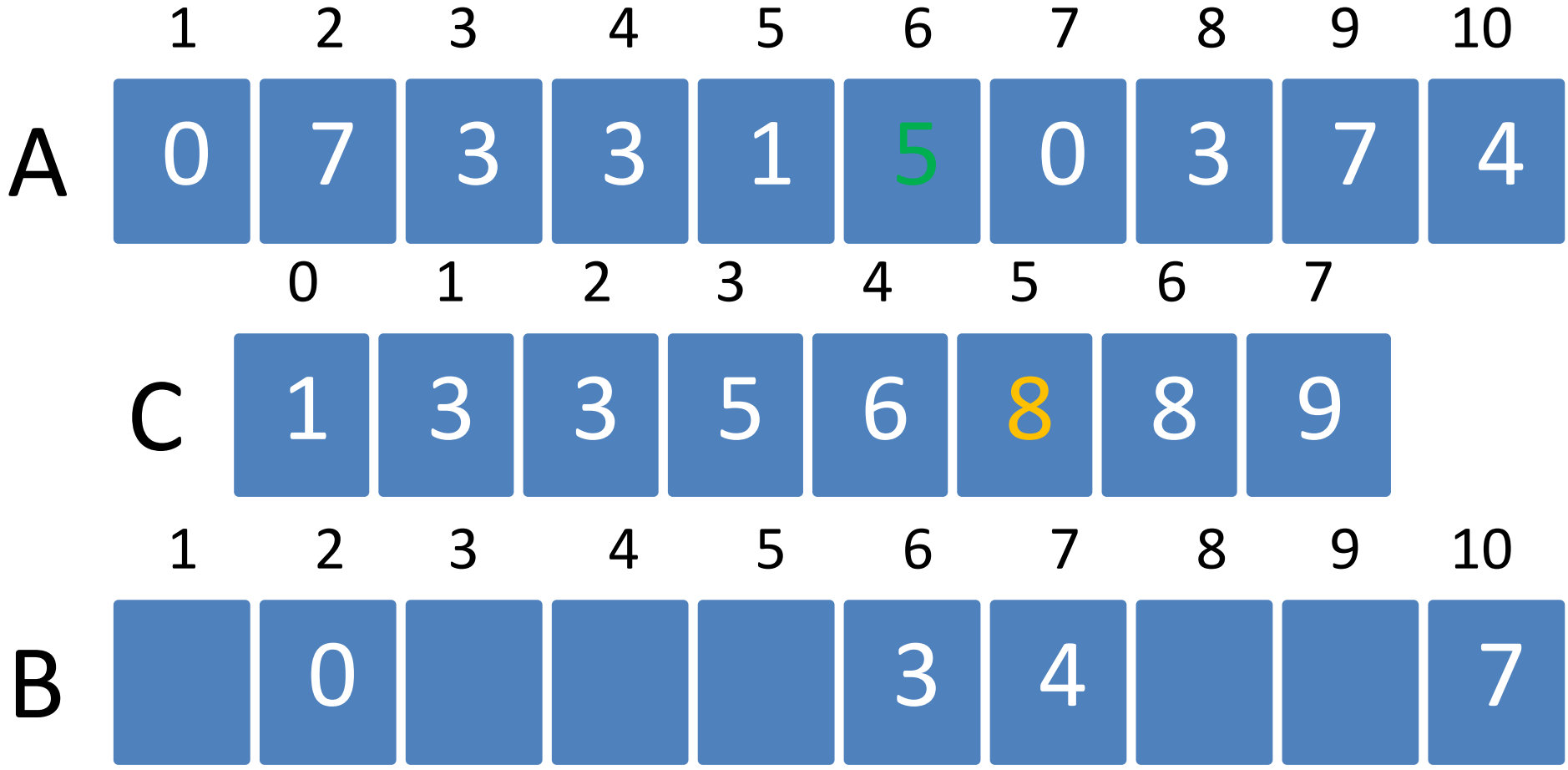
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] − 1
```

j = 6 A.length = 10



```
9   // C[i] now contains the number of elements less than or equal to i.
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] - 1
```

j = 6 A.length = 10



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9   // C[i] now contains the number of elements less than or equal to i.
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11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] - 1
```

j = 6 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

	0	1	2	3	4	5	6	7
C	1	3	3	5	6	8	8	9

	1	2	3	4	5	6	7	8	9	10
B		0				3	4	5		7

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	1	2	3	4	5	6	7	8	9	10
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	0	1	2	3	4	5	6	7
C	1	3	3	5	6	7	8	9

	1	2	3	4	5	6	7	8	9	10
B		0				3	4	5		7

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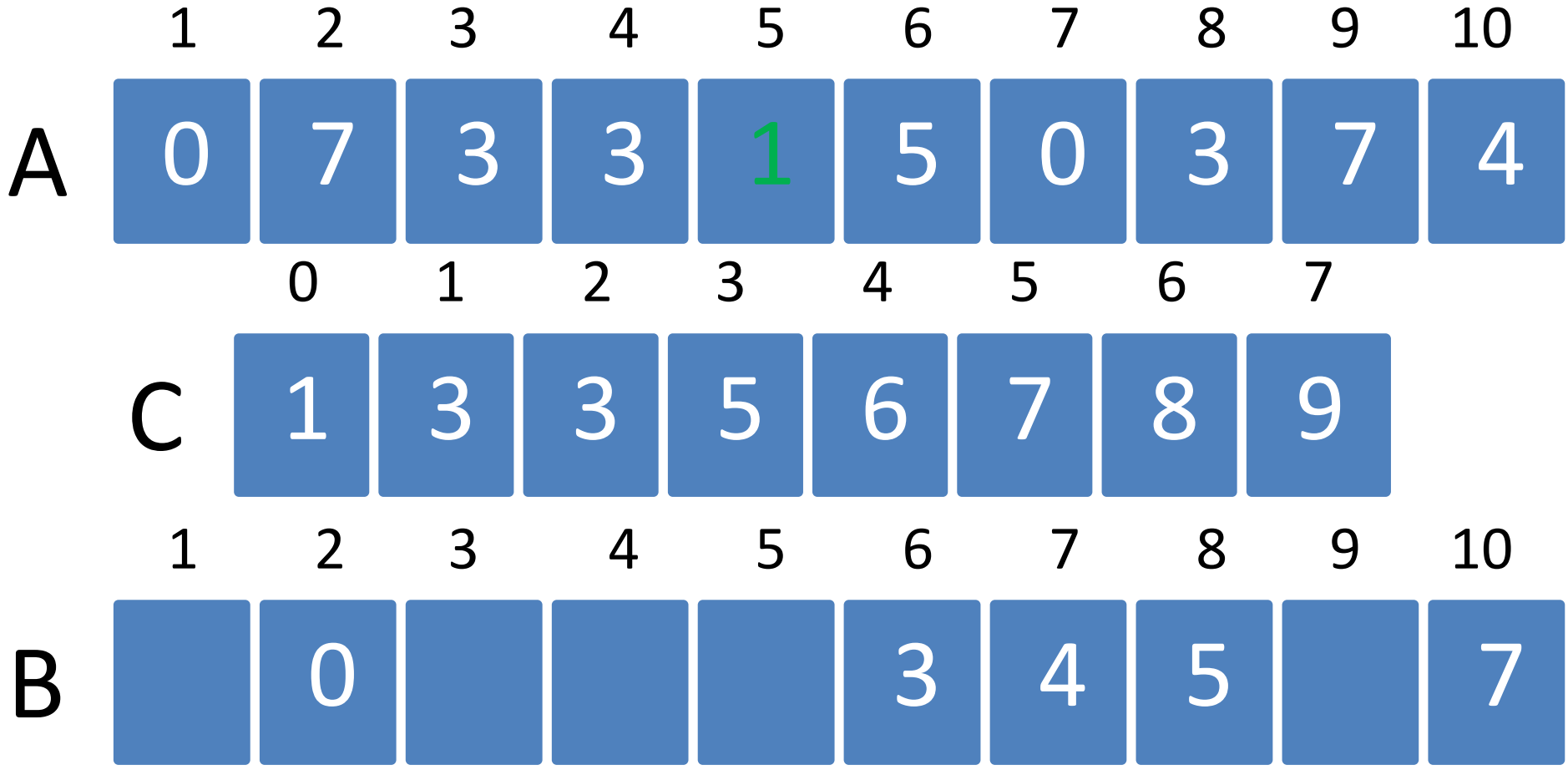
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] - 1
```

j = 5 A.length = 10



```
9   // C[i] now contains the number of elements less than or equal to i.
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] - 1
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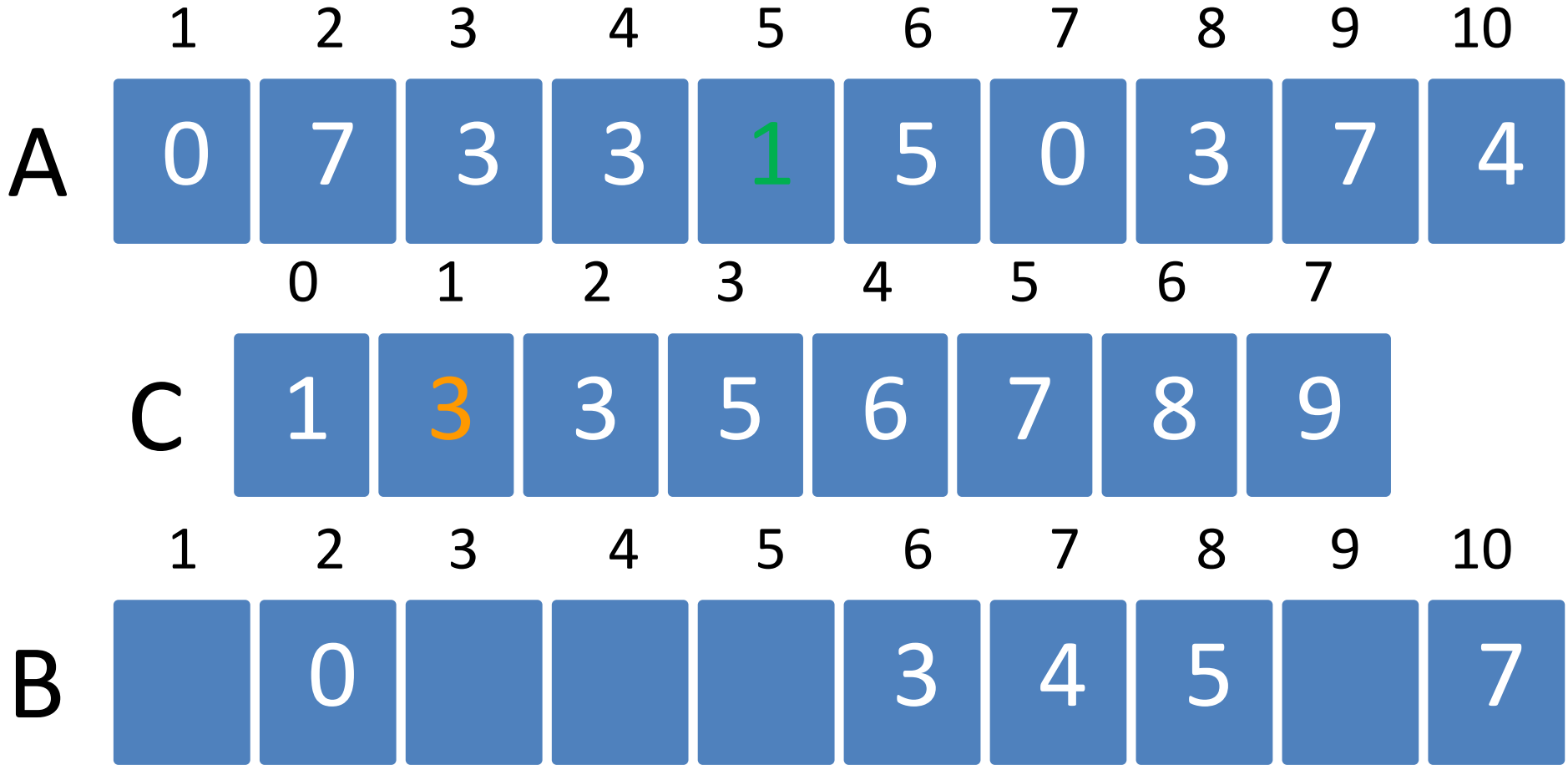

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11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] - 1
```

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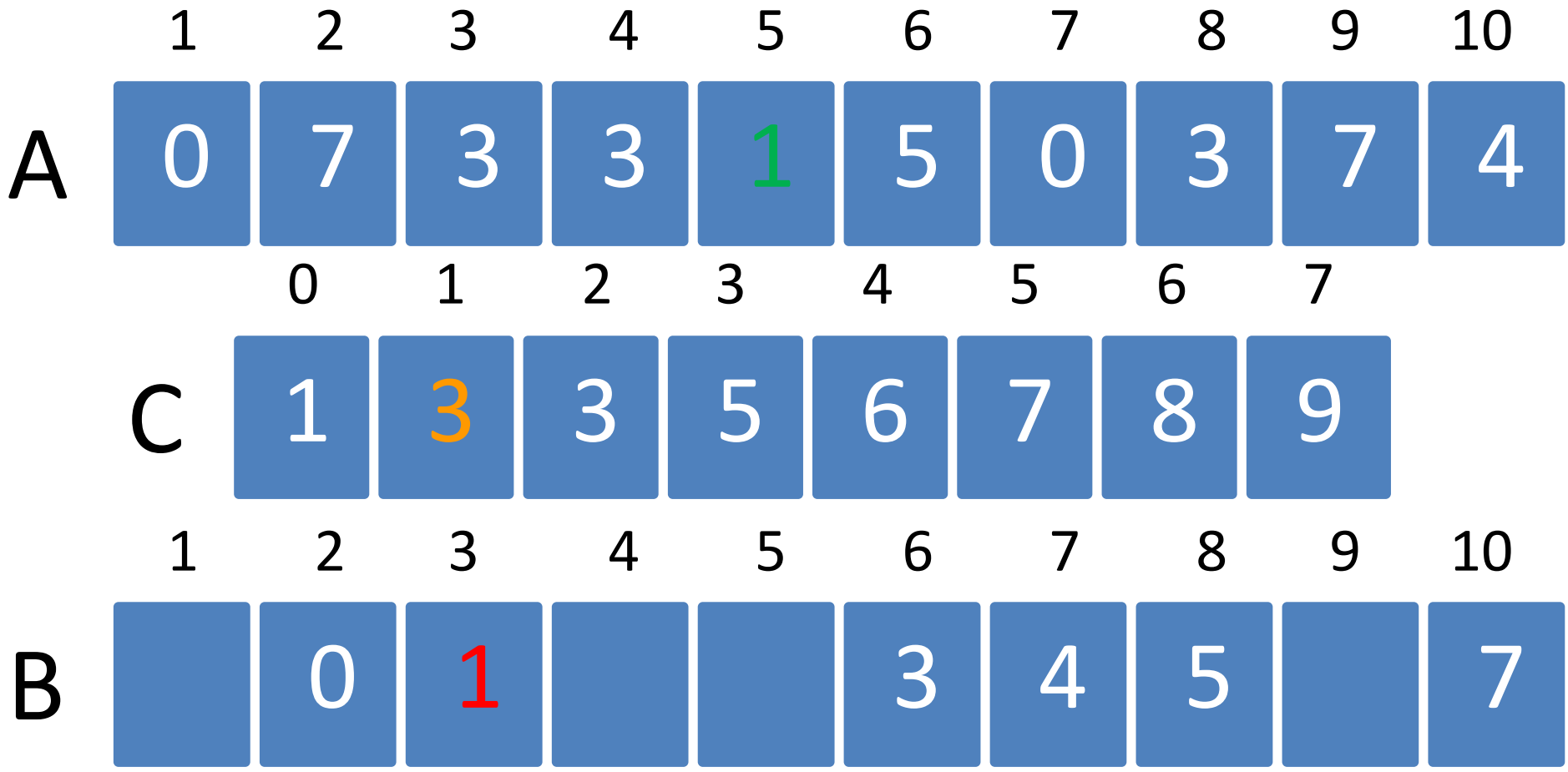

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	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

	0	1	2	3	4	5	6	7
C	1	2	3	5	6	7	8	9

	1	2	3	4	5	6	7	8	9	10
B		0	1			3	4	5		7

```
9   // C[i] now contains the number of elements less than or equal to i.
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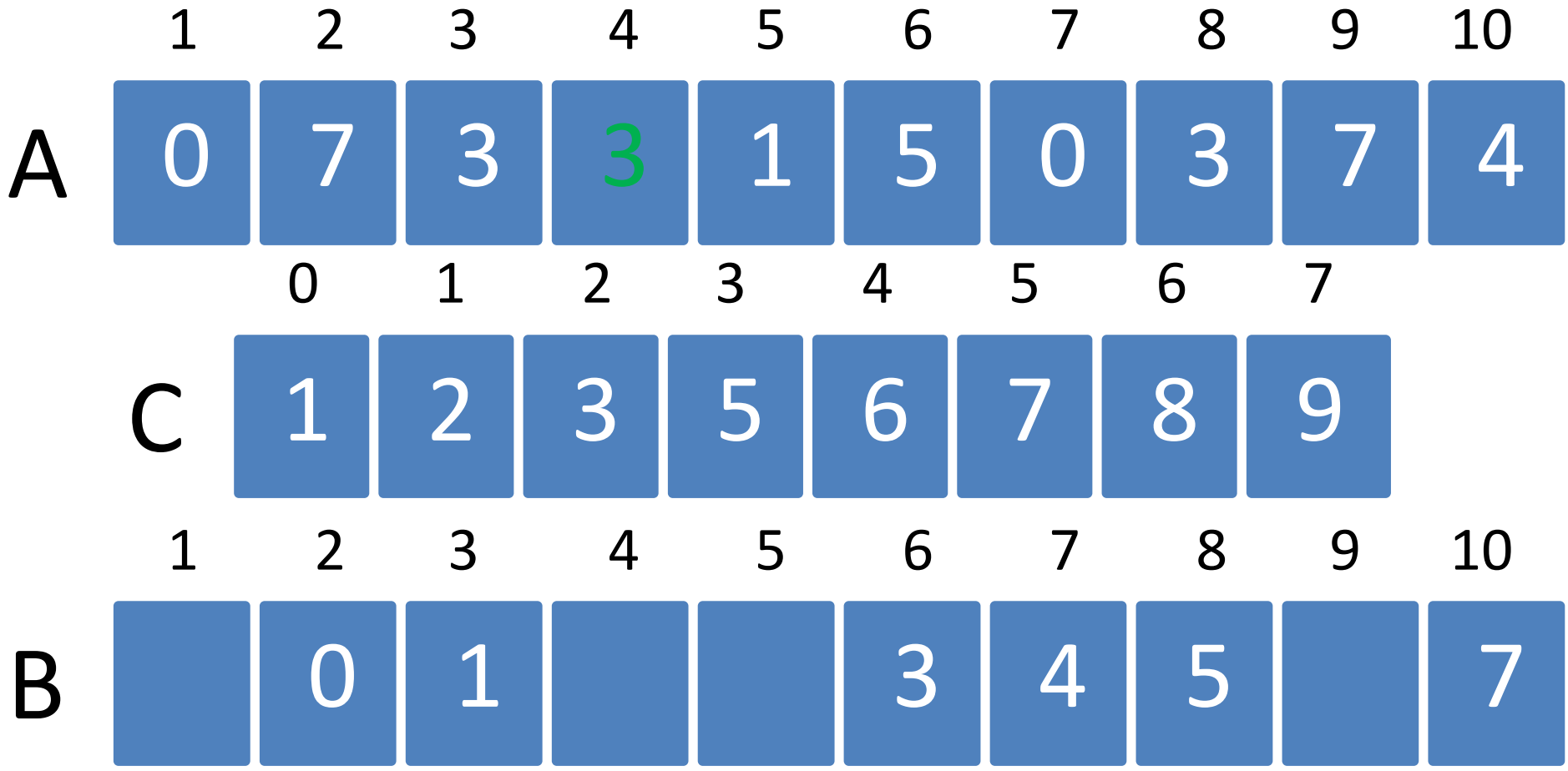
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] - 1
```

j = 4 A.length = 10



```
9   // C[i] now contains the number of elements less than or equal to i.
10  for j = A.length downto 1
11      B[C[A[j]]] = A[j]
12      C[A[j]] = C[A[j]] - 1
```

j = 4 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

	0	1	2	3	4	5	6	7
C	1	2	3	5	6	7	8	9

	1	2	3	4	5	6	7	8	9	10
B		0	1			3	4	5		7

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```

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	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

	0	1	2	3	4	5	6	7
C	1	2	3	5	6	7	8	9

	1	2	3	4	5	6	7	8	9	10
B		0	1		3	3	4	5		7

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	0	1	2	3	4	5	6	7
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	1	2	3	4	5	6	7	8	9	10
B		0	1		3	3	4	5		7

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```

j = 3 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

	0	1	2	3	4	5	6	7
C	1	2	3	4	6	7	8	9

	1	2	3	4	5	6	7	8	9	10
B		0	1		3	3	4	5		7

```
9   // C[i] now contains the number of elements less than or equal to i.
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	0	1	2	3	4	5	6	7
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	1	2	3	4	5	6	7	8	9	10
B		0	1		3	3	4	5		7

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	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

	0	1	2	3	4	5	6	7
C	1	2	3	4	6	7	8	9

	1	2	3	4	5	6	7	8	9	10
B		0	1	3	3	3	4	5		7

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

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10  for j = A.length downto 1
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12      C[A[j]] = C[A[j]] - 1
```

j = 2 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

	0	1	2	3	4	5	6	7
C	1	2	3	3	6	7	8	9

	1	2	3	4	5	6	7	8	9	10
B		0	1	3	3	3	4	5		7

```
9   // C[i] now contains the number of elements less than or equal to i.
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	1	2	3	4	5	6	7	8	9	10
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	0	1	2	3	4	5	6	7
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	1	2	3	4	5	6	7	8	9	10
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```

j = 1 A.length = 10

	1	2	3	4	5	6	7	8	9	10
A	0	7	3	3	1	5	0	3	7	4

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

	1	2	3	4	5	6	7	8	9	10
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	0	1	2	3	4	5	6	7
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	1	2	3	4	5	6	7	8	9	10
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	0	1	2	3	4	5	6	7
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	1	2	3	4	5	6	7	8	9	10
B	0	0	1	3	3	3	4	5	7	7