합병정렬(merge sort)

한컴에듀케이션
이주현

Merge Sort

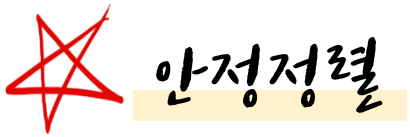
- 폰 노이만(John von Neumann)이 1945년 개발.
- 원소들 간의 비교를 통하여 정렬하는 **비교기반정렬** 알고리즘.
- 원소들 중에 같은 값이 있는 경우 정렬 후에도
  이들의 순서가 유지되는 **안정 정렬**에 속한다.
- 정렬의 과정은 분할 -> 정복 -> 합병(결합) -> 복사로 이루어진다.
  대표적인 분할 정복 알고리즘의 한 예이다.
- N개의 데이터를 정렬할 때, **시간복잡도는 O(N * logN)이 보장**된다.
- 데이터가 배열에 저장된 경우 N크기의 추가적인 배열이 필요하다.

Merge Sort

폰노이만(John von Neumann)

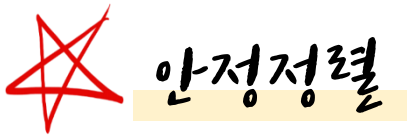
- 수학자, 물리학자, 발명가, 컴퓨터 공학자.
- 20세기의 수학자들 가운데 가장 중요한 인물로 거론되는 인물.
  인류사가 시작된 이래 가장 위대한 천재중 하나로, 당대 그 어떤 수학자도 폰 노이만을 능가하는 자가 없었을 정도였다.
- **폰 노이만 구조** : 현재와 같은 CPU, 메모리, 프로그램 구조를 갖는 범용 컴퓨터 구조의 확립.
- 게임이론의 창시자.
- 1903/12/28 ~ 1957/2/18 (향년 53년 52일)
- 헝가리 -> 미국

Merge Sort



이름	과목 수
Neumann	4
Turing	1
Euler	3
Gauss	1
Archimedes	5
Knuth	2
Newton	3

Merge Sort



과목수가 같은 경우 초기 순서를 유지하고 있다.

이름	과목 수
Neumann	4
Turing	1
Euler	3
Gauss	1
Archimedes	5
Knuth	2
Newton	3

과목수의 오름차순 정렬 후

이름	과목 수
Turing	**1**
Gauss	**1**
Knuth	2
Euler	**3**
Newton	**3**
Neumann	4
Archimedes	5

Merge Sort

정렬과정

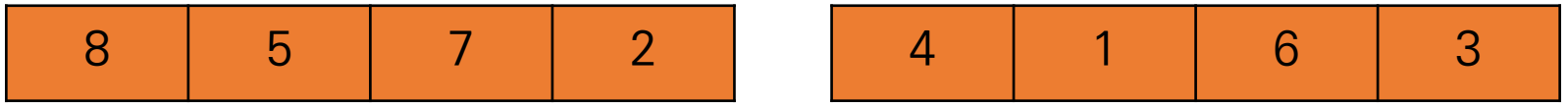
초기 배열

Merge Sort

정렬과정

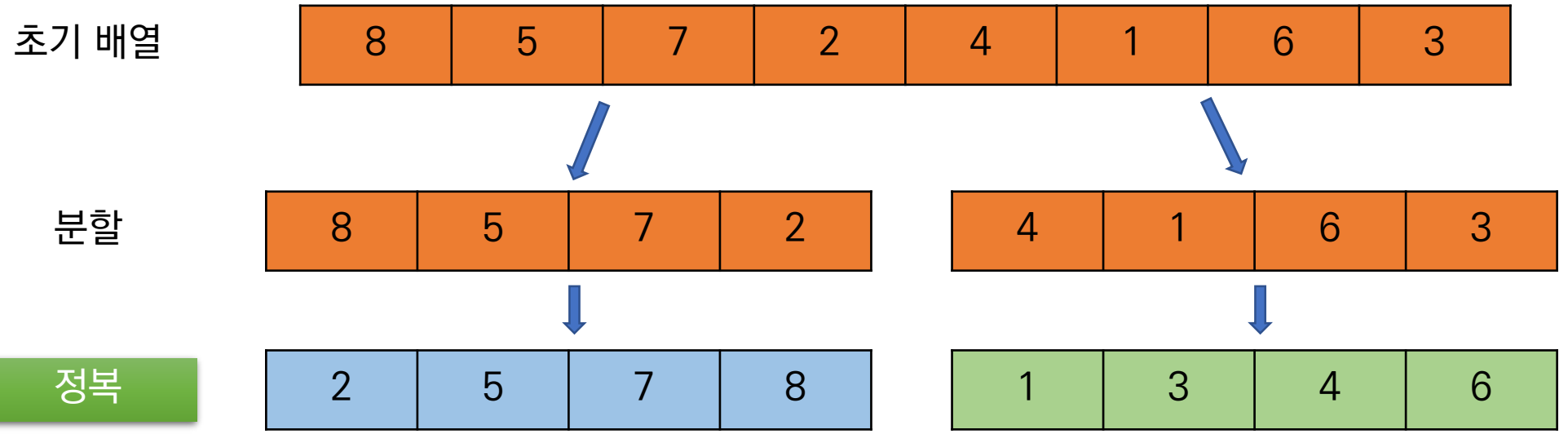
초기 배열

분할



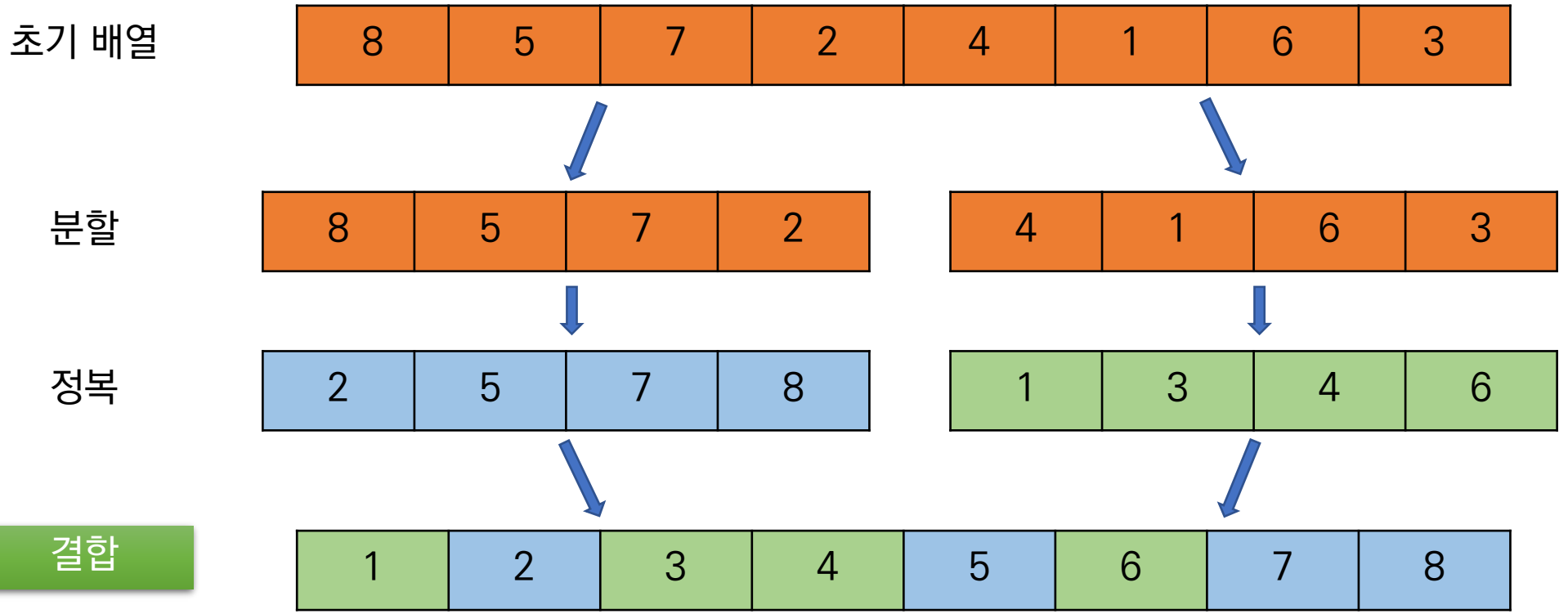
Merge Sort

정렬과정



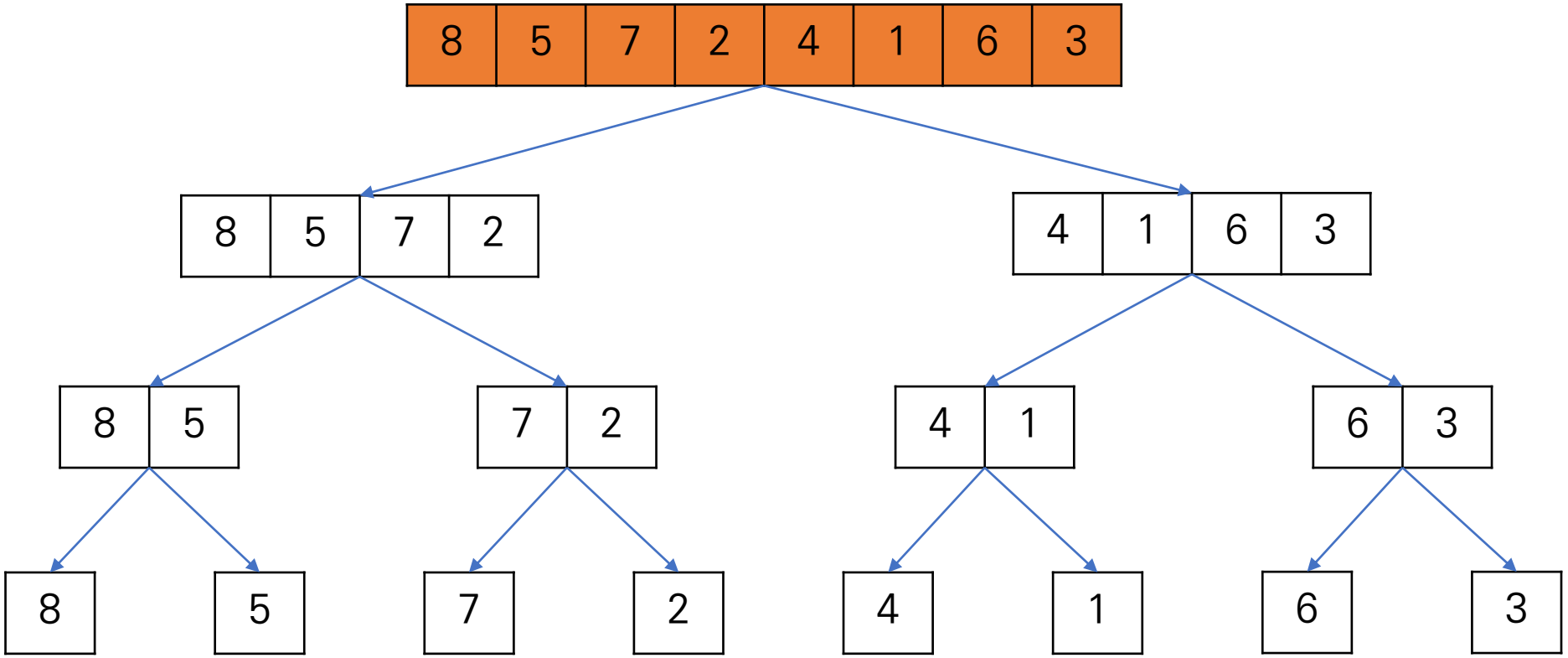
Merge Sort

정렬과정



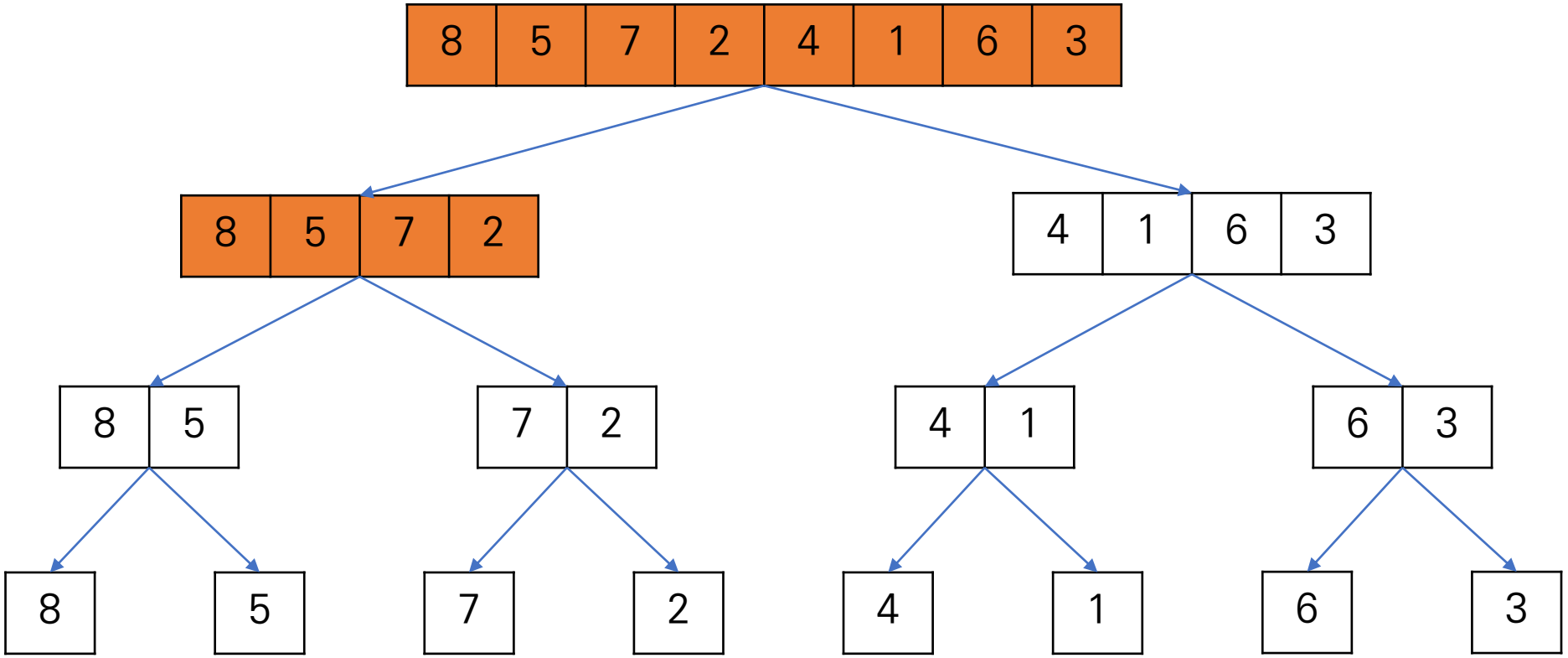
Merge Sort

정렬과정



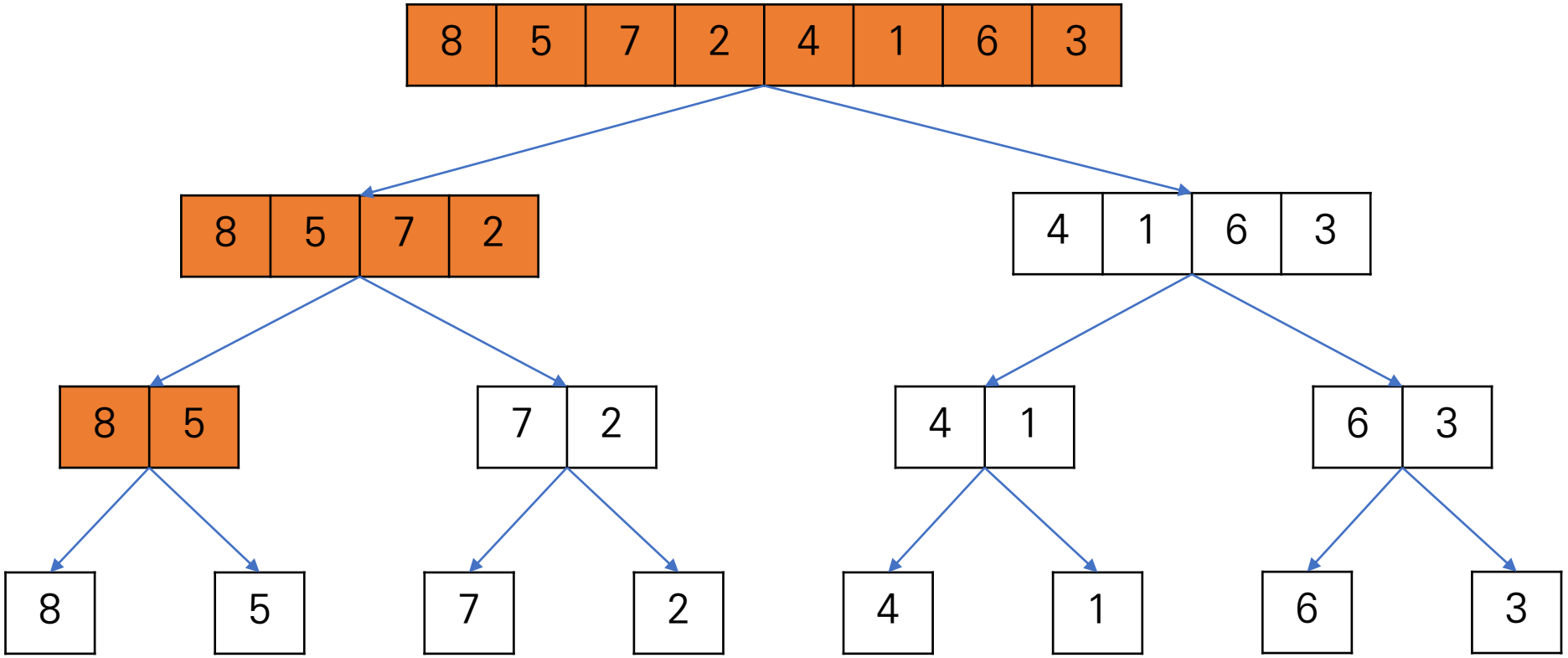
Merge Sort

정렬과정



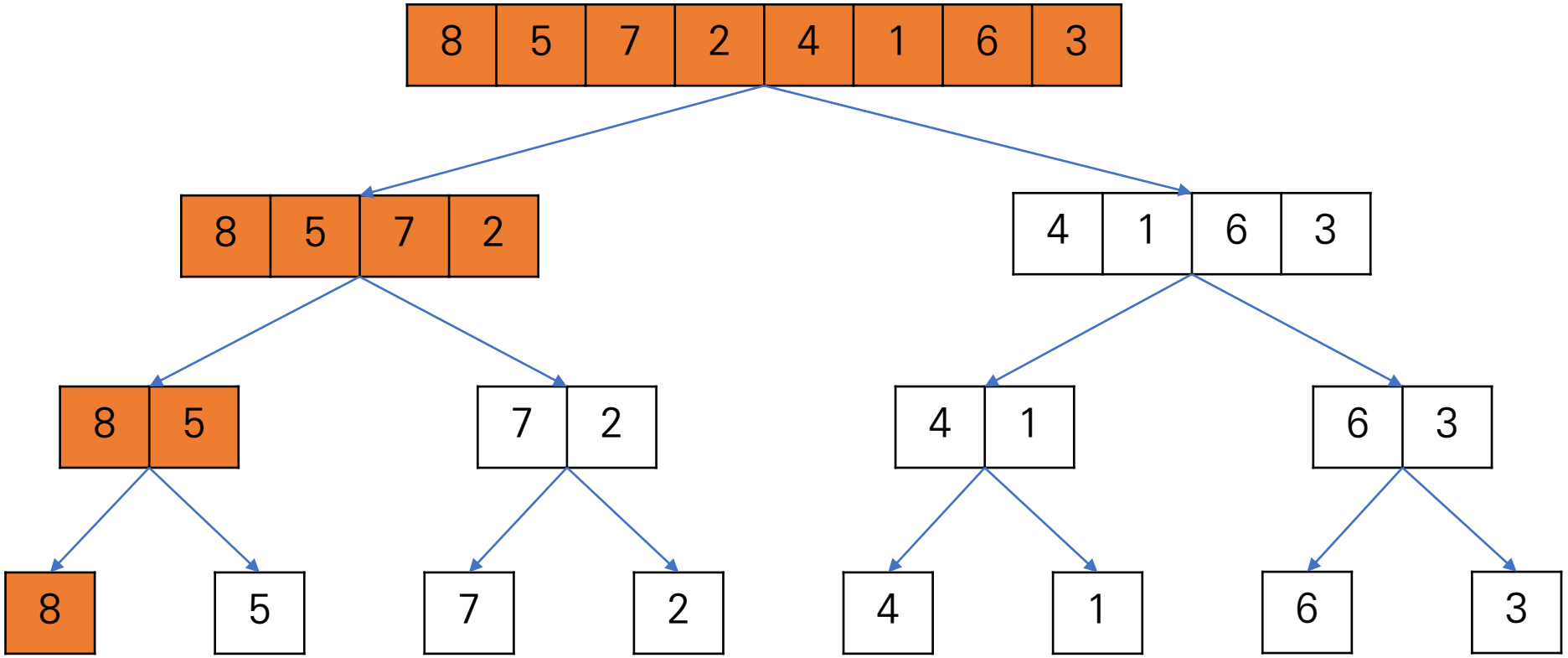
Merge Sort

정렬과정



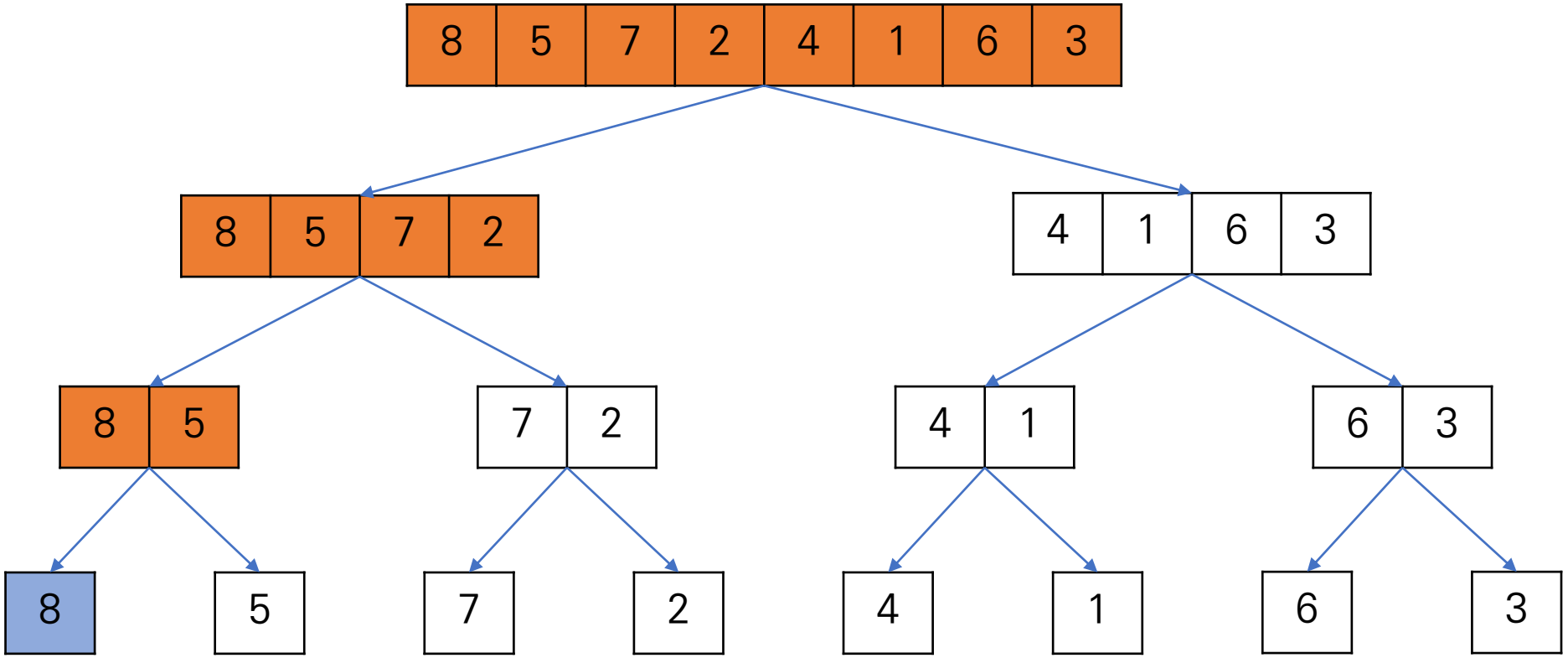
Merge Sort

정렬과정



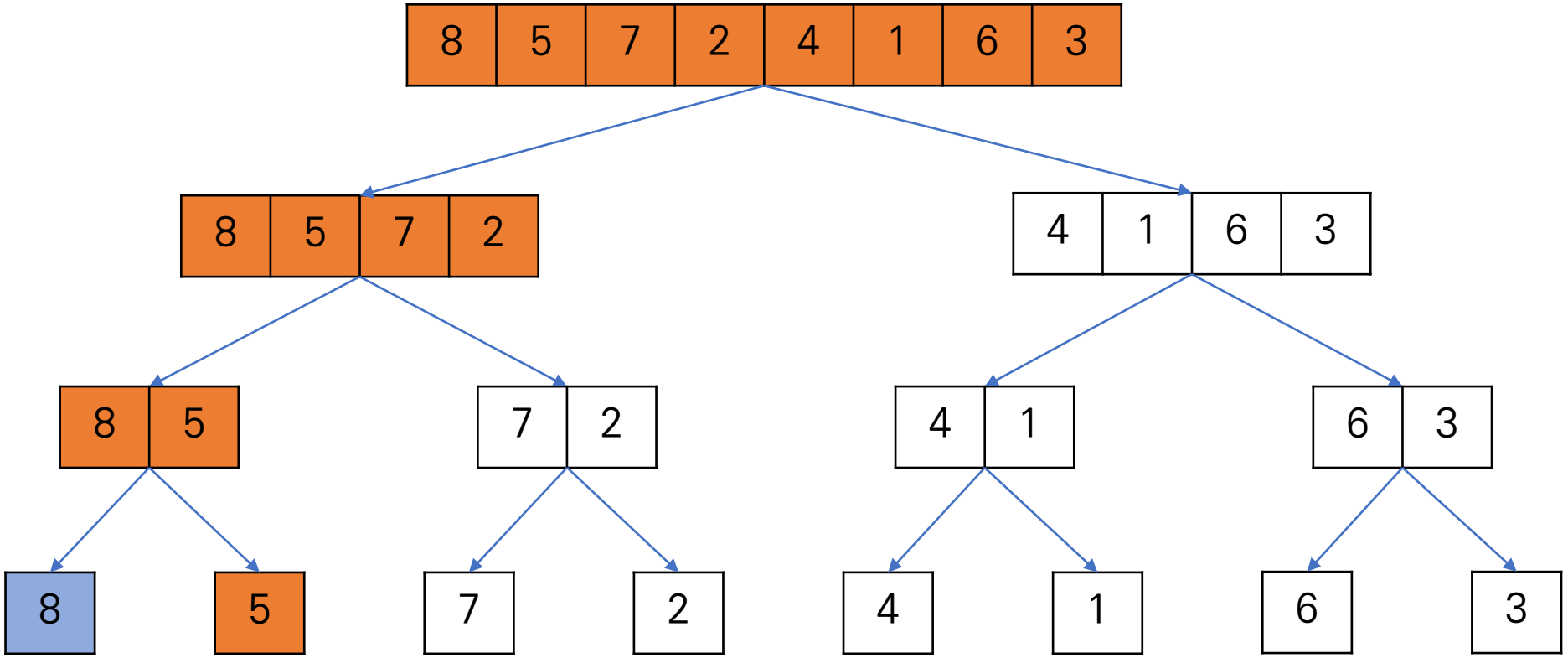
Merge Sort

정렬과정



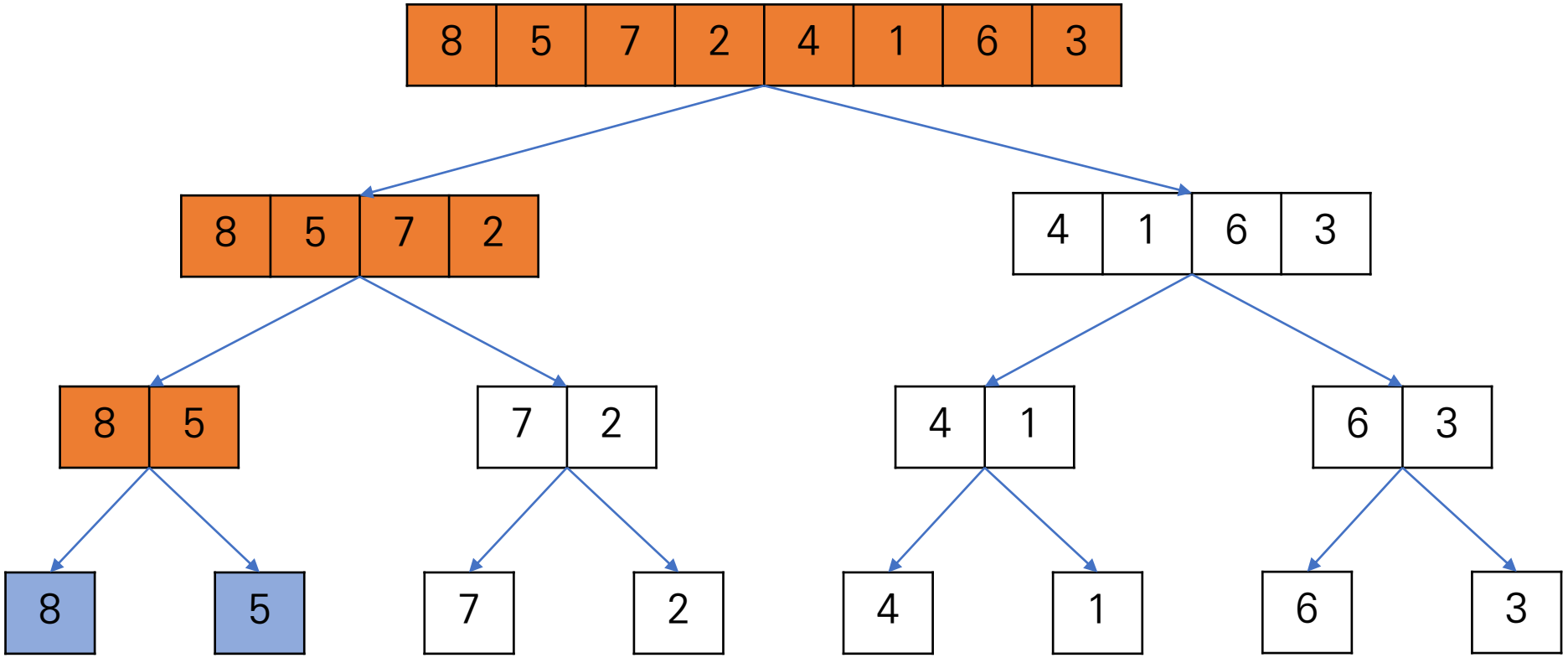
Merge Sort

정렬과정



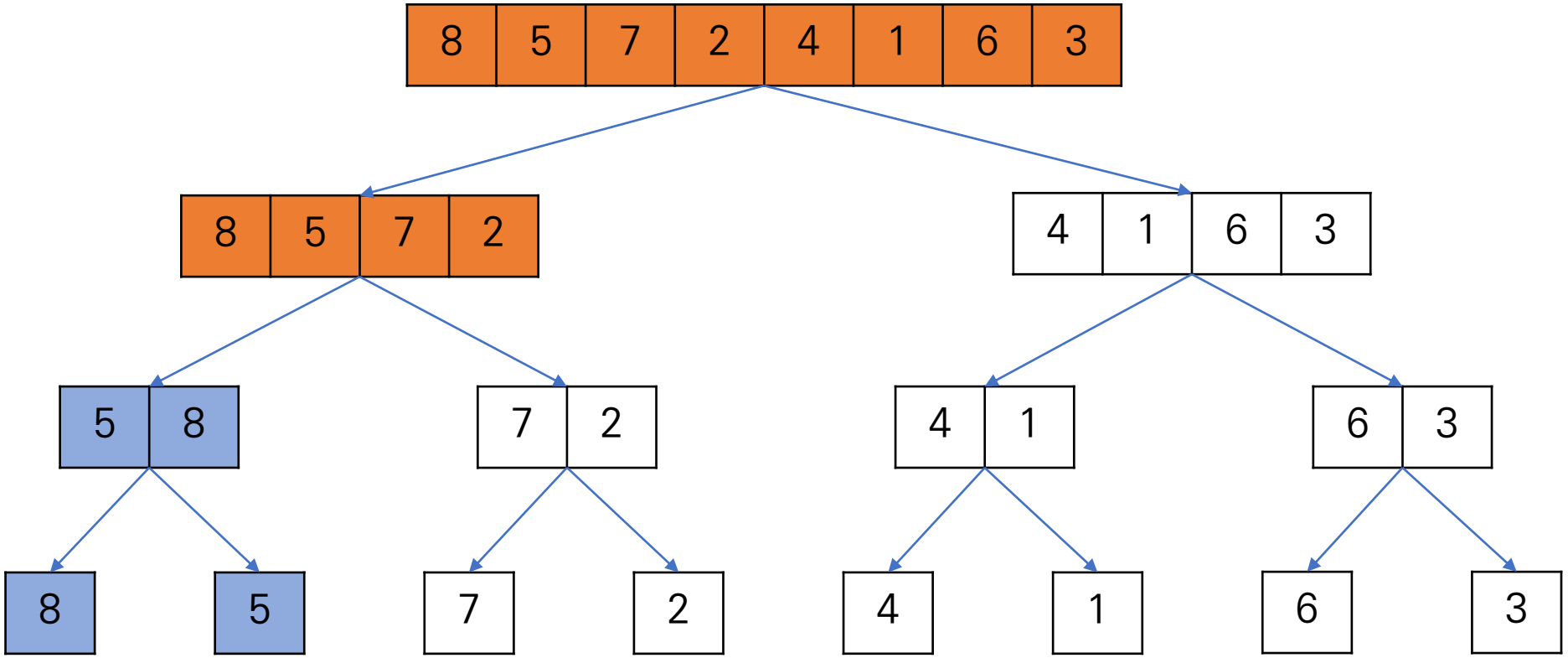
Merge Sort

정렬과정



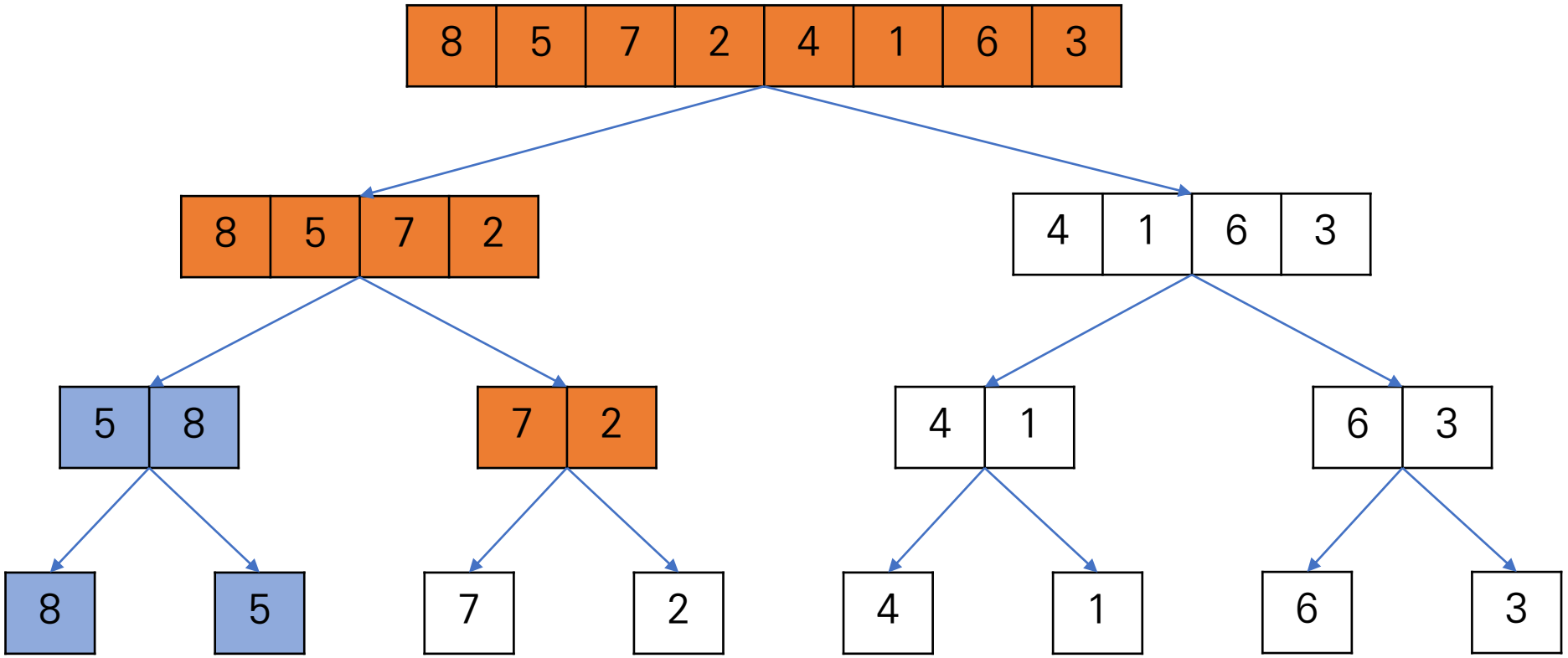
Merge Sort

정렬과정



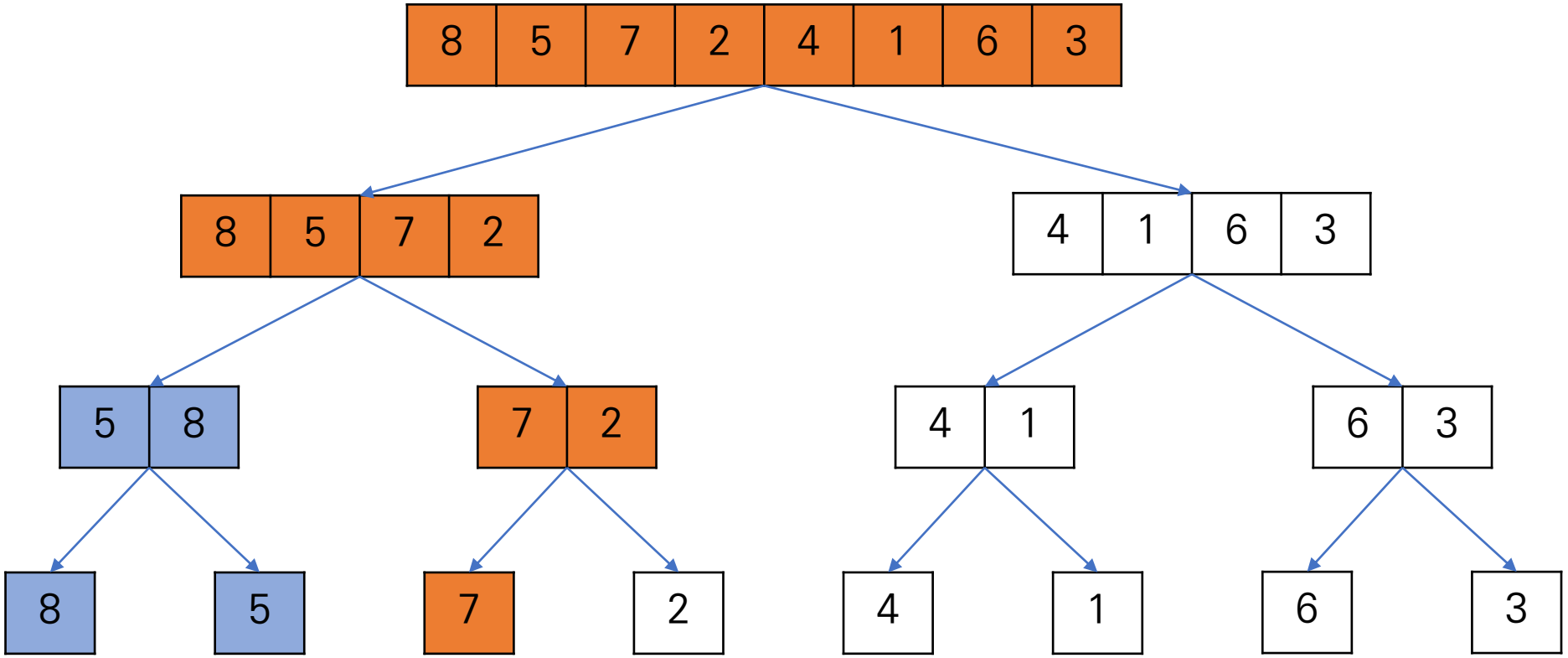
Merge Sort

정렬과정



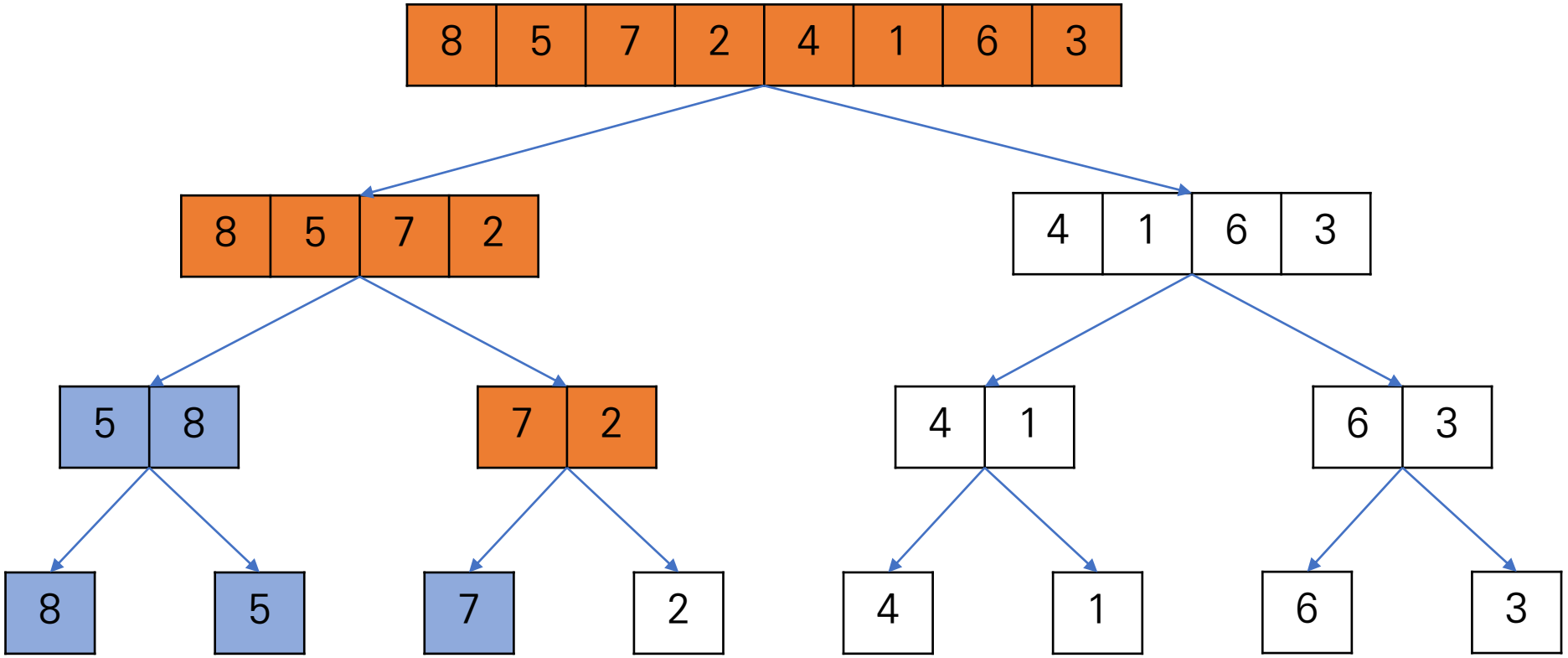
Merge Sort

정렬과정



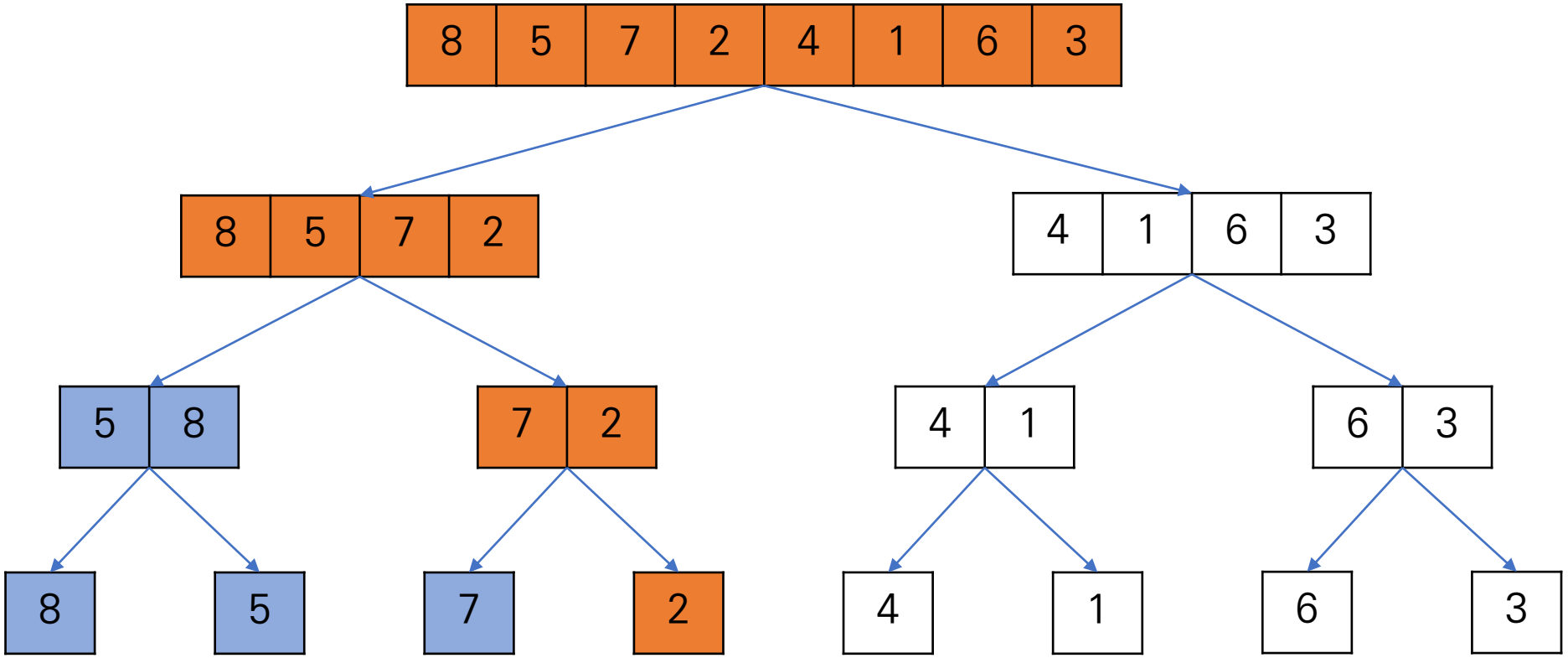
Merge Sort

정렬과정



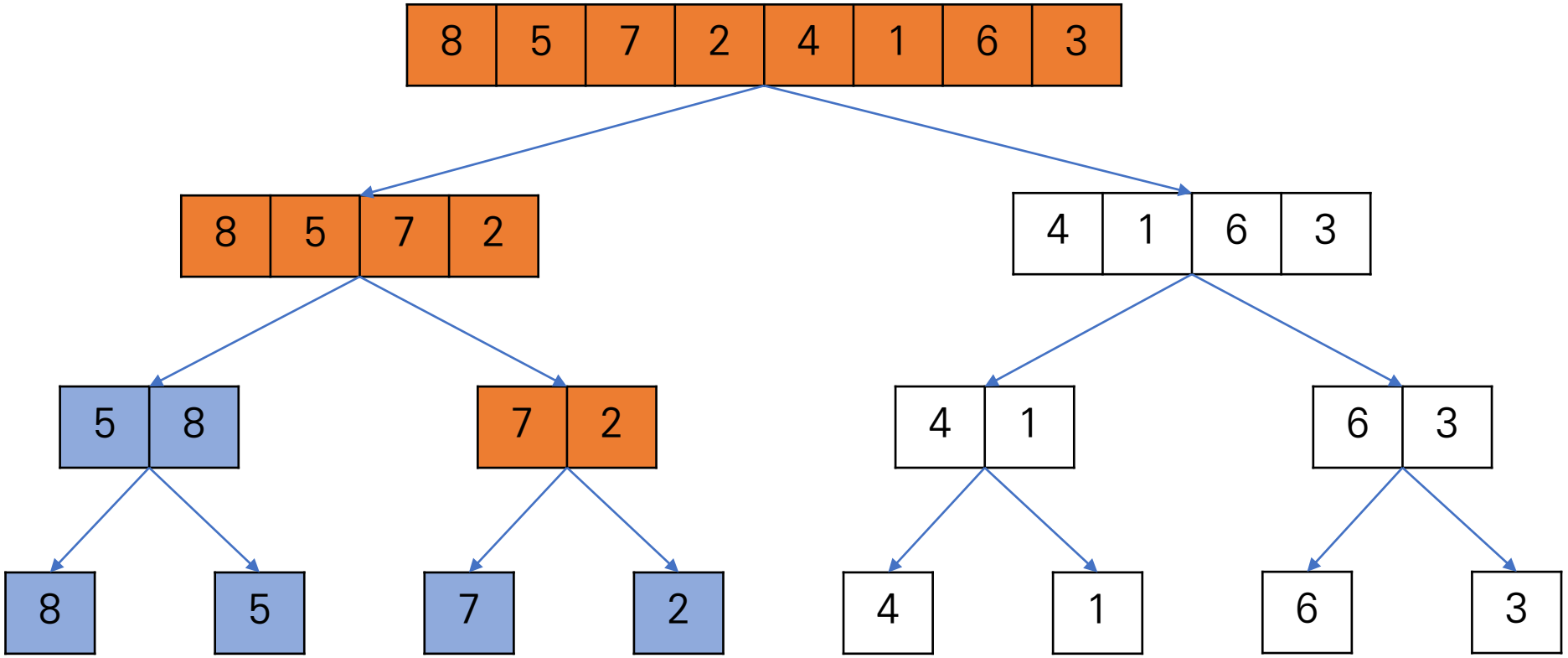
Merge Sort

정렬과정



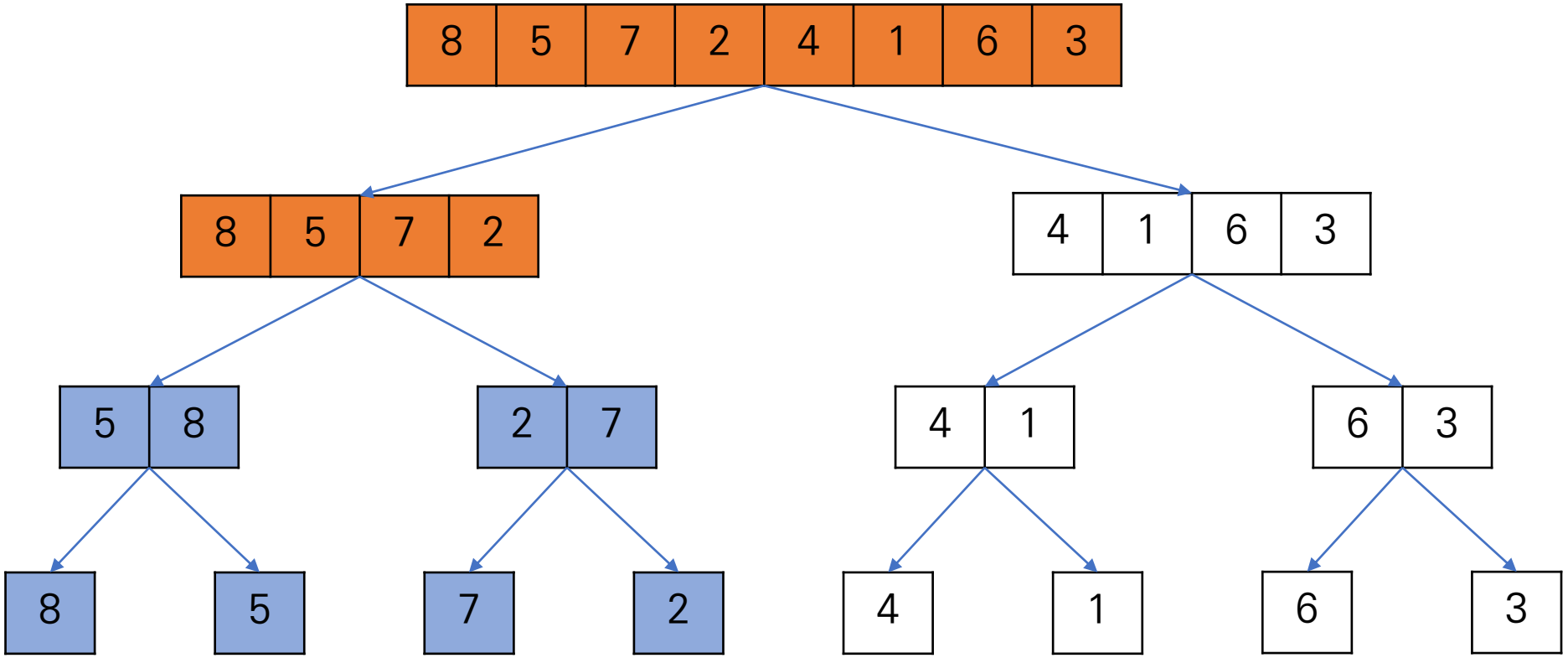
Merge Sort

정렬과정



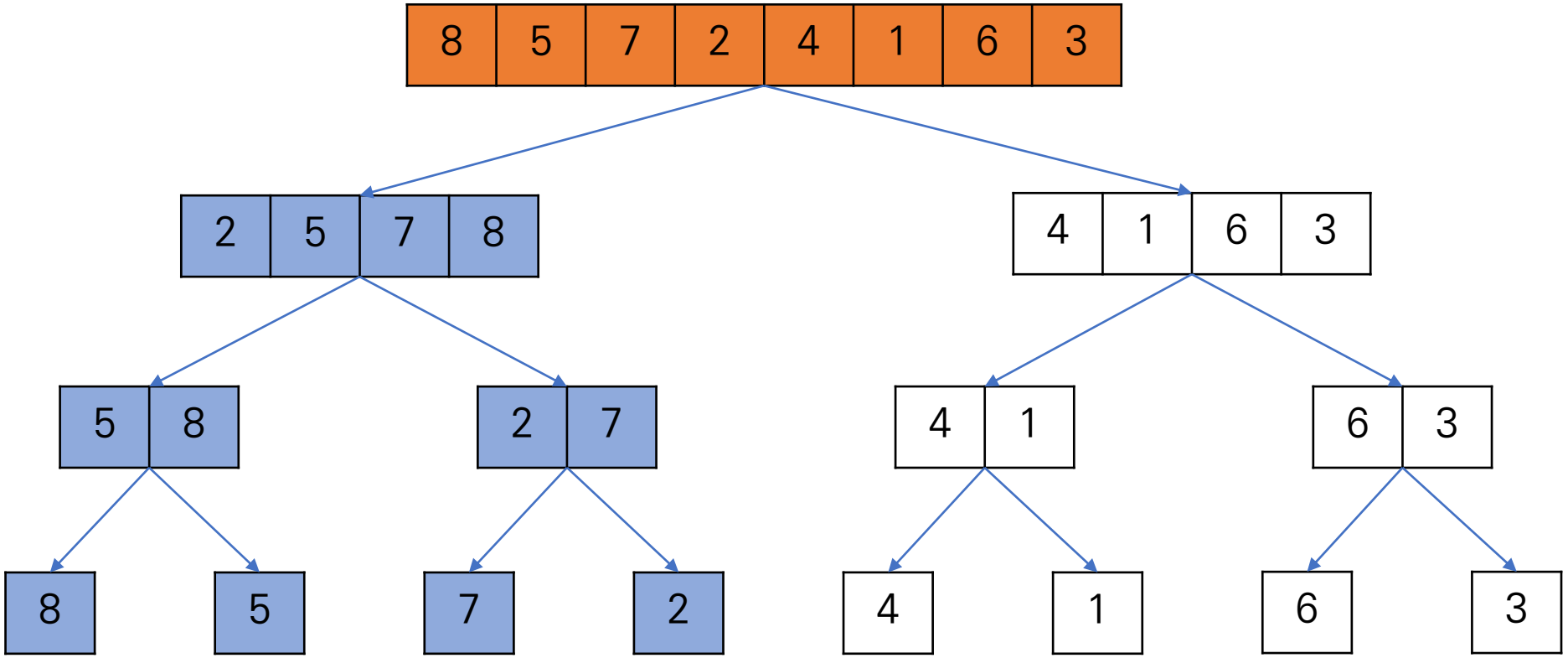
Merge Sort

정렬과정



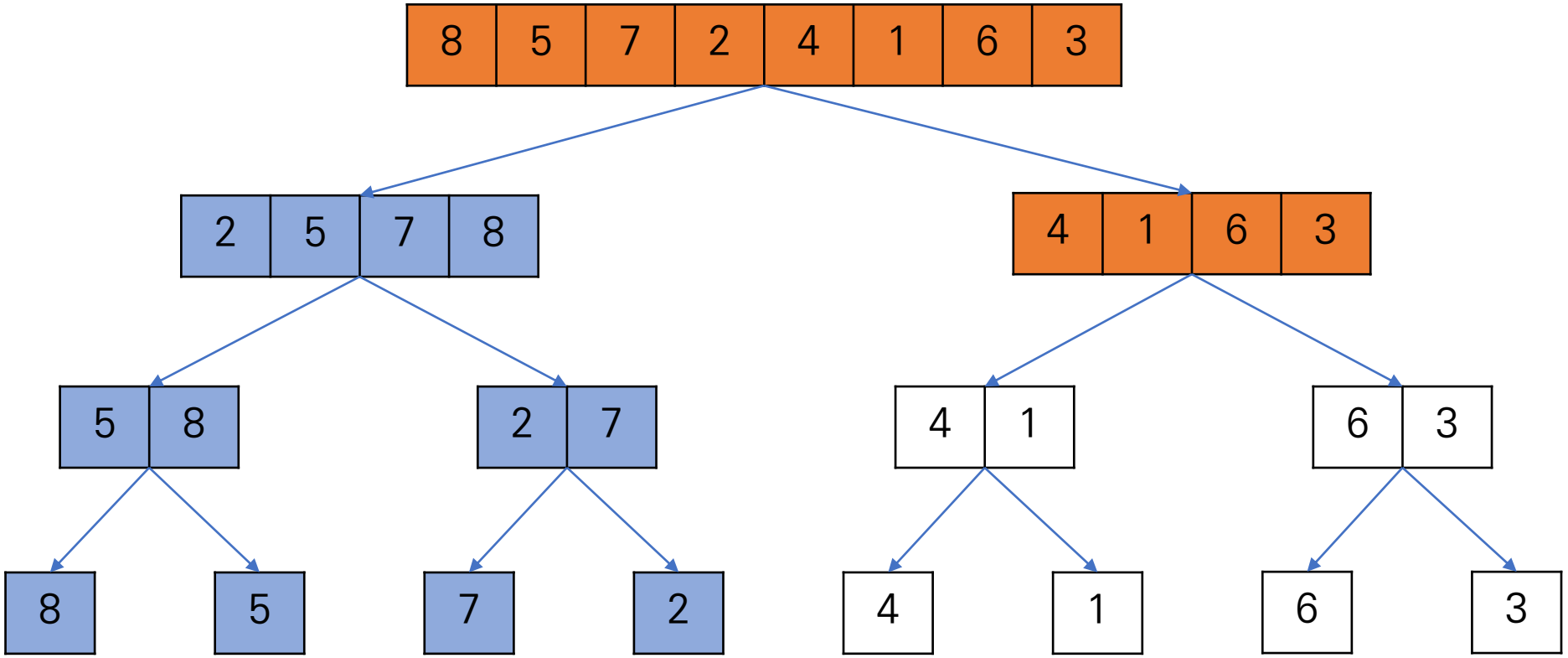
Merge Sort

정렬과정



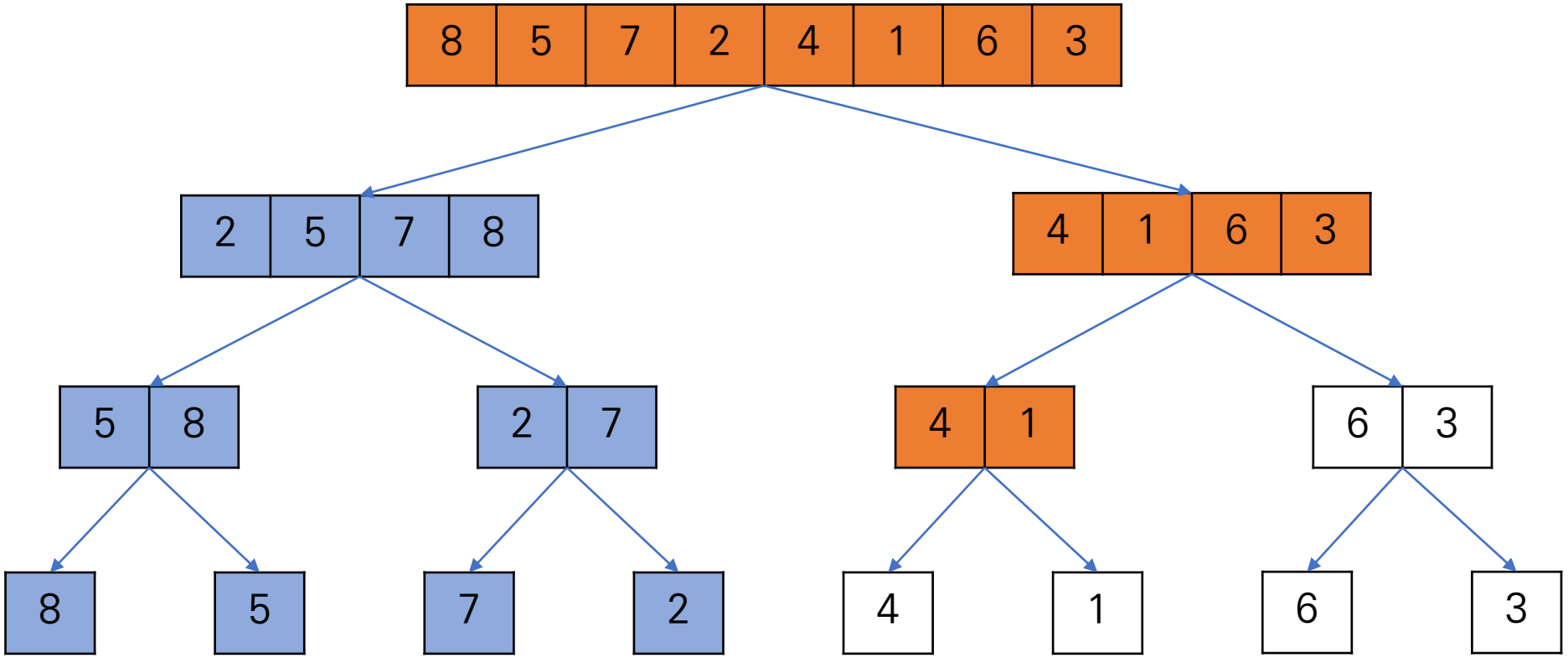
Merge Sort

정렬과정



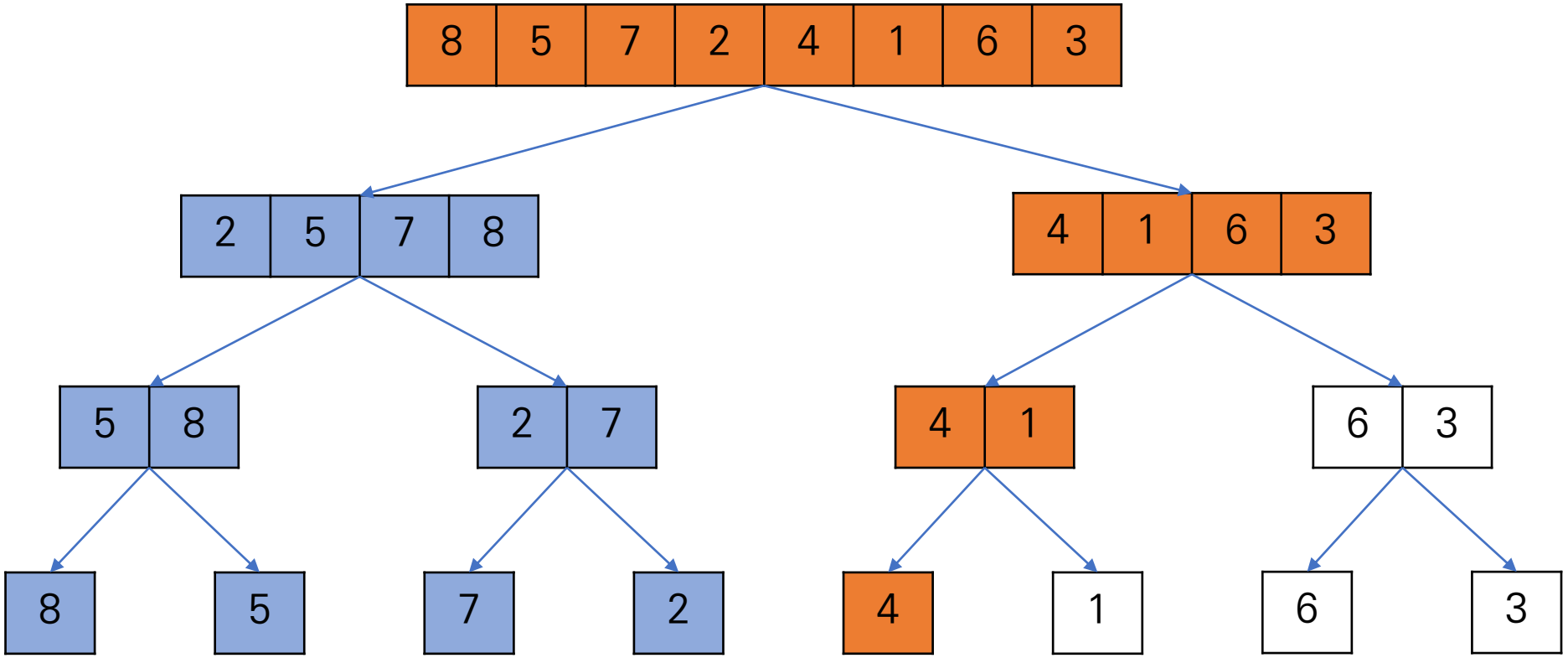
Merge Sort

정렬과정



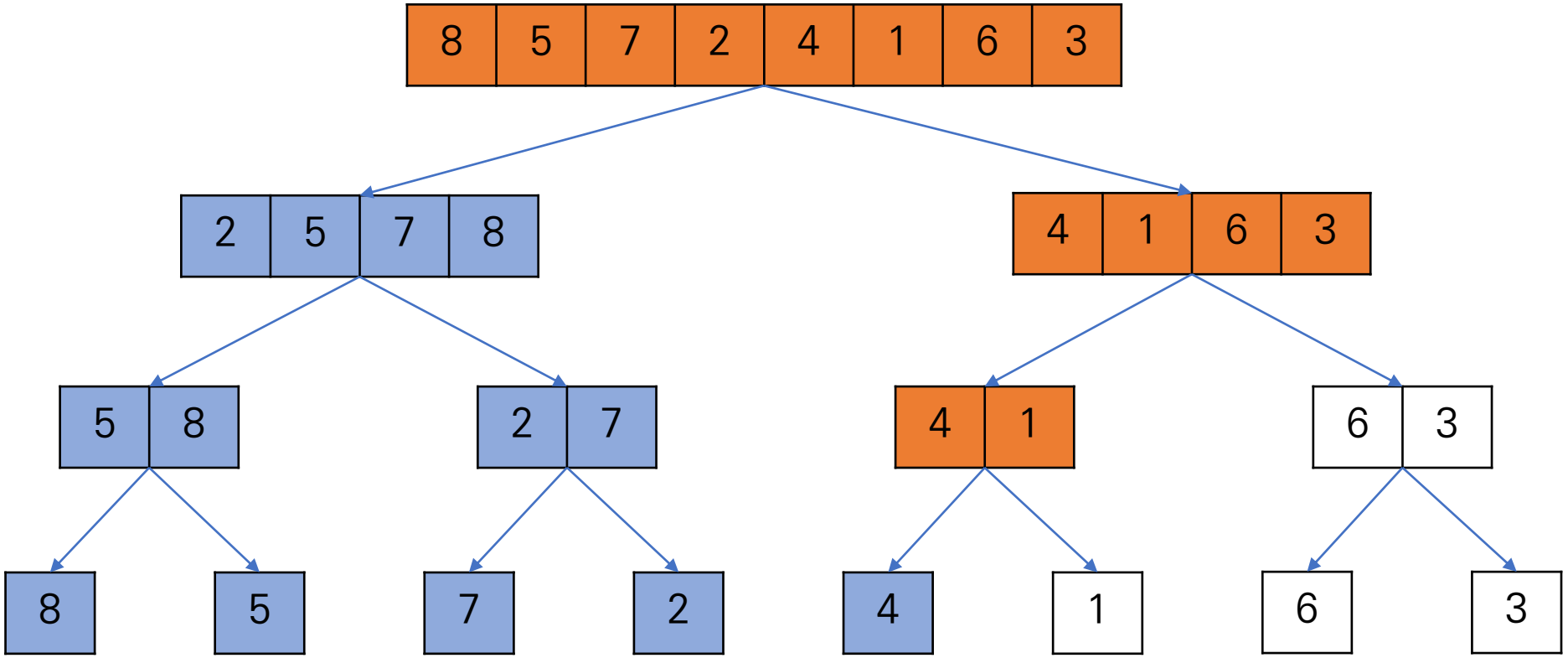
Merge Sort

정렬과정



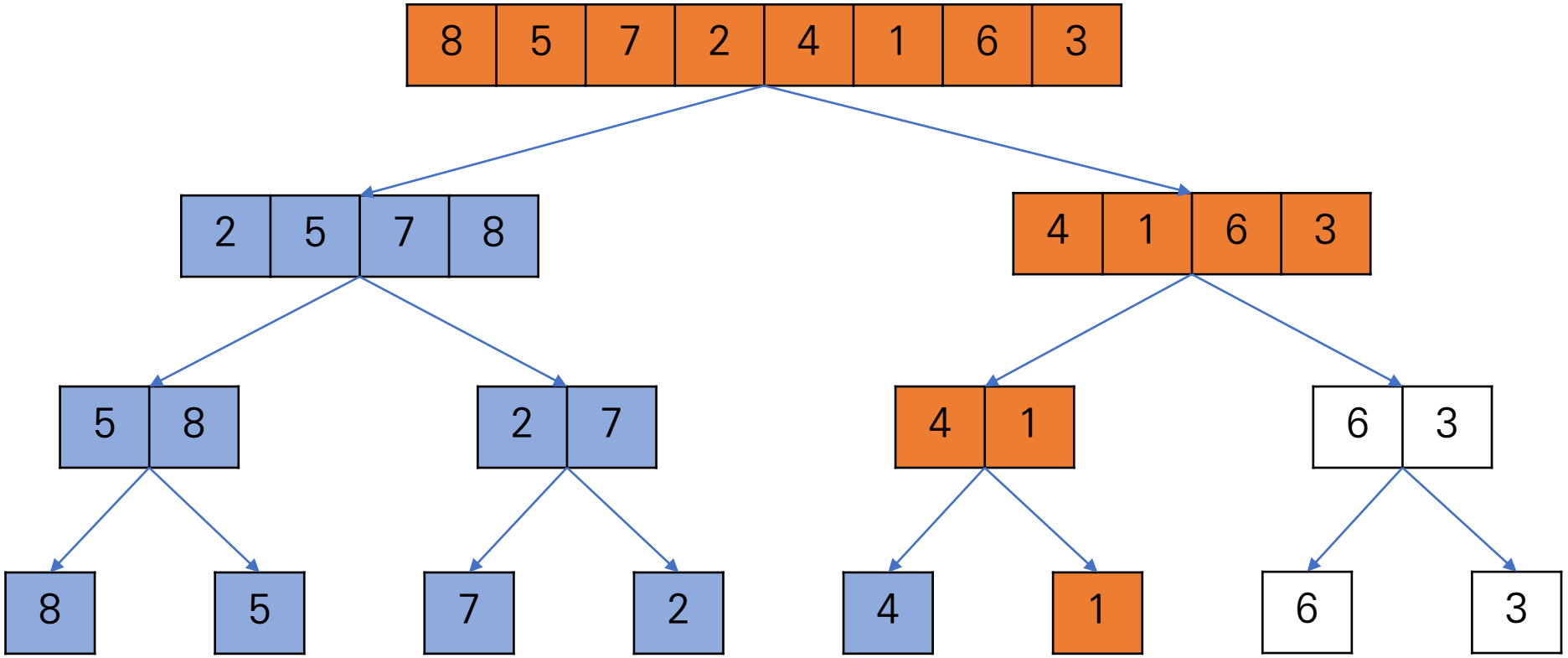
Merge Sort

정렬과정



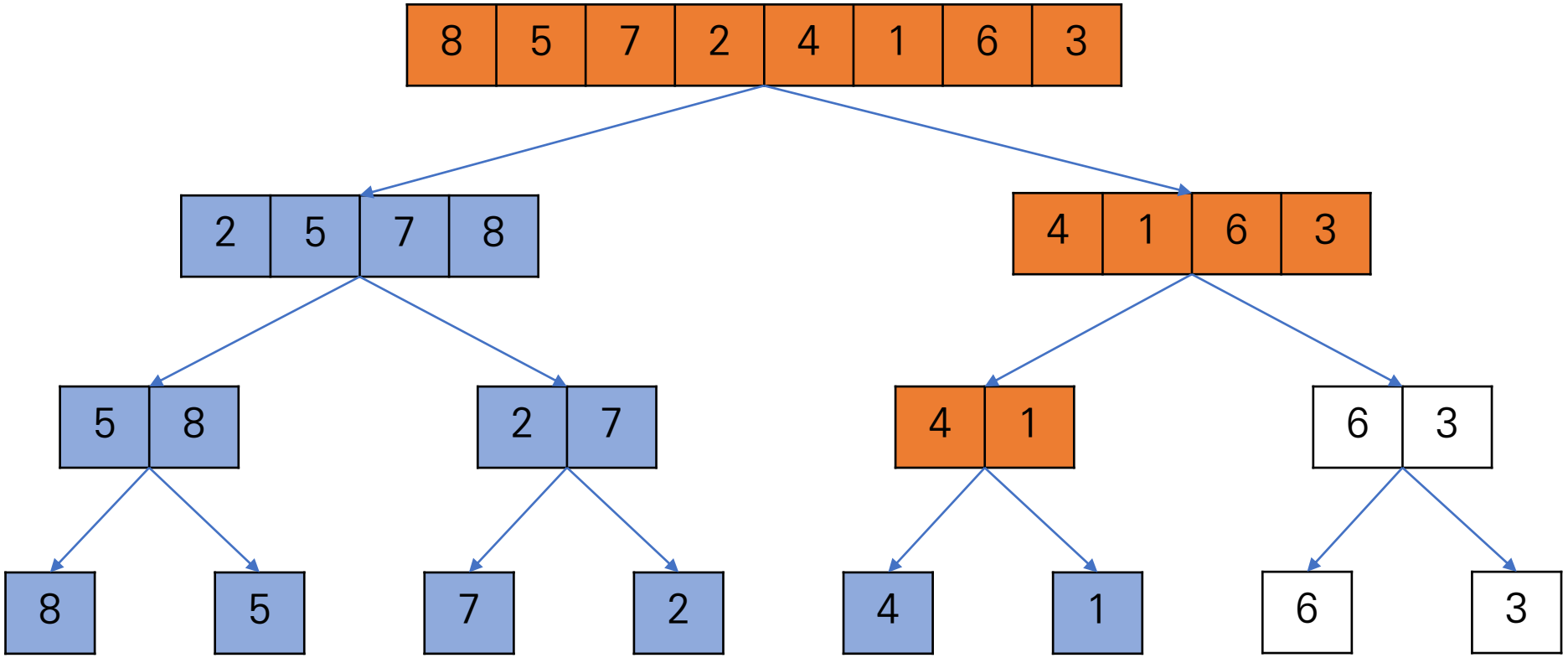
Merge Sort

정렬과정



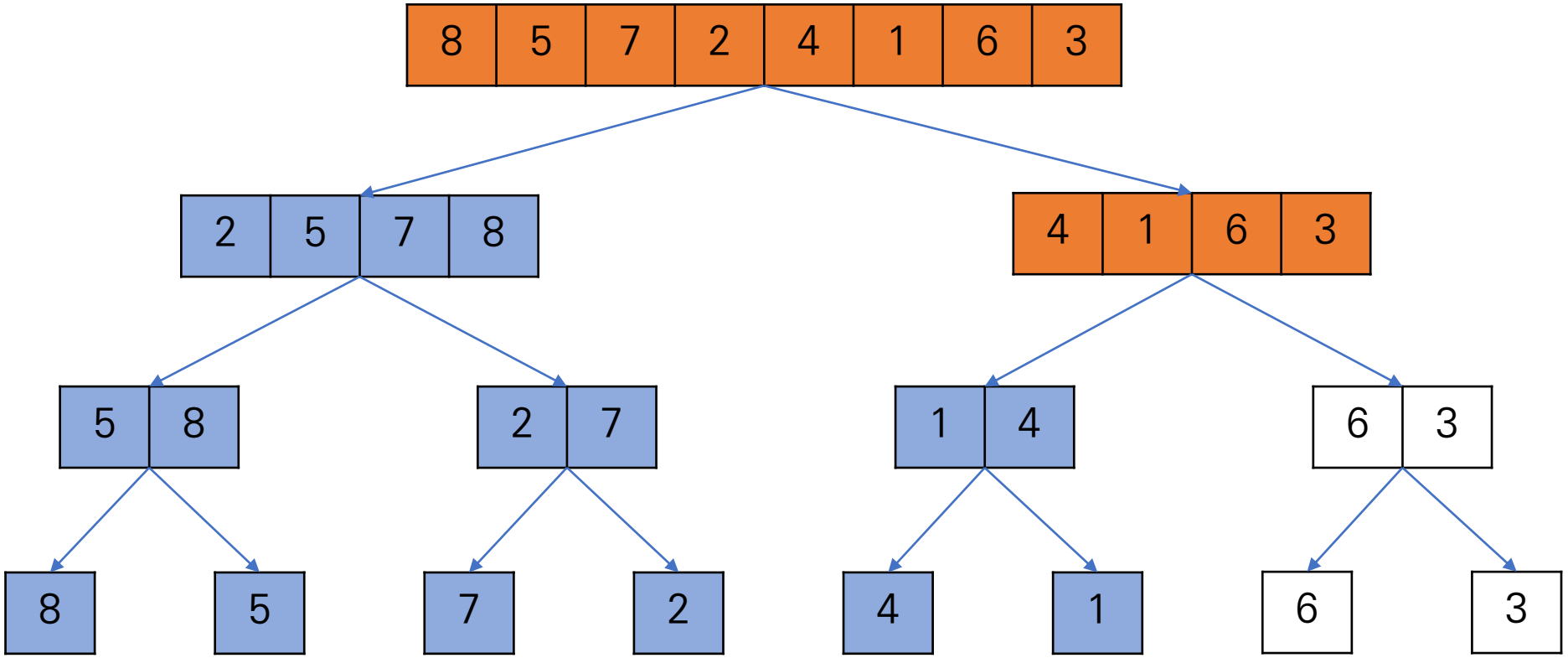
Merge Sort

정렬과정



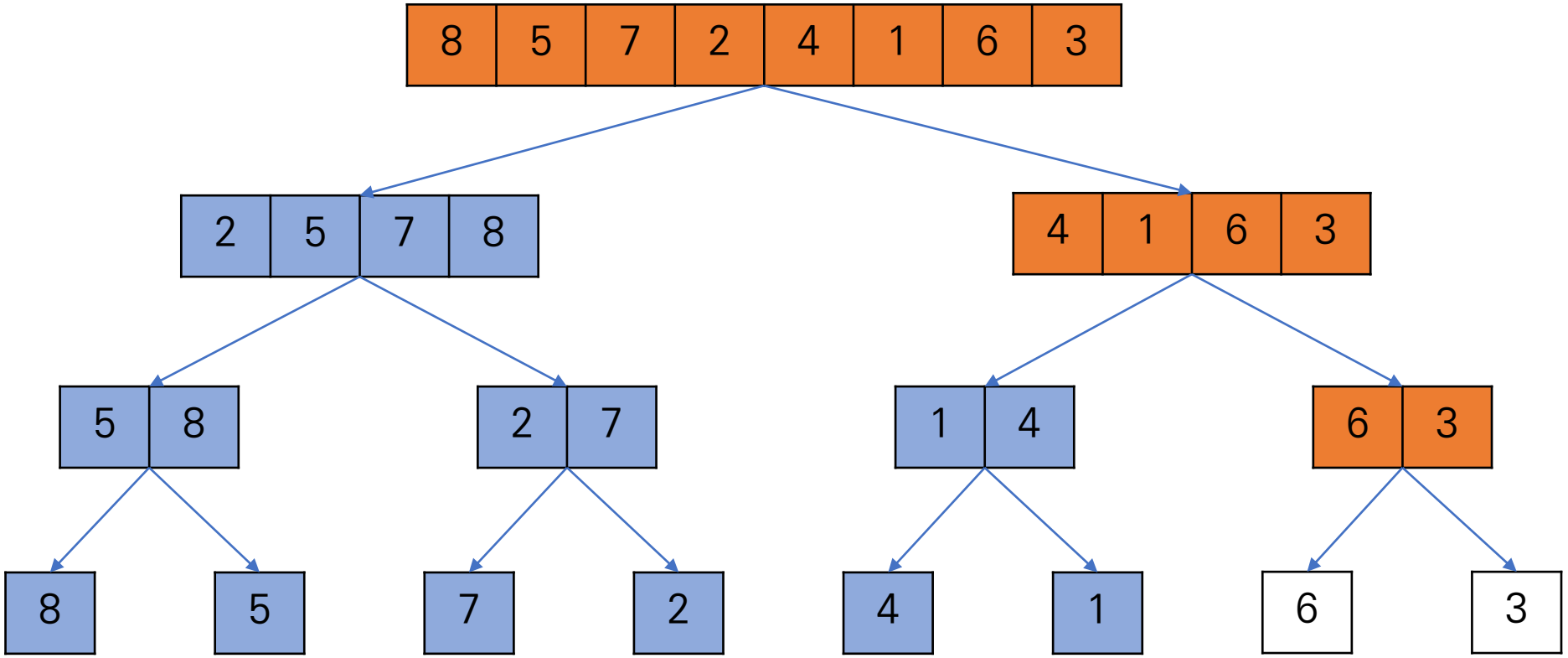
Merge Sort

정렬과정



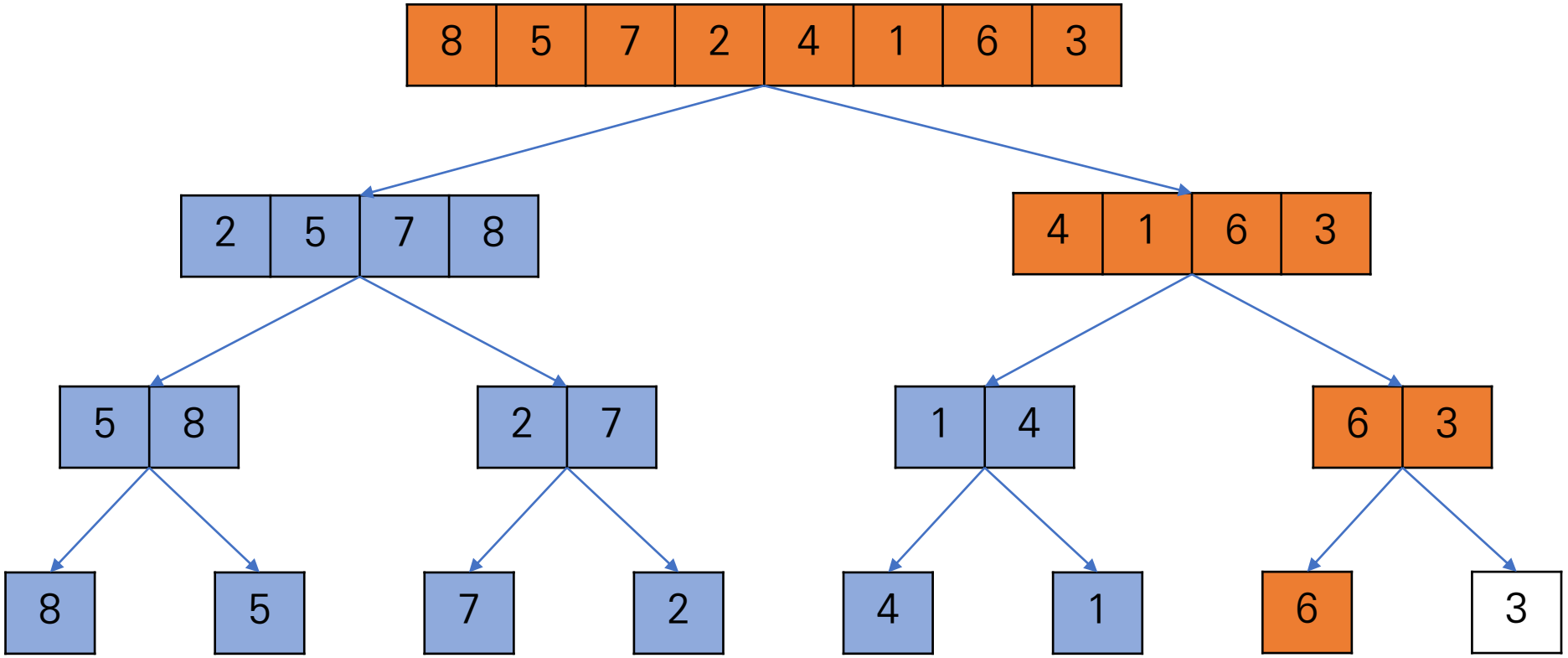
Merge Sort

정렬과정



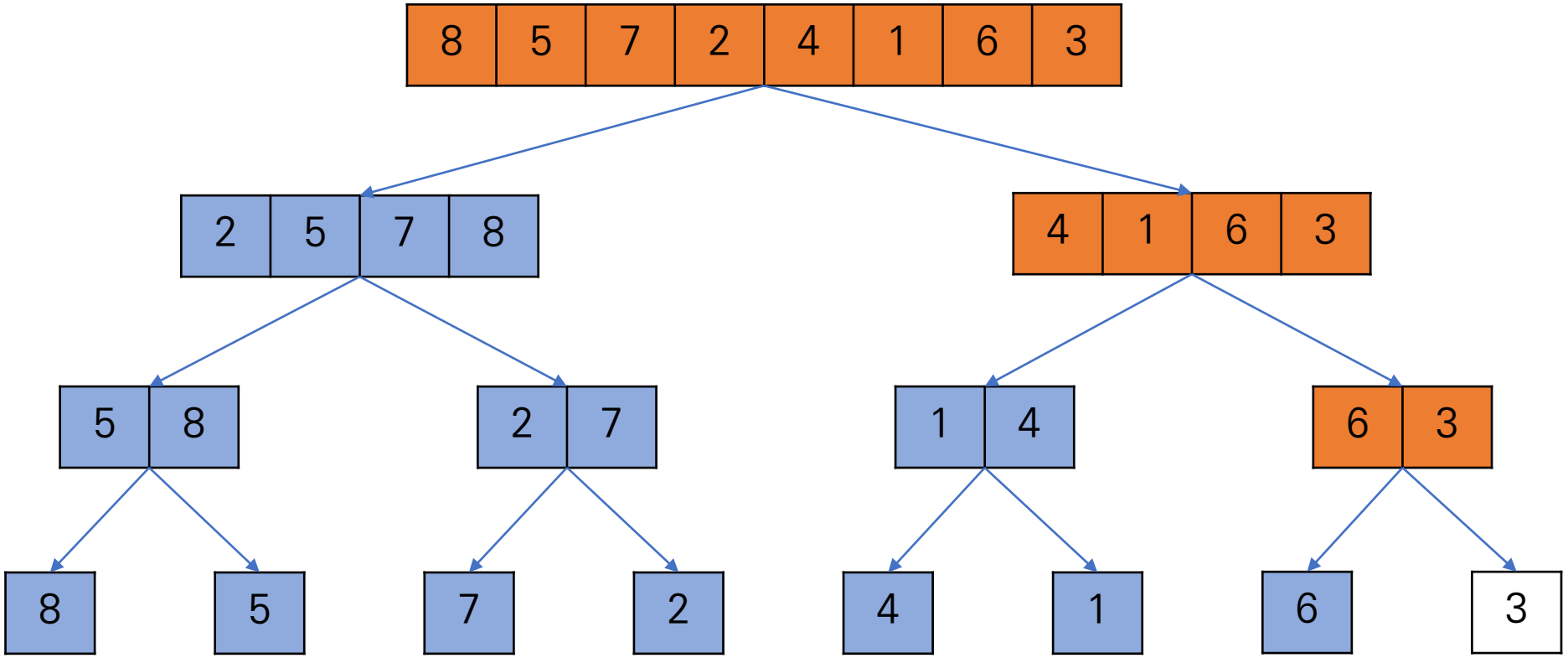
Merge Sort

정렬과정



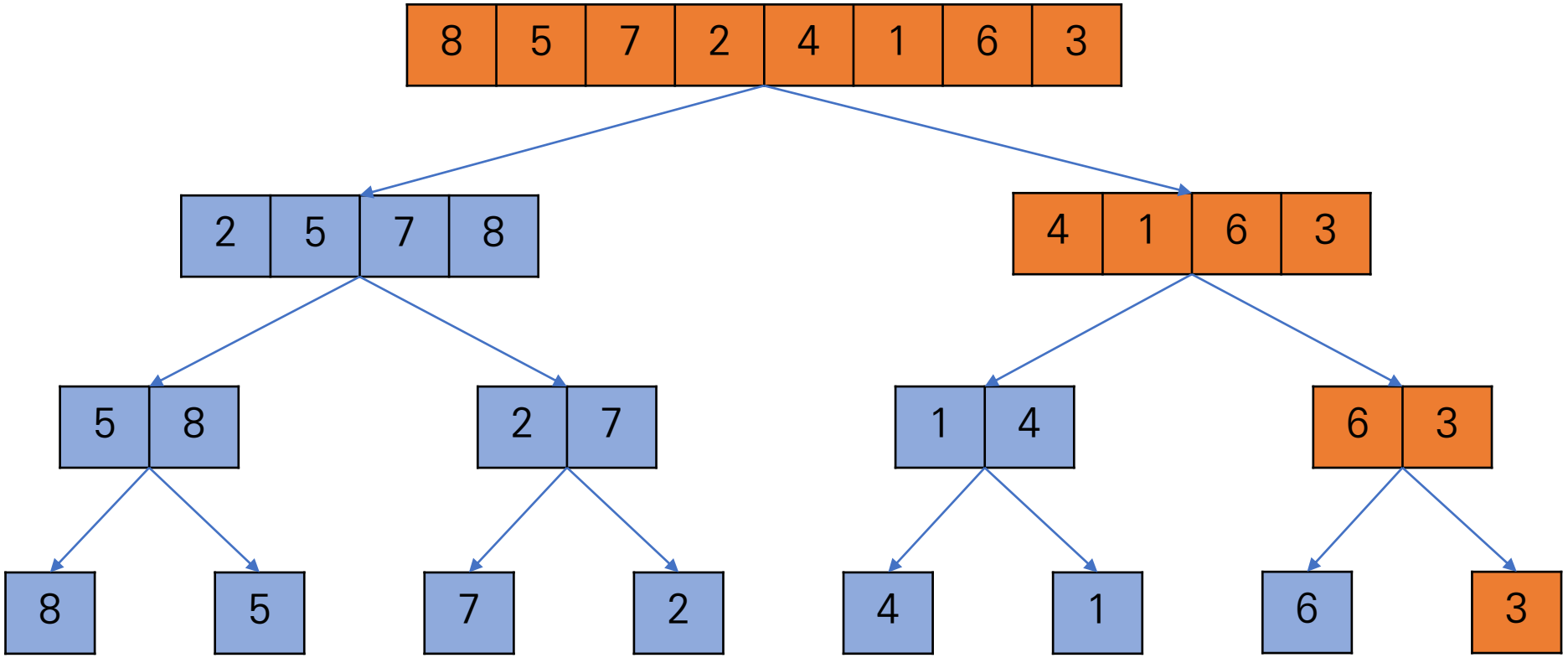
Merge Sort

정렬과정



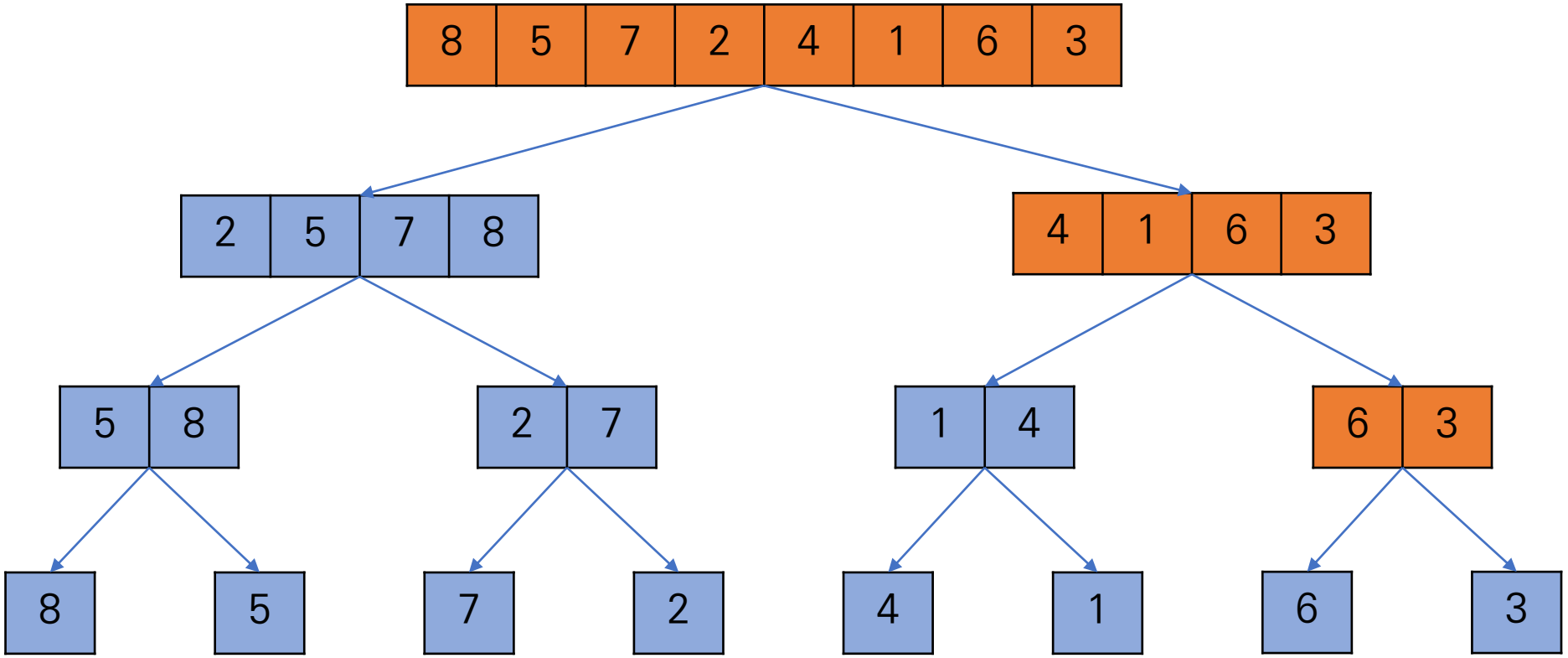
Merge Sort

정렬과정



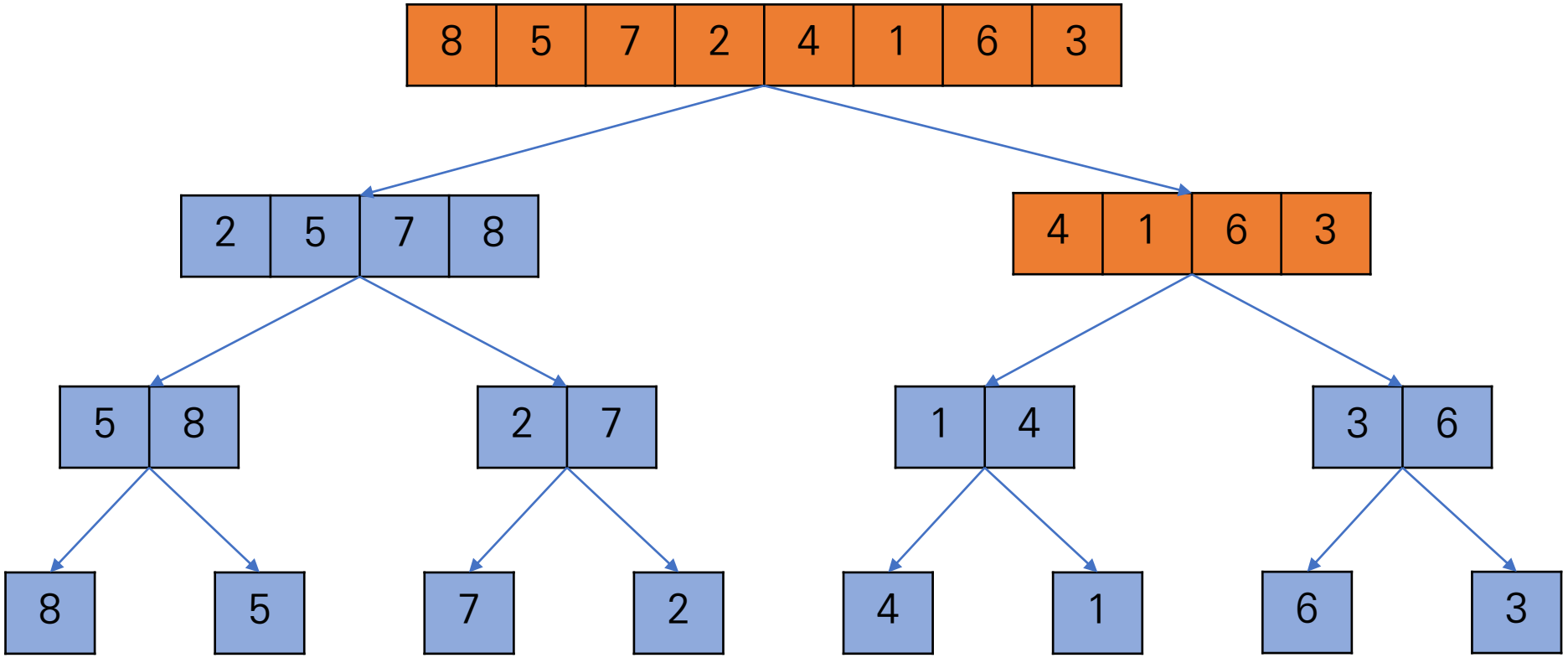
Merge Sort

정렬과정



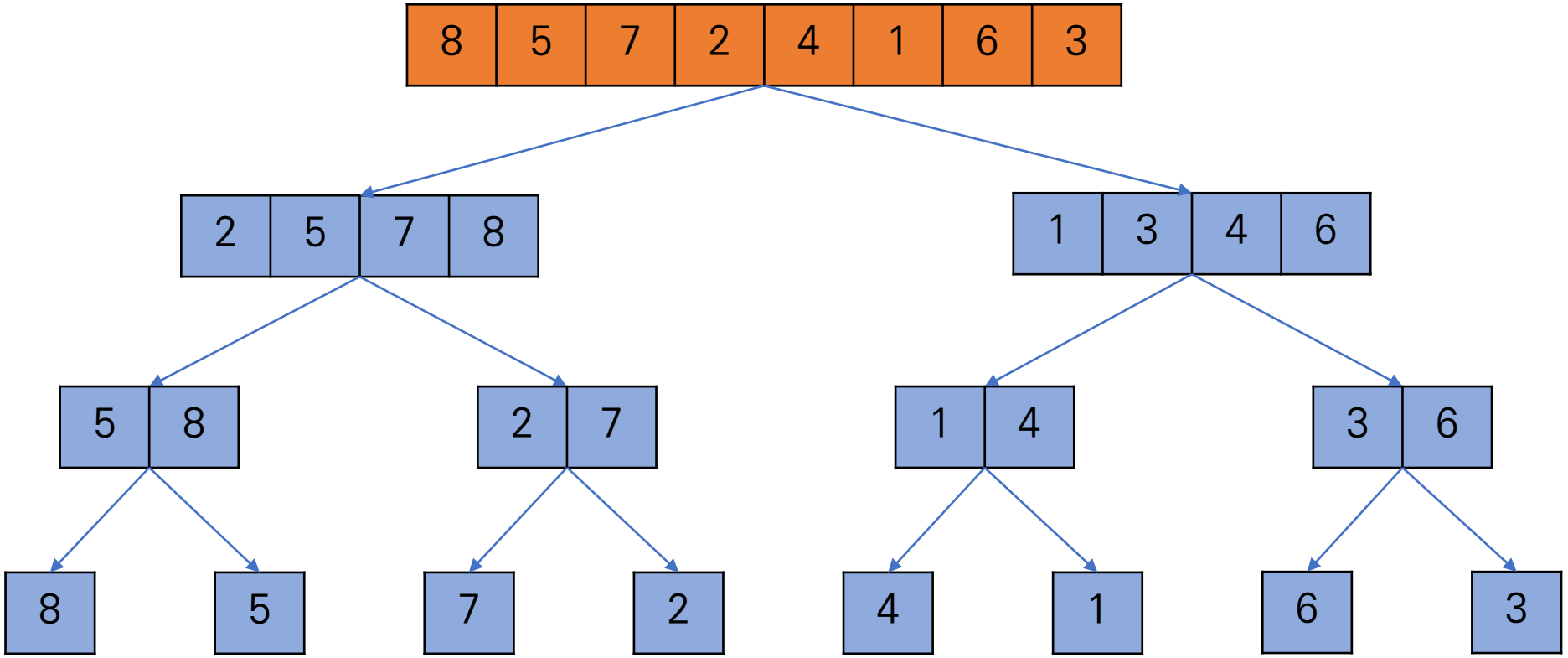
Merge Sort

정렬과정



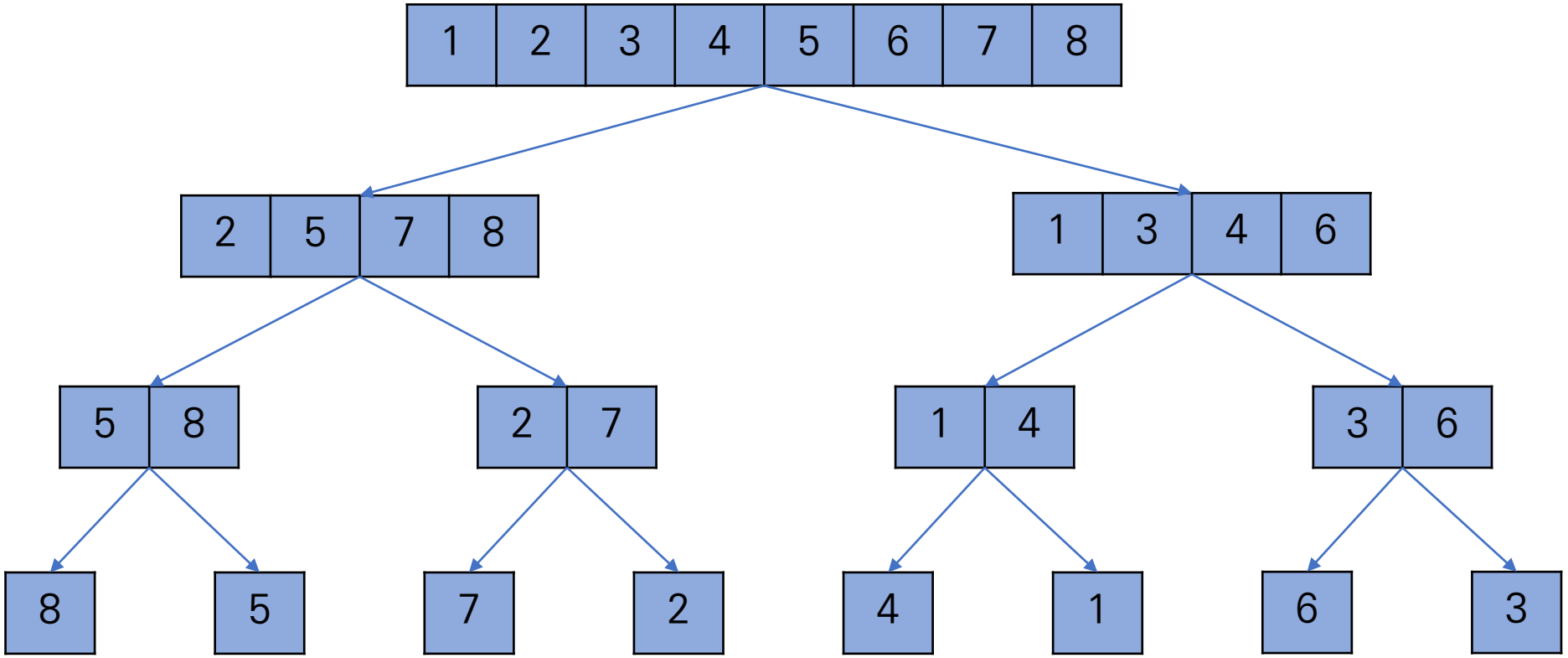
Merge Sort

정렬과정



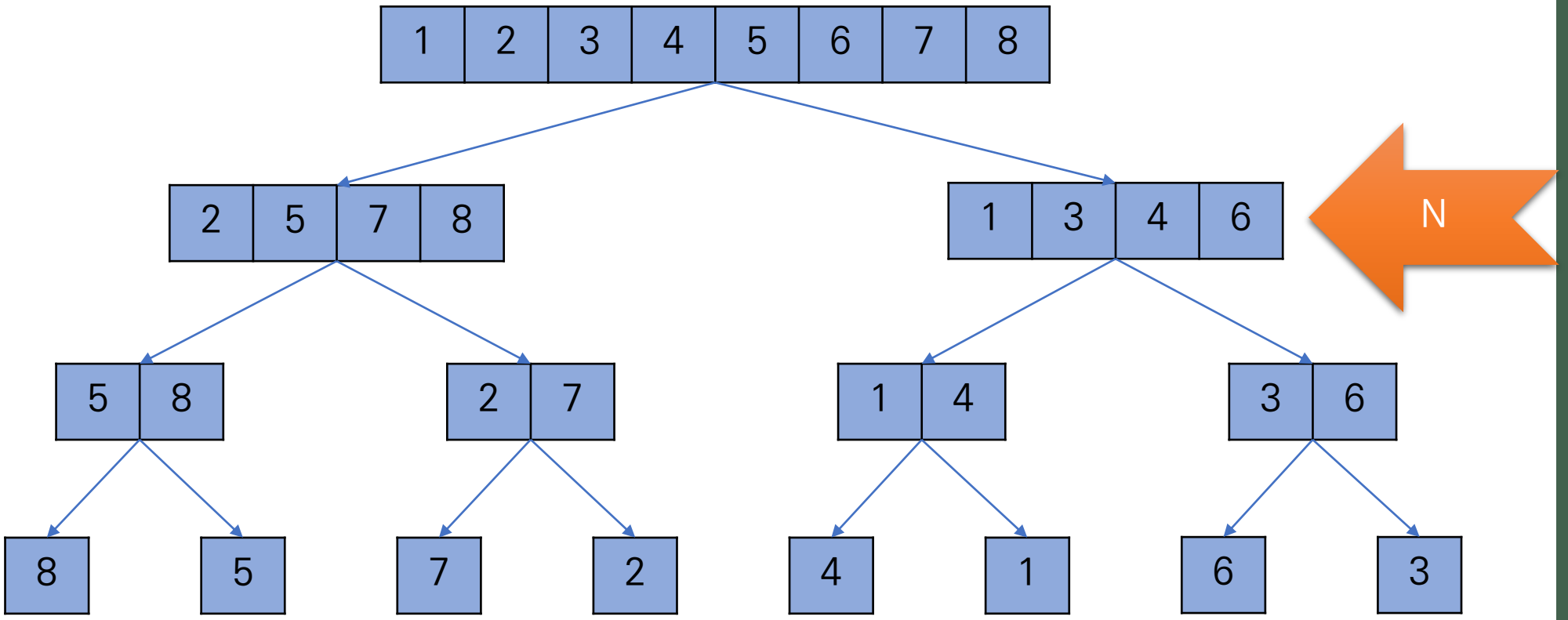
Merge Sort

정렬과정



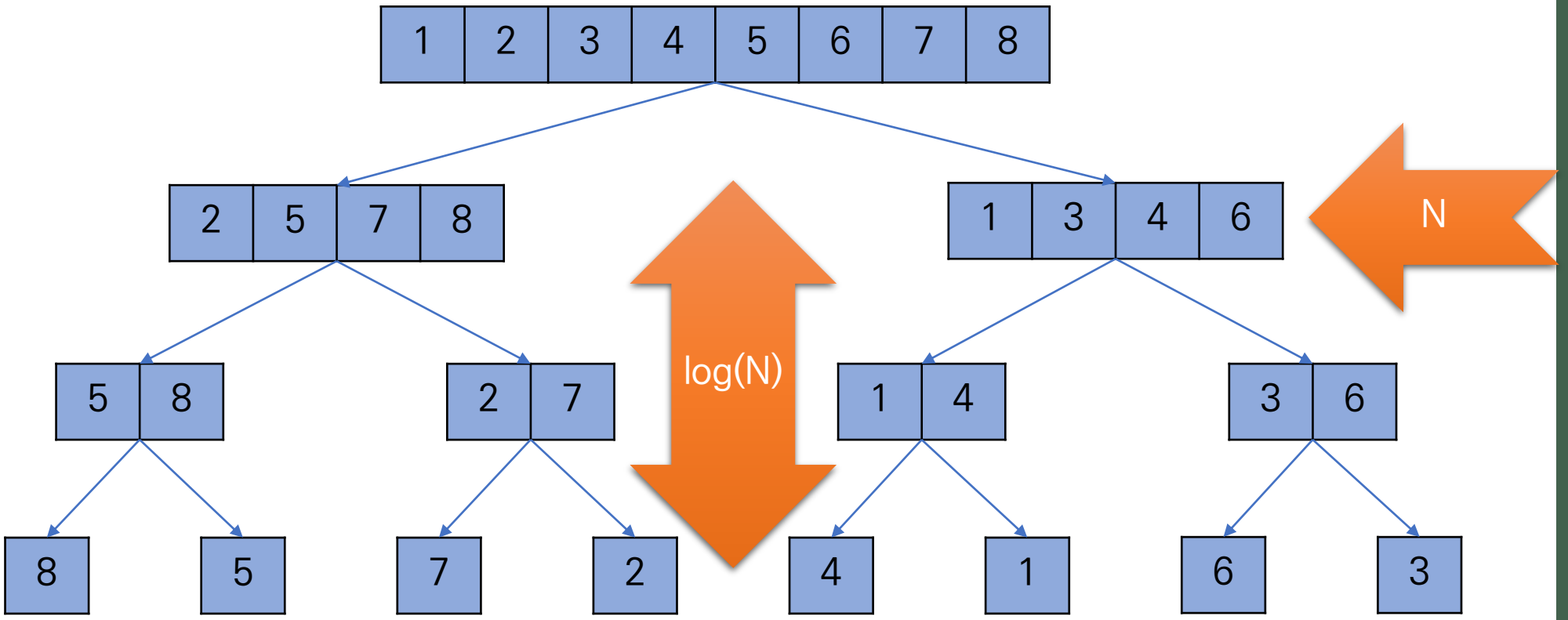
Merge Sort

time complexity



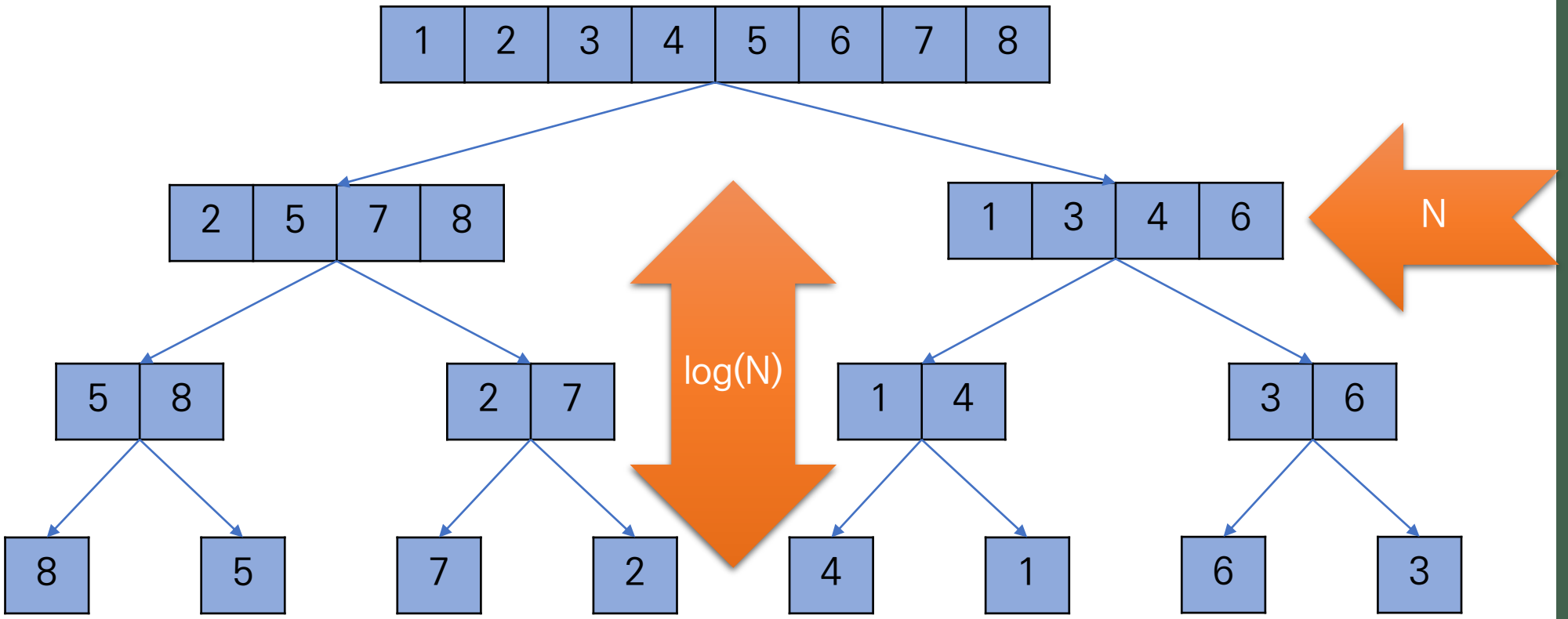
Merge Sort

time complexity



Merge Sort

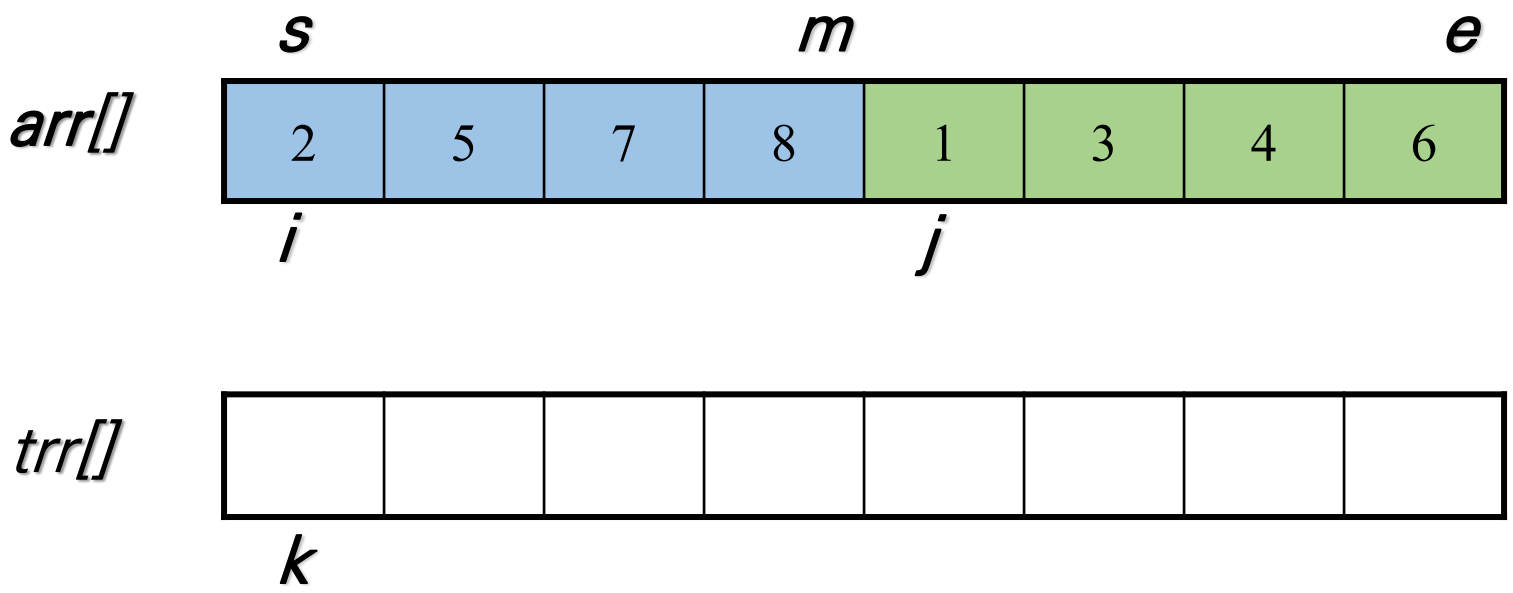
time complexity : N * log(N)



Merge Sort

merge(combine)과정

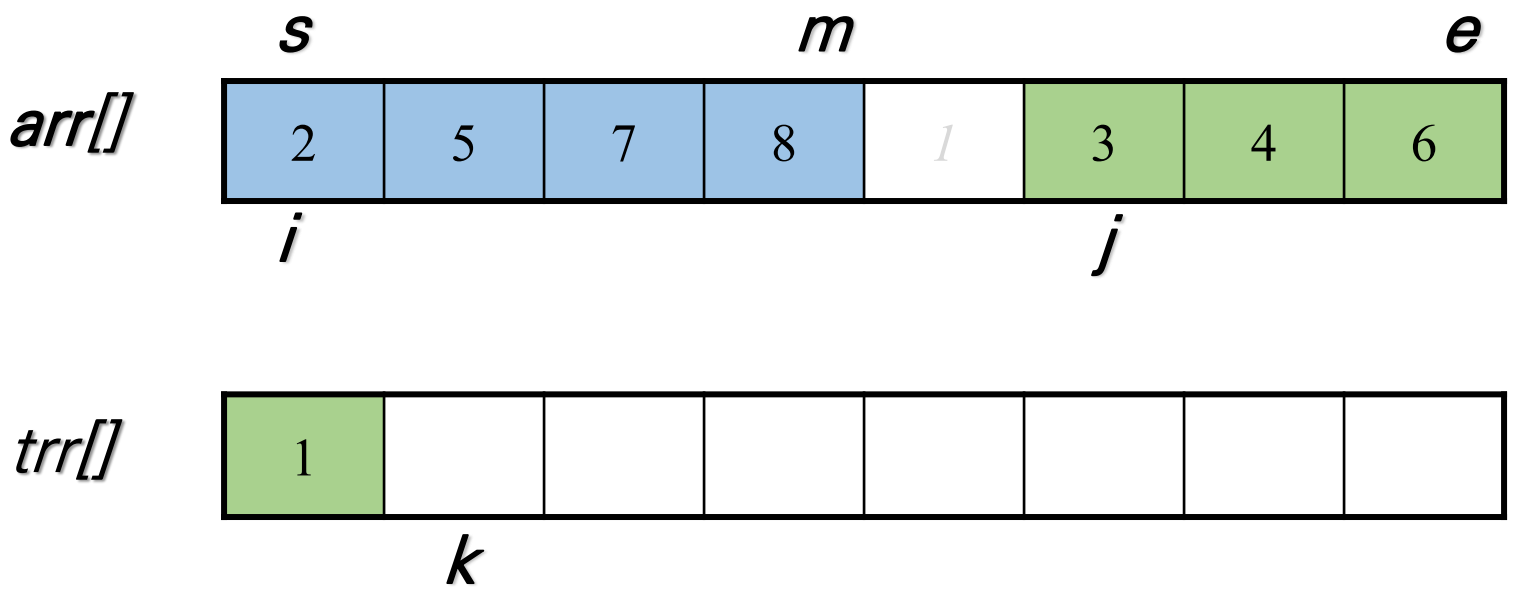
- 앞쪽 절반과 뒤쪽 절반이 각각 정렬된 상태이다.



Merge Sort

merge(combine)과정

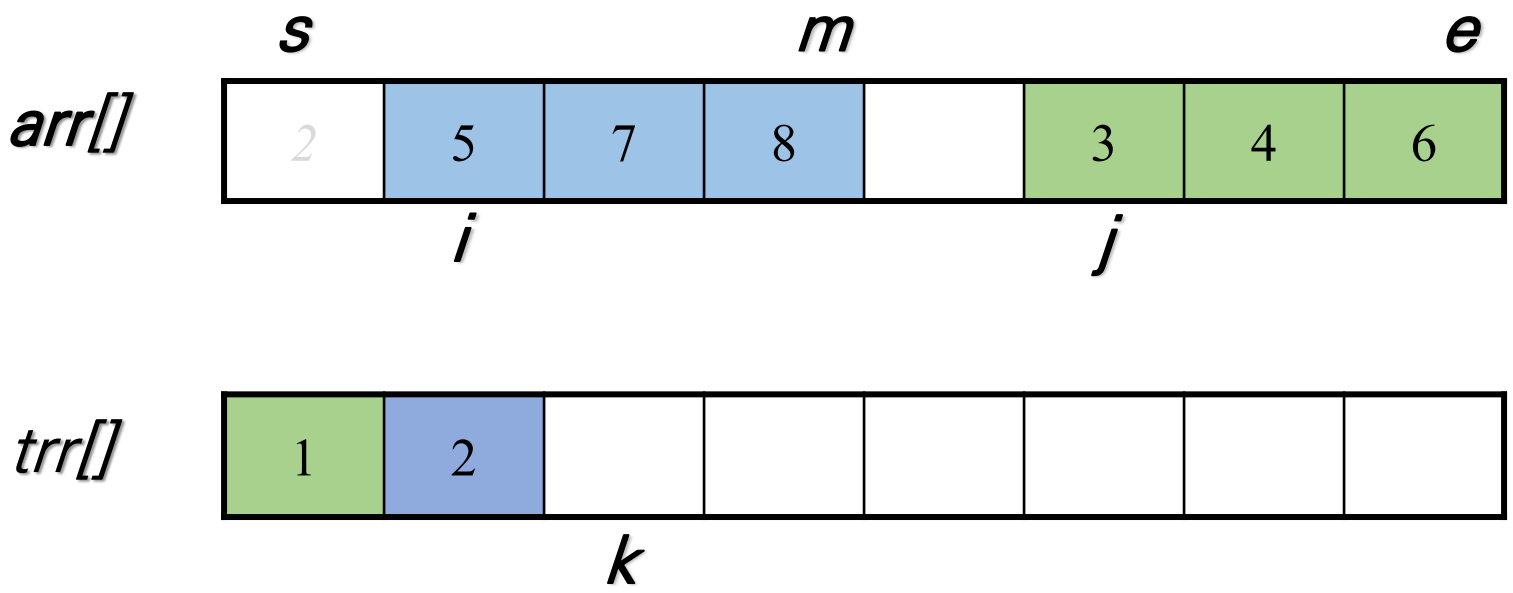
- i 번째 값과 j번째 값을 비교하여 더 작은 값이 1을 trr[k]에 넣는다.



Merge Sort

merge(combine)과정

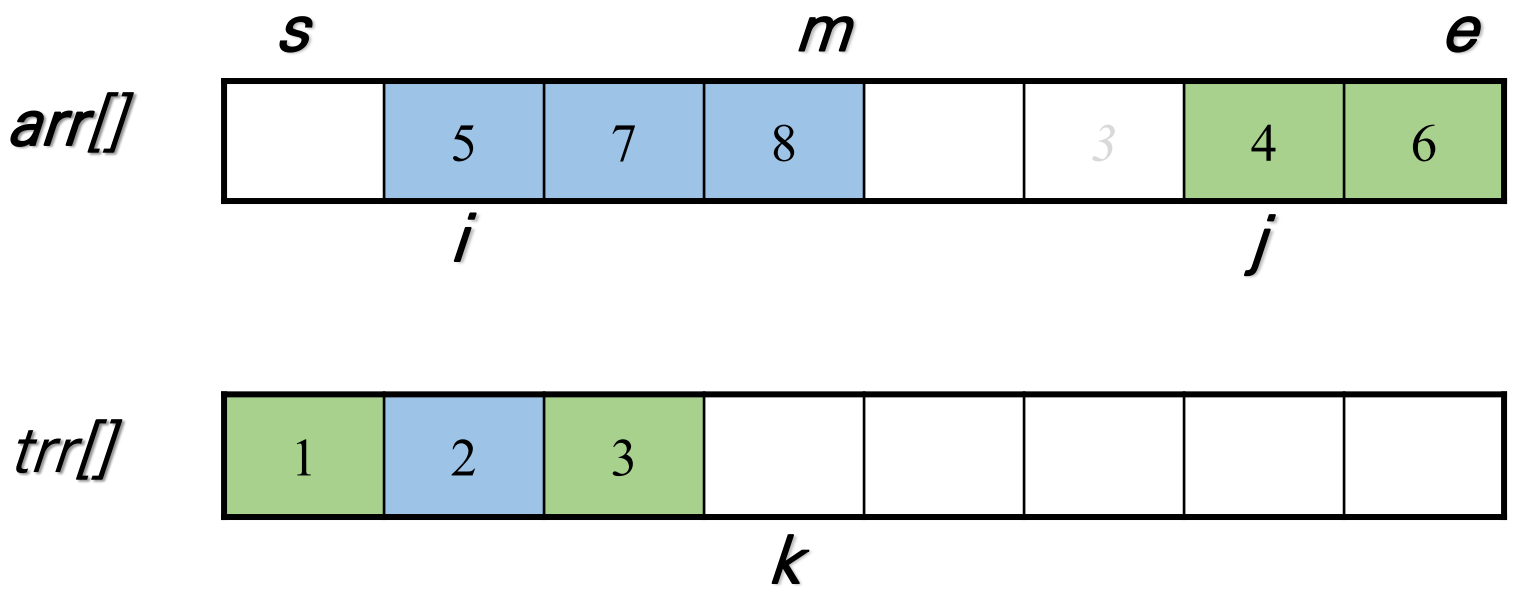
- i 번째 값과 j번째 값을 비교하여 더 작은 값이 2를 trr[k]에 넣는다.



Merge Sort

merge(combine)과정

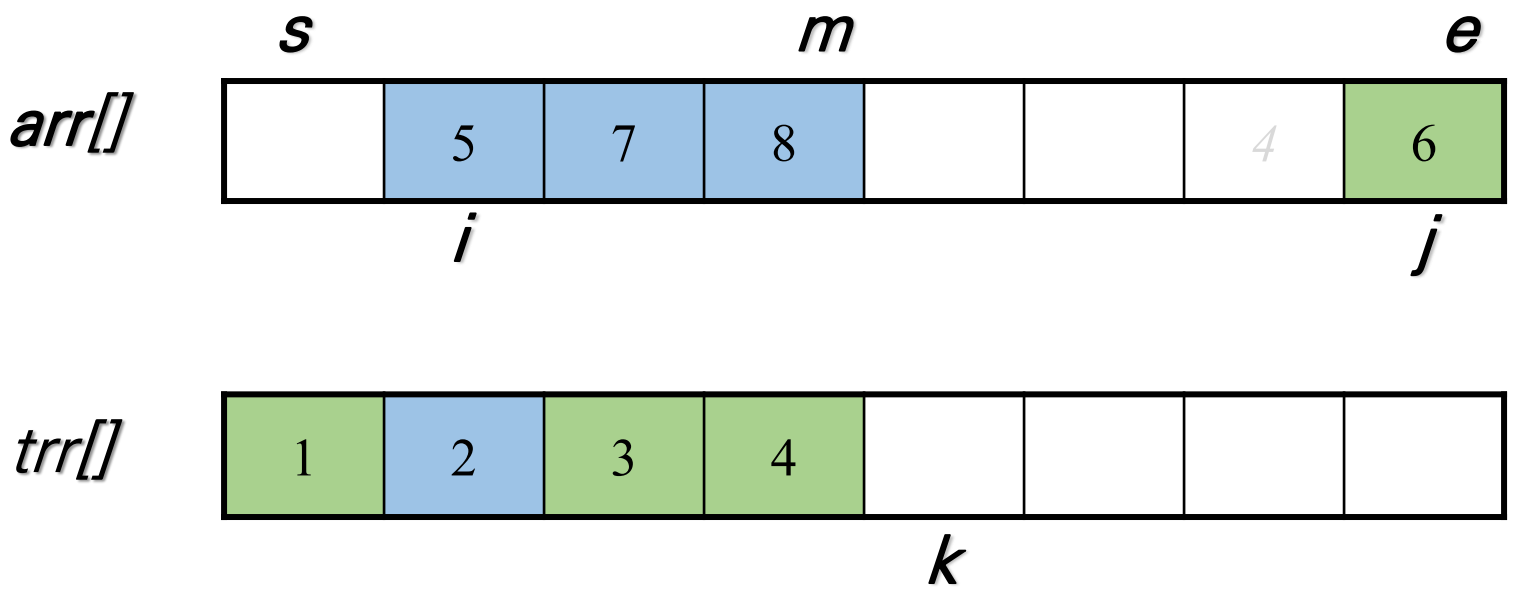
- i 번째 값과 j번째 값을 비교하여 더 작은 값이 3을 trr[k]에 넣는다.



Merge Sort

merge(combine)과정

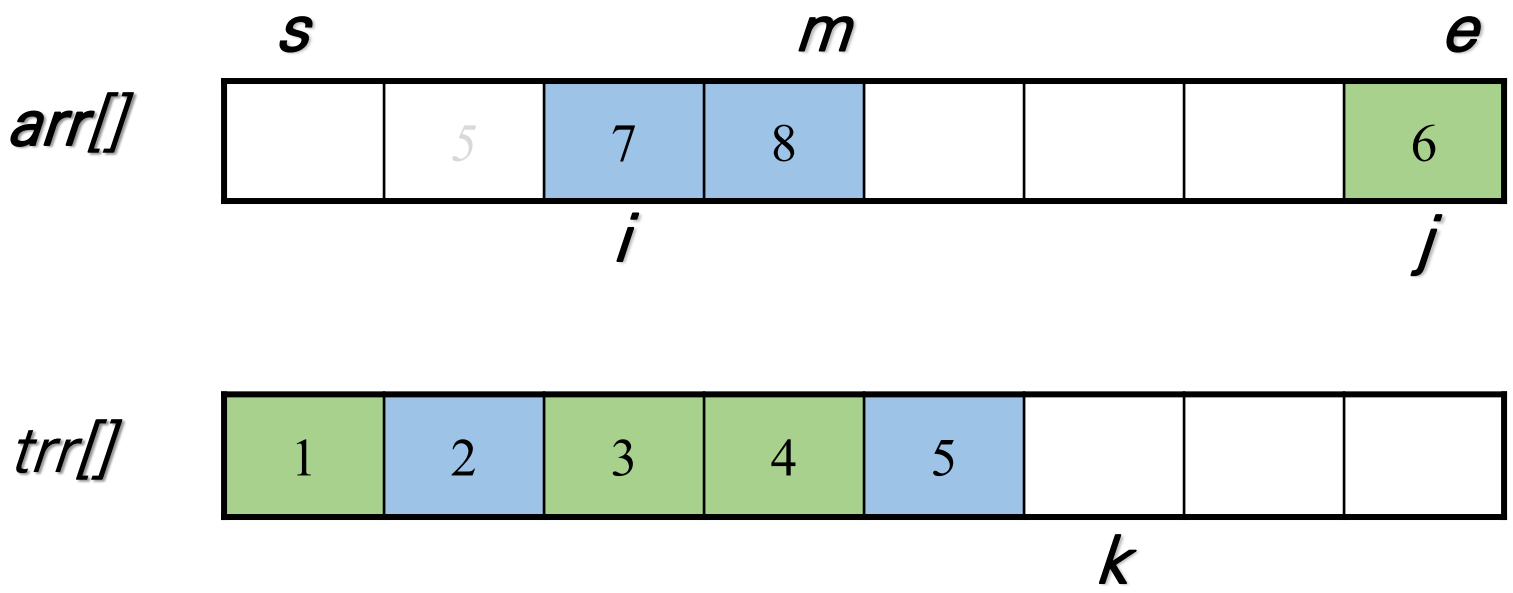
- i 번째 값과 j번째 값을 비교하여 더 작은 값이 4를 trr[k]에 넣는다.



Merge Sort

merge(combine)과정

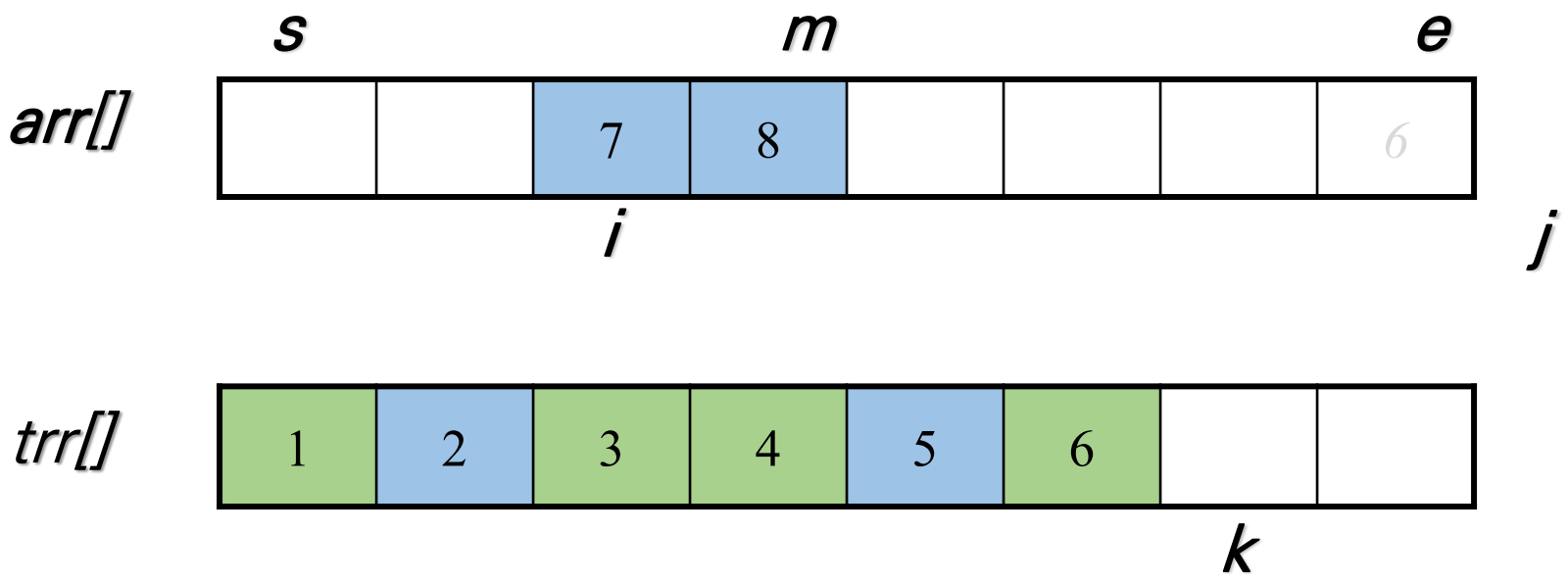
- i 번째 값과 j번째 값을 비교하여 더 작은 값이 5를 trr[k]에 넣는다.



Merge Sort

merge(combine)과정

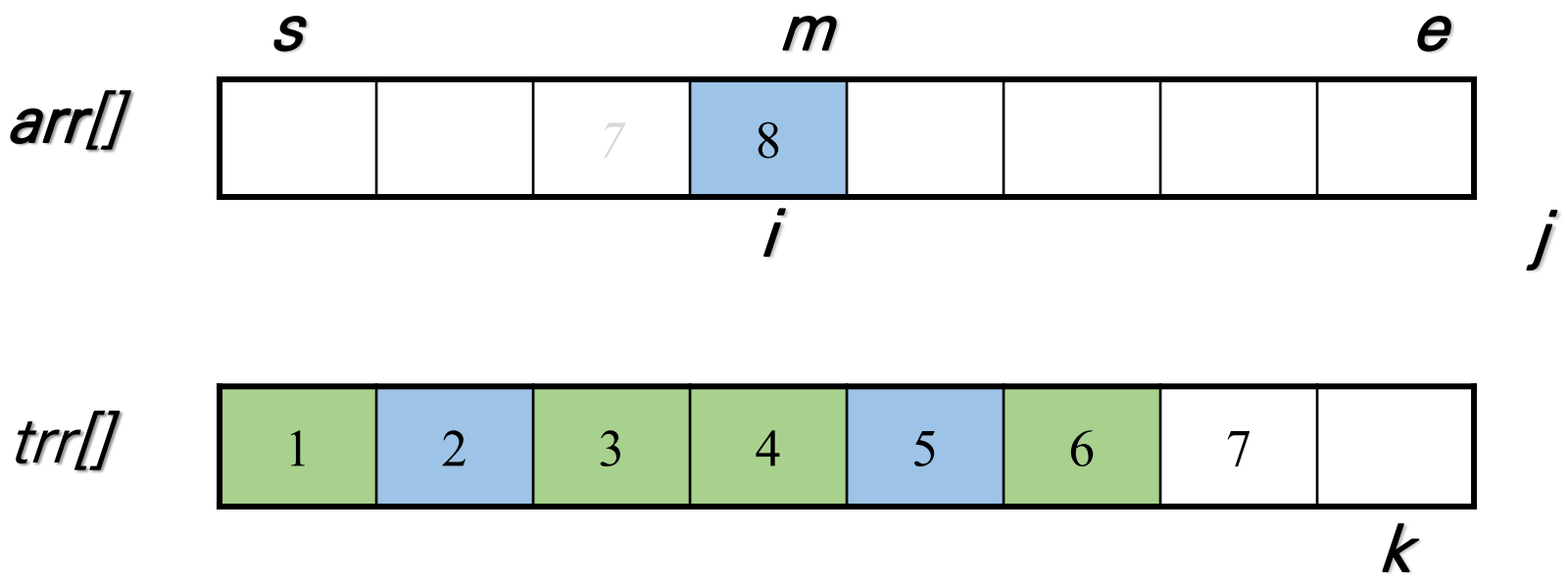
- i 번째 값과 j번째 값을 비교하여 더 작은 값이 6을 trr[k]에 넣는다.



Merge Sort

merge(combine)과정

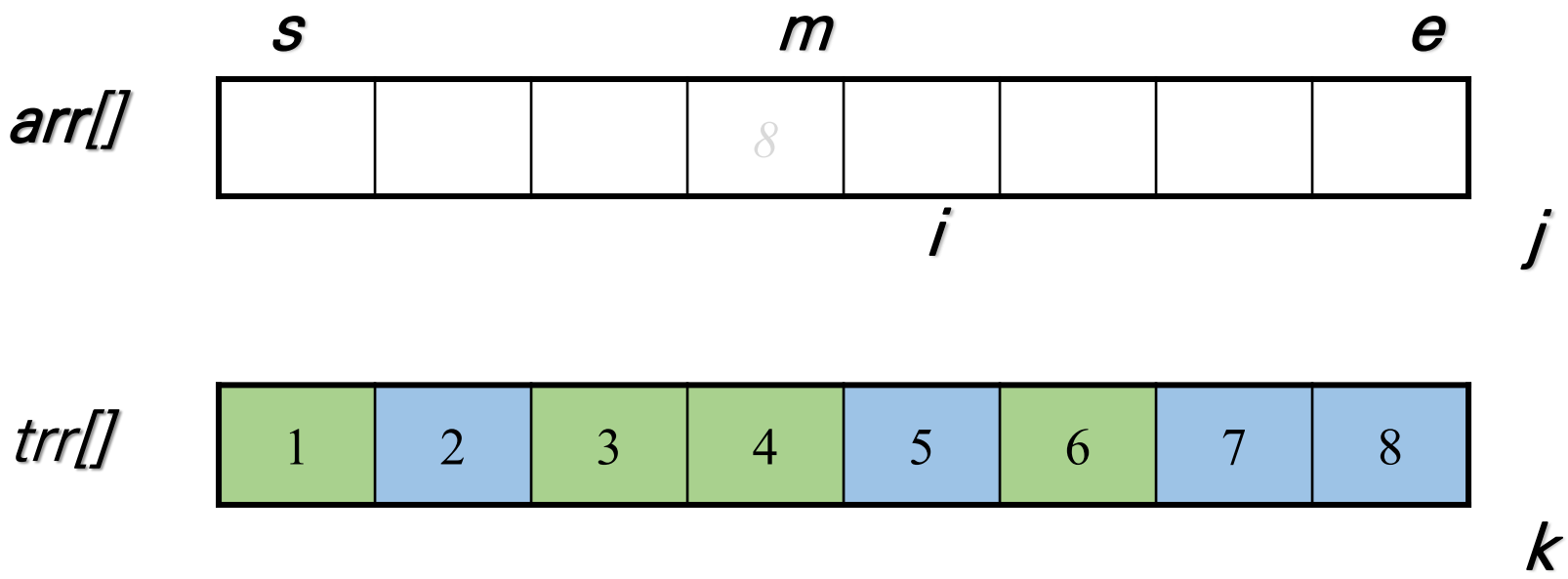
- i 번째 값과 j번째 값을 비교하여 더 작은 값이 7을 trr[k]에 넣는다.



Merge Sort

merge(combine)과정

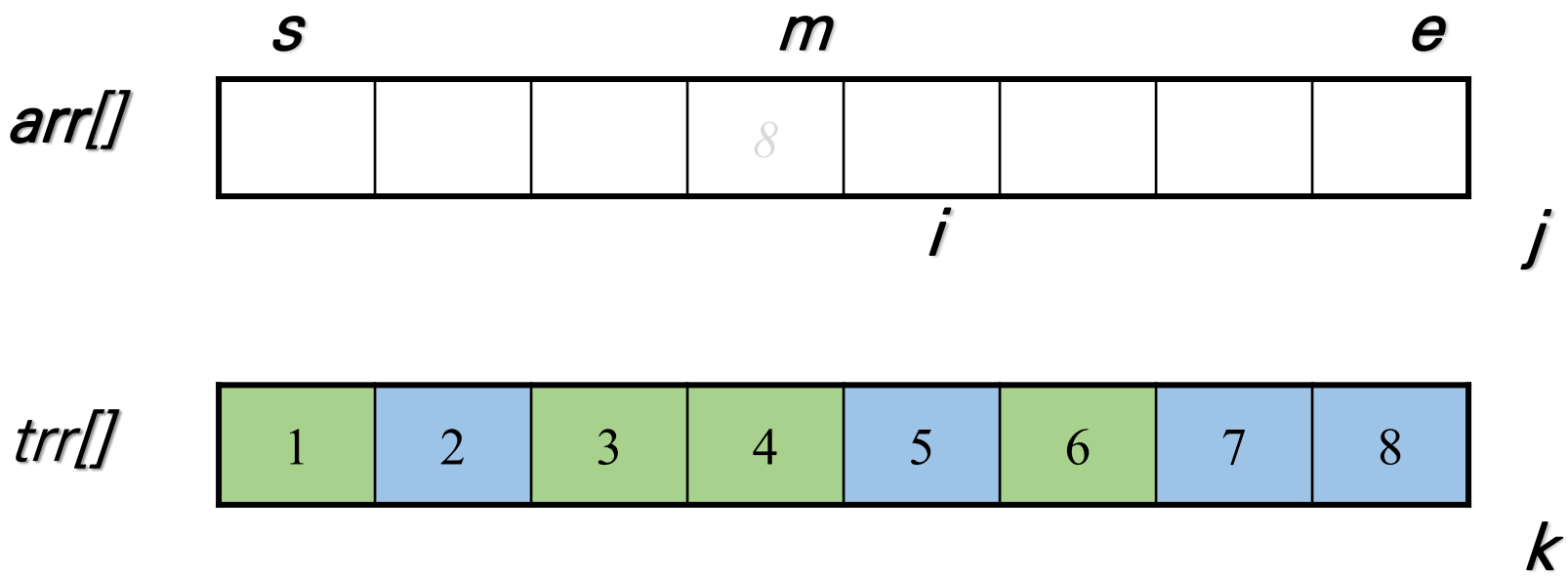
- i 번째 값과 j번째 값을 비교하여 더 작은 값이 8을 trr[k]에 넣는다.



Merge Sort

merge(combine)과정 time complexity : O(N)

- i 번째 값과 j번째 값을 비교하여 더 작은 값이 8을 trr[k]에 넣는다.



code example 1

```
int trr[SIZE];
void mergeSort(int *arr, int s, int e)
{
    if (s >= e) return;          // ---------------------- 0. base condition

    int m = (s + e) / 2;         // ---------------------- 1. divide
    mergeSort(arr, s, m);        // ---------------------- 2. conquer
    mergeSort(arr, m+1, e);

    int i = s, j = m+1, k = s; // ---------------------- 3. merge
    for (k=s;k<=e;k++) {
        if (j > e) trr[k] = arr[i++];
        else if (i > m) trr[k] = arr[j++];
        else if (arr[i] <= arr[j]) trr[k] = arr[i++];
        else trr[k] = arr[j++];
    }

    for (i=s;i<=e;i++)           // ---------------------- 4. copy
        arr[i] = trr[i];
}
```

code example 2

```
int trr[SIZE];
void mergeSort(int *arr, int s, int e)
{
    if (s >= e) return;

    int m = (s + e) / 2;
    mergeSort(arr, s, m);
    mergeSort(arr, m+1, e);

    int i = s, j = m+1, k = s;
    while (i<=m && j<=e) {
        if (arr[i] <= arr[j]) trr[k++] = arr[i++];
        else trr[k++] = arr[j++];
    }

    while (i<=m) trr[k++] = arr[i++];
    while (j<=e) trr[k++] = arr[j++];

    for (i=s;i<=e;i++) arr[i] = trr[i];
}
```

감사합니다