算法与数据结构体系课程

liuyubobobo

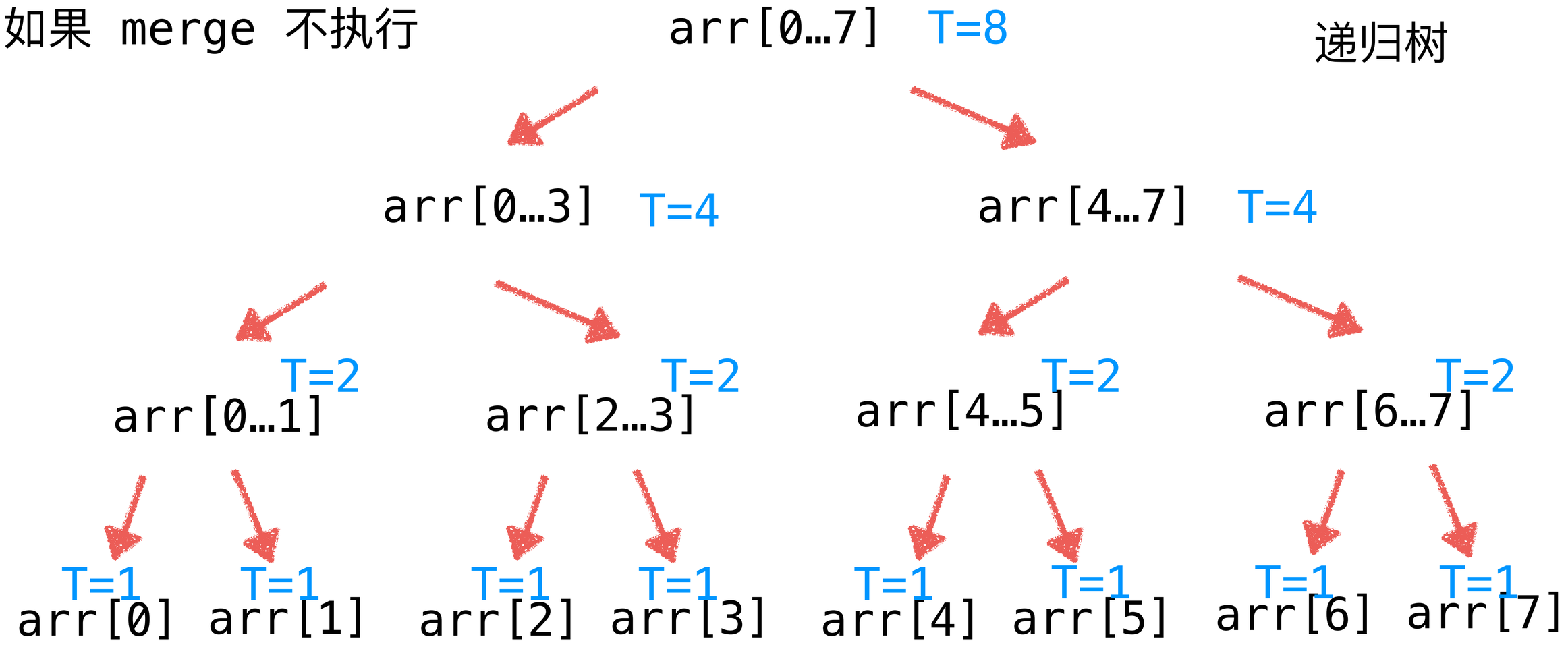
更多关于归并排序法

归并排序算法的优化

必要时才 merge

实践：必要时才 merge

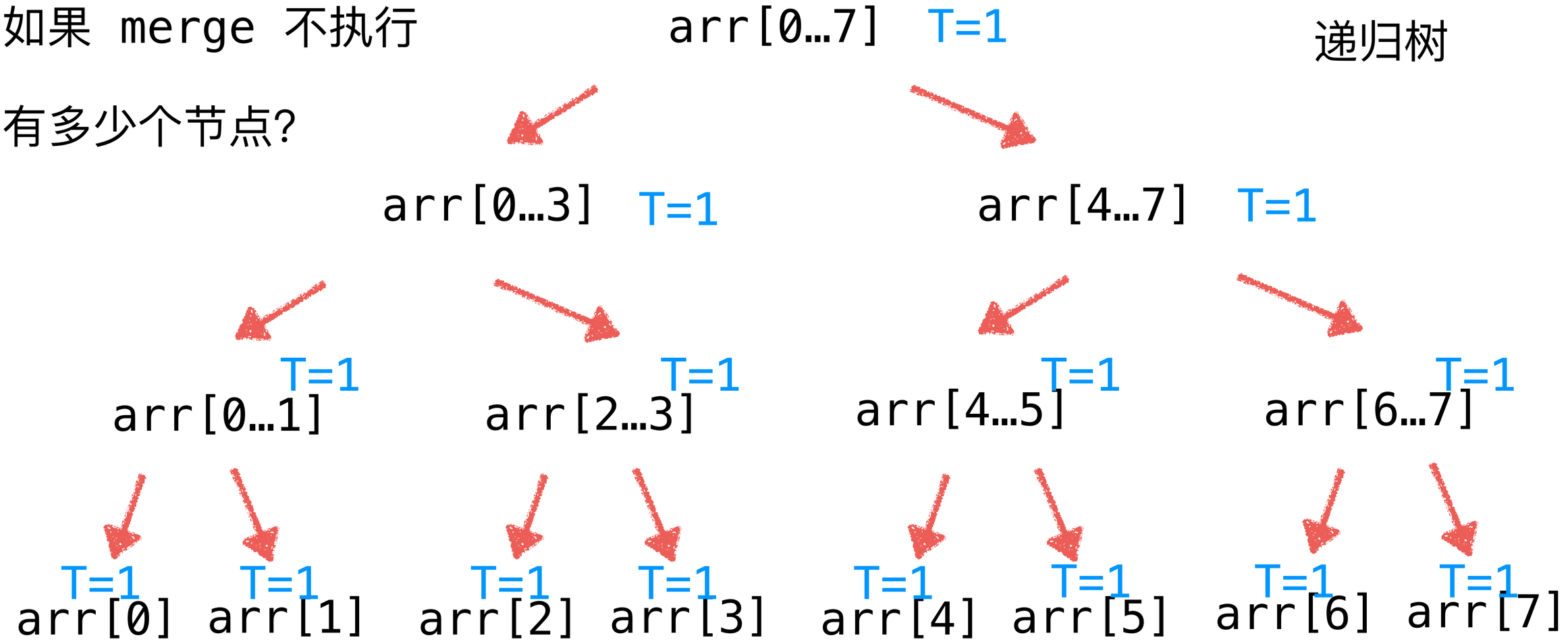
归并排序法的复杂度分析



归并排序法的复杂度分析

如果 merge 不执行

有多少个节点?



归并排序法的复杂度分析

非叶子节点：　n/2 + n/4 + n/8 + … + 1

$$= \frac{\frac{n}{2}(1-(\frac{1}{2})^m)}{\frac{1}{2}} \quad < n \quad = O(n)$$

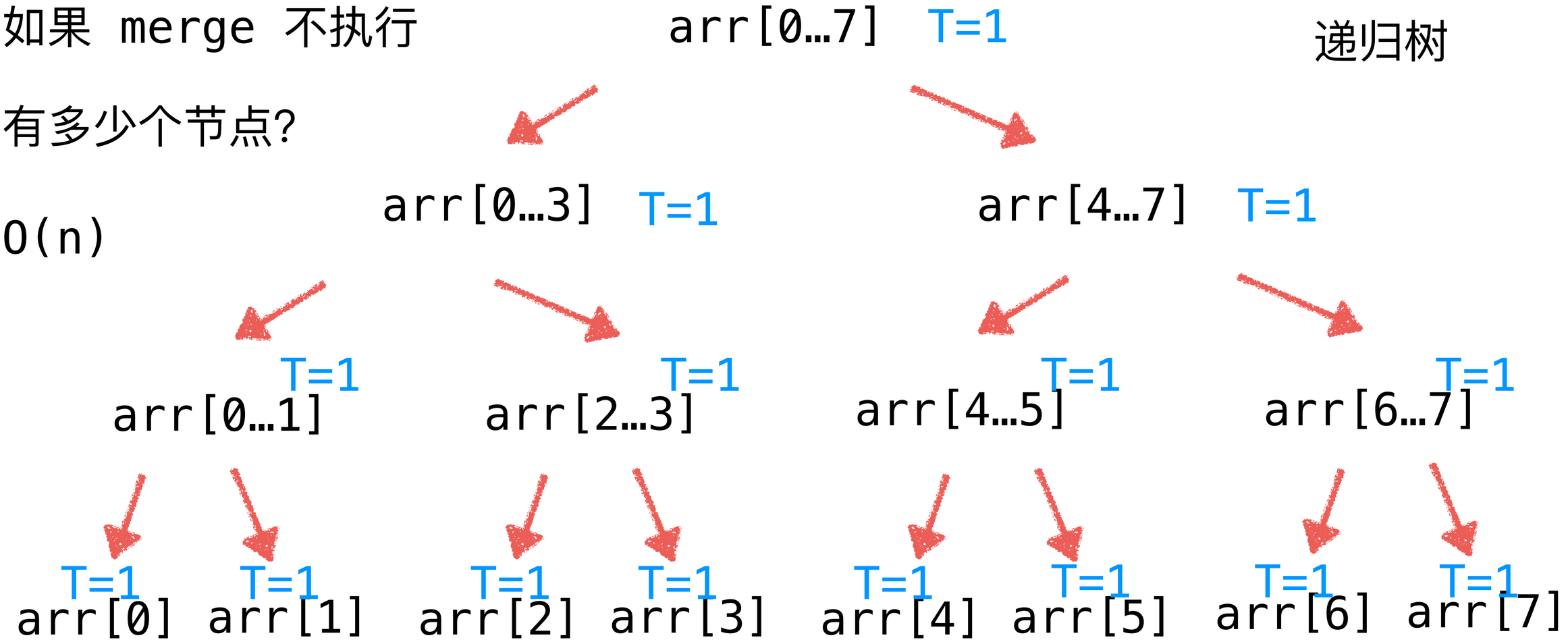
叶子节点：　n

归并排序法的复杂度分析

如果 merge 不执行

有多少个节点?

O(n)



归并排序法的复杂度分析

对 merge 进行判断后，对完全有序的数组归并排序是 O(n) 的

插入排序法对完全有序的数组是 O(n) 的

使用插入排序法优化

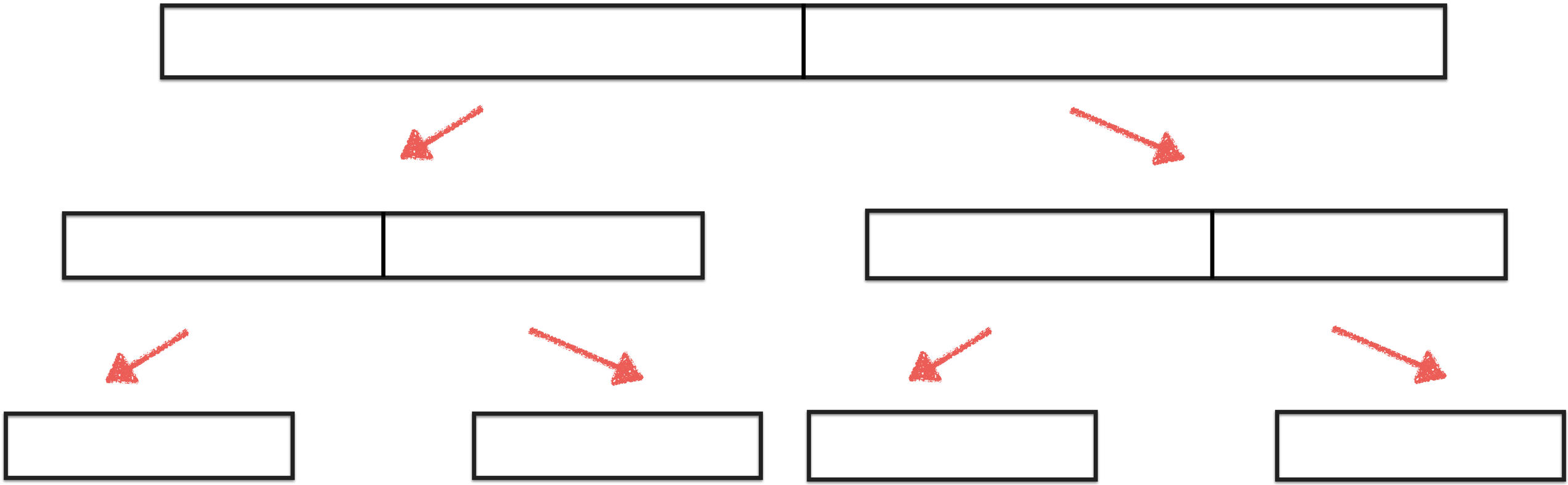
实践：使用插入排序优化

归并排序算法的内存优化

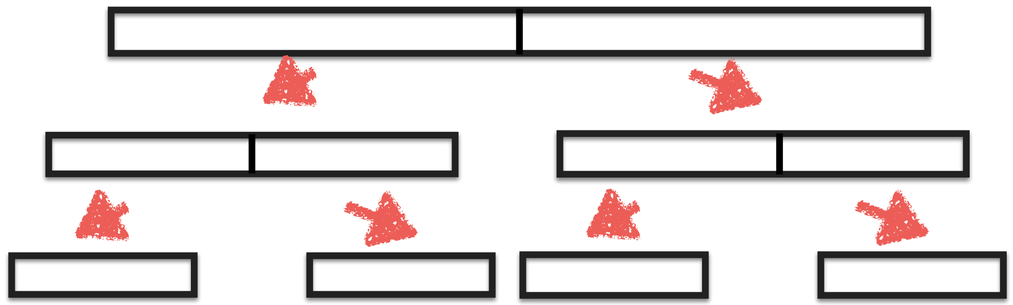
实践：使用统一的 temp

自底向上的归并排序算法

归并排序法



归并排序法



注意递归函数的“宏观”语意

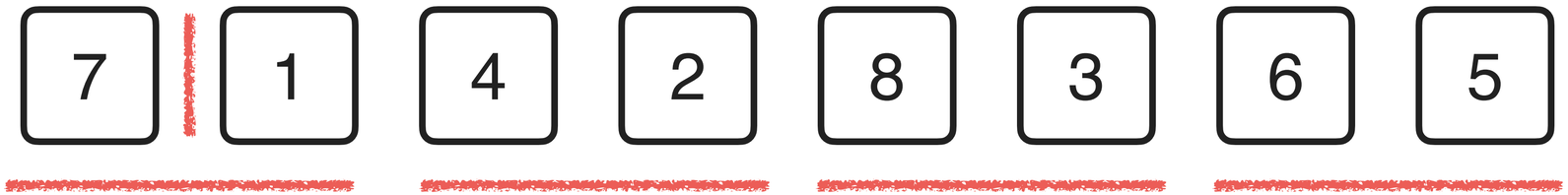
`MergeSort(arr, l, r)`

对 arr 的 [l, r] 部分排序

```
MergeSort(arr, l, r){

    if(l >= r) return;

    int mid = (l + r) / 2;

    // 对 arr[l, mid] 进行排序
    MergeSort(arr, l, mid);

    // 对 arr[mid + 1, r] 进行排序
    MergeSort(arr, mid + 1, r);

    // 将arr[l,mid]和arr[mid+1,r]合并
    merge(arr, l, mid, r);

}
```

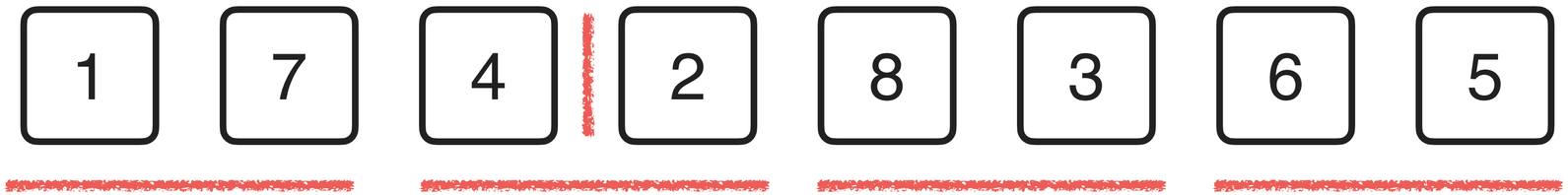
自底向上归并排序

sz = 1



自底向上归并排序

sz = 1



自底向上归并排序

sz = 1

自底向上归并排序

```
sz = 1
```

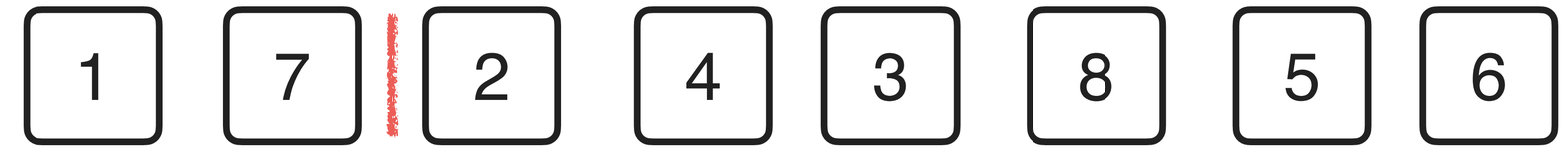
自底向上归并排序

```
sz = 1
```

自底向上归并排序

sz = 1

sz = 2



自底向上归并排序

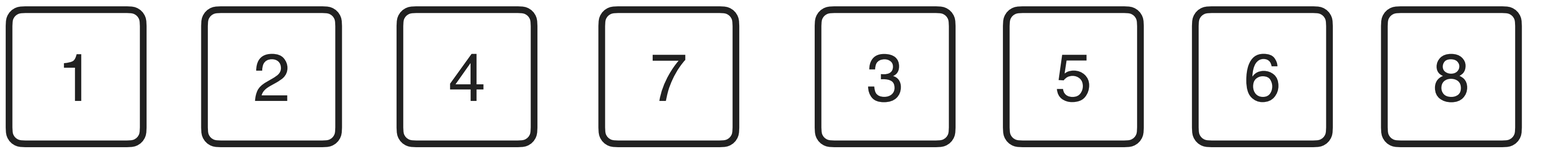
sz = 1

sz = 2

自底向上归并排序

sz = 1

sz = 2

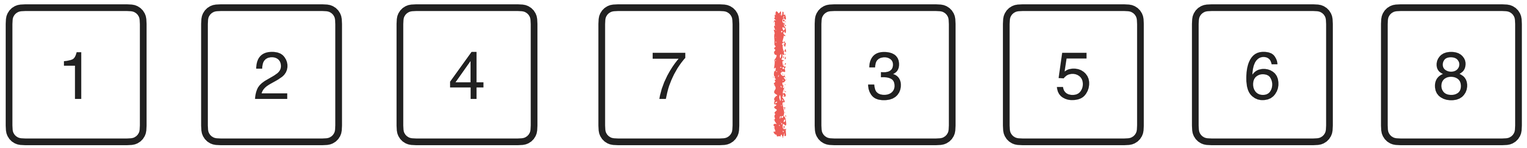


自底向上归并排序

sz = 1

sz = 2

sz = 4

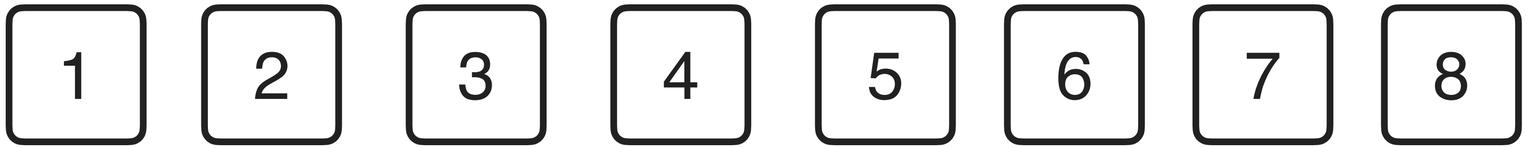


自底向上归并排序

sz = 1

sz = 2

sz = 4



自底向上归并排序

sz = 1

sz = 2

sz = 4

sz = 8

实现自底向上的归并排序

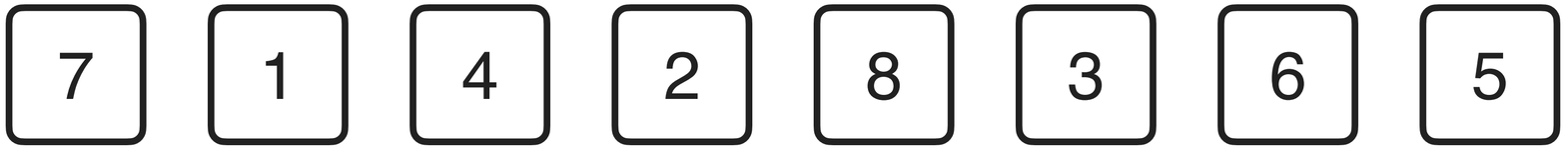
实践：实现自底向上的归并排序

作业：使用插入排序
优化自底向上的归并排序

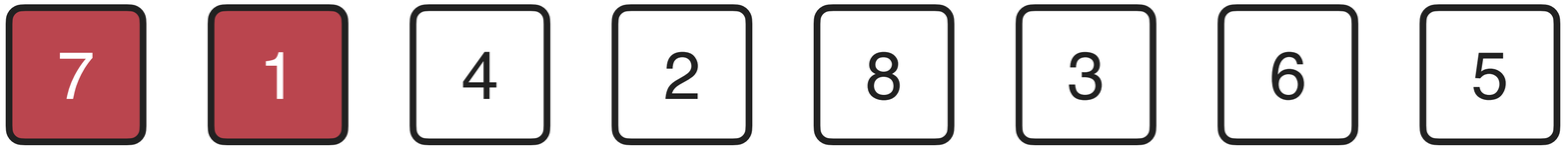
作业解析：使用插入排序优化自底向上的归并排序

逆序数对个数问题

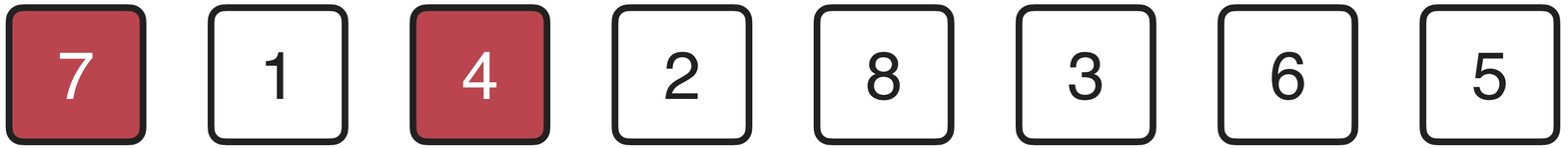
逆序数对个数



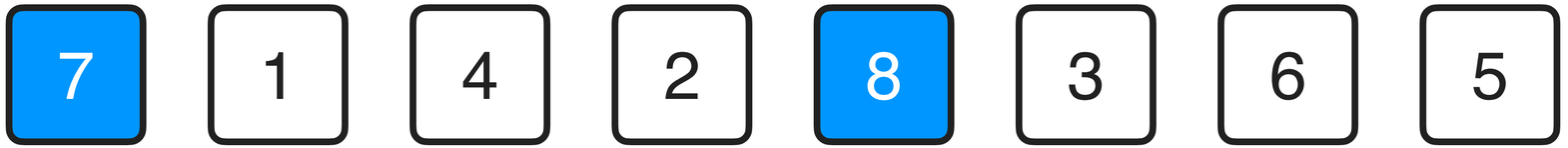
逆序数对个数



逆序数对个数



逆序数对个数

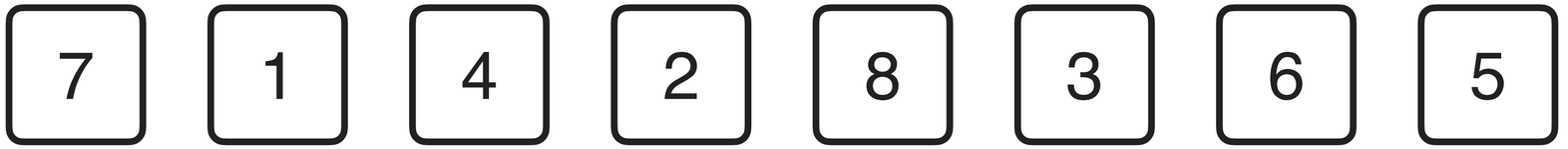


逆序数对个数

最朴素的想法：遍历所有的数据对

```
for(int i = 0; i < n; i ++)
    for(int j = i + 1; j < n; j ++)
        if(arr[i] > arr[j]) res ++;
```

O(n^2)

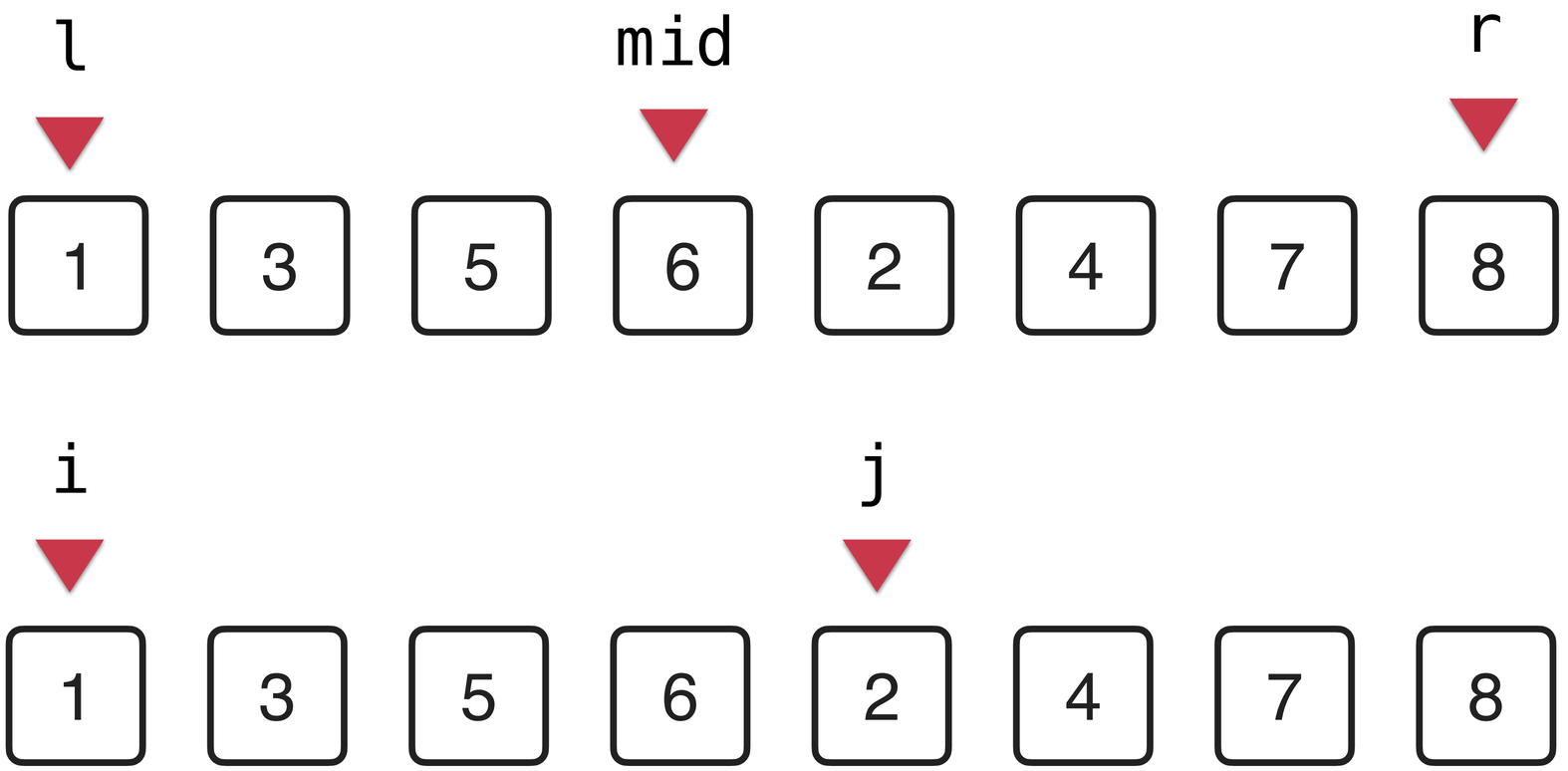


实验：暴力求解逆序数对问题

https://leetcode-cn.com/problems/shu-zu-zhong-de-ni-xu-dui-lcof/

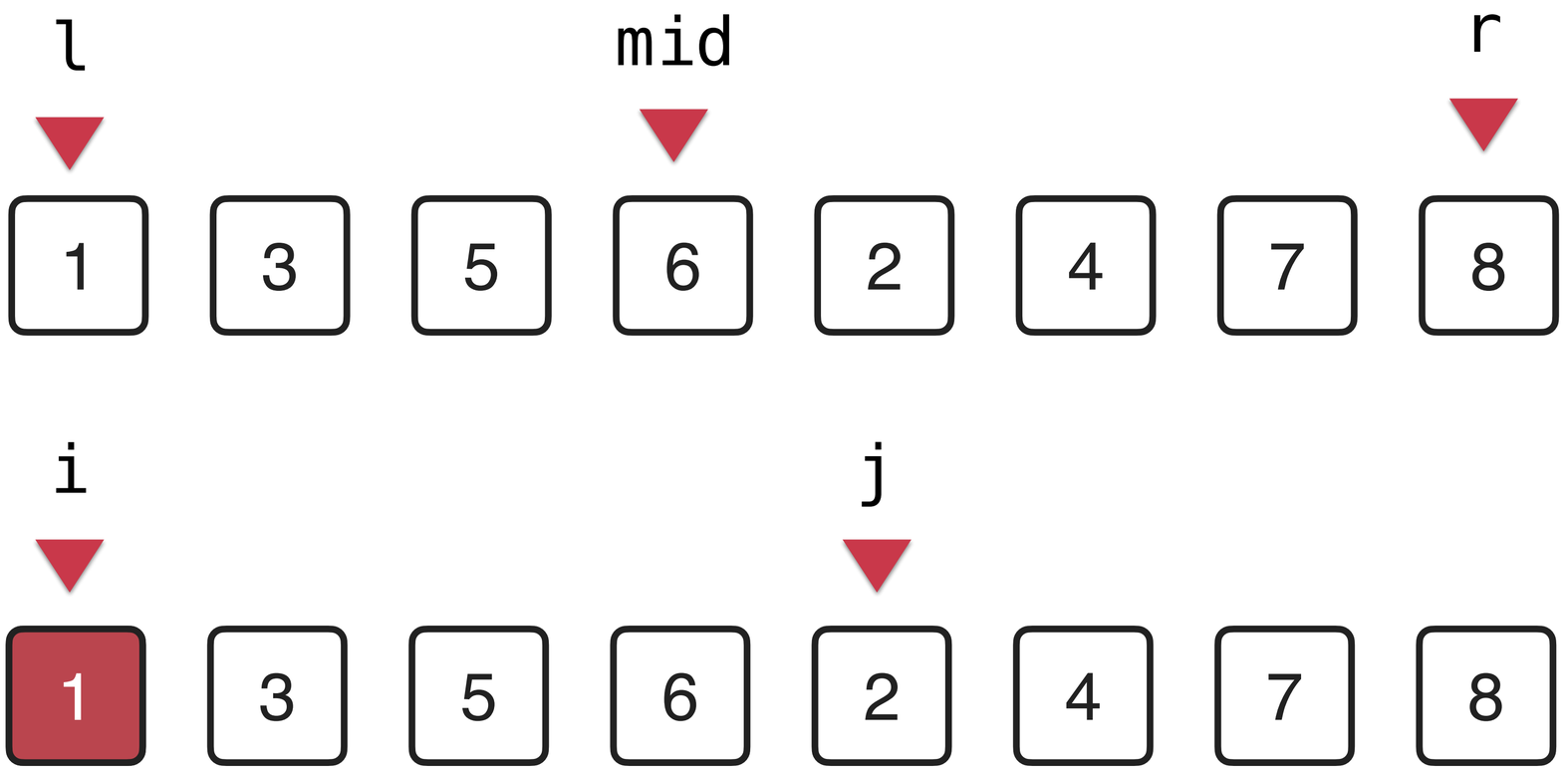
使用归并排序法求解逆序数对个数问题

归并过程

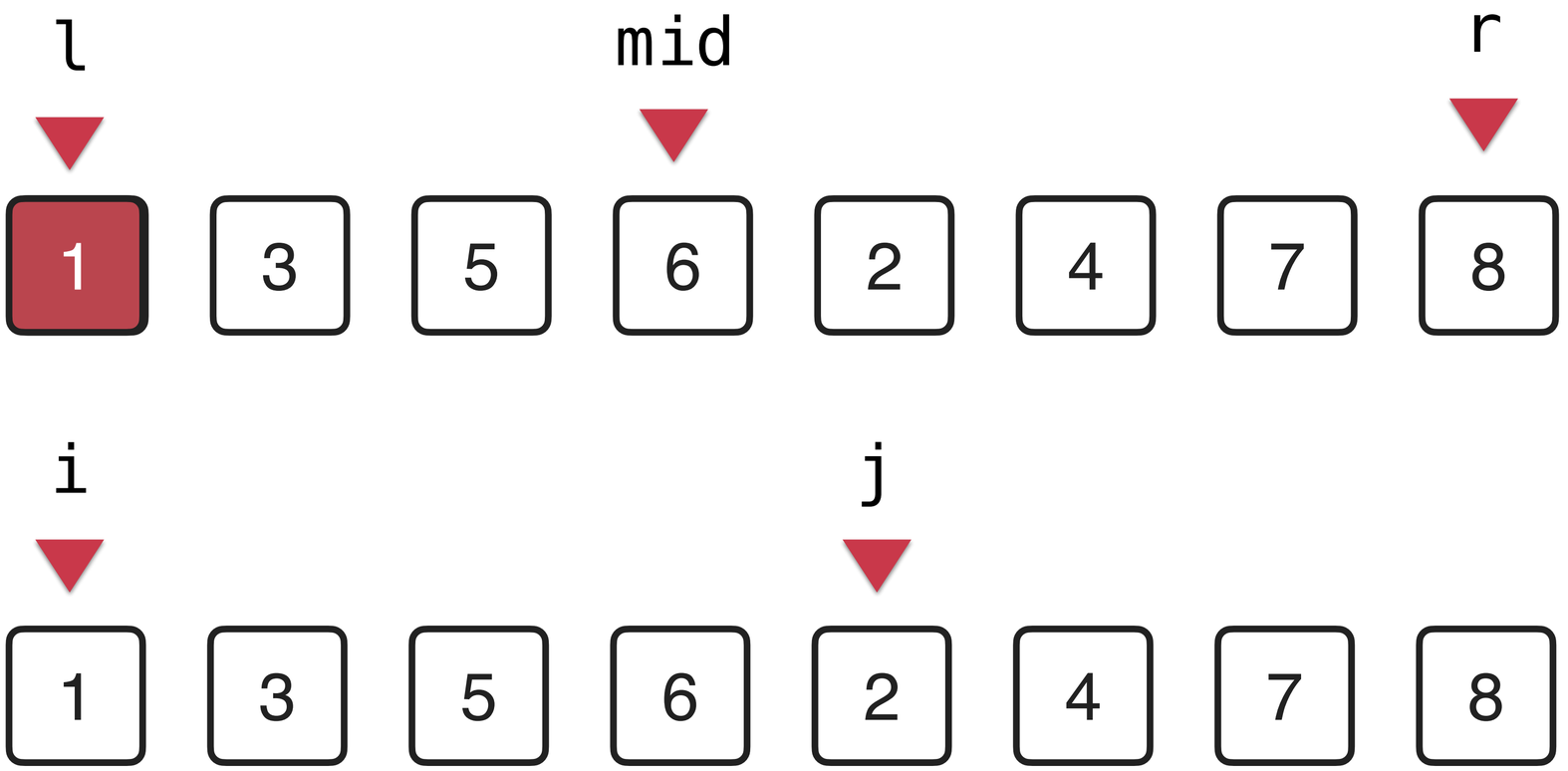


归并过程

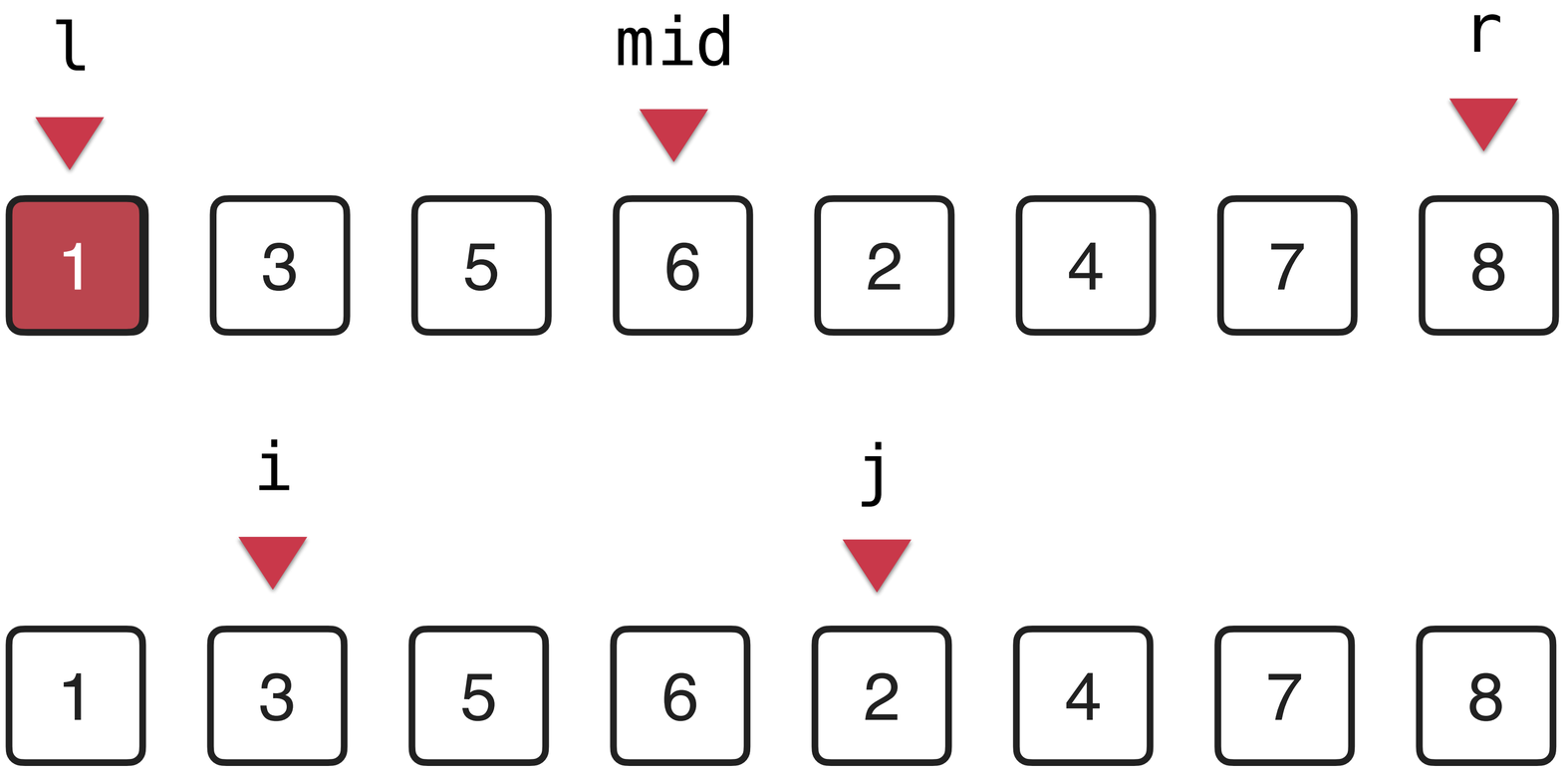
在整个区间，1 不和任何数字形成逆序数对



归并过程

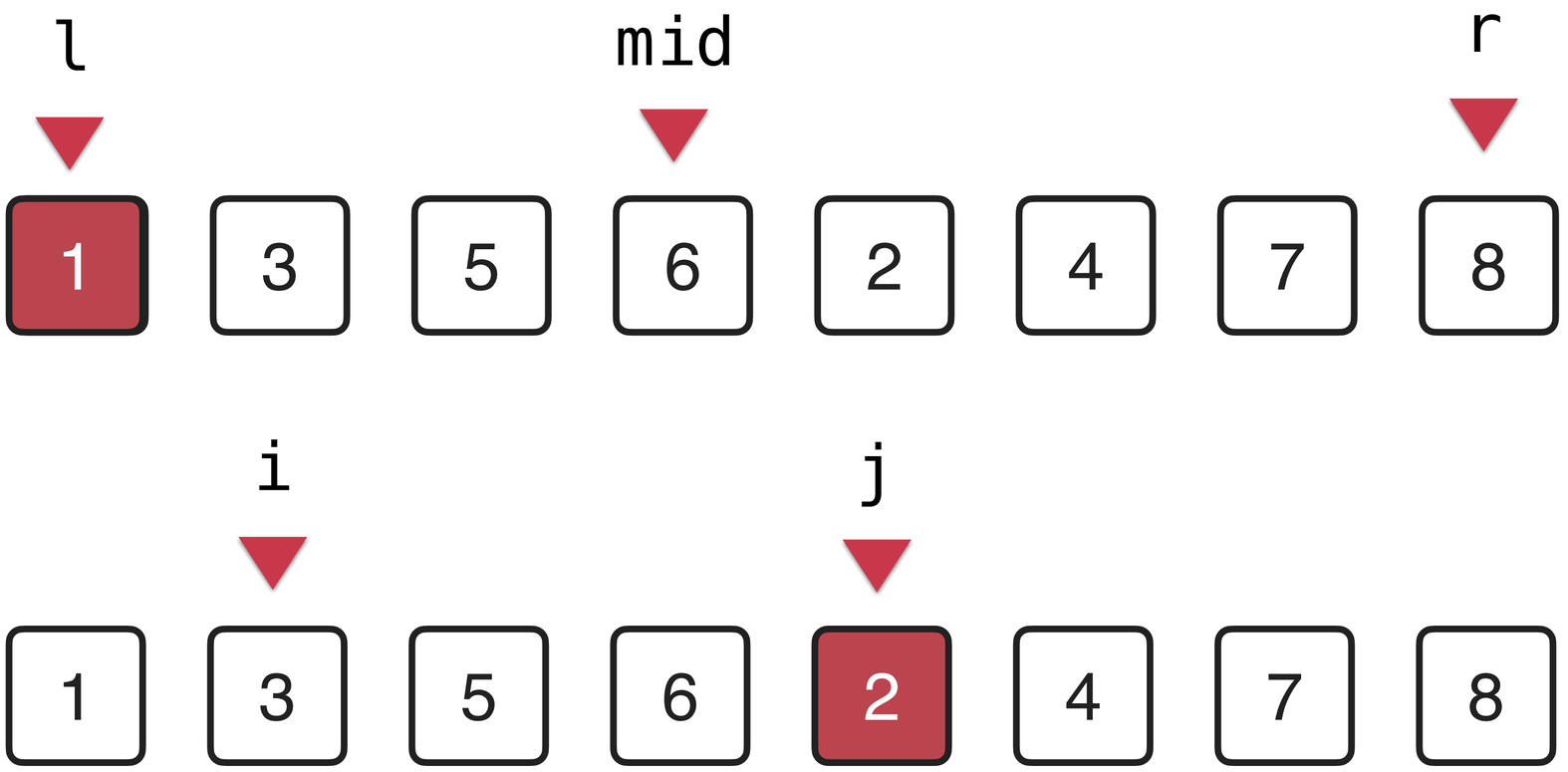


归并过程

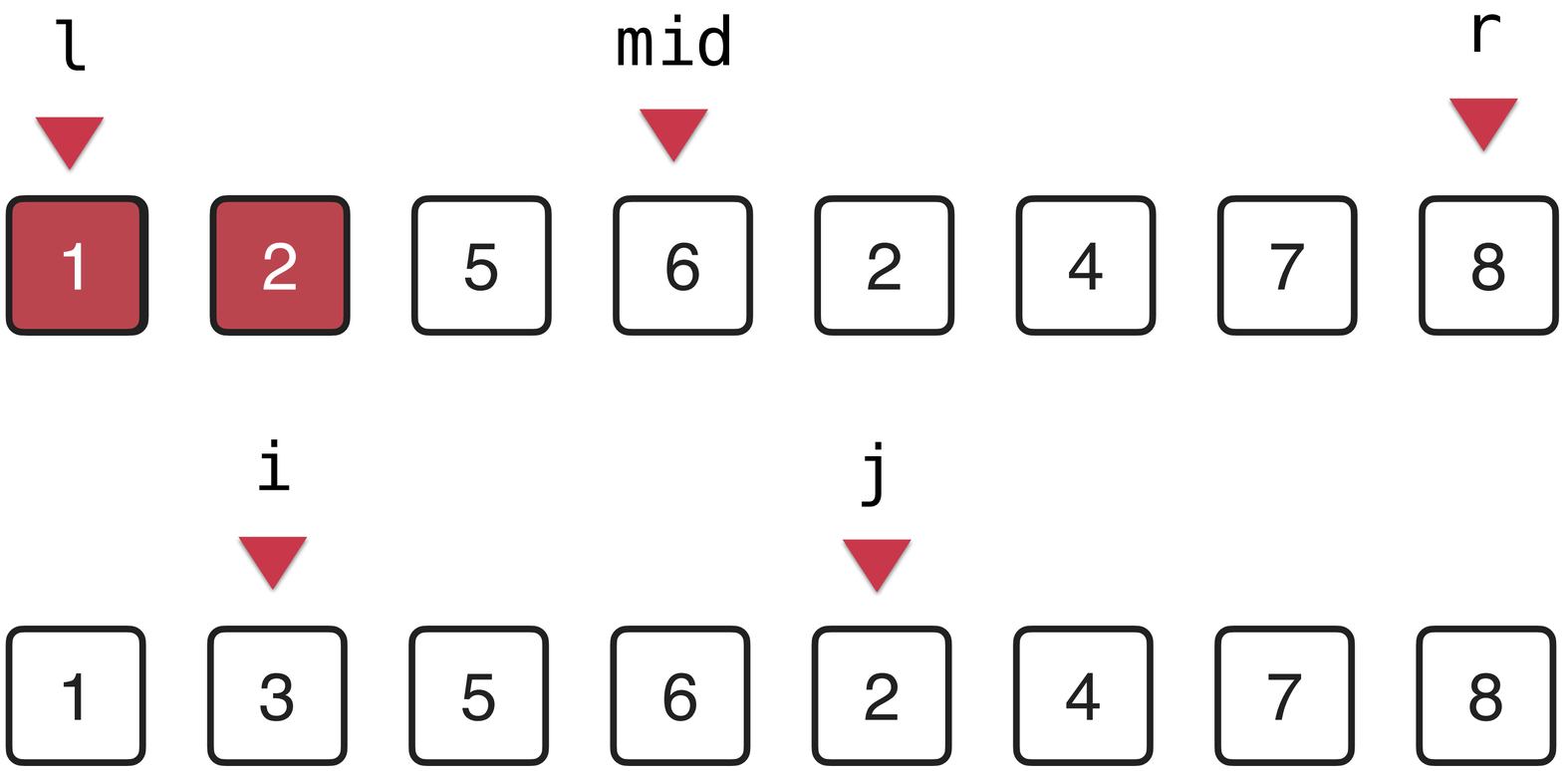


归并过程

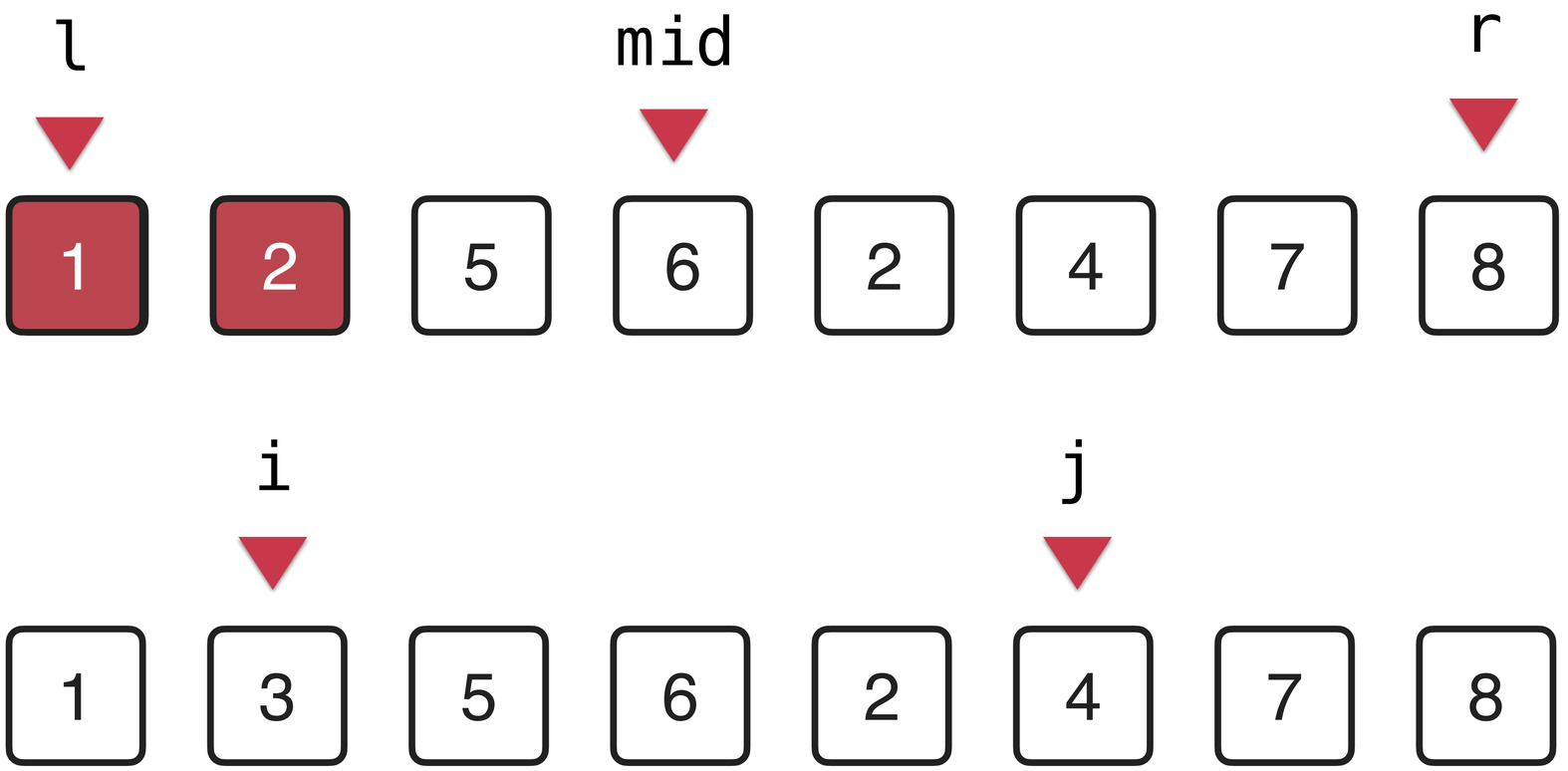
2 和 3，5，6 形成逆序数对



归并过程

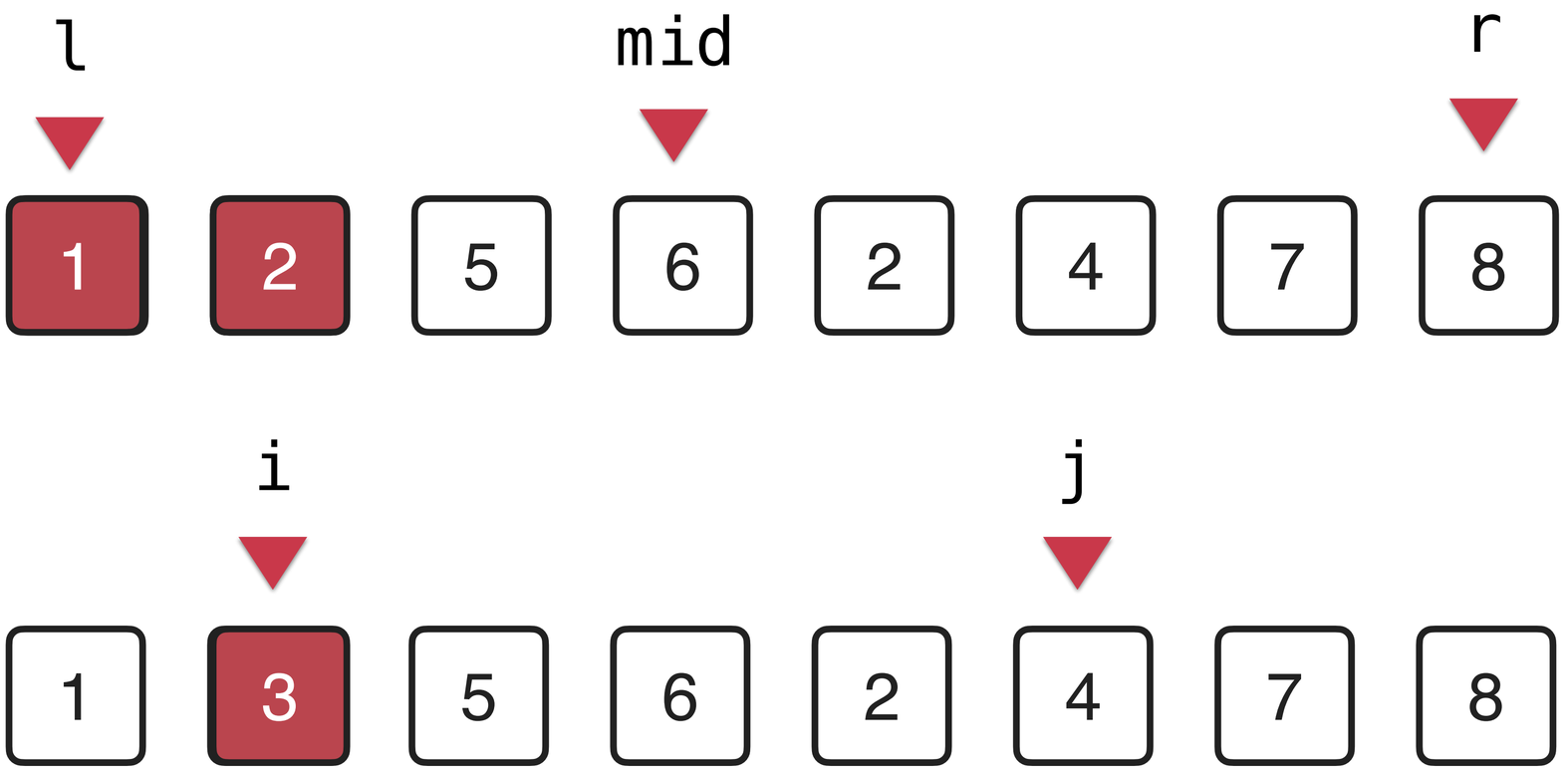


归并过程

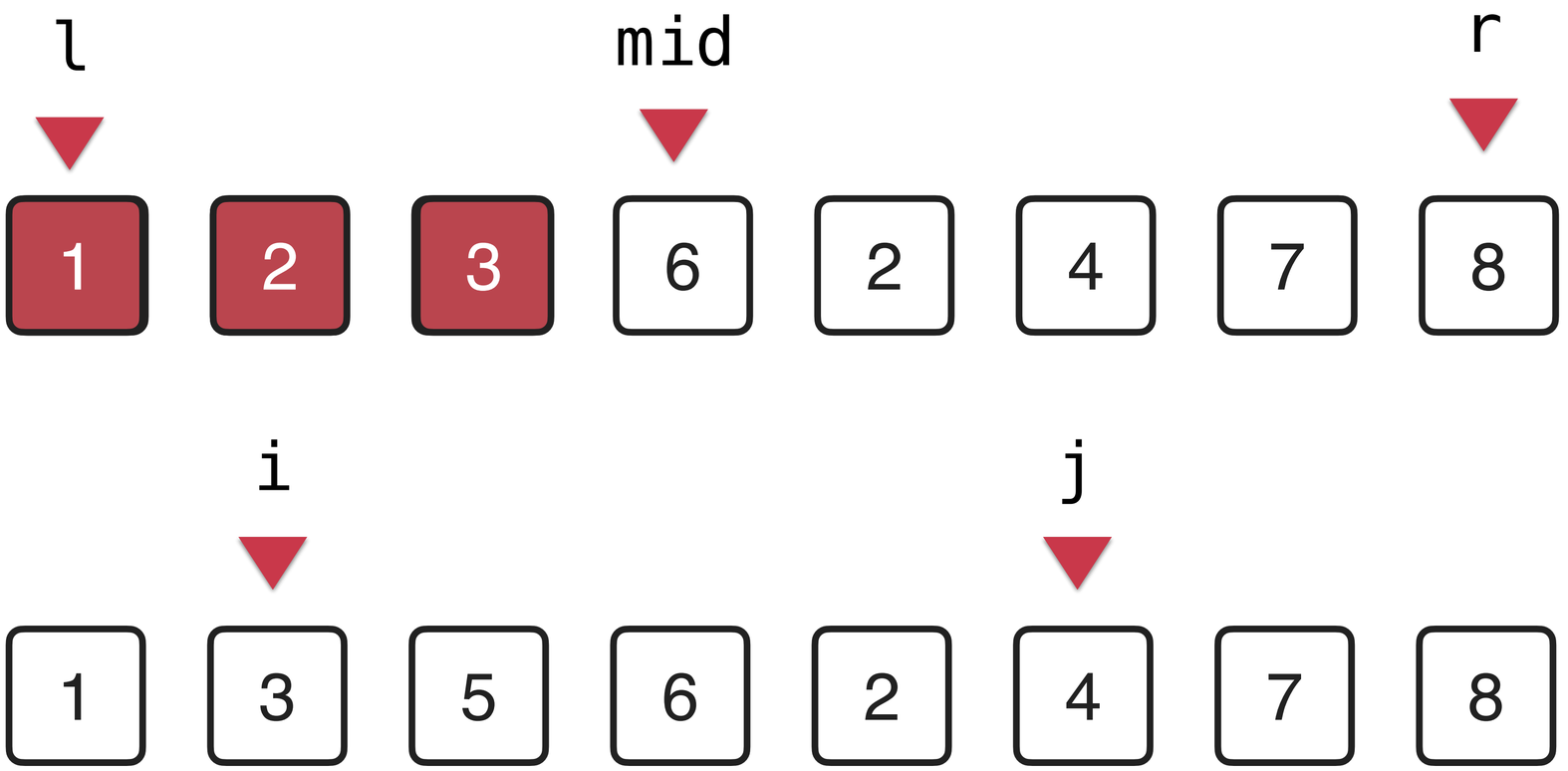


归并过程

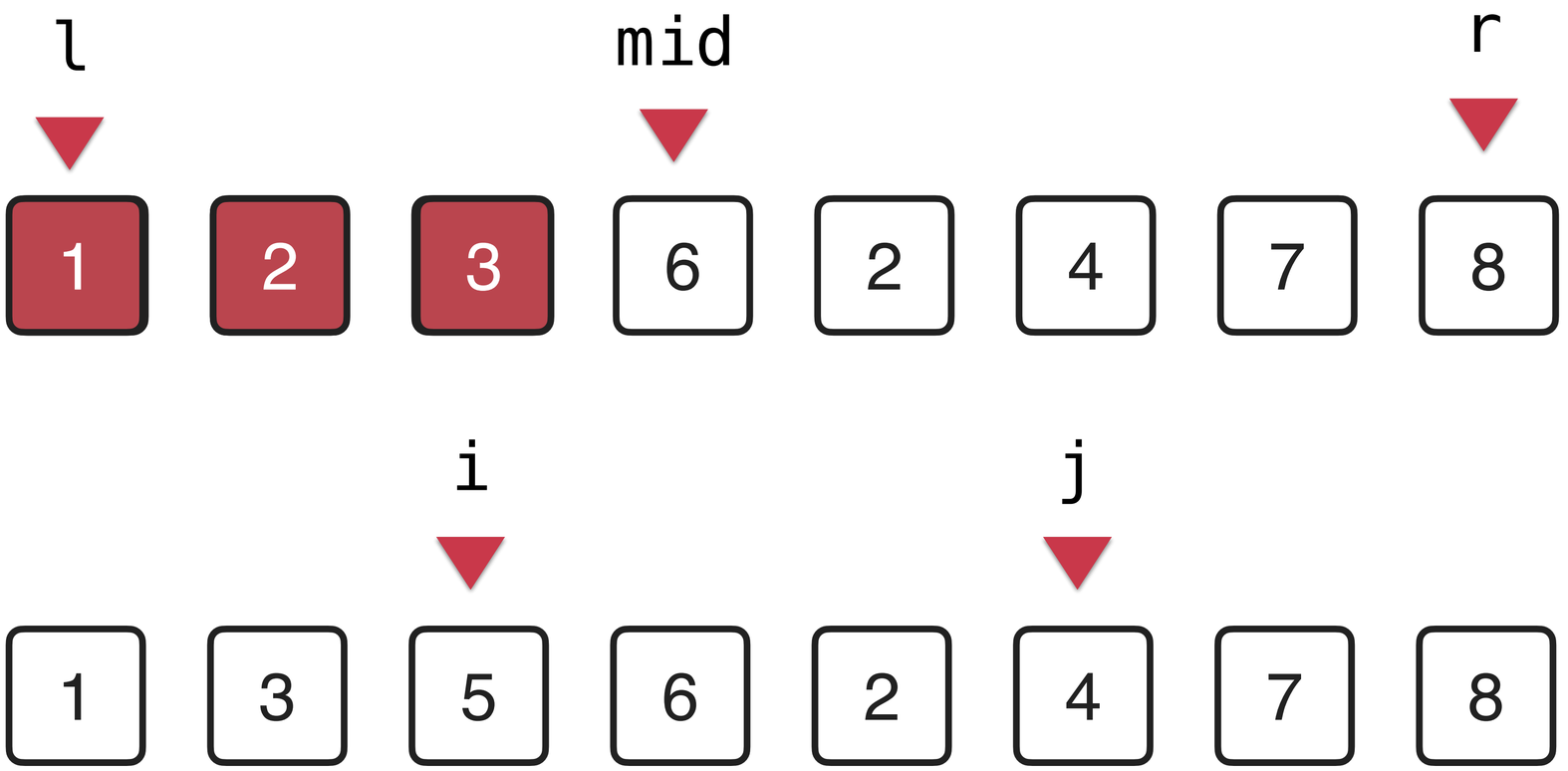
3 不和任何数字形成逆序数对



归并过程

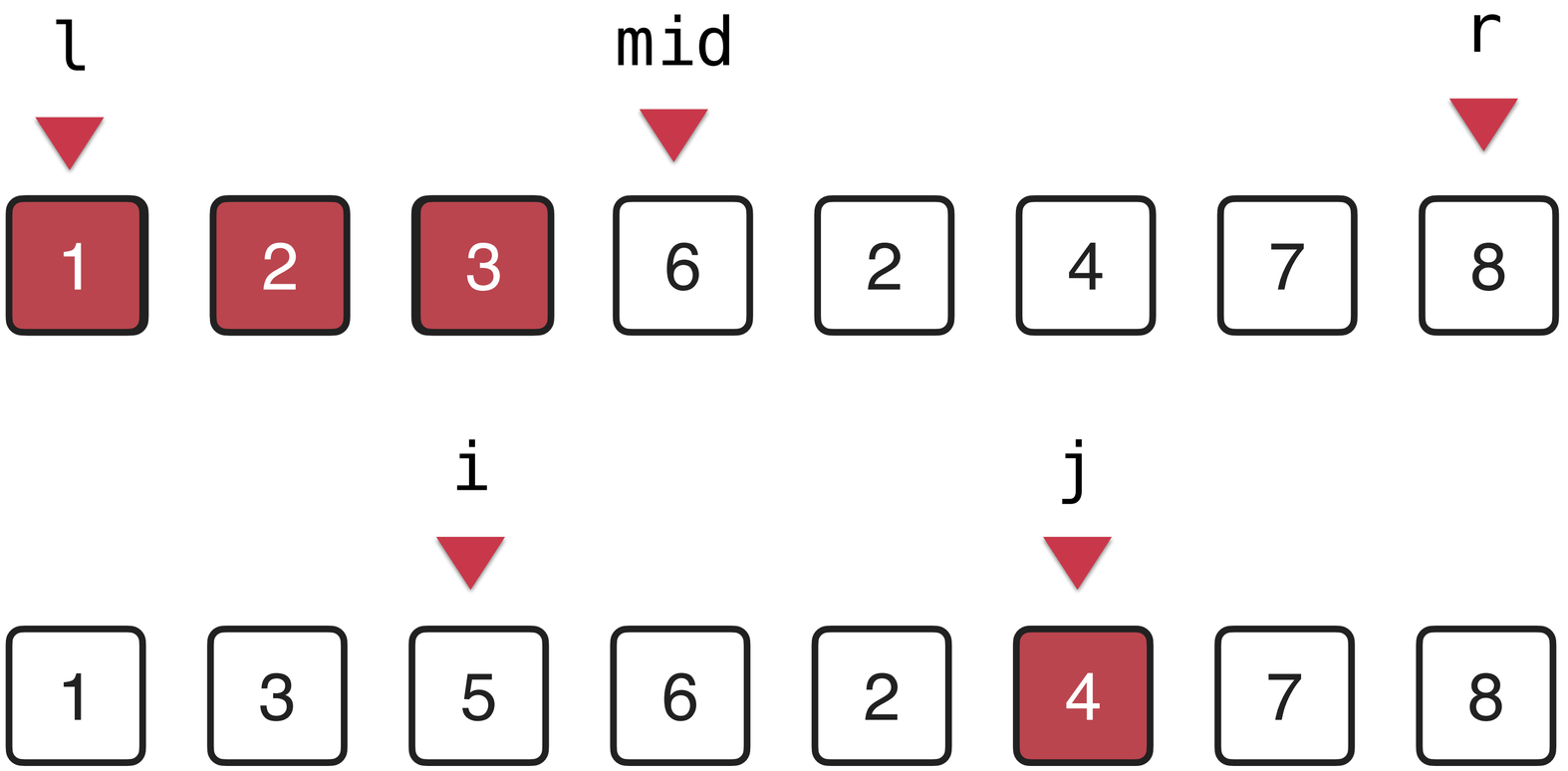


归并过程

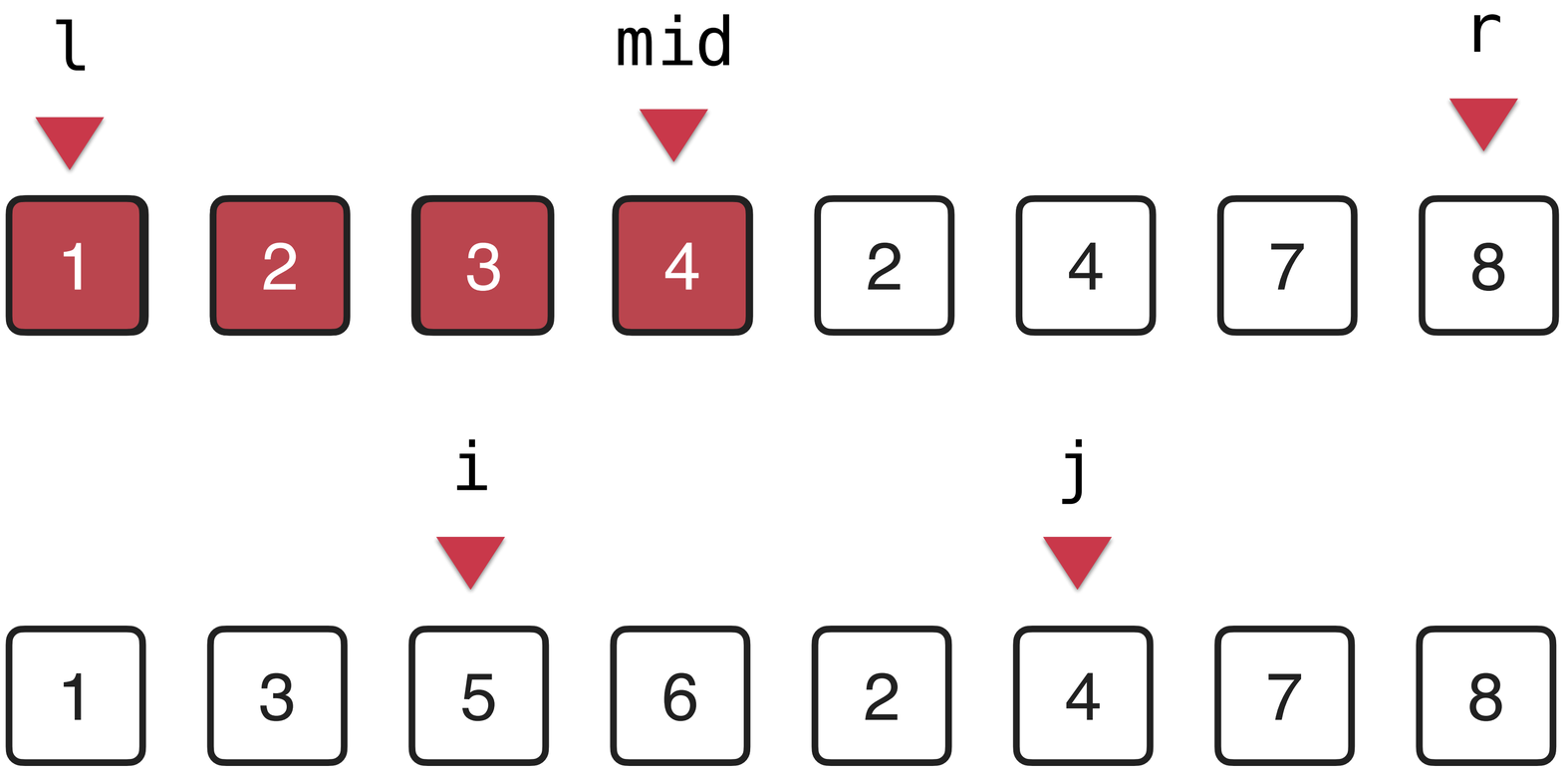


归并过程

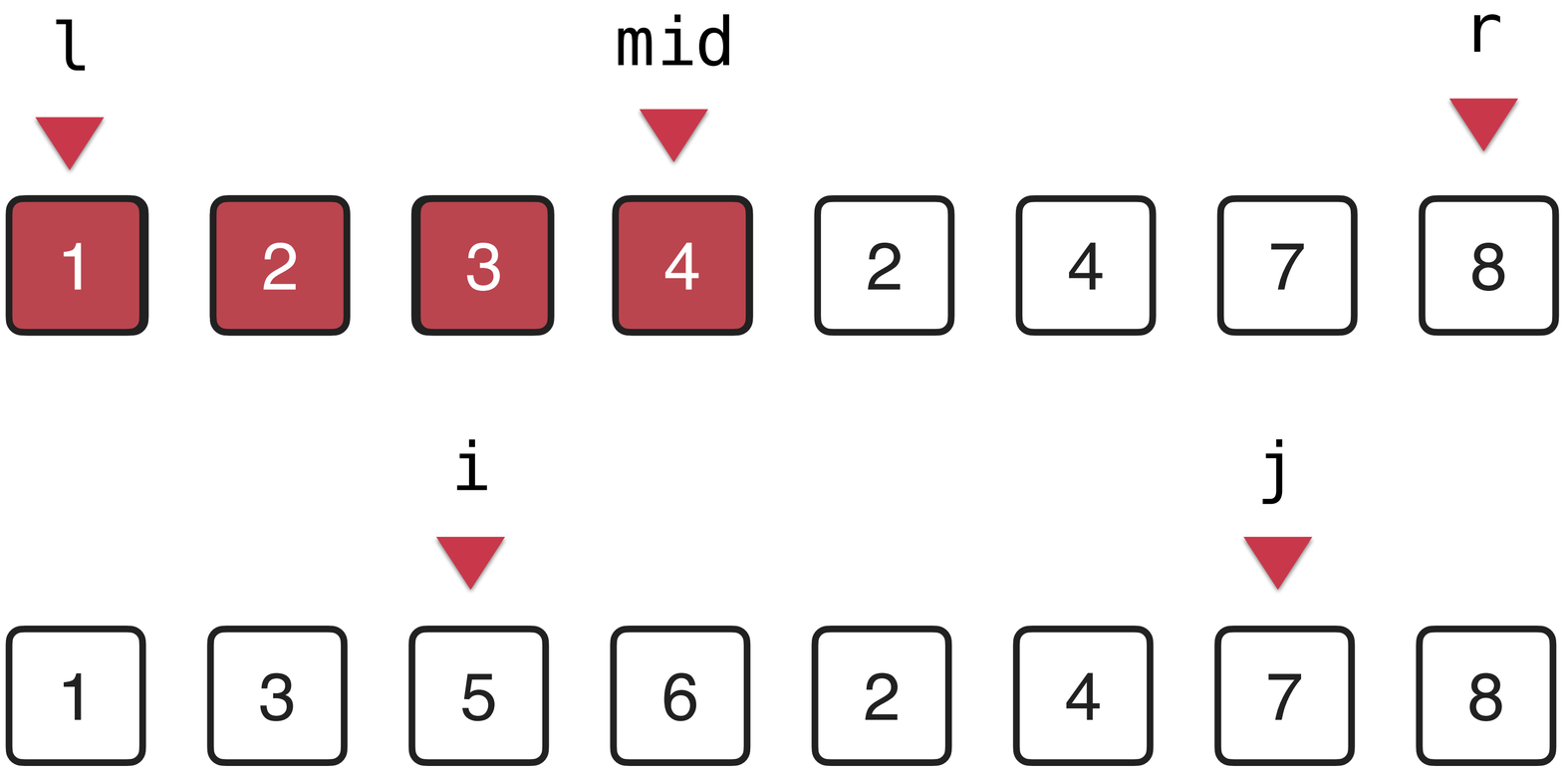
4 和 5，6 形成逆序数对



归并过程

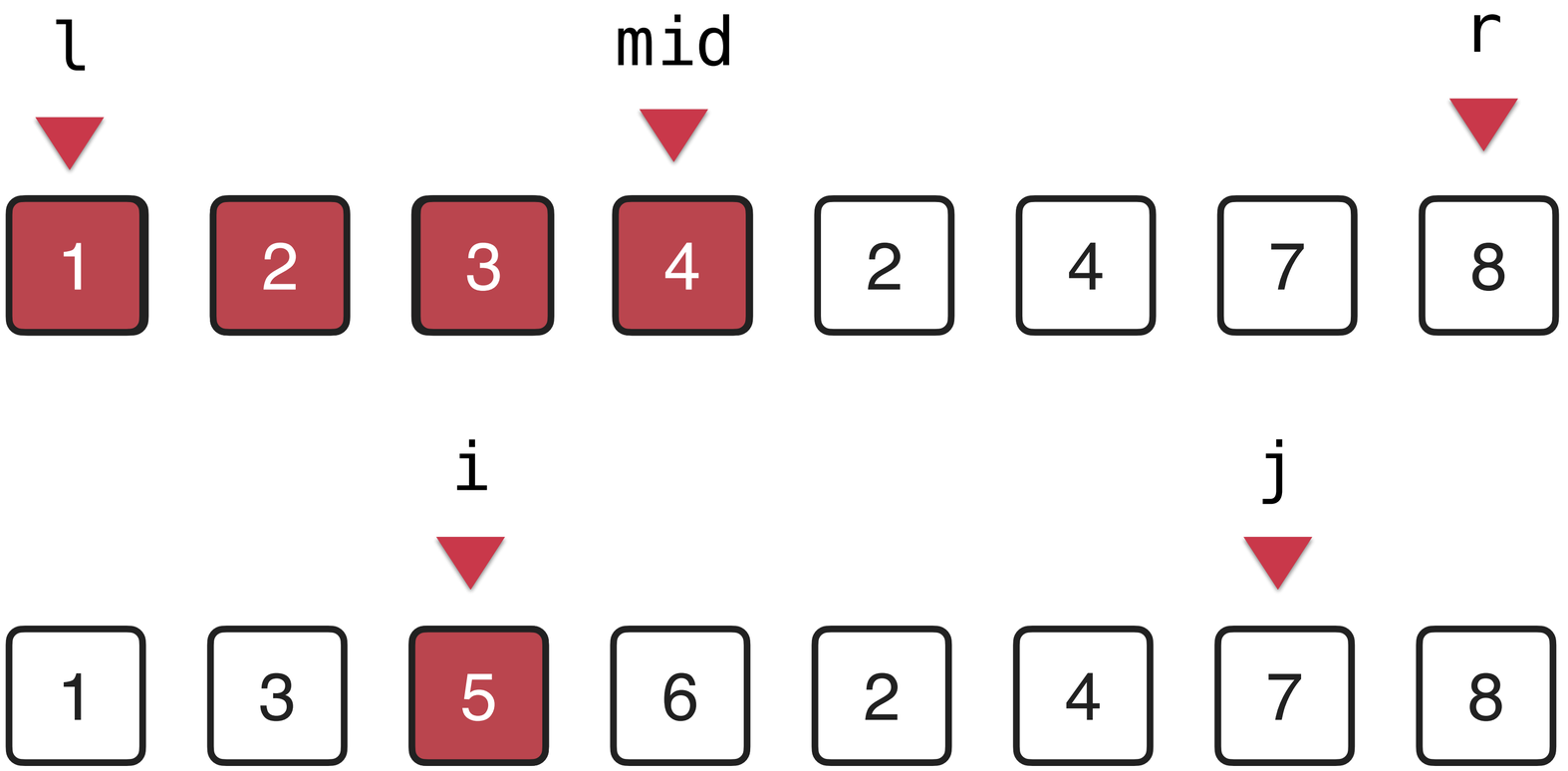


归并过程

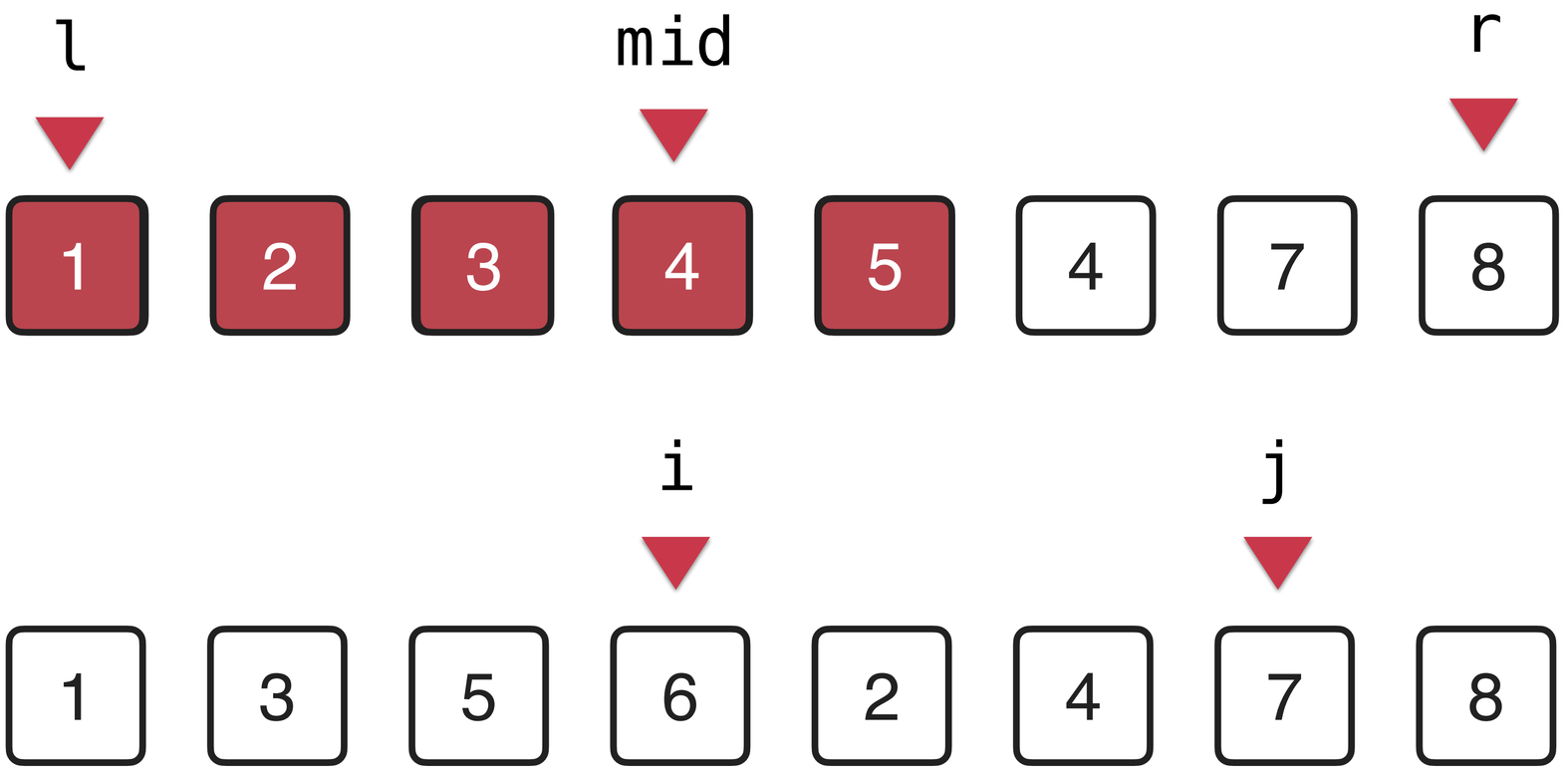


归并过程

5 不和任何数字形成逆序数对

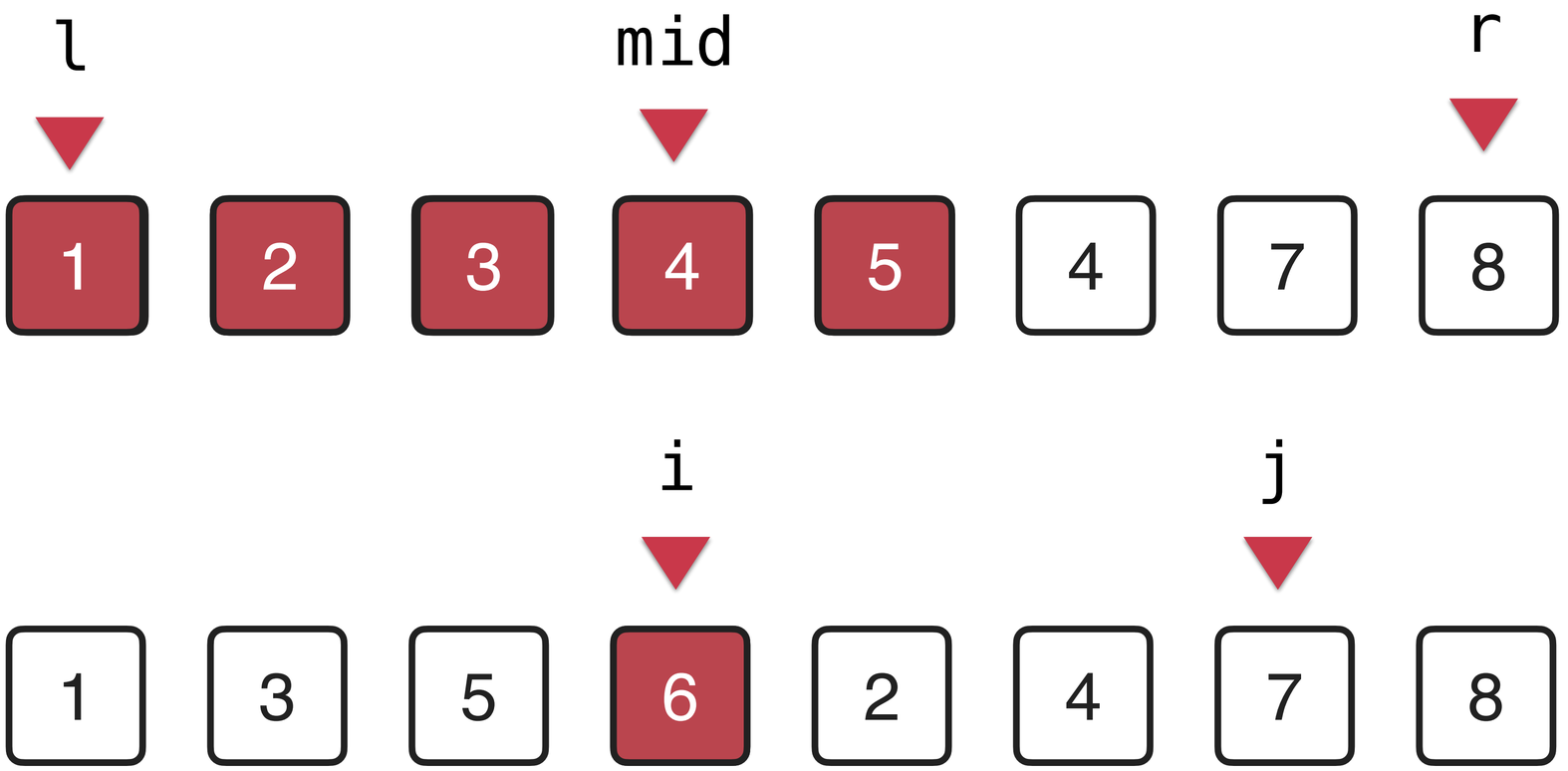


归并过程

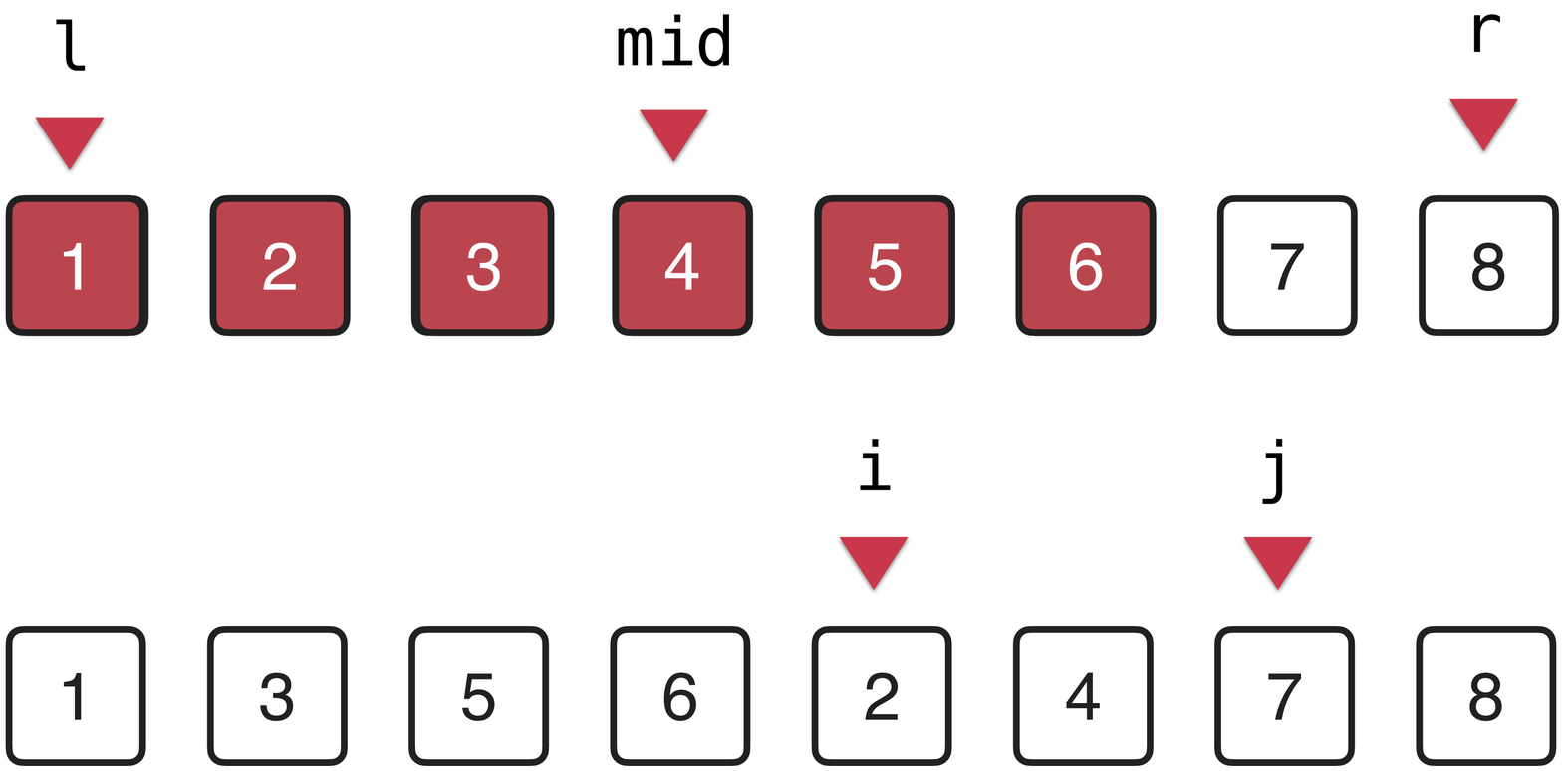


归并过程

6 不和任何数字形成逆序数对

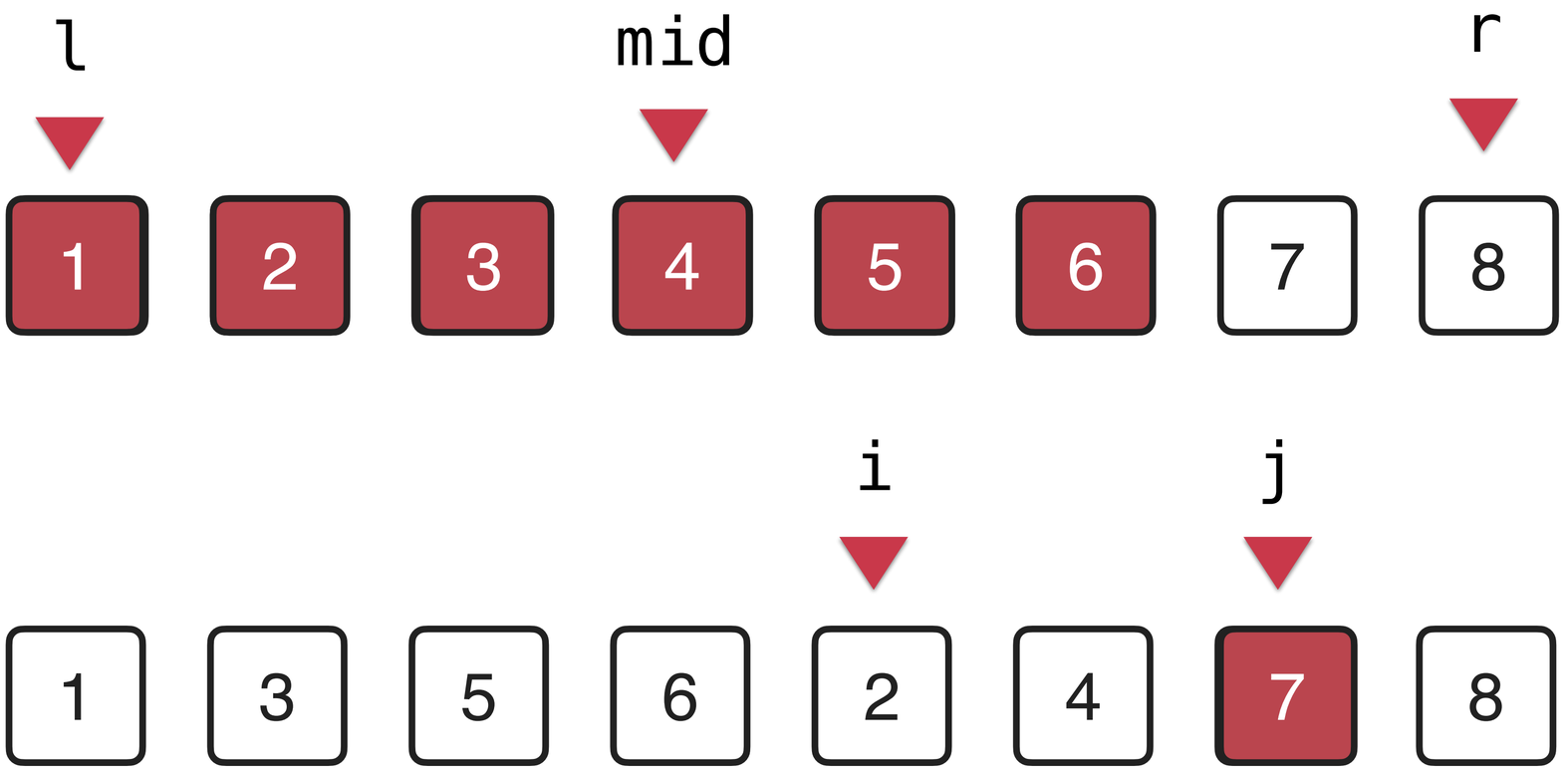


归并过程

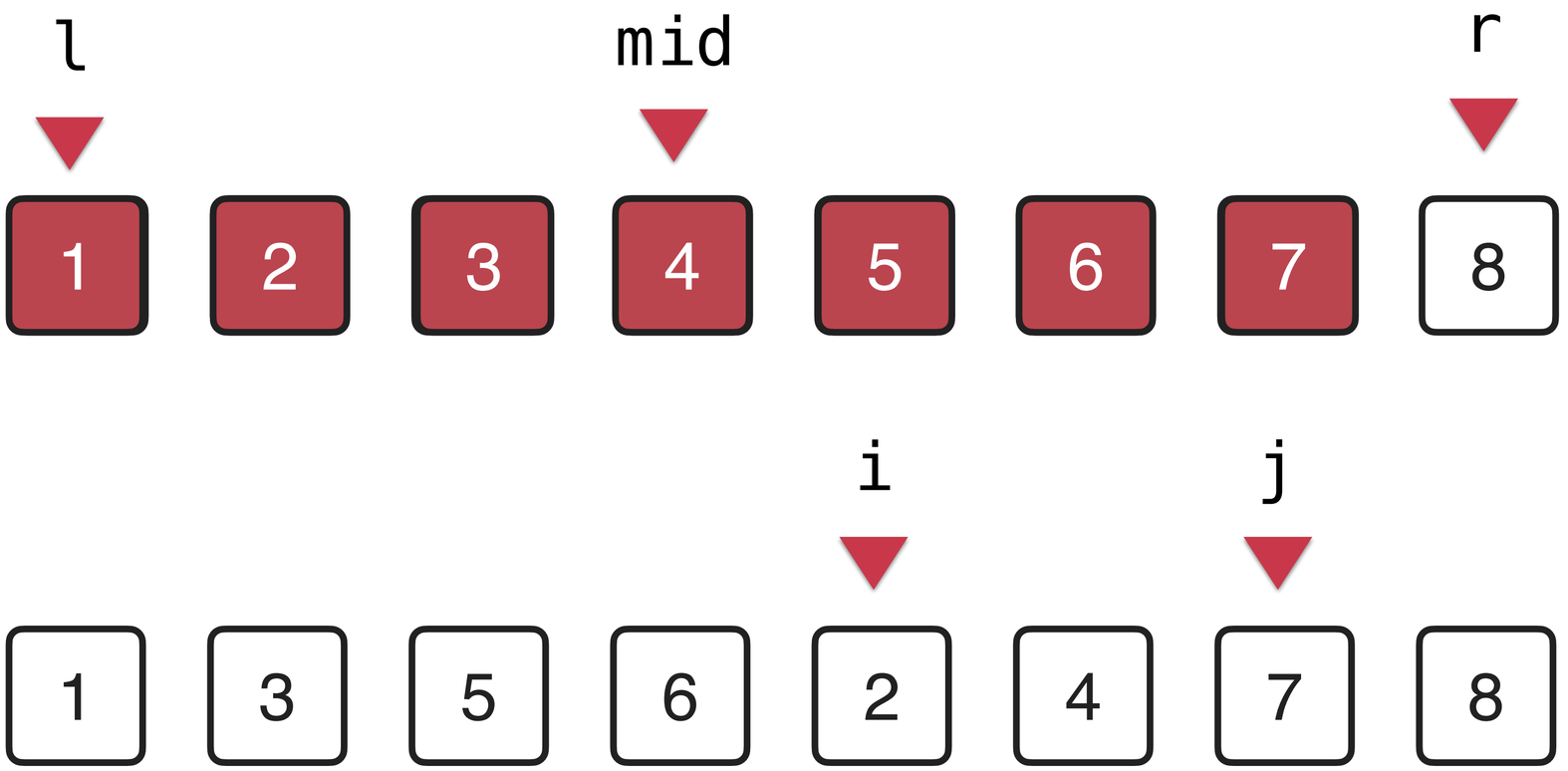


归并过程

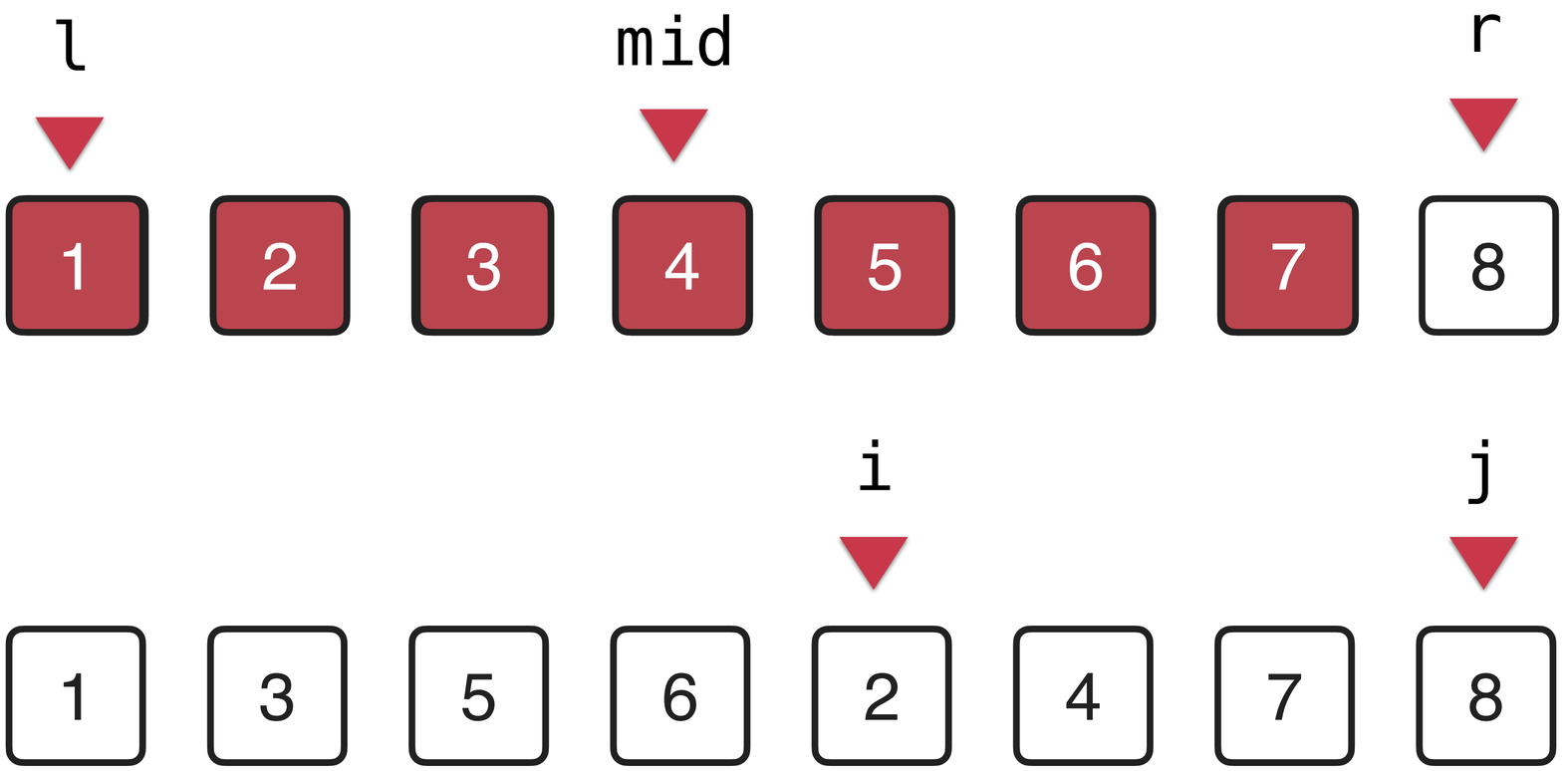
7 不和任何数字形成逆序数对



归并过程

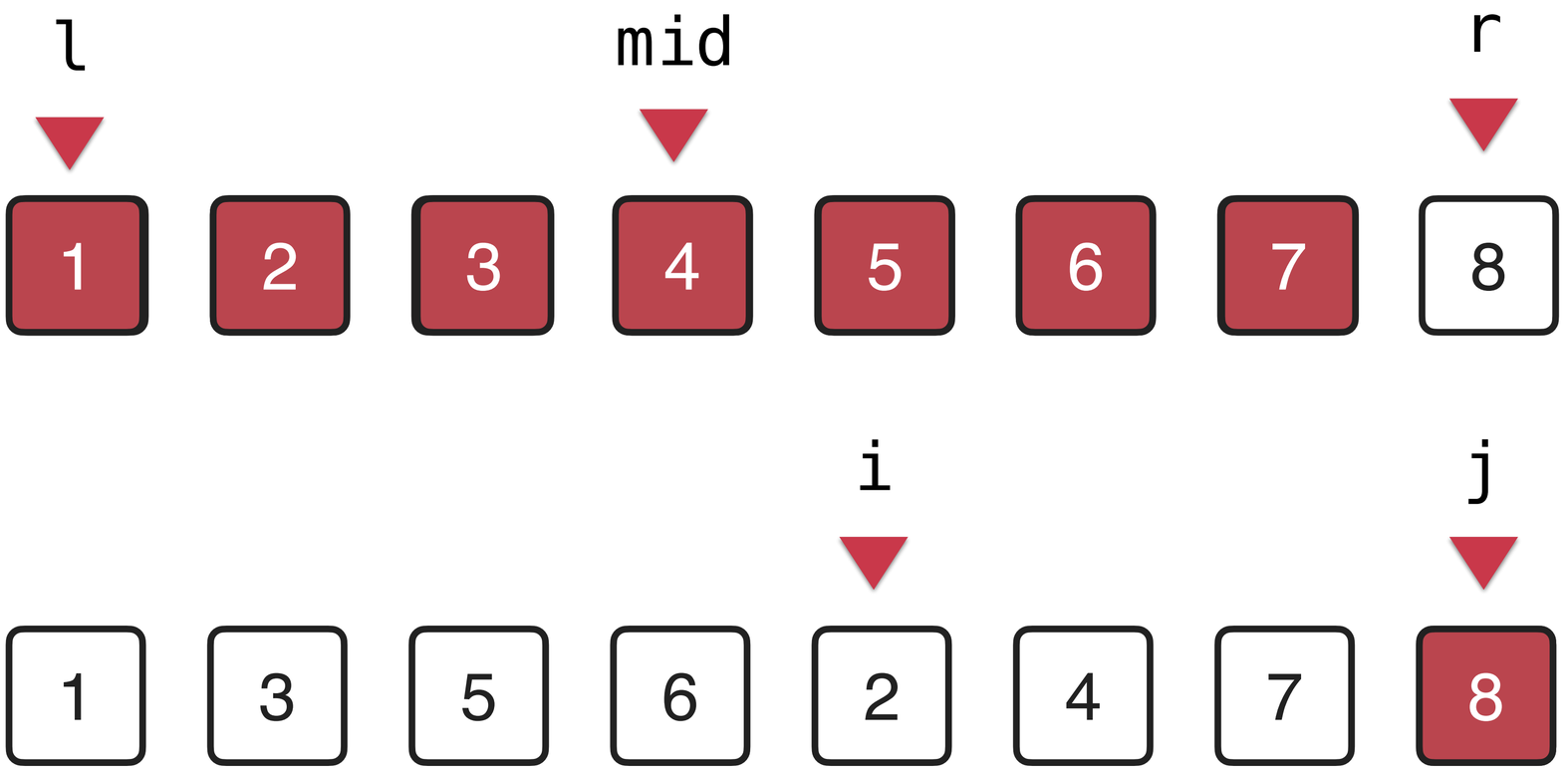


归并过程

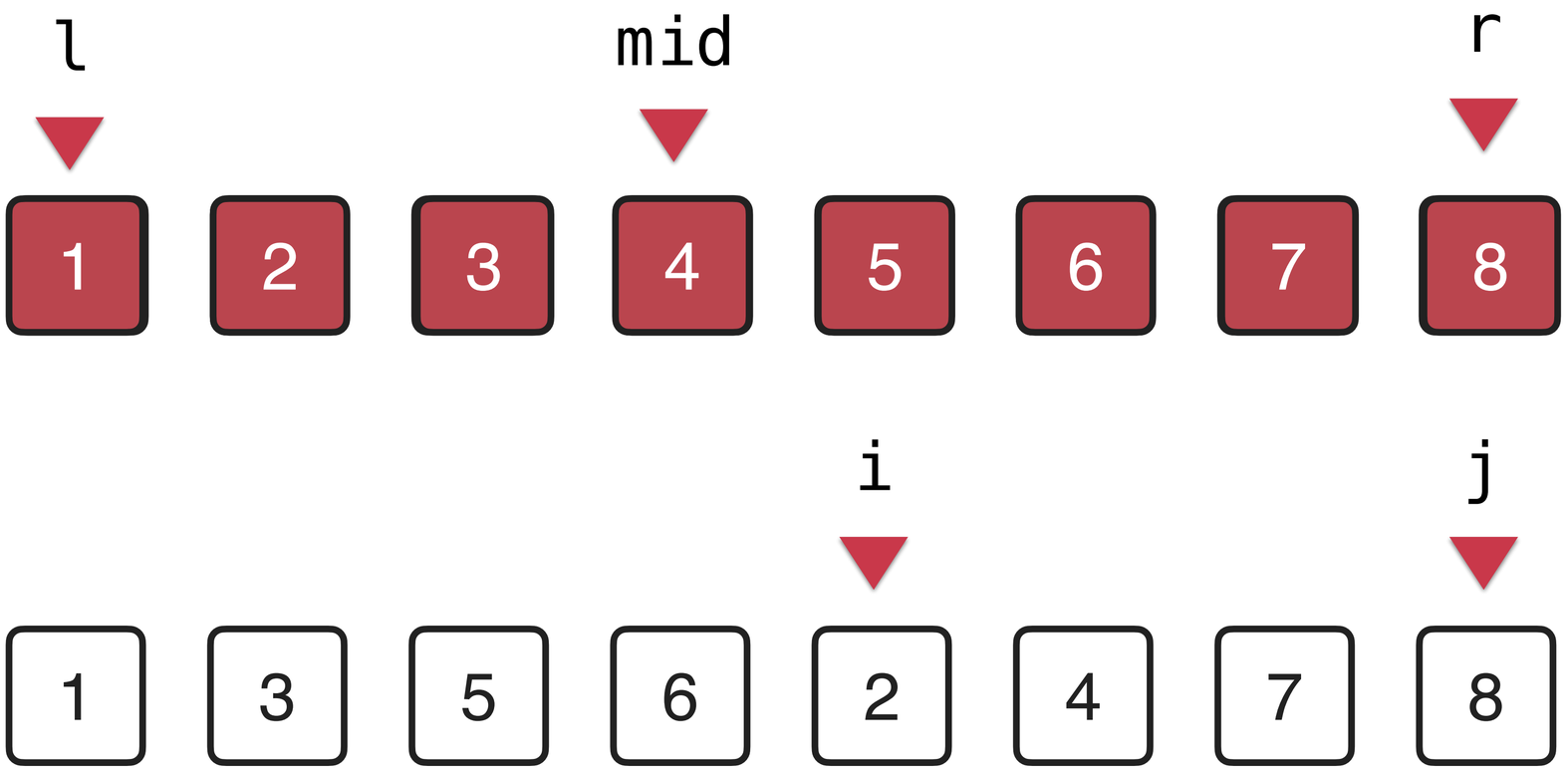


归并过程

8 不和任何数字形成逆序数对

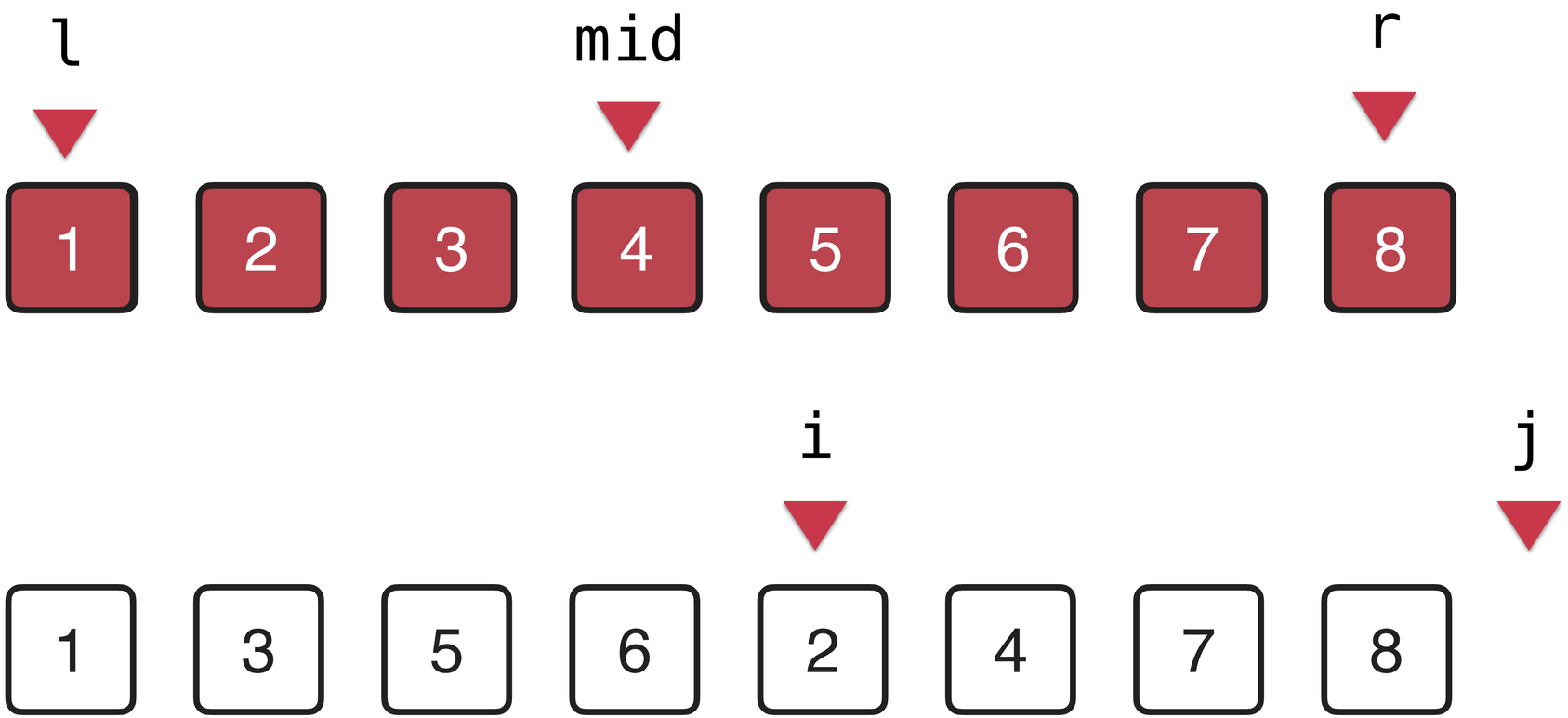


归并过程



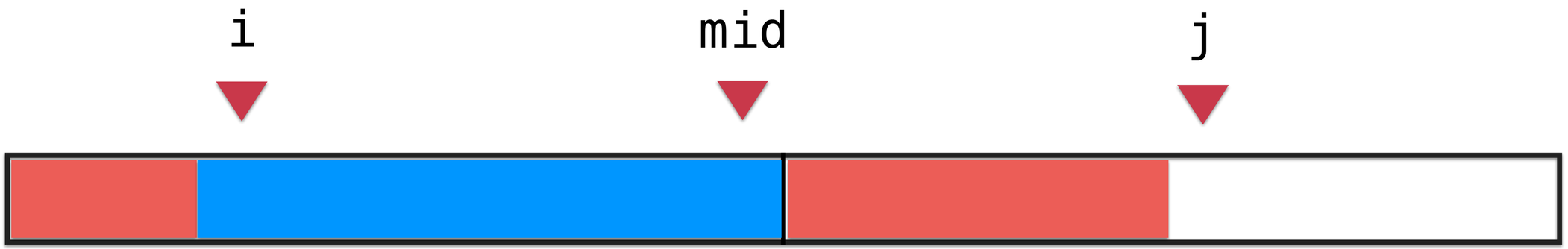
归并过程

后面区间的元素归并上来时，和前面区间剩余元素形成逆序数对



使用归并排序法求解逆序数对个数问题

后面区间的元素归并上来时，和前面区间剩余元素形成逆序数对



如果 arr[j] < arr[i]　　res += (mid - i + 1)

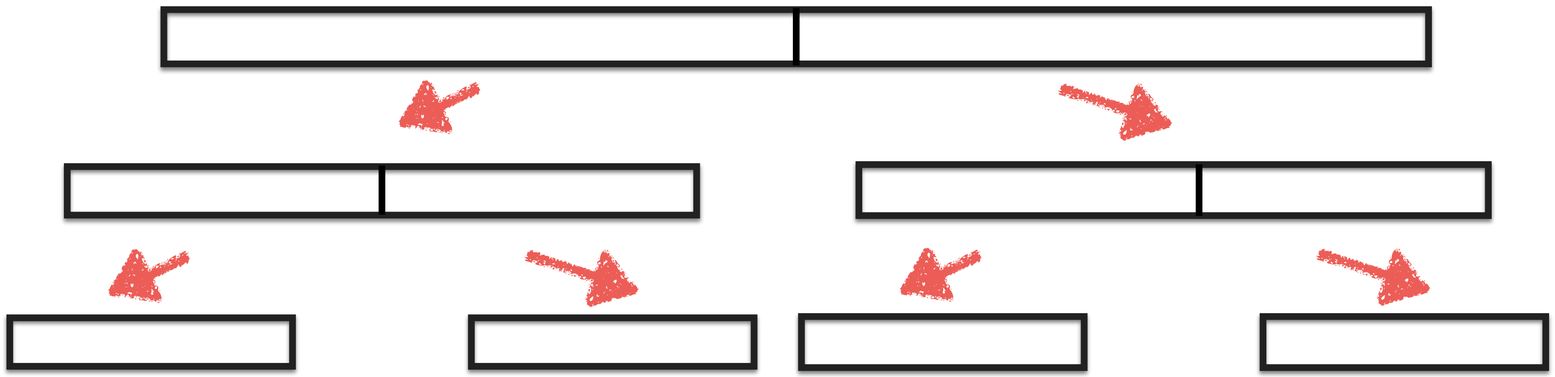
实践：使用归并排序法求解逆序数对个数问题

归并排序法总结

归并排序法

递归算法

分治算法



归并排序法

时间复杂度分析

O(nlogn)

加入对 merge 的优化，
对有序数组，是 O(n) 的

归并排序法

优化 1：判断是否需要 merge

优化 2：对小规模数据使用插入排序

优化 3：只创建一个临时空间

归并排序算法不是原地排序算法

空间复杂度 O(n)

归并排序法

自顶向下的归并排序

自底向上的归并排序

归并排序法

解决逆序对数问题

使用自底向上的归并排序?

使用插入排序法优化?

归并排序法

其他

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