12-B2

优先级队列

完全二叉堆：插入

时迁看见土地庙后一株大柏树，便把两只腿夹定，一节节爬将上去树头顶，骑马儿坐在枝柯上。

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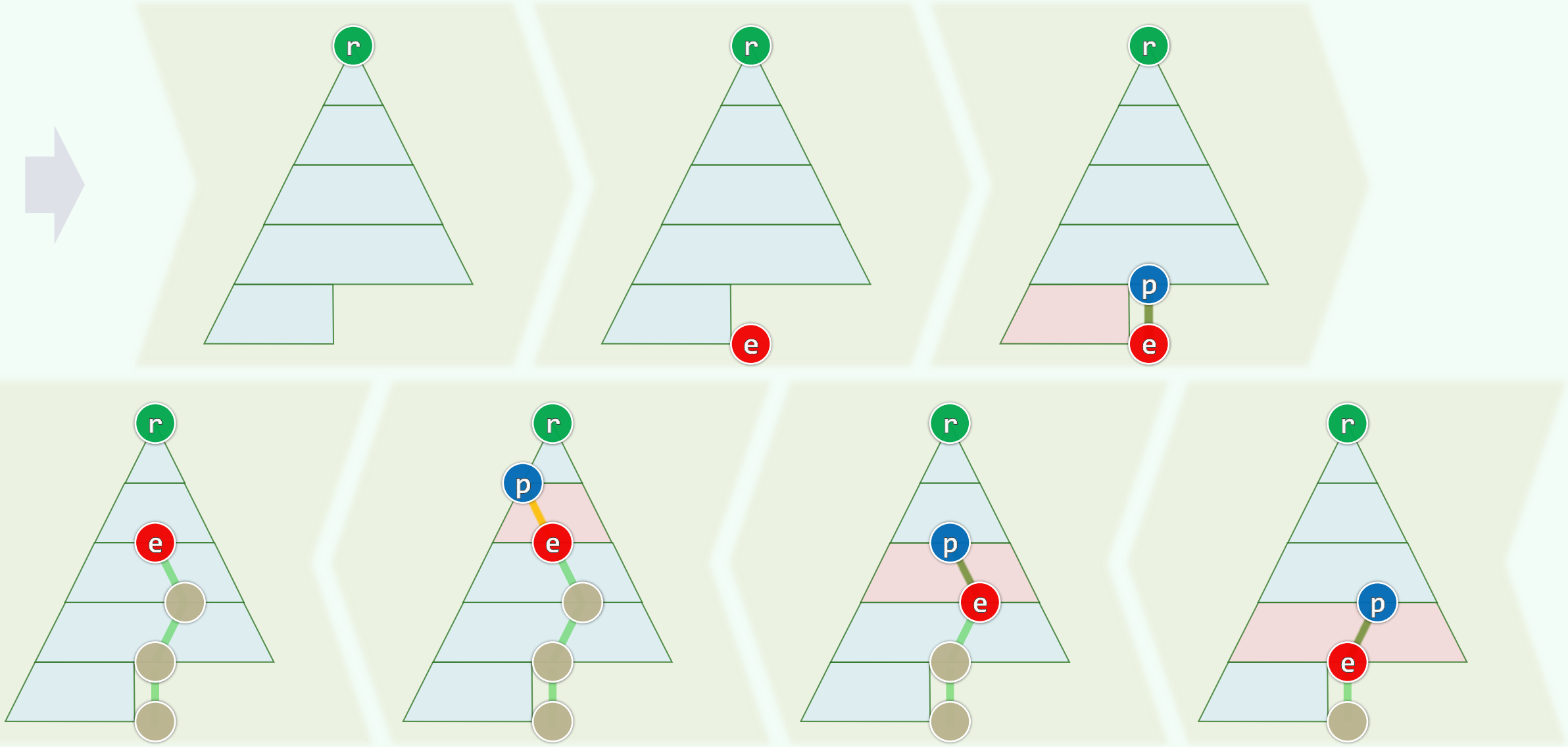
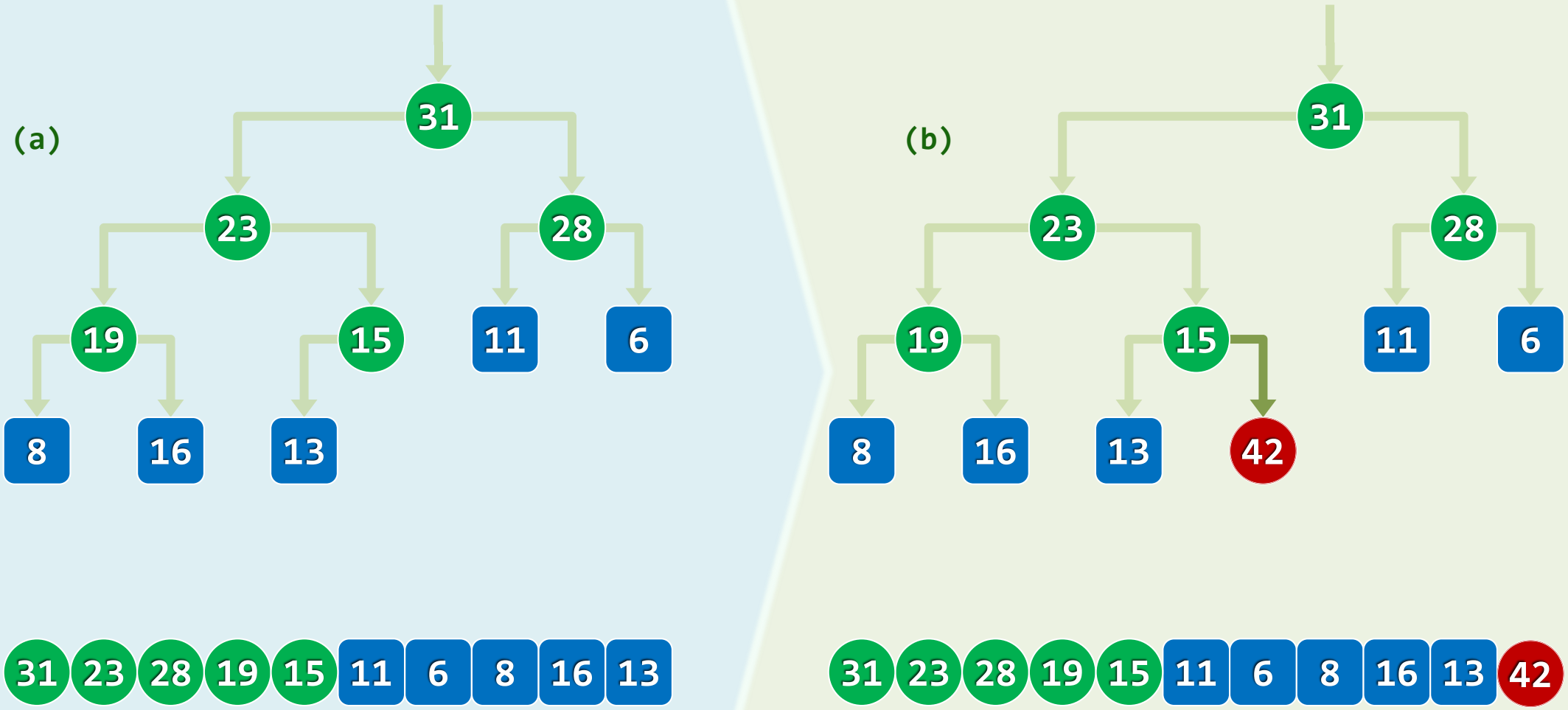
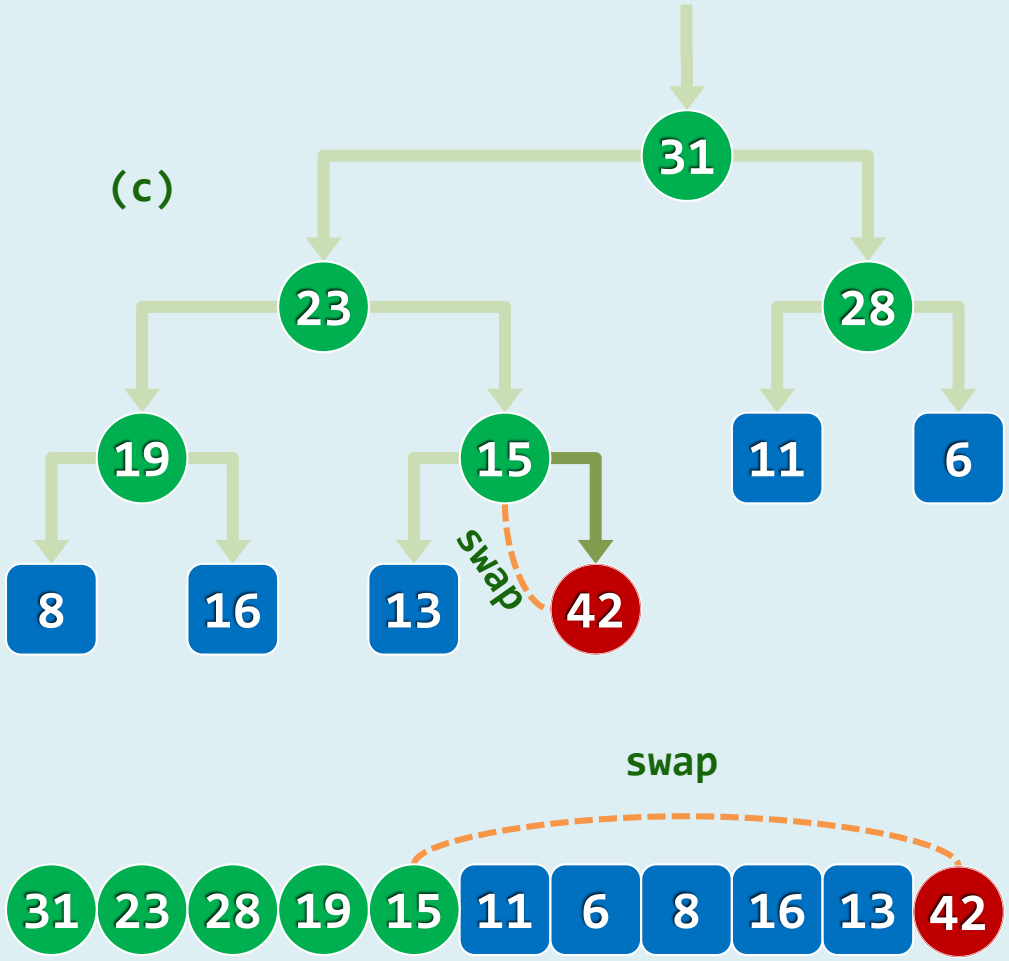
算法：逐层上滤

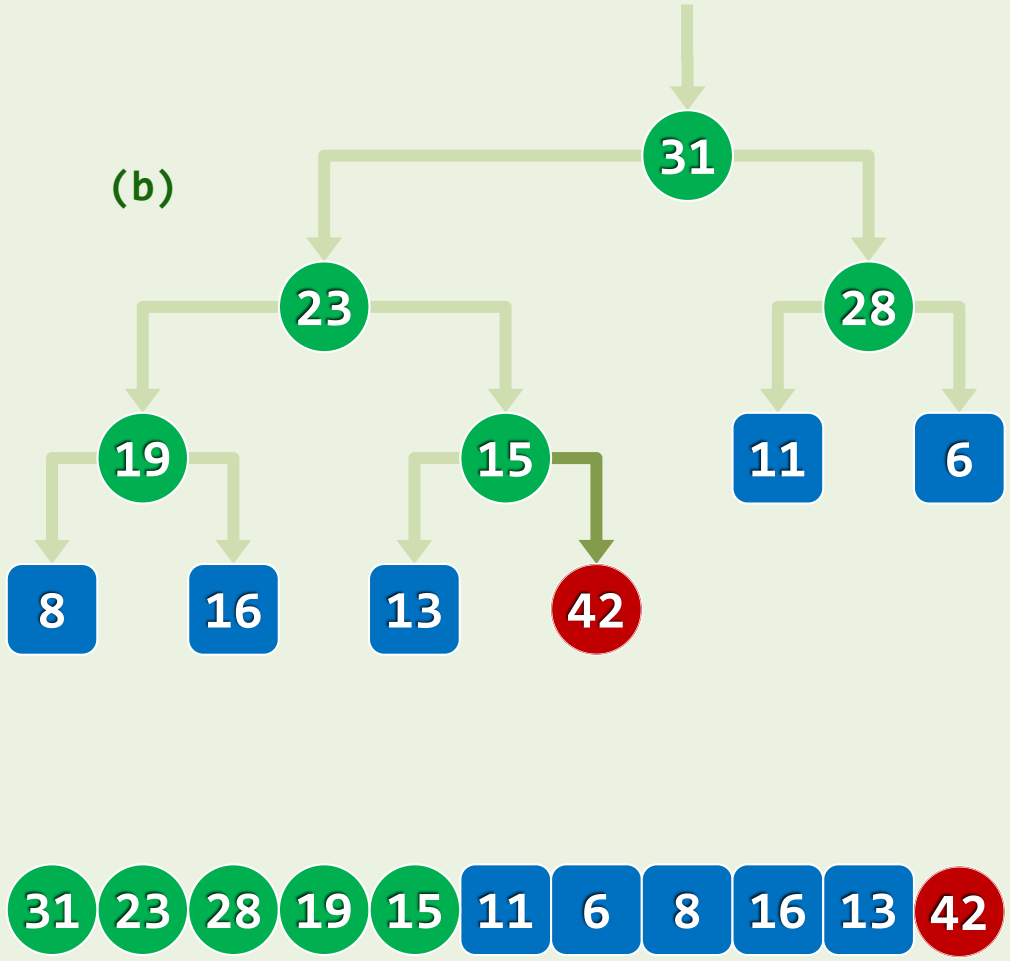


实例（1/5）

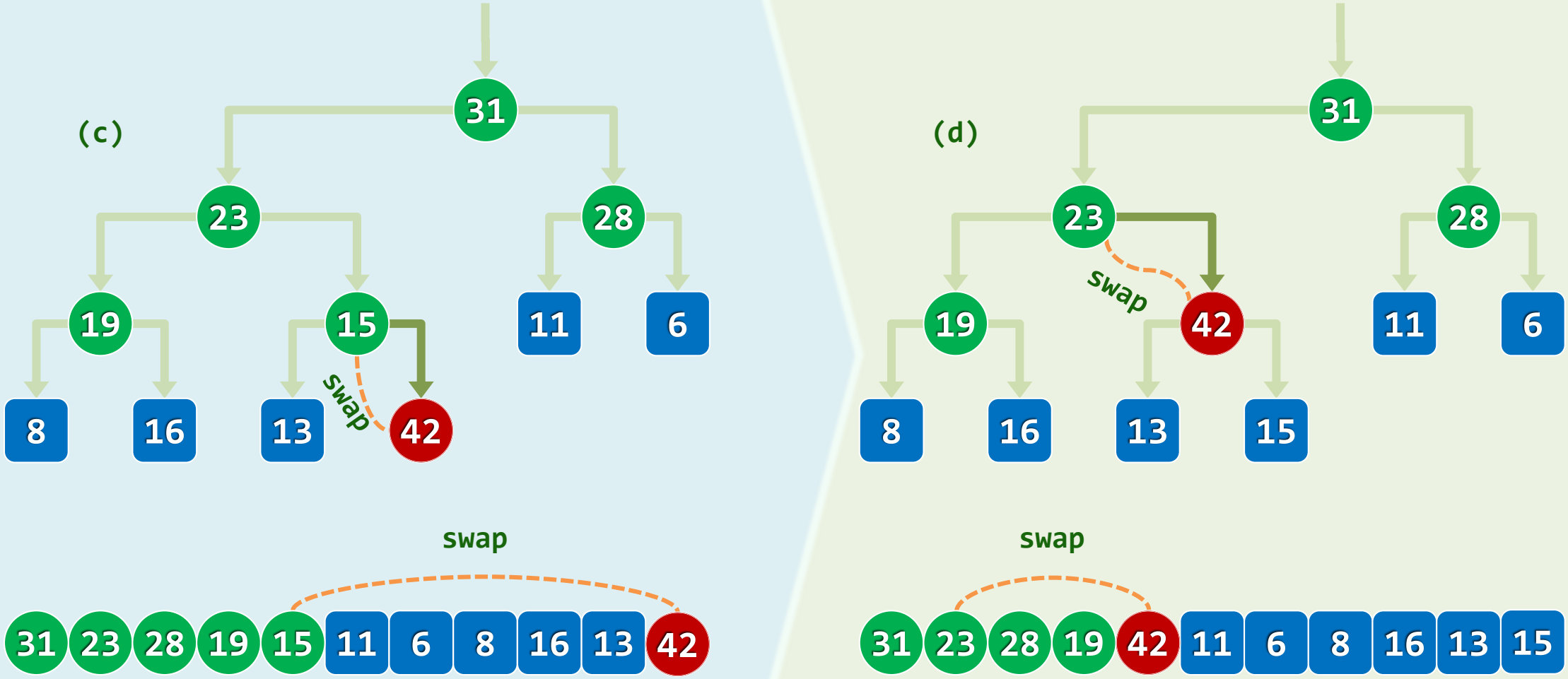

(a)
31
23
28
19
15
11
6
8
16
13
31 23 28 19 15 11 6 8 16 13
(b)
31
23
28
19
15
11
6
8
16
13
42
31 23 28 19 15 11 6 8 16 13 42

实例（2/5）

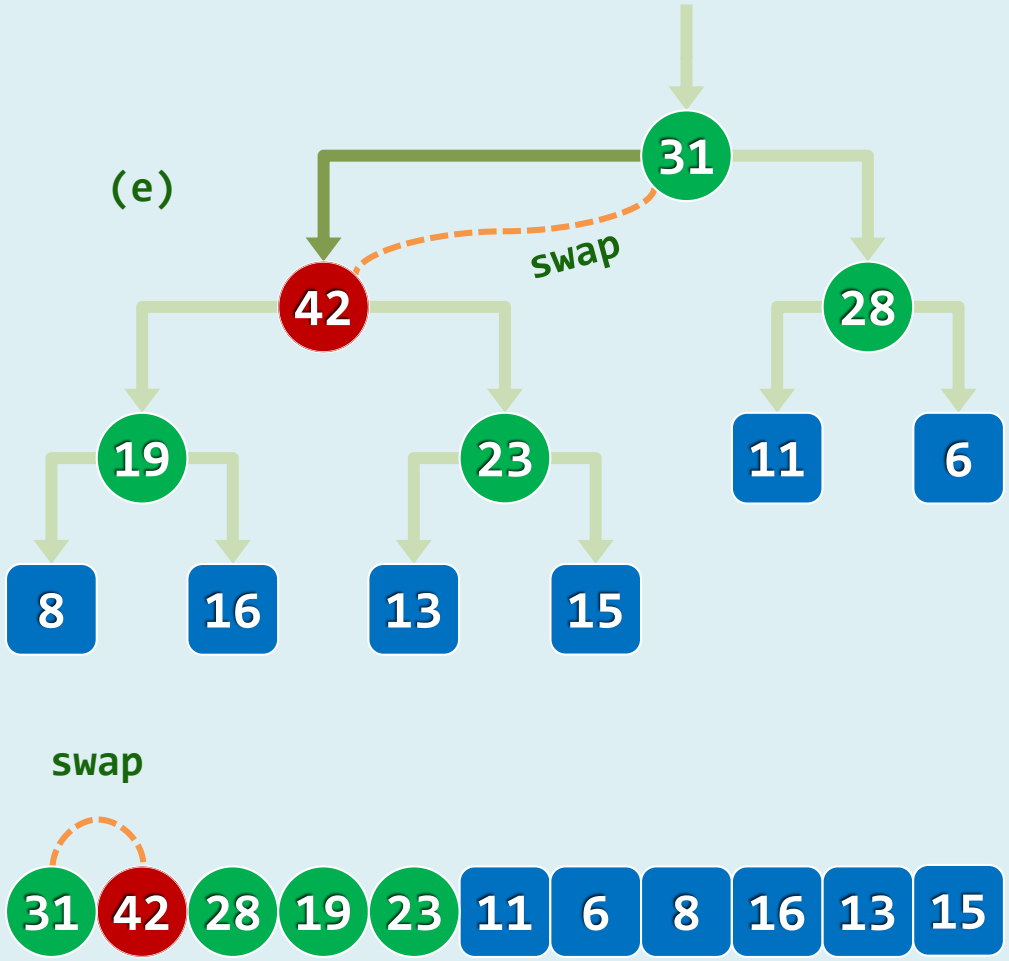

(c)
31
23
28
19
15
11
6
8
16
13
swap
42
swap
31 23 28 19 15 11 6 8 16 13 42

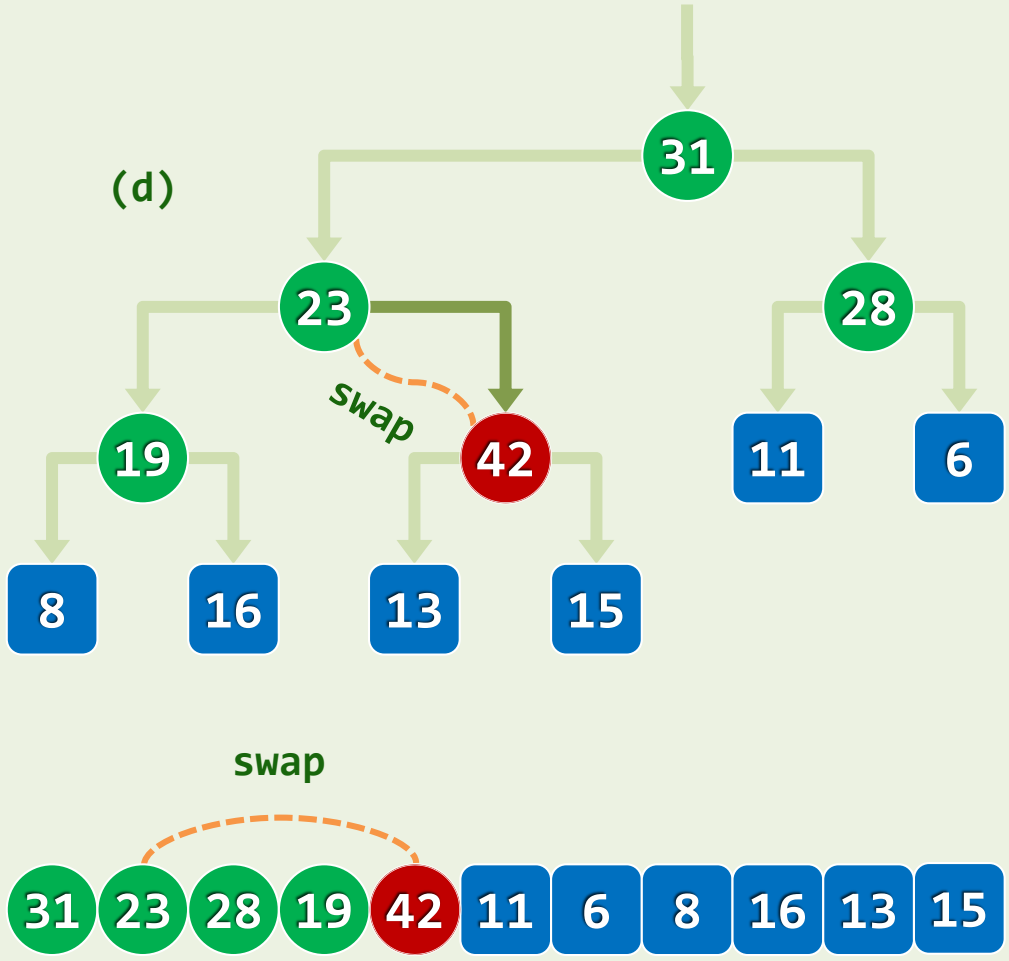

(b)
31
23
28
19
15
11
6
8
16
13
42
31 23 28 19 15 11 6 8 16 13 42

实例（3/5）

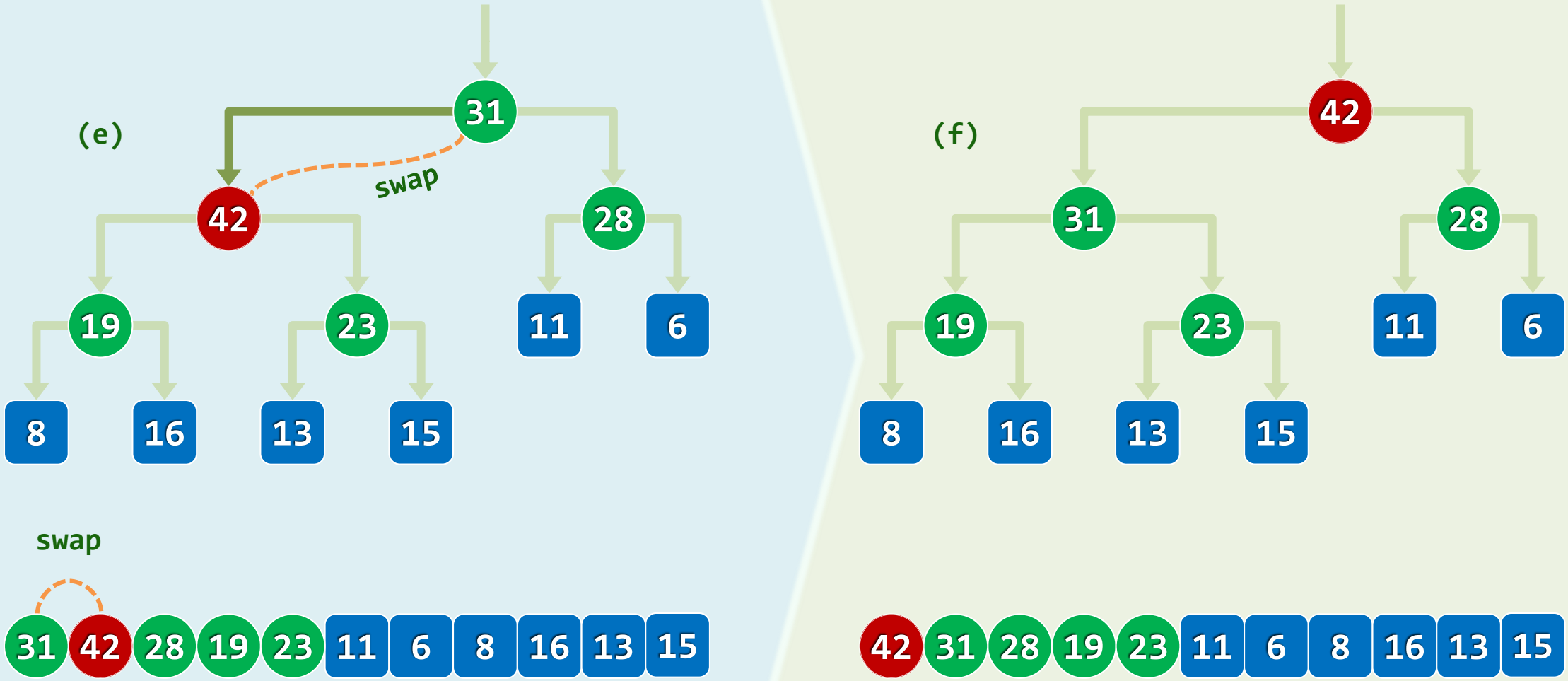

(c)
31
23
28
19
15
11
6
8
16
13
swap
42
swap
31 23 28 19 15 11 6 8 16 13 42
(d)
31
23
28
swap
19
42
11
6
8
16
13
15
swap
31 23 28 19 42 11 6 8 16 13 15

实例（4/5）


(e)
31
swap
42
28
19
23
11
6
8
16
13
15
swap
31
42
28
19
23
11
6
8
16
13
15


(d)
31
23
swap
28
19
42
11
6
8
16
13
15
swap
31
23
28
19
42
11
6
8
16
13
15

实例（5/5）


(e)
31
swap
42
28
19
23
11
6
8
16
13
15
swap
31 42 28 19 23 11 6 8 16 13 15
(f)
42
31
28
19
23
11
6
8
16
13
15
42 31 28 19 23 11 6 8 16 13 15

实现

```
❖ template <typename T> void PQ_ComplHeap<T>::insert( T e ) //插入
    { Vector<T>::insert( e ); percolateUp( _elem, _size - 1 ); } //此insert()非彼
```

```
❖ template <typename T> Rank percolateUp( T* A, Rank i ) { //0 <= i < _size
    while ( 0 < i ) { //在抵达堆顶之前，反复地
       Rank j = Parent( i ); //考查[i]之父亲[j]
       if ( lt( A[i], A[j] ) ) break; //一旦父子顺序，上滤旋即完成；否则
       swap( A[i], A[j] ); i = j; //父子换位，并继续考查上一层
    } //while
    return i; //返回上滤最终抵达的位置
  }
```

效率

- e在上滤过程中，只可能与祖先们交换
- 完全树必平衡，e的祖先不超过$O(\log n)$个
- 故知插入操作可在$O(\log n)$时间内完成
- 然而就数学期望而言

  实际效率往往远远更高...