11-F2

图应用

Kruskal算法：并查集

Following the leader, the leader, the leader,

We're following the leader wherever he may go.

这里的人事关系是由一个个“单位”组成的……白天里“单位”是魂，人活在一个一个的单位里……我很庆幸，我是个有单位的人。

邓俊辉

deng@tsinghua.edu.cn

Union-Find

- 给定一组互不相交的等价类

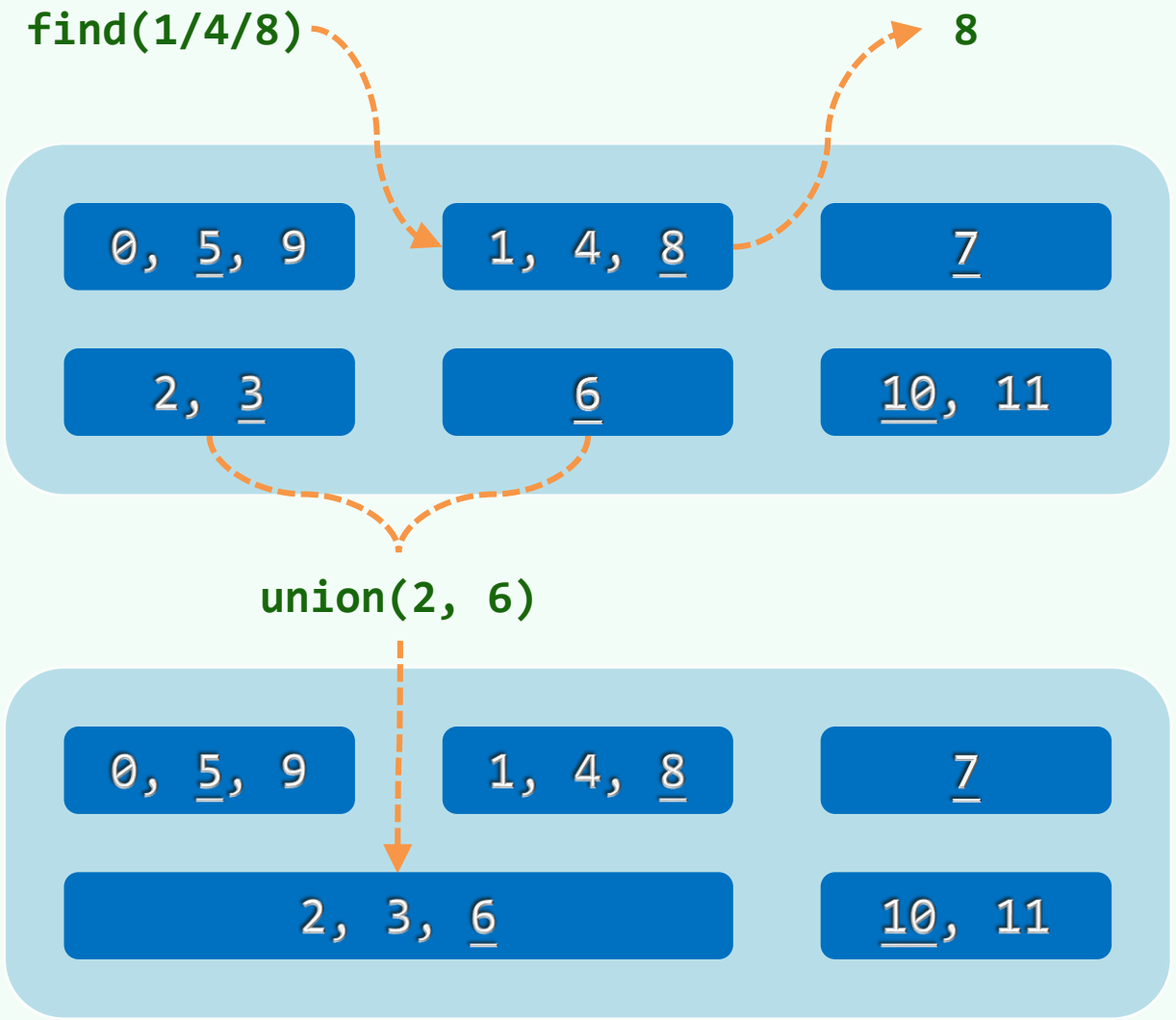
  各由其中一个成员作为代表

- Find(x)：找到元素x所属等价类

- Union(x, y)：合并x和y所属等价类

- Singleton：初始时各包含一个元素

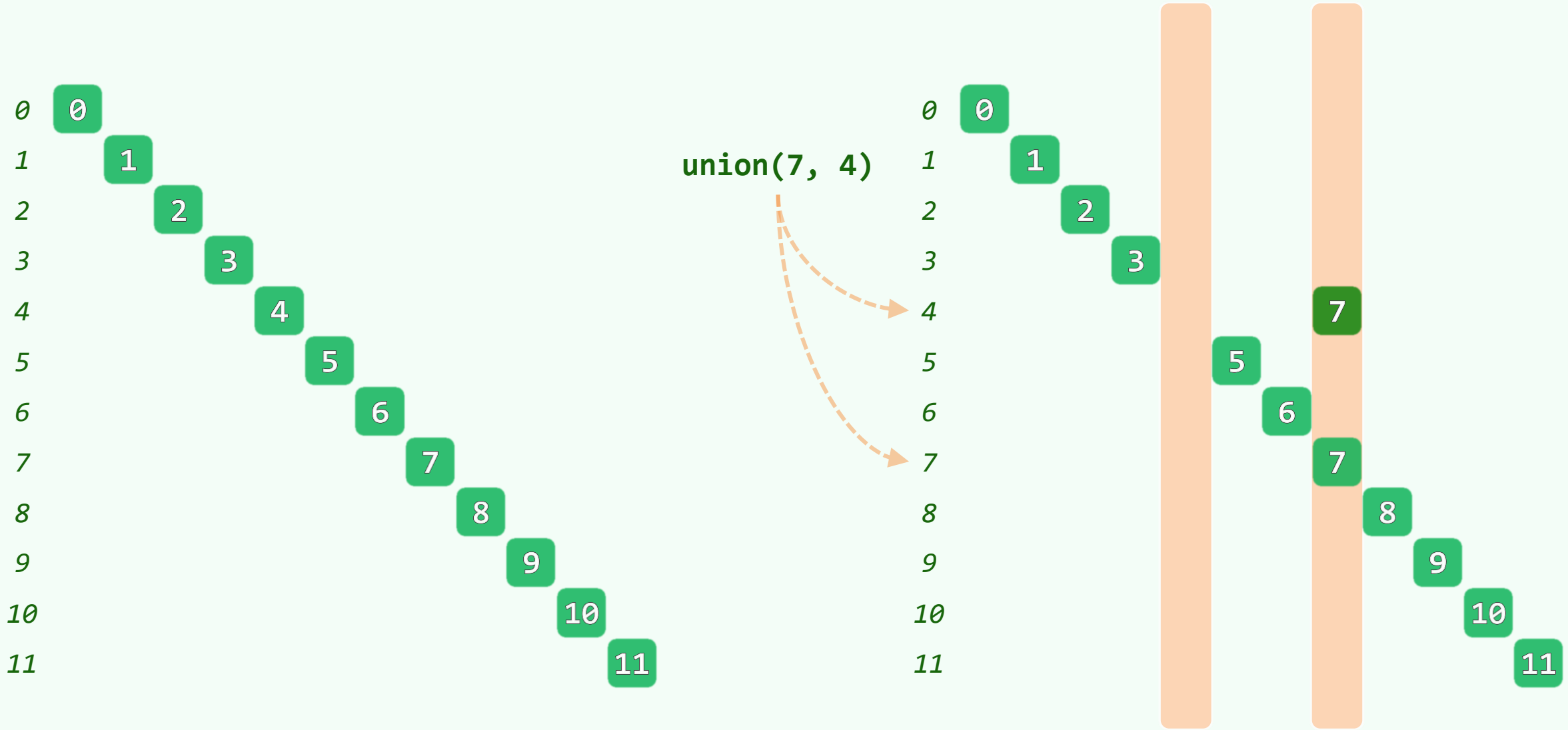
- Kruskal = Union-Find



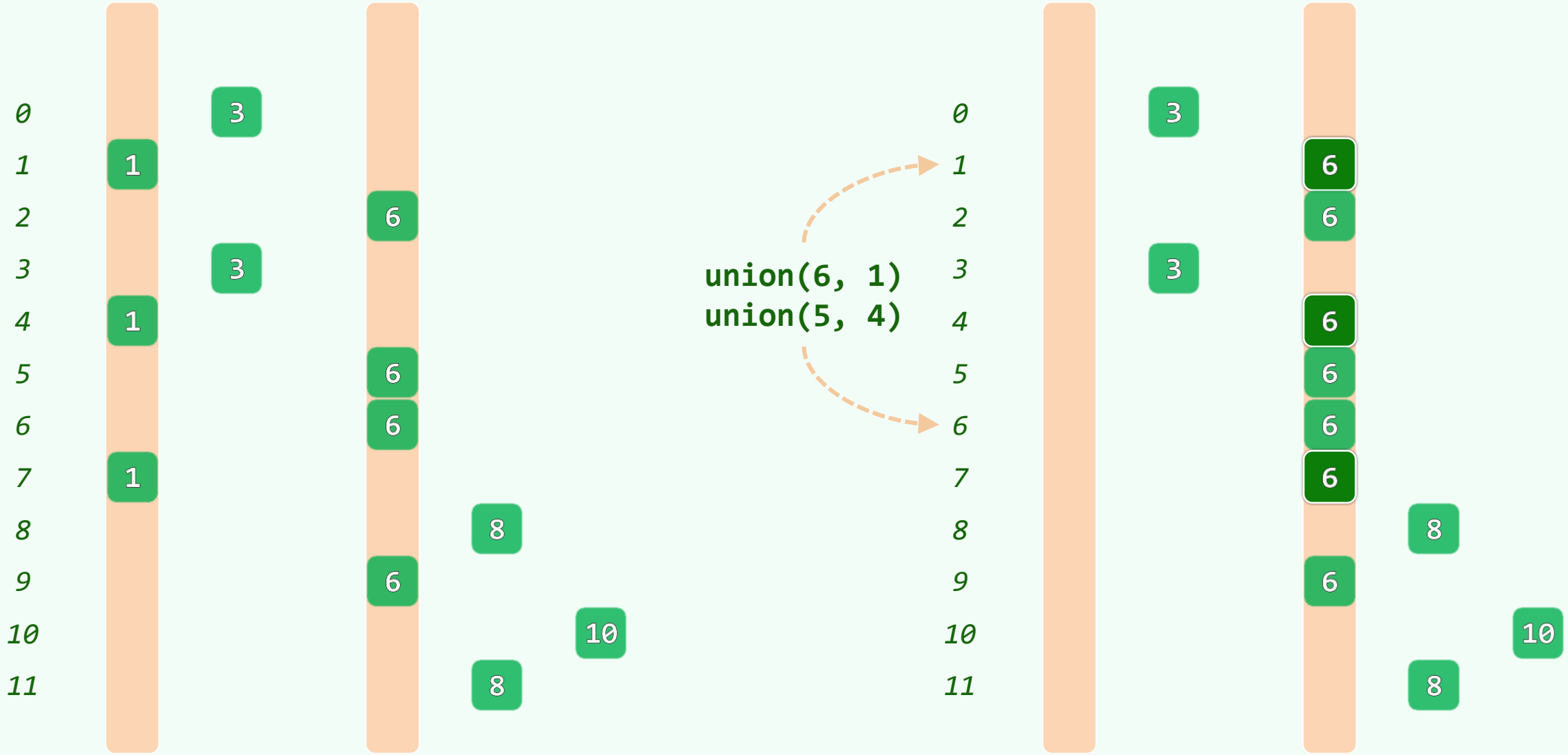
Quick-Find

```
class UnionFind:
    def __init__(self, n): #group[]记录各元素所属子集；初始各成一类，以[0,n)间整数标识
        self.g = self.n = n; self.group = [ k for k in range(n) ]
    def find(self, k):
        return self.group[k]
    def union(self, i, j):
        iGroup , jGroup = self.group[i] , self.group[j]
        if iGroup == jGroup: return
        for k in range(self.n):
            if (self.group[k] == jGroup): self.group[k] = iGroup
        self.g -= 1
```

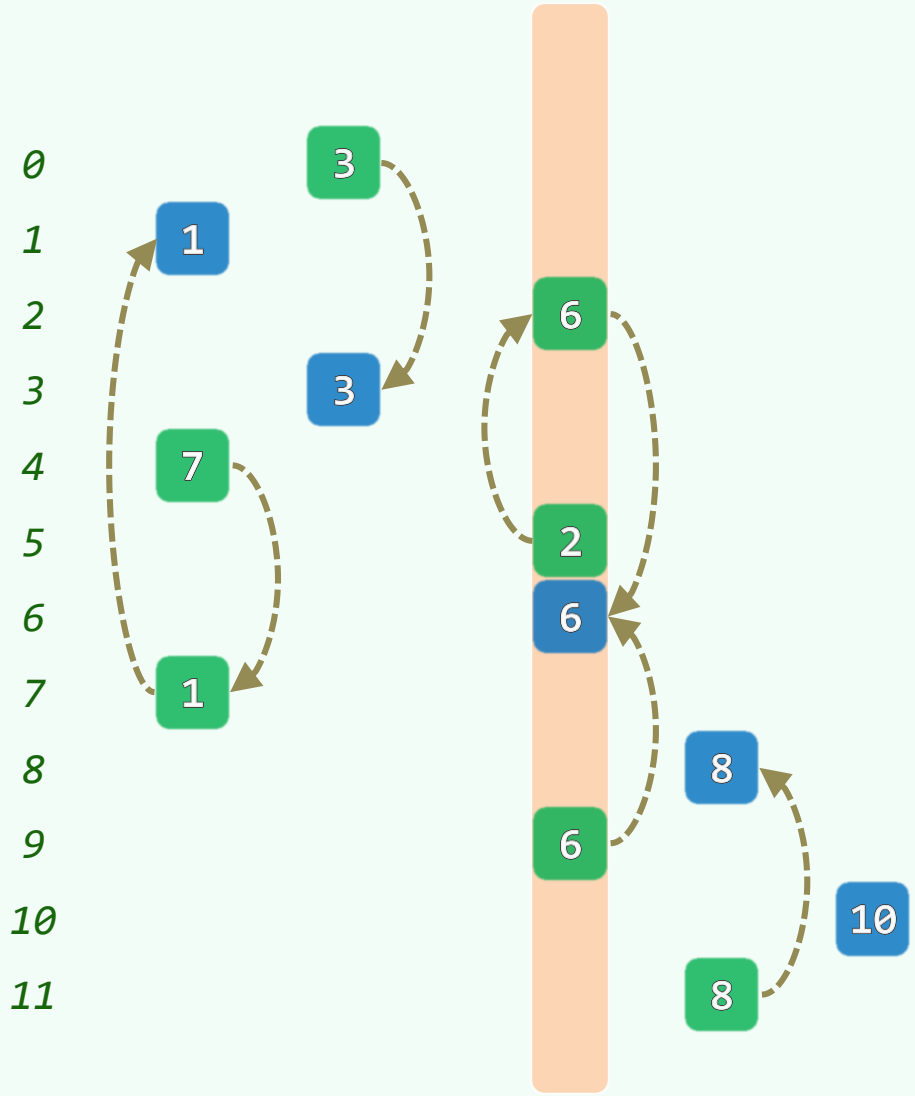
Quick-Find


0 0
1 1
2 2
3 3
4 4
5 5
6 6
7 7
8 8
9 9
10 10
11 11
union(7, 4)
0 0
1 1
2 2
3 3
4 7
5 5
6 6
7 7
8 8
9 9
10 10
11 11

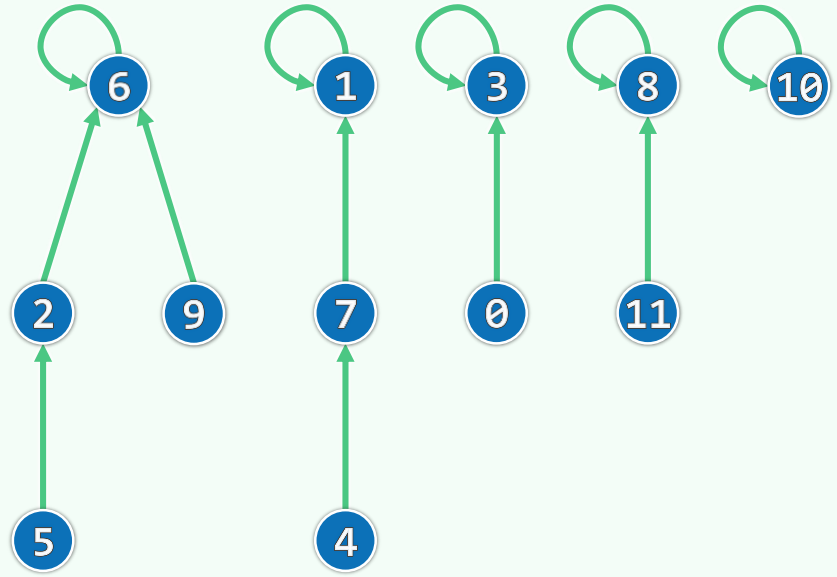
Slow-Union



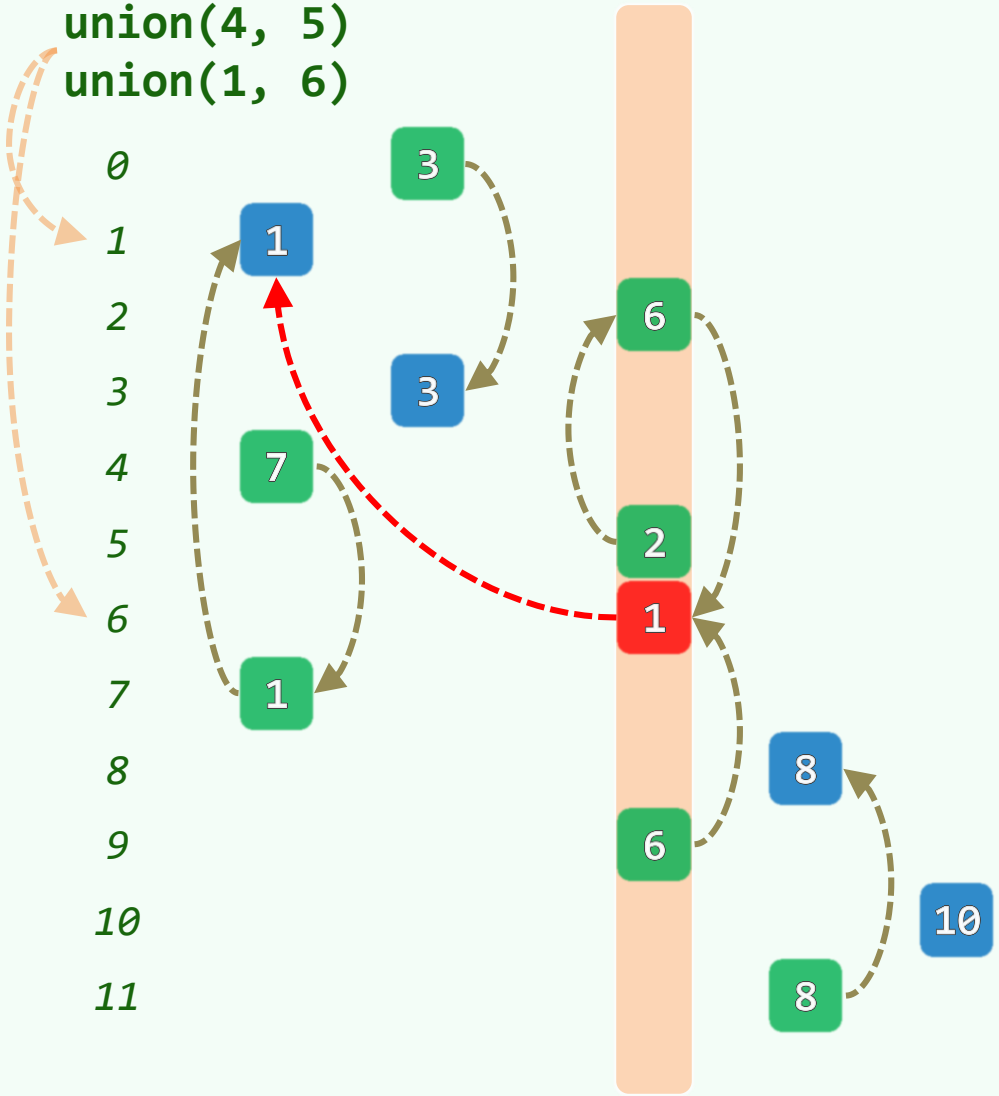
Group ~ Parent ~ Root



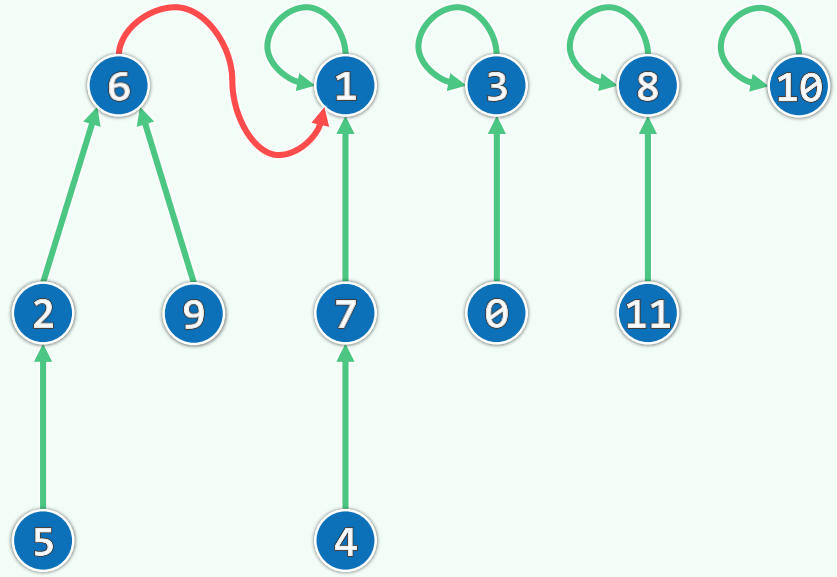
	rank	parent
0	3	3
1	1	1
2	6	6
3	3	3
4	7	7
5	2	2
6	6	6
7	1	1
8	8	8
9	6	6
10	10	10
11	8	8



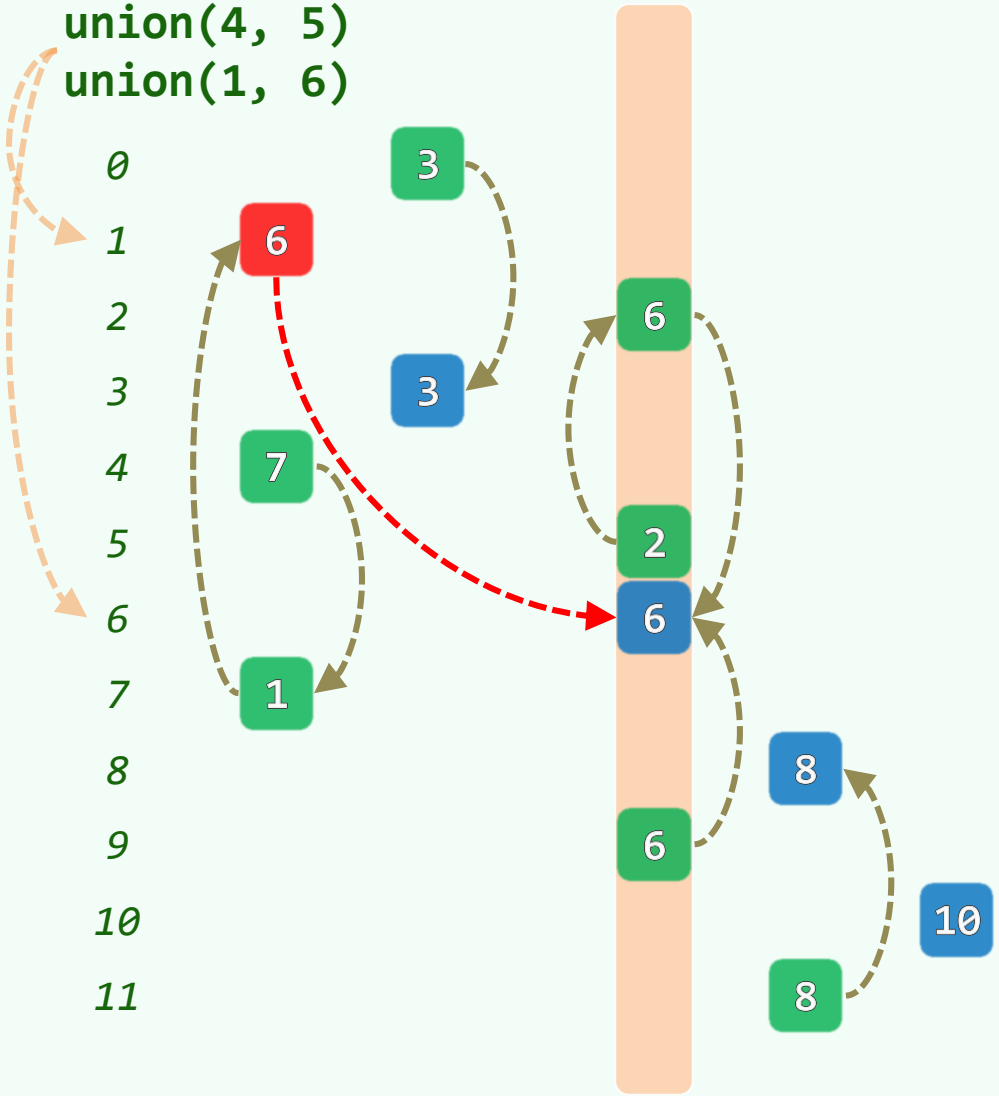
Quick-Union



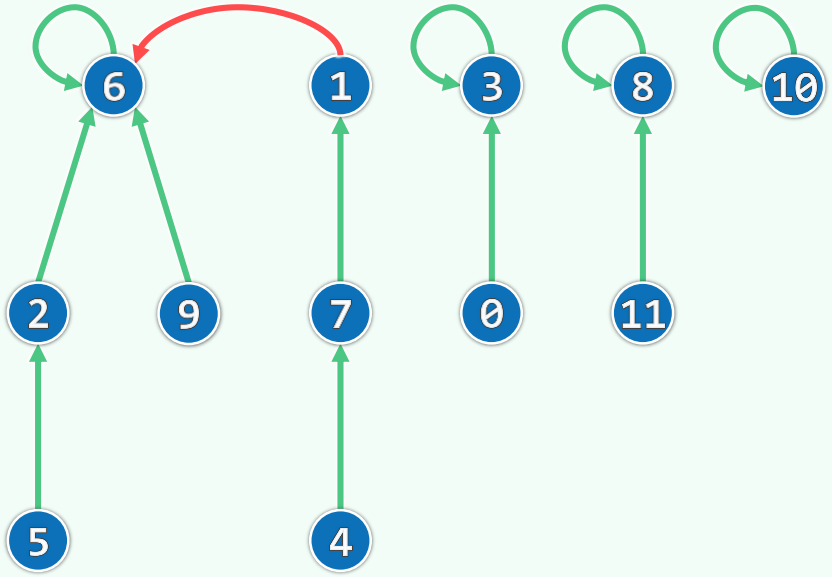
	rank	parent
0	0	3
1	1	1
2	2	6
3	3	3
4	4	7
5	5	2
6	6	1
7	7	1
8	8	8
9	9	6
10	10	10
11	11	8



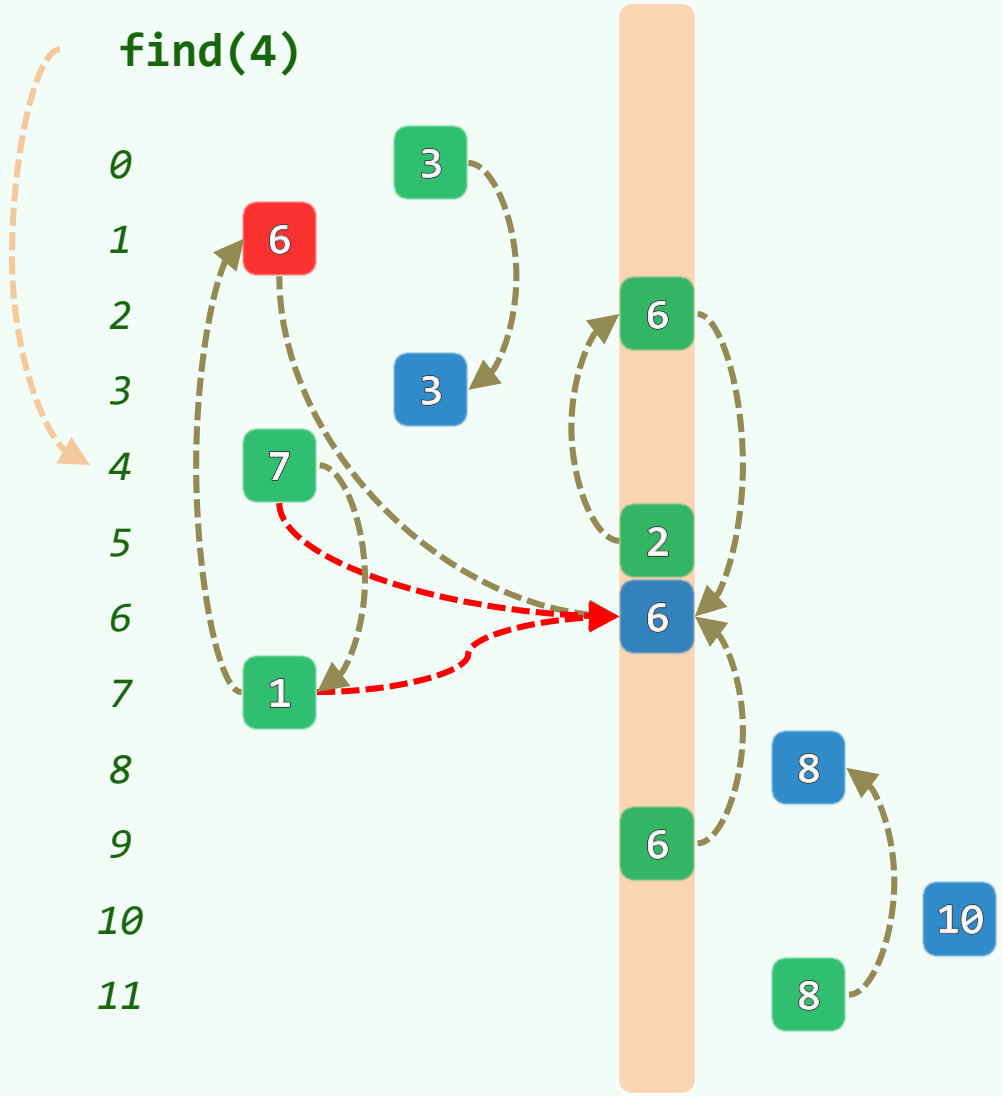
Weighting



	rank	parent	size
0		3	
1		6	~~3~~
2		6	
3		3	2
4		7	
5		2	
6		6	~~4~~7
7		1	
8		8	2
9		6	
10		10	1
11		8	



Path Compression



rank	parent	size
0	3	
1	6	
2	6	
3	3	2
4	6	
5	2	
6	6	7
7	6	
8	8	2
9	6	
10	10	1
11	8