**20181109数据结构作业**

**1800022769 张靖昆 20181109**

**我承诺诚实作业，没有抄袭他人！**

**P159 8.**使用重量权衡合并规则与路径压缩，对下列从0~15之间的数的等价对进行归并，并给出所得树的父指针表示法的数组表示。在初始情况下，集合中的每个元素分别在独立的等价类中。当两棵树规模同样大时，使结点值较大的根结点作为值较小的根结点的子结点。

(0,2) (1,2) (3,4) (3,1) (3,5) (9,11) (12,14) (3,9) (4,14) (6,7) (8,10) (8,7) (7,0) (10,15) (10,13)

**解**：

**\*\*记规则“当两棵树规模同样大时，使结点值较大的根结点作为值较小的根结点的子结点”为规则1**。

**\*\*记规则“重量权衡合并，即根结点不同的两棵树-规模小的树归并到规模大的树上”为规则2**。

**\*\*记规则“路径压缩规则”为规则3**。

**\*\*定义单独结点**：单独结点是指没有归入树中独立存在的结点，它们的根结点是他们自身。

**\*\*说明1**：由于数据本身的特殊性，因此表中第一行即是值同样也是该值对应的数组下标。

**\*\*说明2**：以{根结点，结点1，结点2…}表示一棵树的构成，仅是为了提升可阅读性。

1. **合并(0,2)**：经find操作发现0,2是单独结点。  
   根据规则1，令0为2的父节点。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  |  | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |

当前已有树：{0,2}

1. **合并(1,2)**：经find操作发现1是单独结点， 2的根结点为0。  
   根据规则2，令1的父结点为0。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |

当前已有树：{0,2,1}

1. **合并(3,4)**：经find操作发现3、4均是单独结点。  
   根据规则1，令4的父结点为3。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 |  | 3 |  |  |  |  |  |  |  |  |  |  |  |

当前已有树：{0,2,1}、{3,4}

1. **合并(3,1)**：经find操作发现3是单独结点，1的根结点为0。  
   根据规则2，令3的父结点为0。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 3 |  |  |  |  |  |  |  |  |  |  |  |

当前已有树：{0,2,1,3,4}

1. **合并(3,5)**：经find操作发现5是单独结点，3的根结点为0。  
   根据规则2，令5的父结点为0。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 3 | 0 |  |  |  |  |  |  |  |  |  |  |

当前已有树：{0,2,1,3,4,5}

1. **合并(9,11)**：经find操作发现9、11均是单独结点。  
   根据规则1，令11的父结点为9。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 3 | 0 |  |  |  |  |  | 9 |  |  |  |  |

当前已有树：{0,2,1,3,4,5}、{9,11}

1. **合并(12,14)**：经find操作发现12、14均是单独结点。  
   根据规则1，令14的父结点为12。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 3 | 0 |  |  |  |  |  | 9 |  |  | 12 |  |

当前已有树：{0,2,1,3,4,5}、{9,11}、{12,14}

1. **合并(3,9)**：经find操作发现9是一棵规模为2的树的根结点，3的根结点是0且树的规模为6。  
   根据规则2，令9的父结点为0。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 3 | 0 |  |  |  | 0 |  | 9 |  |  | 12 |  |

当前已有树：{0,2,1,3,4,5,9,11}、{12,14}

1. **合并(4,14)**：经find操作发现4的根结点是0，所在树规模为8，14的根结点是12，所在树规模为2。  
   根据规则2，令12的父结点为0。  
   同时，在有关结点4的find操作中，结点4父指针不是根结点0，根据规则3，令结点4的父节点为0。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 0 | 0 |  |  |  | 0 |  | 9 | 0 |  | 12 |  |

当前已有树：{0,2,1,3,4,5,9,11,12,14}

1. **合并(6,7)**：经find操作发现6、7均是单独结点。  
   根据规则1，令7的父结点为6。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 0 | 0 |  | 6 |  | 0 |  | 9 | 0 |  | 12 |  |

当前已有树：{0,2,1,3,4,5,9,11,12,14}、{6,7}

1. **合并(8,10)**：经find操作发现8、10均是单独结点。  
   根据规则1，令10的父结点为8。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 0 | 0 |  | 6 |  | 0 | 8 | 9 | 0 |  | 12 |  |

当前已有树：{0,2,1,3,4,5,9,11,12,14}、{6,7}、{8,10}

1. **合并(8,7)**：经find操作发现8是一颗规模为2的树的根结点，7的根结点是6，且所在树的规模为2。  
   根据规则1，令8的父结点为6。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 0 | 0 |  | 6 | 6 | 0 | 8 | 9 | 0 |  | 12 |  |

当前已有树：{0,2,1,3,4,5,9,11,12,14}、{6,7,8,10}

1. **合并(7,0)**：经find操作发现0是一颗规模为10的树的根结点，7的根结点是6，所在树规模为4。  
   根据规则2，令6的父结点为0。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 0 | 8 | 9 | 0 |  | 12 |  |

当前已有树：{0,2,1,3,4,5,9,11,12,14,6,7,8,10}

1. **合并(10,15)**：经find操作发现15是单独结点，10的根结点是0。  
   根据规则2，令15的父结点下标为0。  
   同时，在有关结点10的find操作中，结点10、结点8的父结点均不是根结点，从而令结点10、结点8的父结点为0。  
   更新结点下标表。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** |  | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 9 | 0 |  | 12 | 0 |

当前已有树：{0,2,1,3,4,5,9,11,12,14,6,7,8,10,15}

1. **合并(10,13)**：经find操作发现13是单独结点，10的根结点是0。  
   根据规则2，令13的父结点下标为0，更新结点下标表。  
   **该表即为重量权衡归并下的父指针表示法的表**。

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **值(下标同值)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **父结点下标** | \ | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 9 | 0 | 0 | 12 | 0 |

当前已有树：{0,2,1,3,4,5,9,11,12,14,6,7,8,10,15,13}

经过上述归并，得到了经过重量权衡归并得到的归并树，其中0为根结点，树结构如下：

0

2

1

3

5

9

12

6

15

13

4

8

10

7

14

11