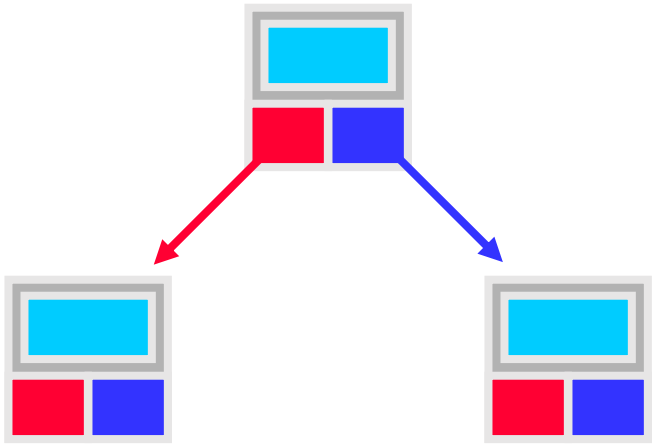
In-order Traversal

Outline of In-Order Traversal

- **Three principle steps:**
  - **Traverse Left**
  - **Do work (Current)**
  - **Traverse Right**

- **Work can be anything**
- **Separate work from traversal**

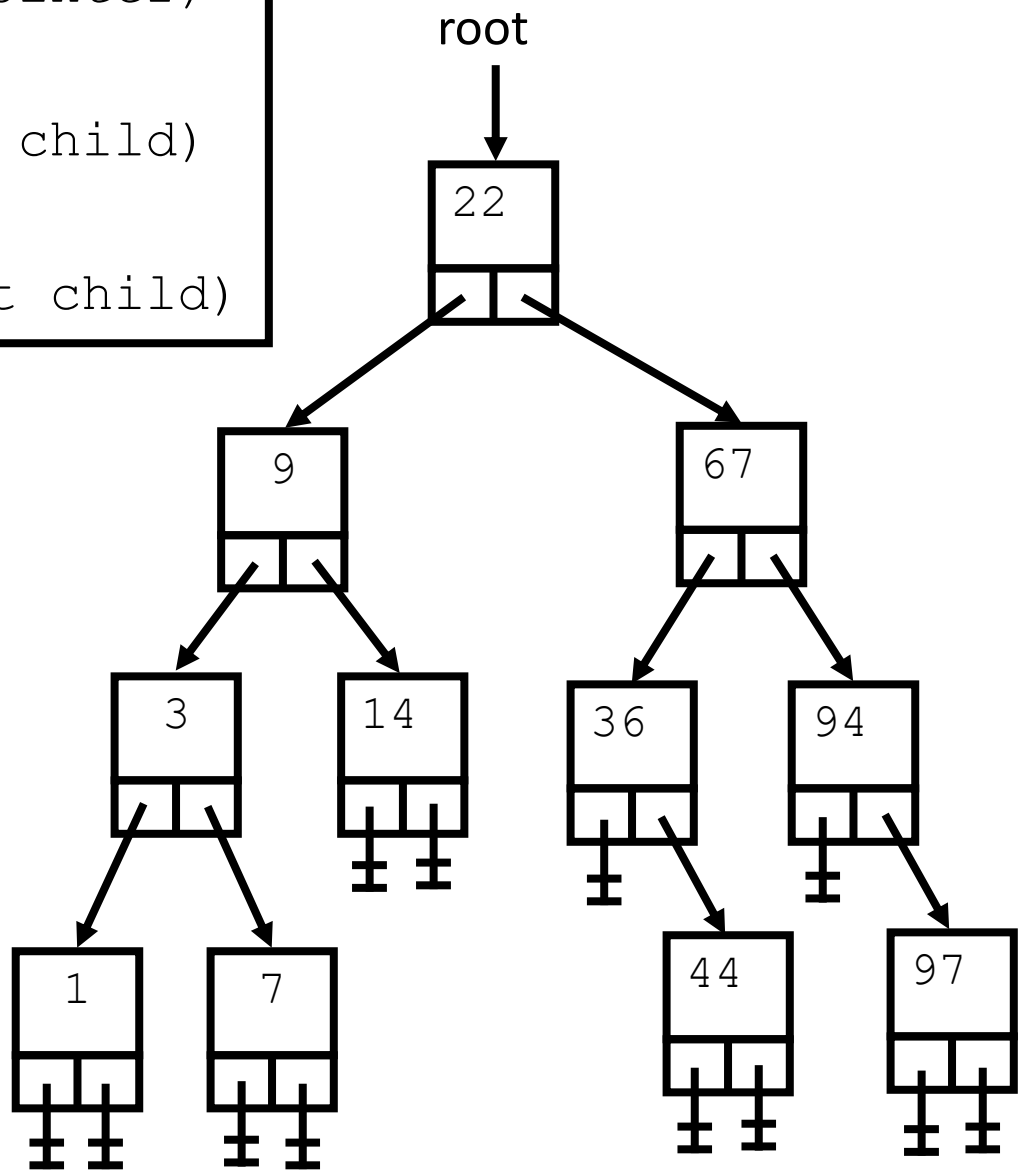


- Traverse the tree “In order”:
  - Visit the tree’s left sub-tree
  - Visit the current and do work
  - Visit right sub-tree

In-Order Traversal Procedure

```
procedure In_Order(cur iot in Ptr toa Tree_Node)
// Purpose: perform in-order traversal, call
//          Do_Something for each node
// Preconditions: cur points to a binary tree
// Postcondition: Do_Something on each tree
//                node in "in-order" order
  if( cur <> NIL ) then
    In_Order( cur^.left_child )
    Do_Something( cur^.data )
    In_Order( cur^.right_child )
  endif
endprocedure   // In_Order
```

```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```



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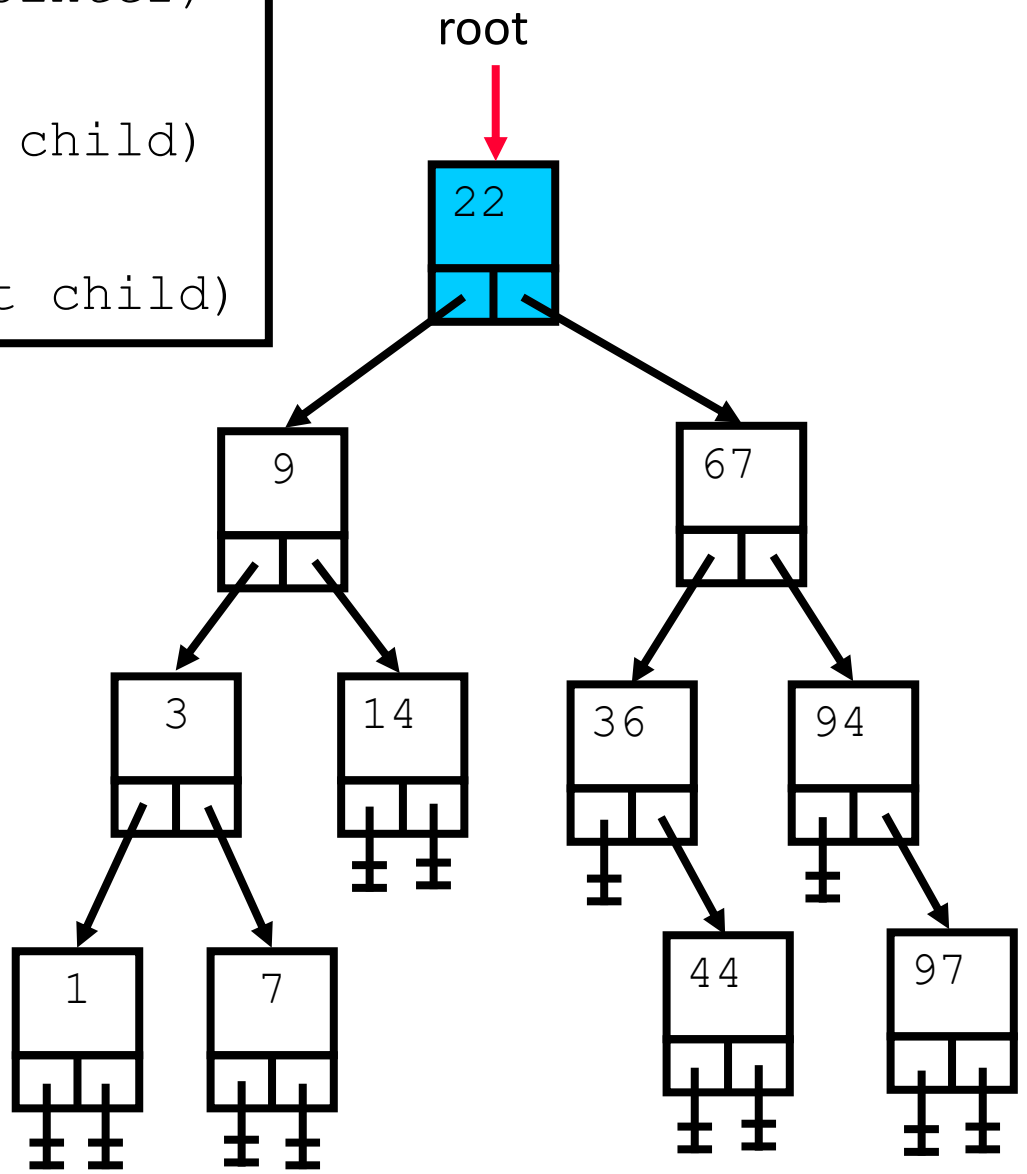

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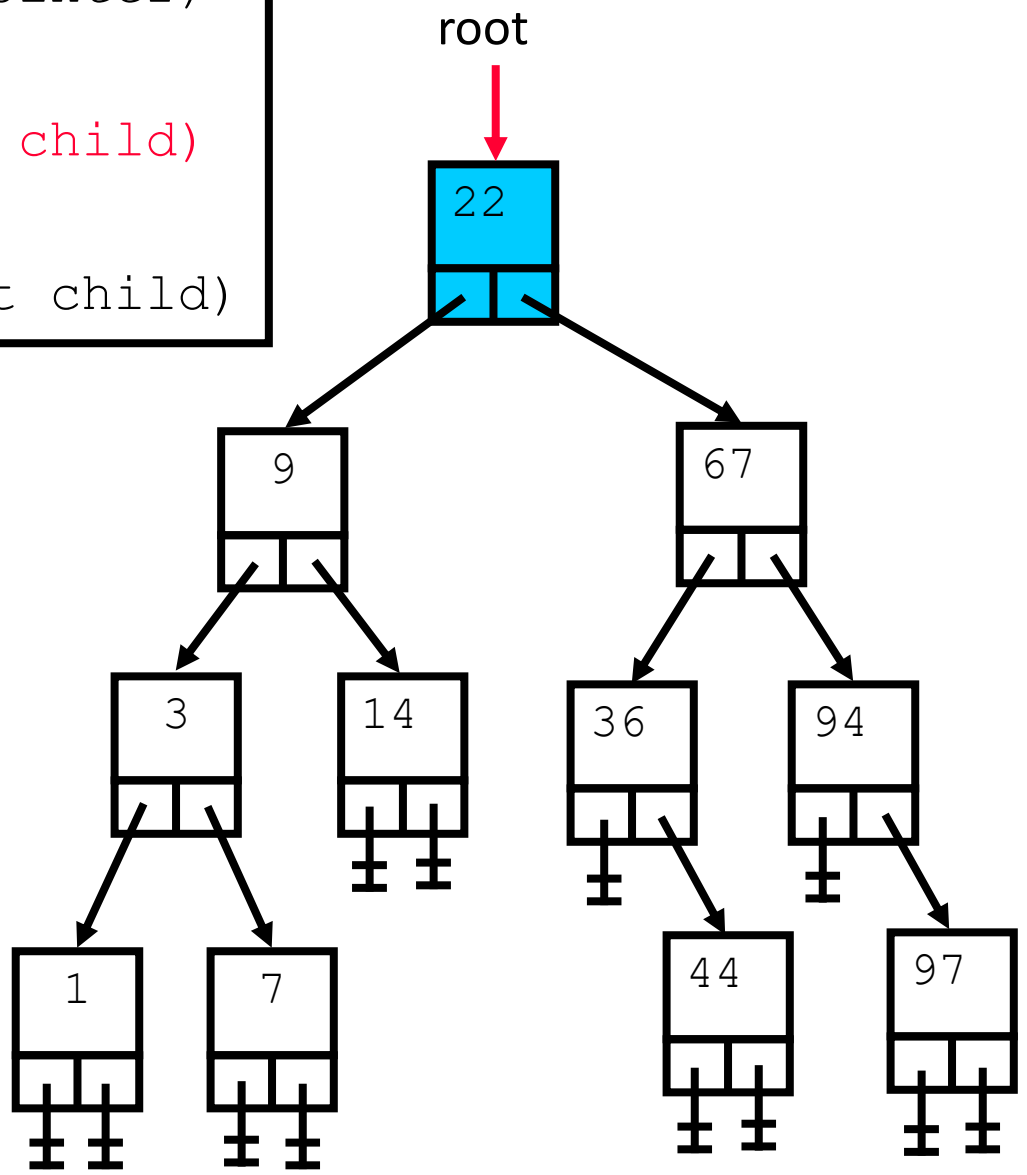

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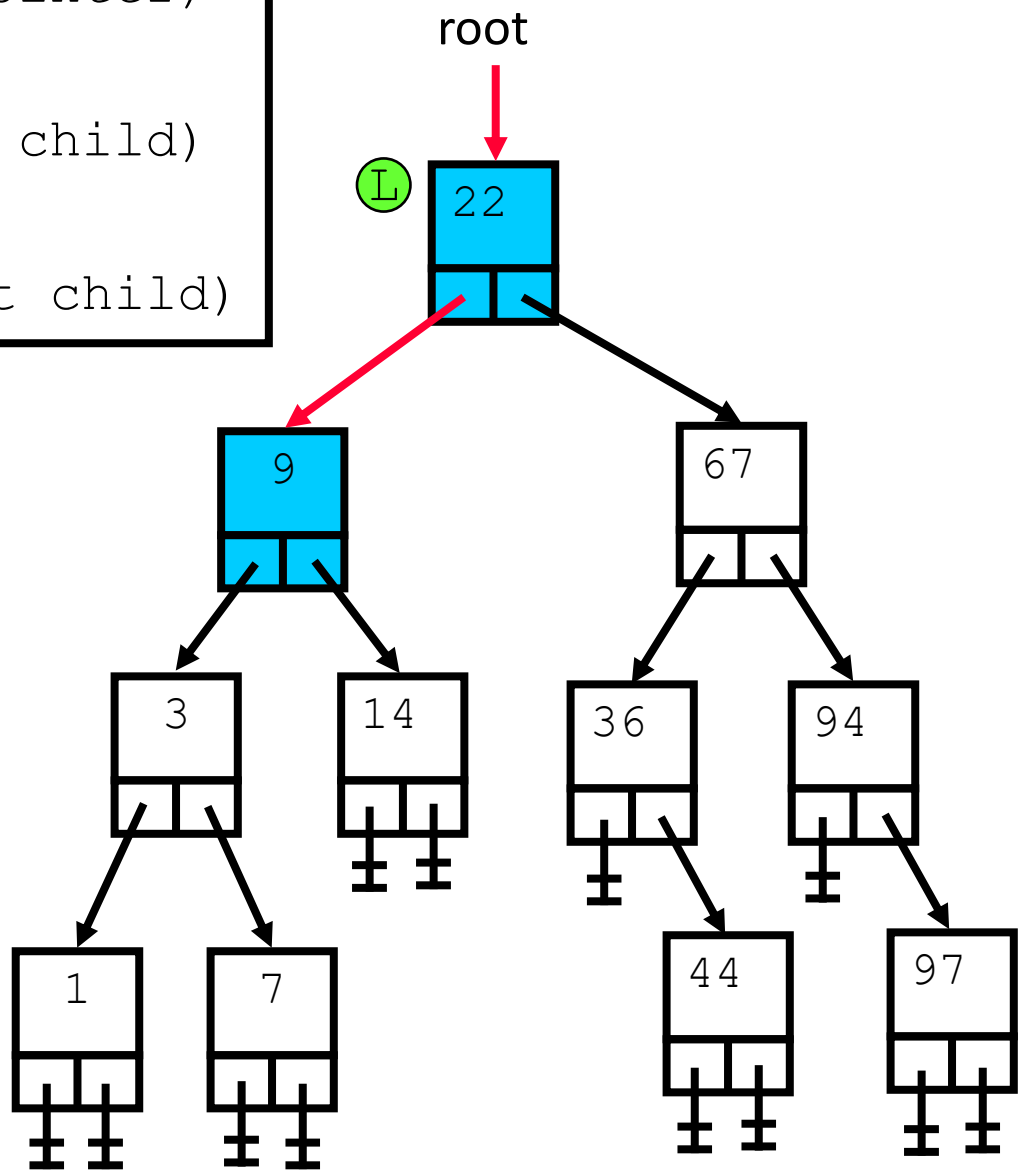

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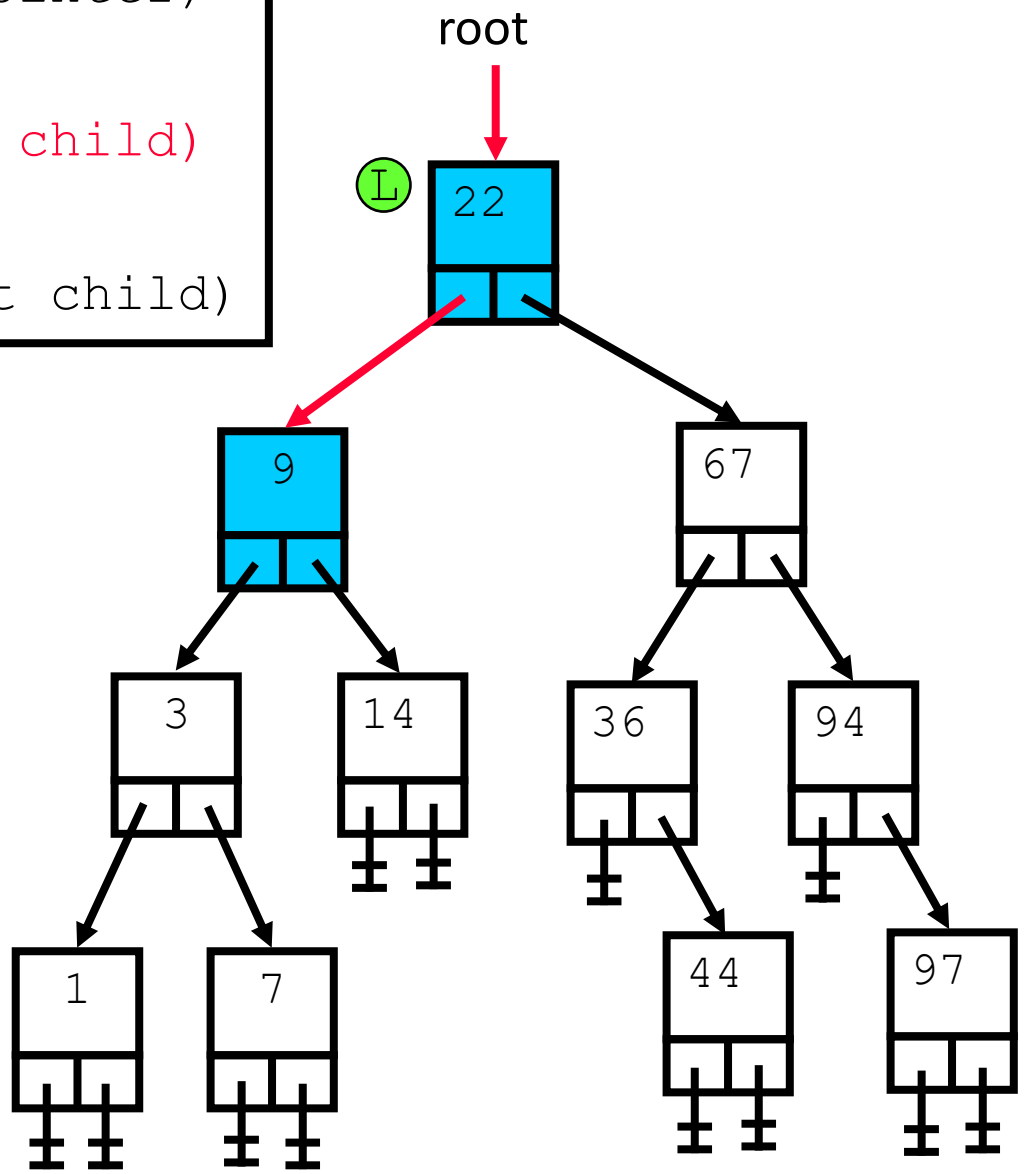

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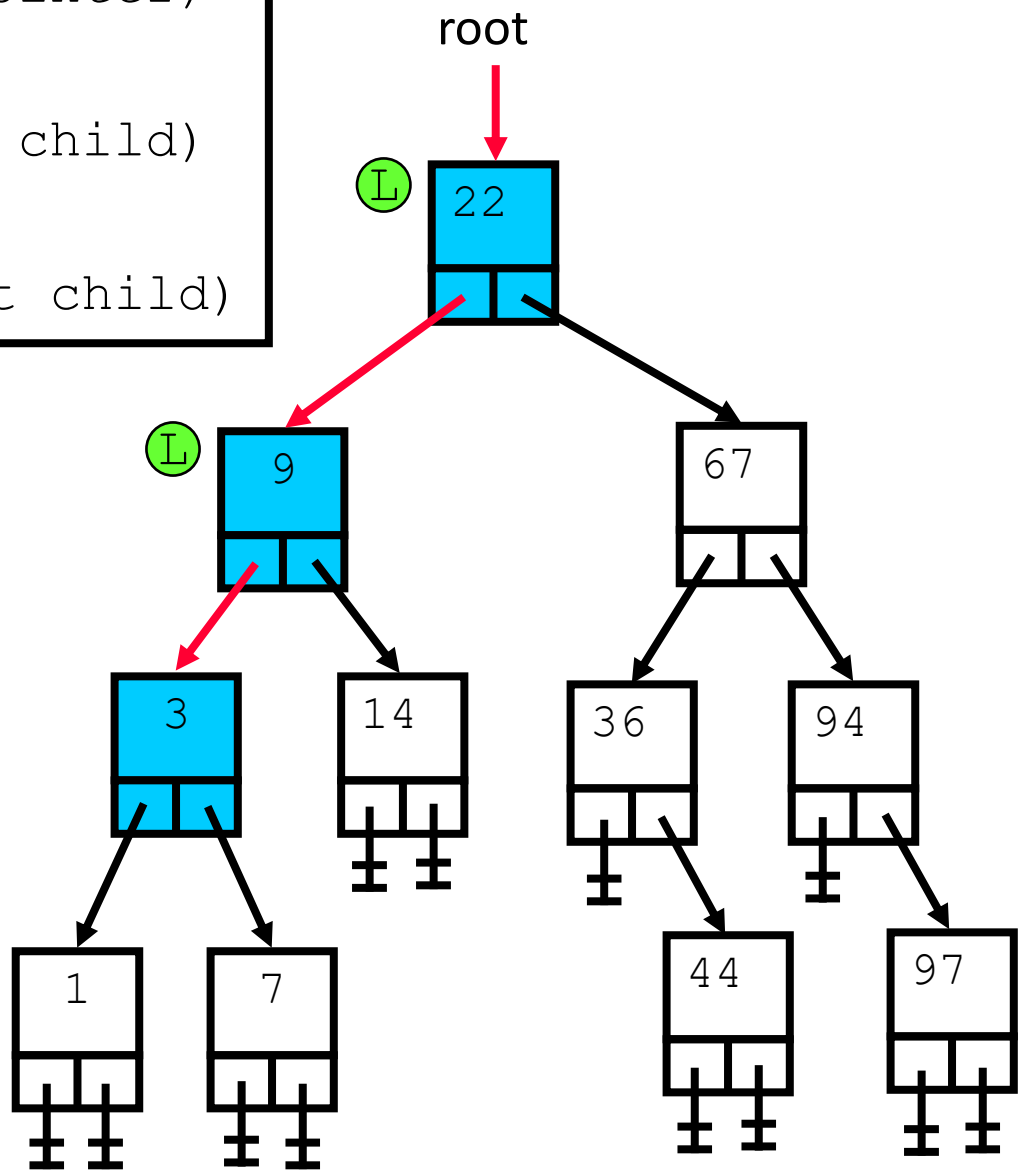

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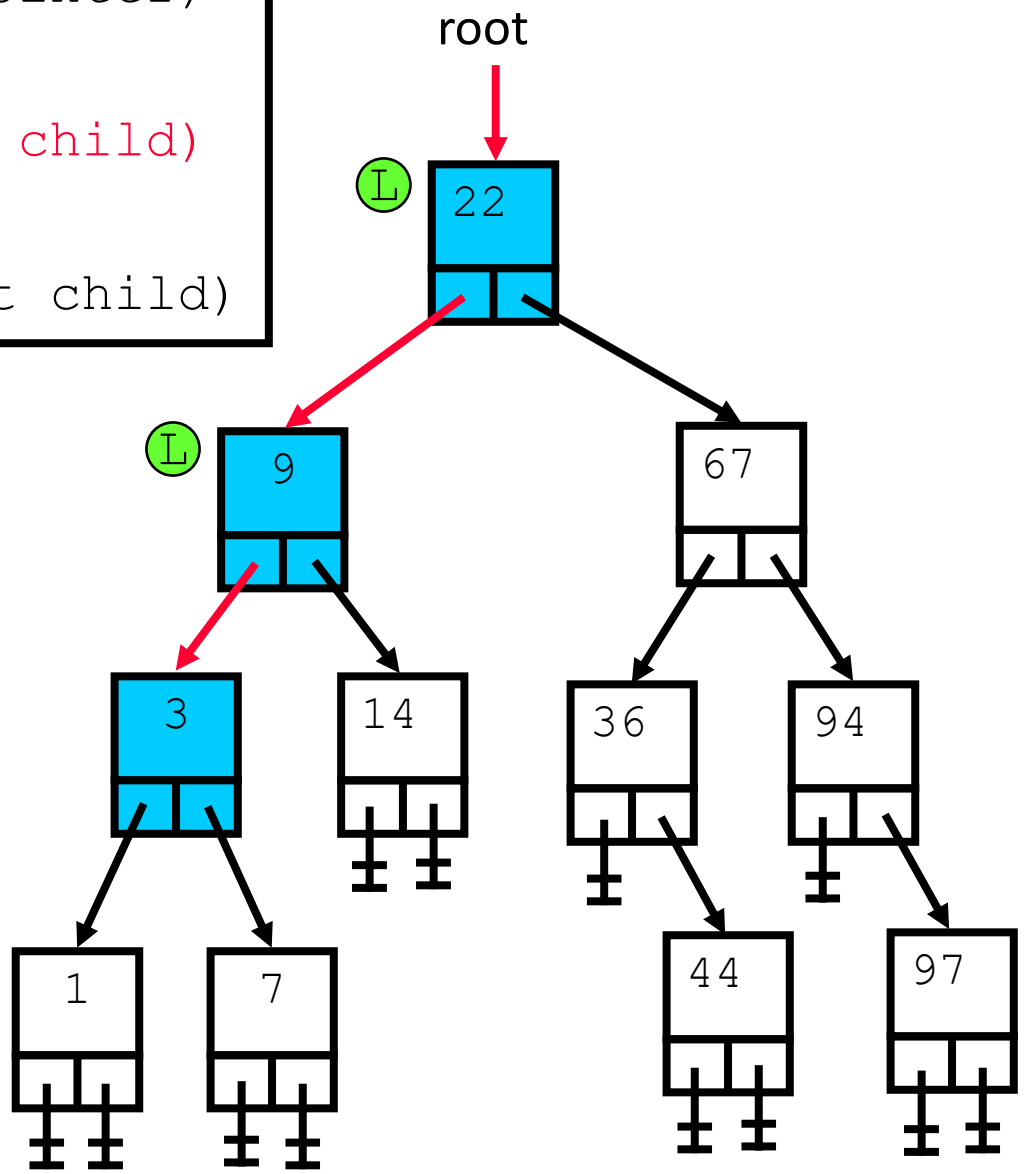

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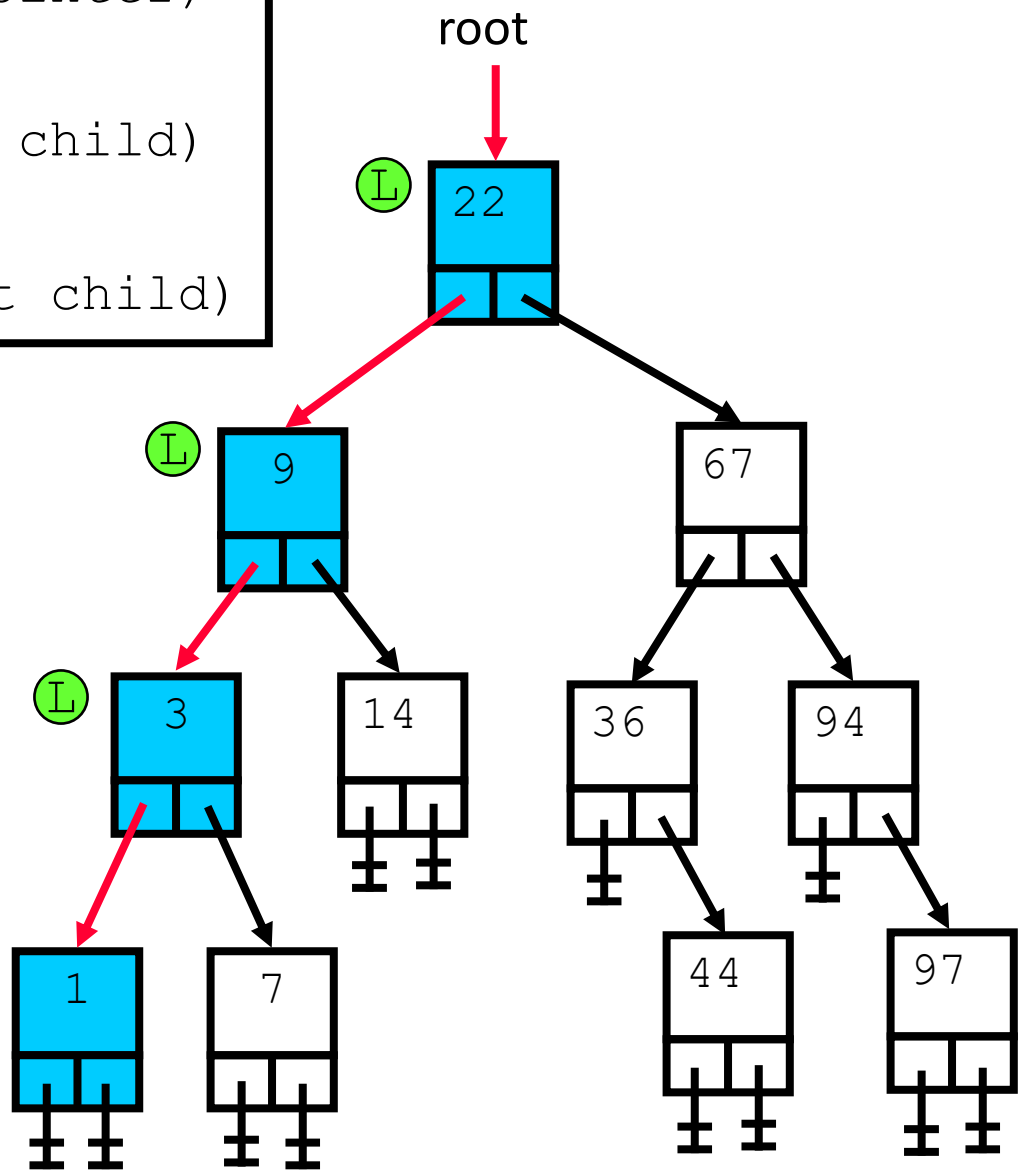

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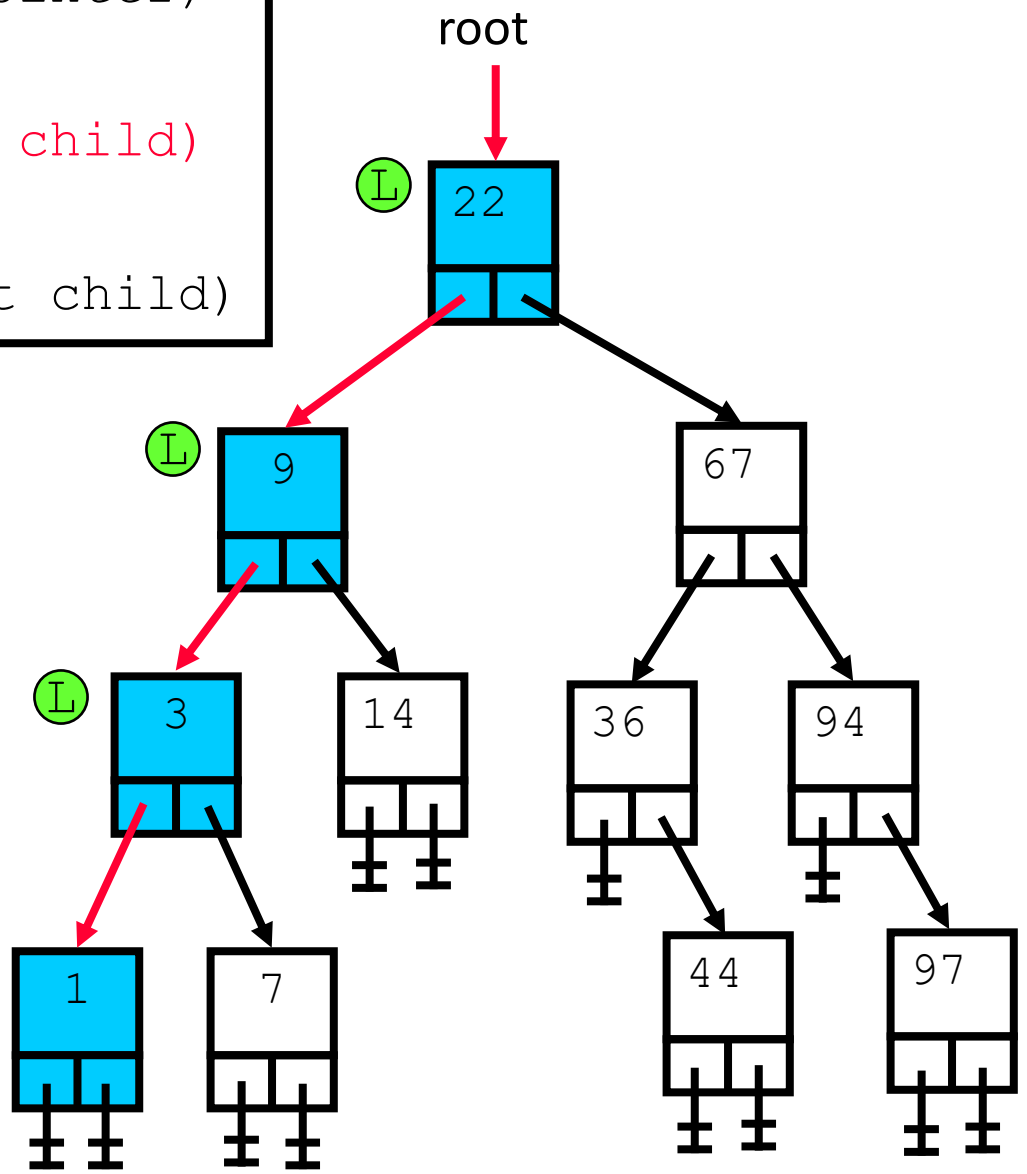

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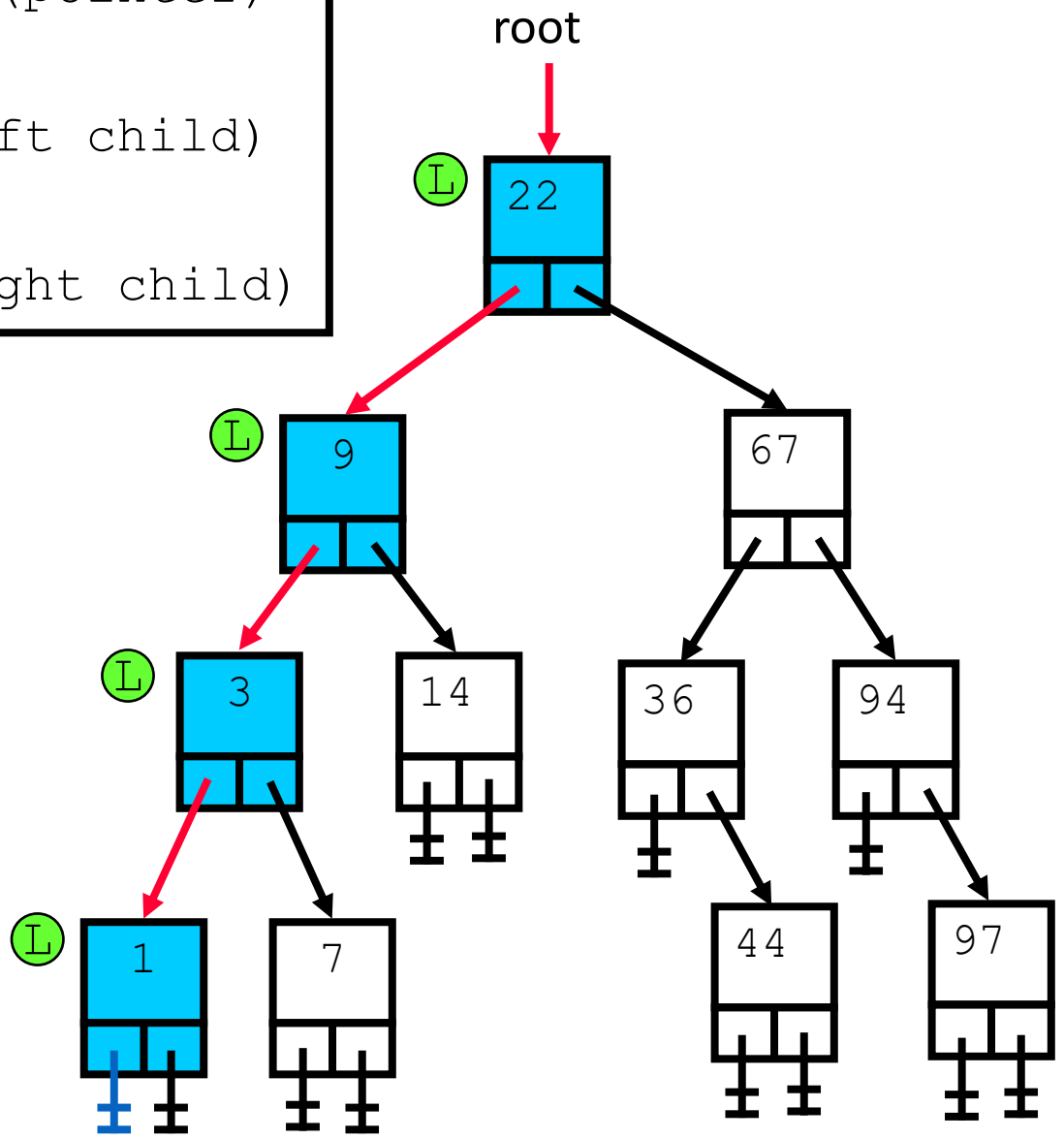

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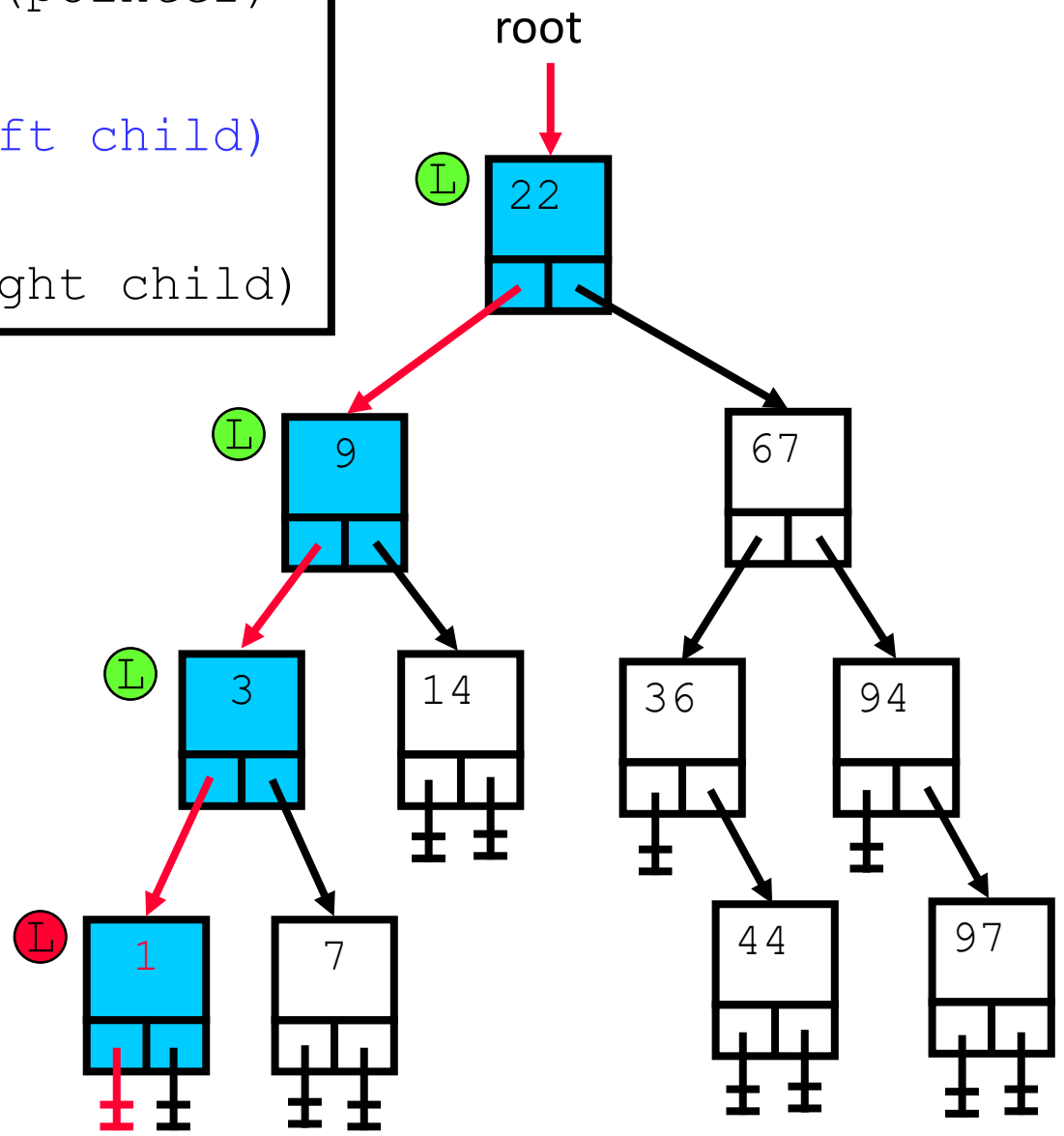

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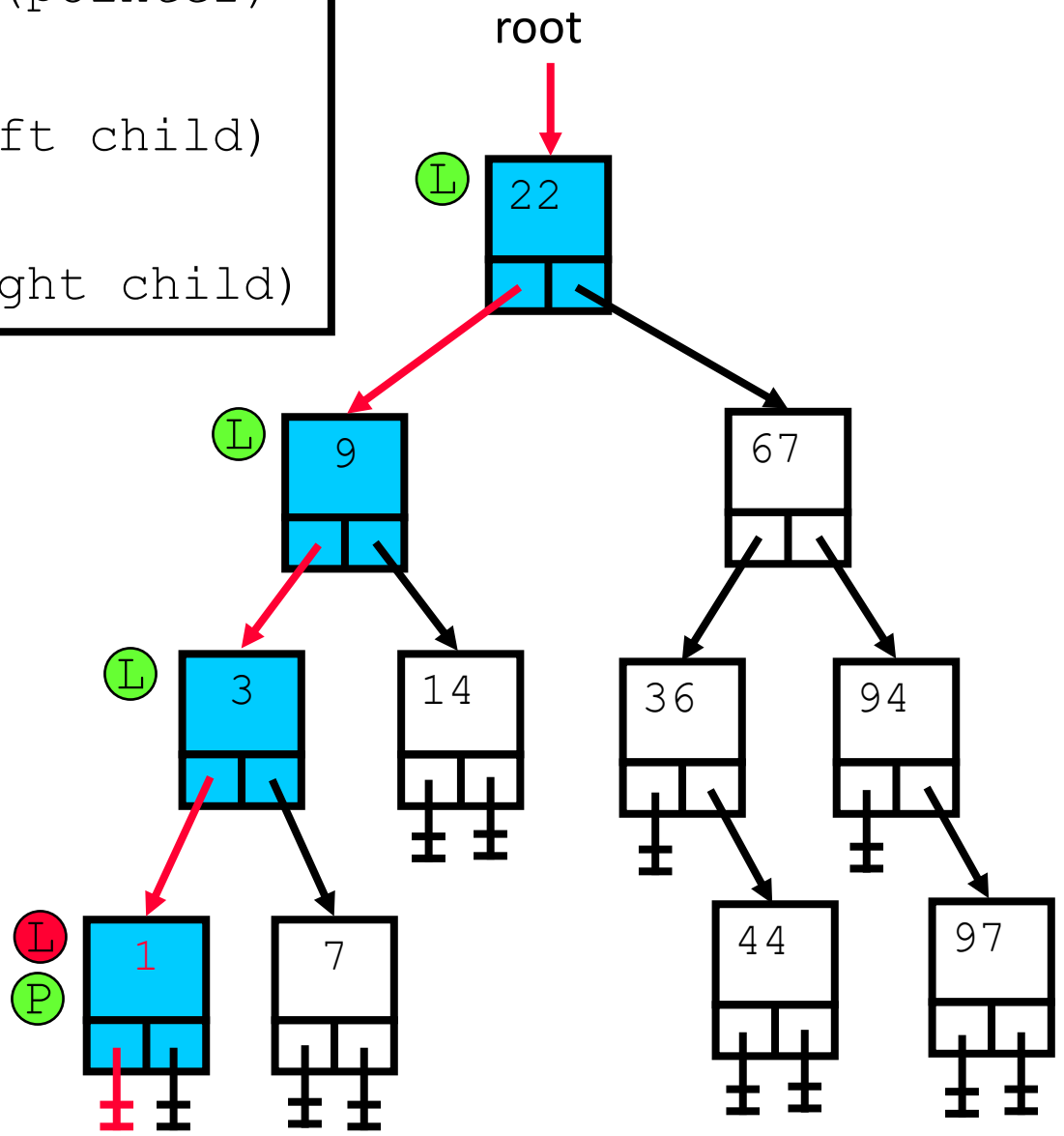

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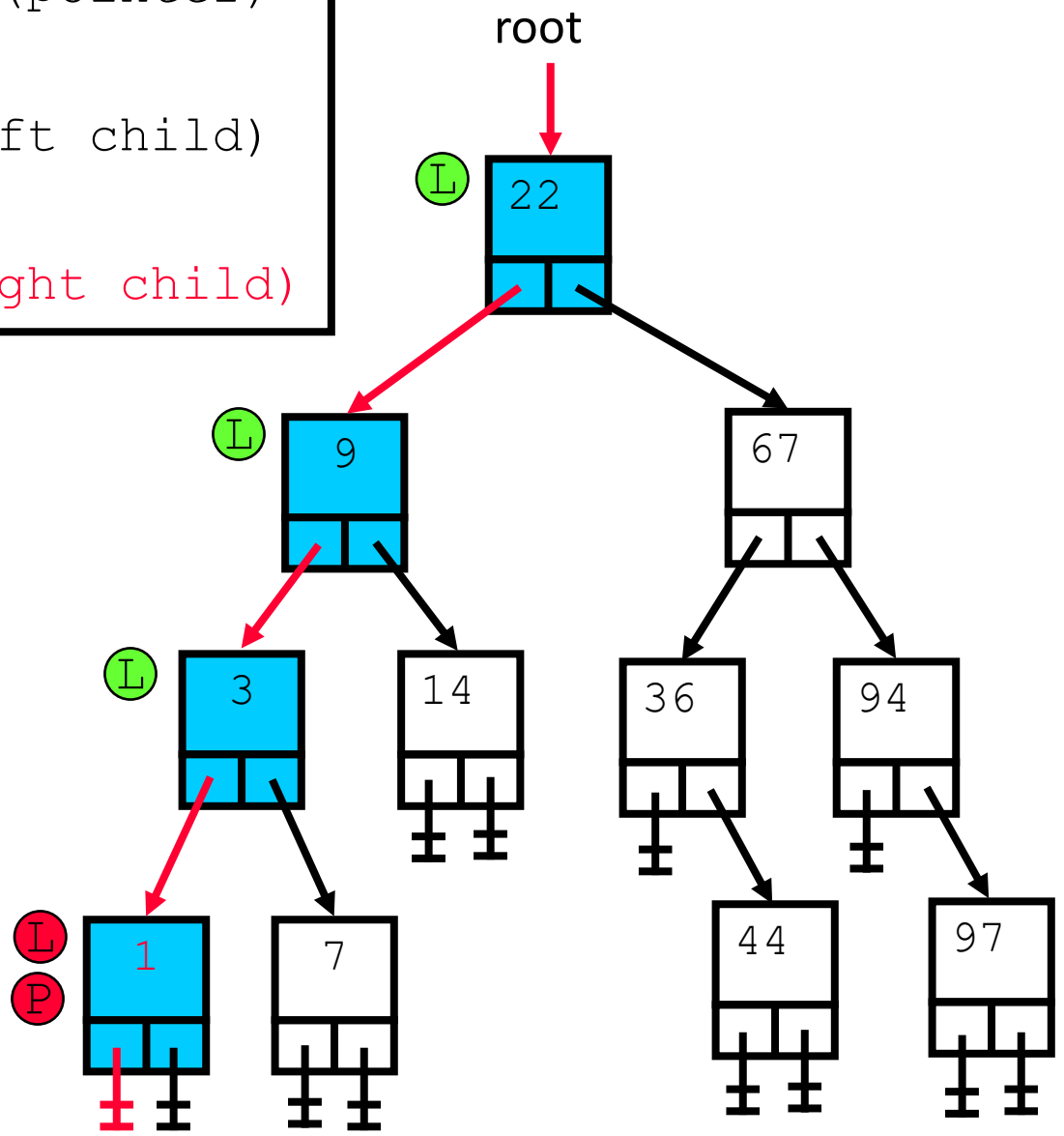

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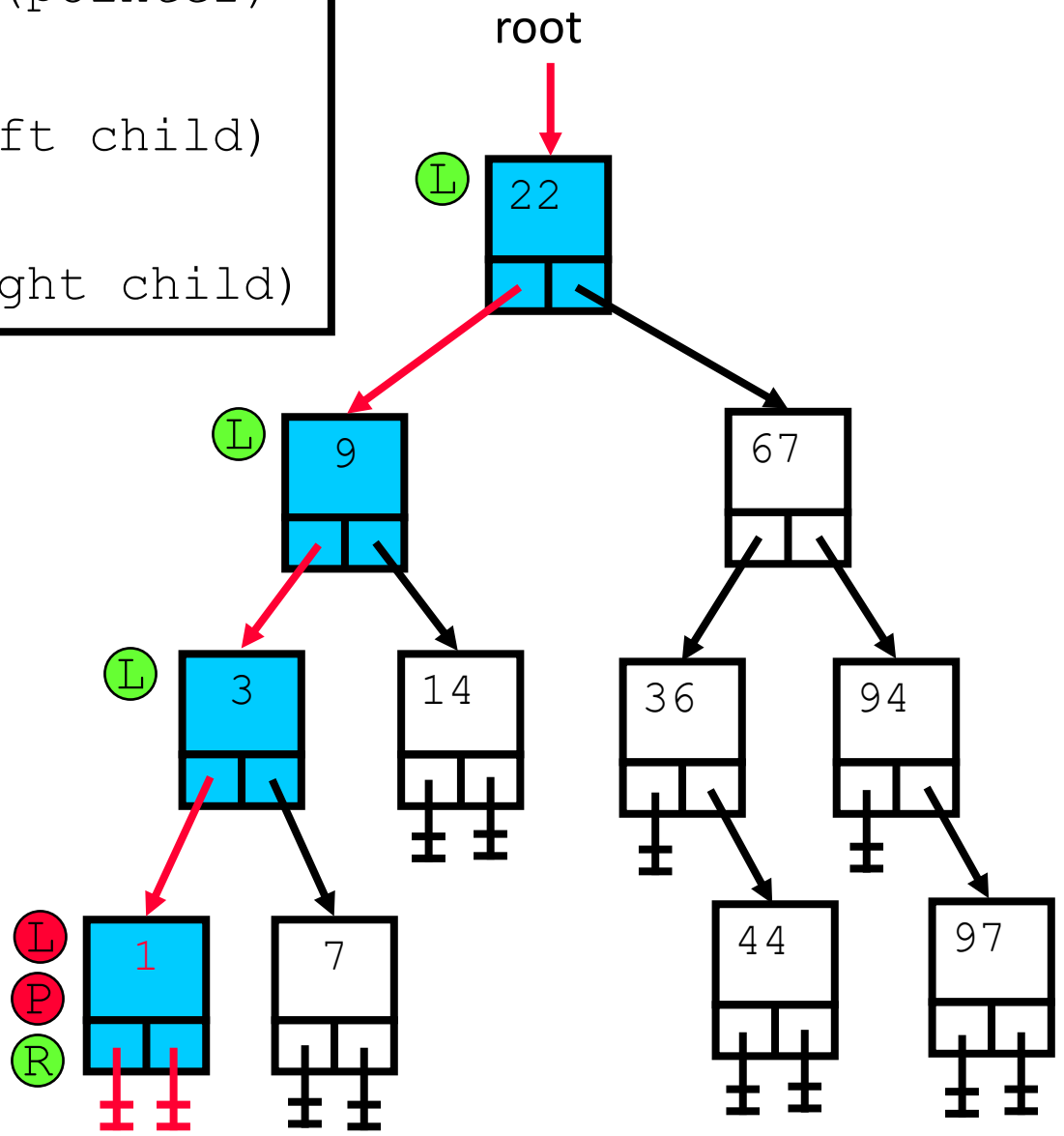

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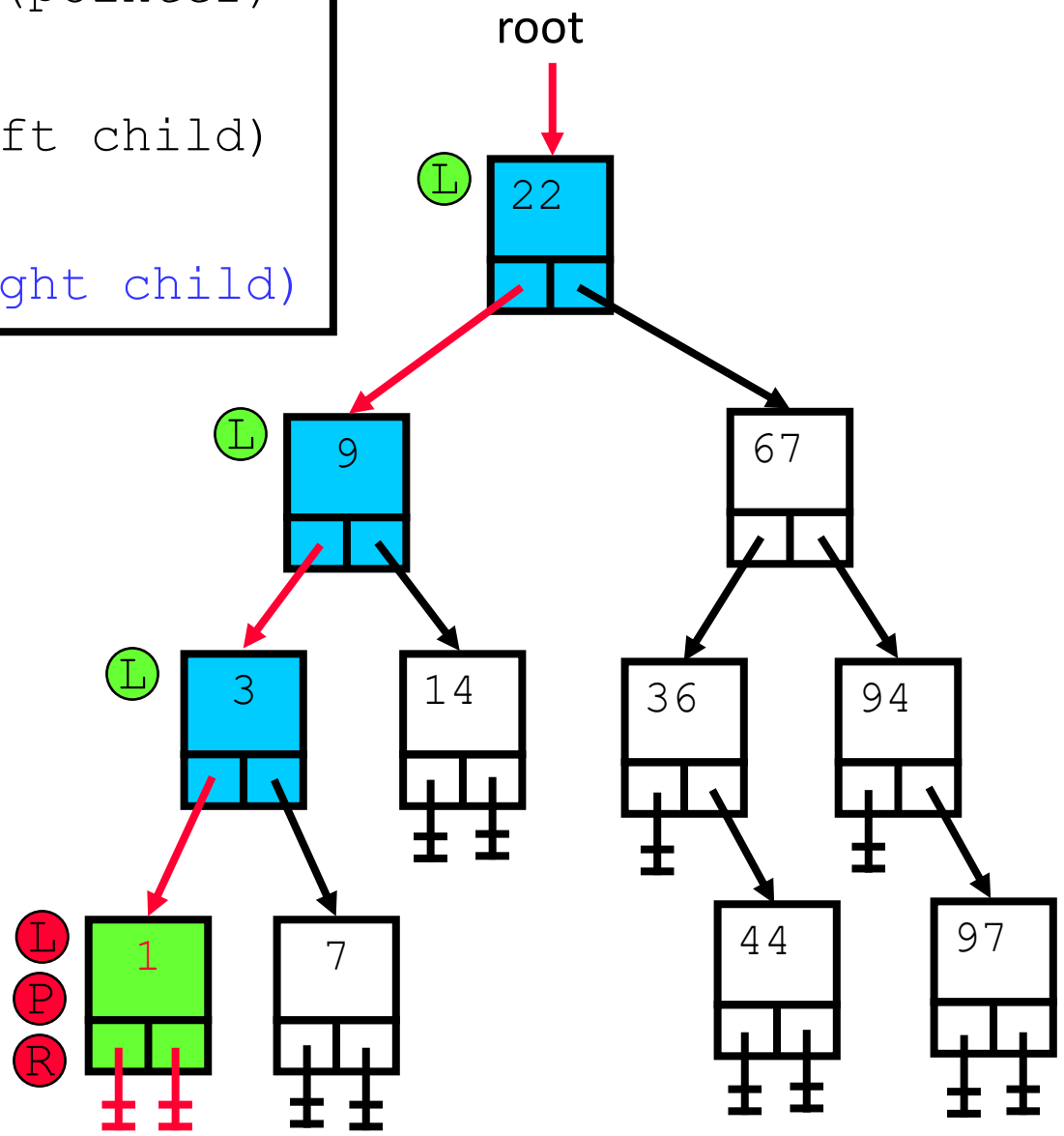

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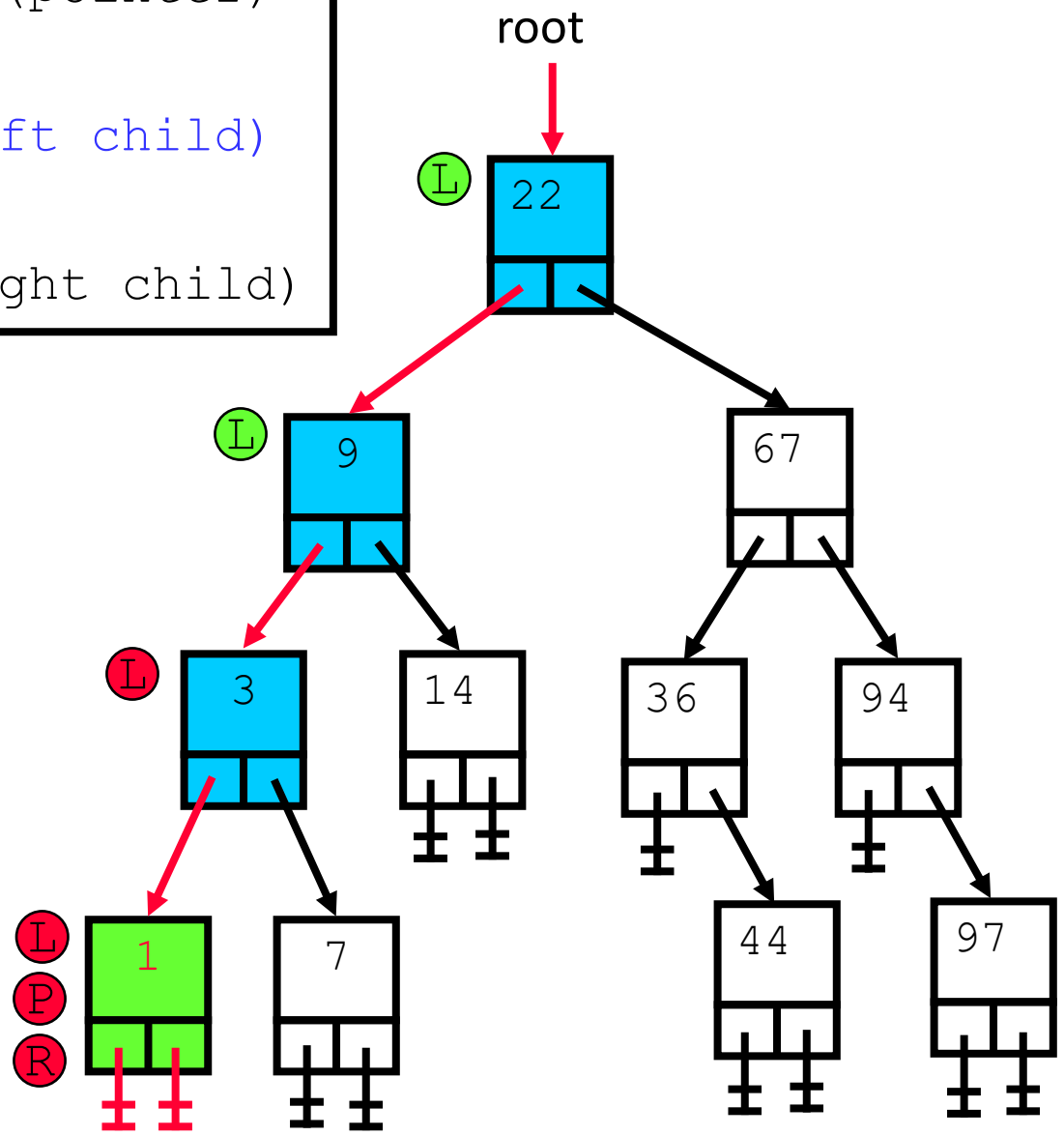

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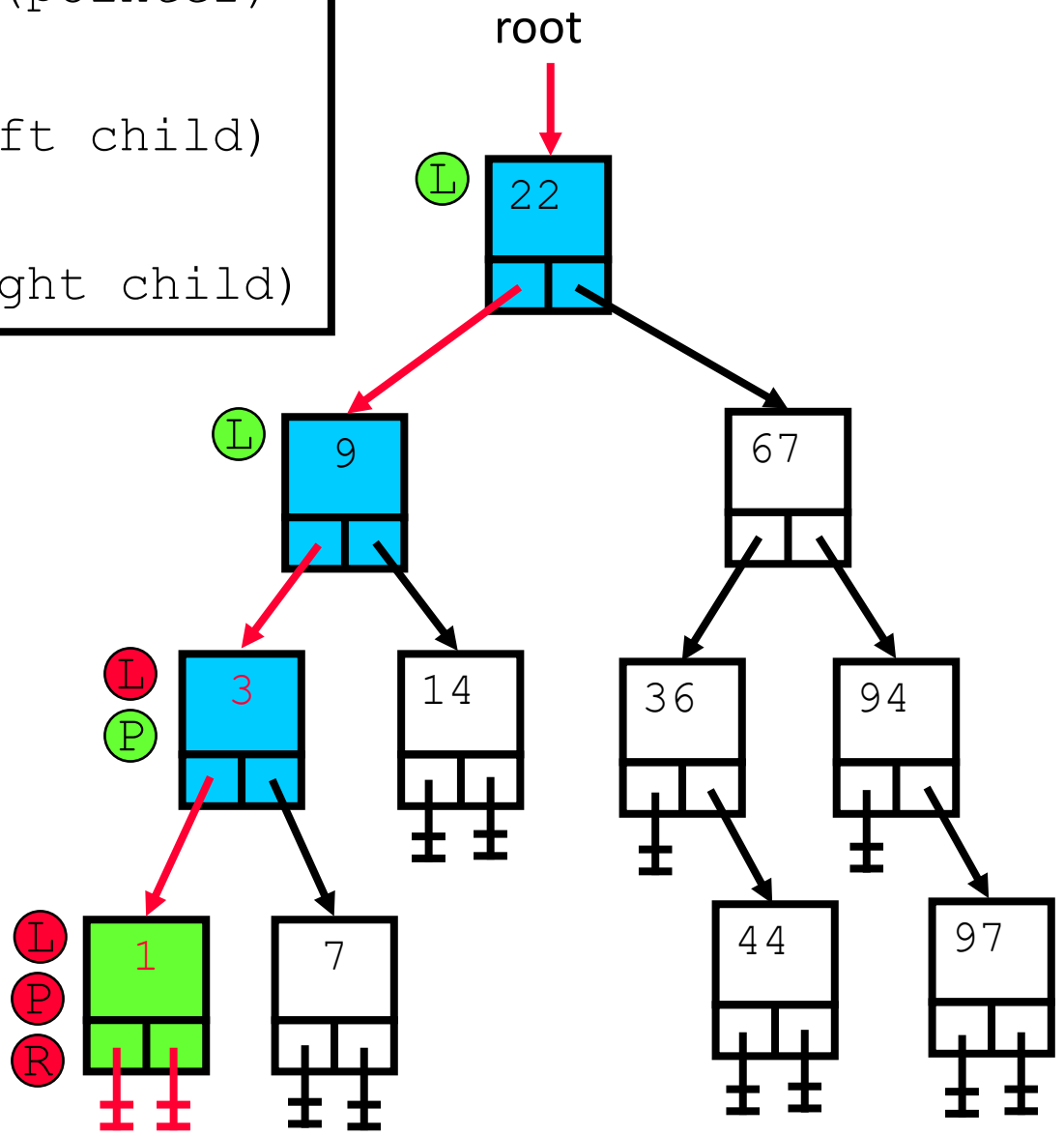

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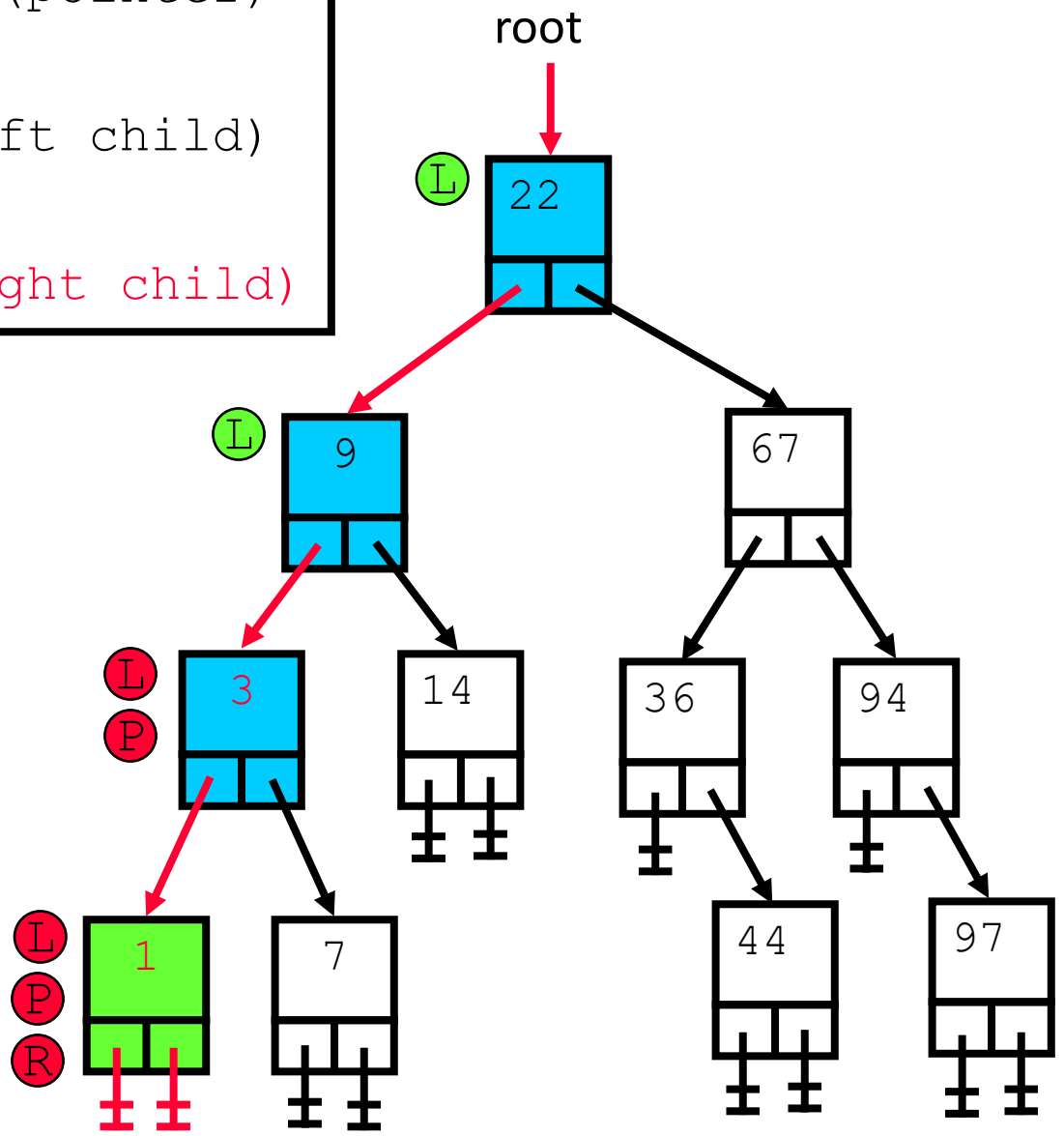

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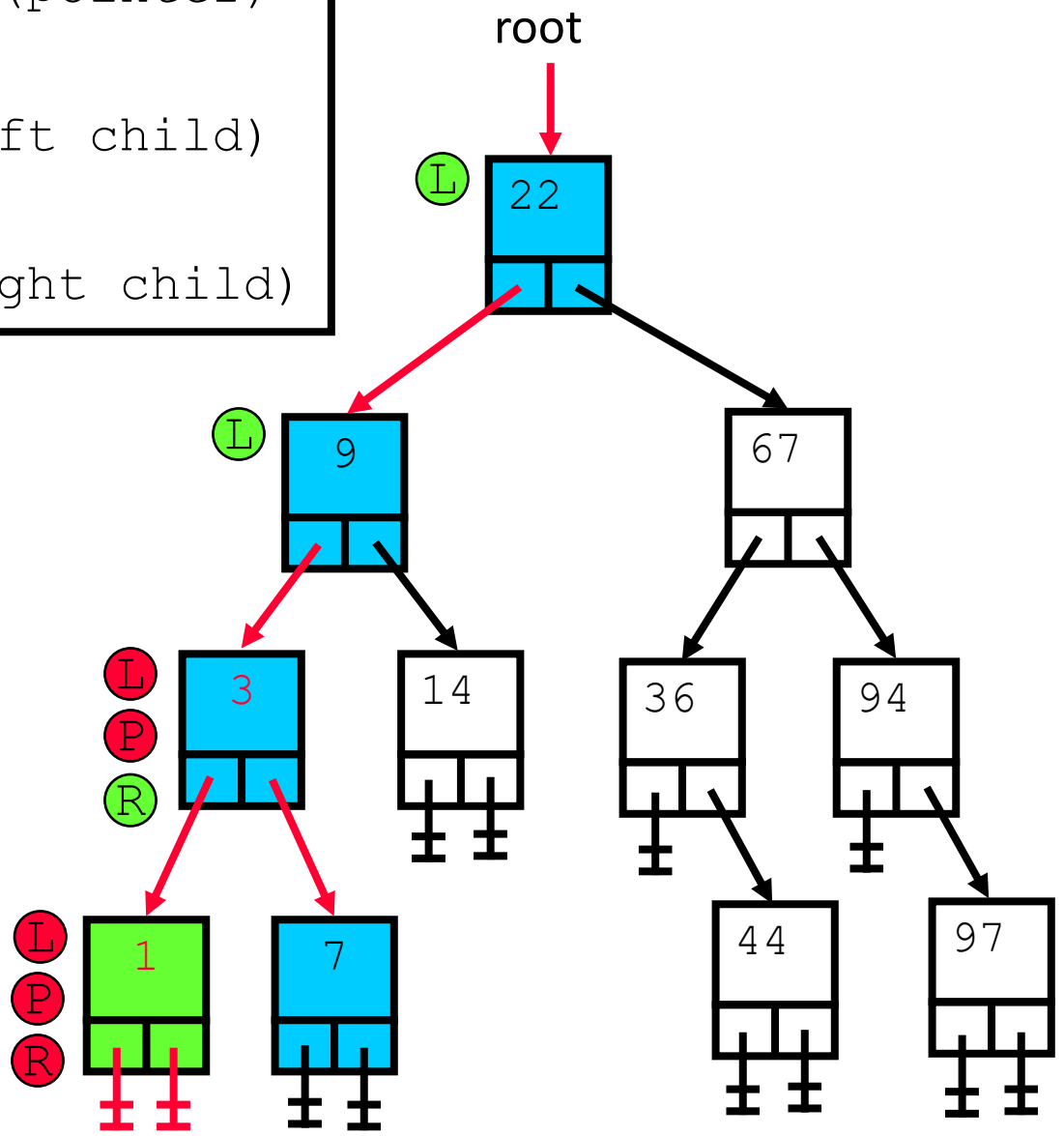

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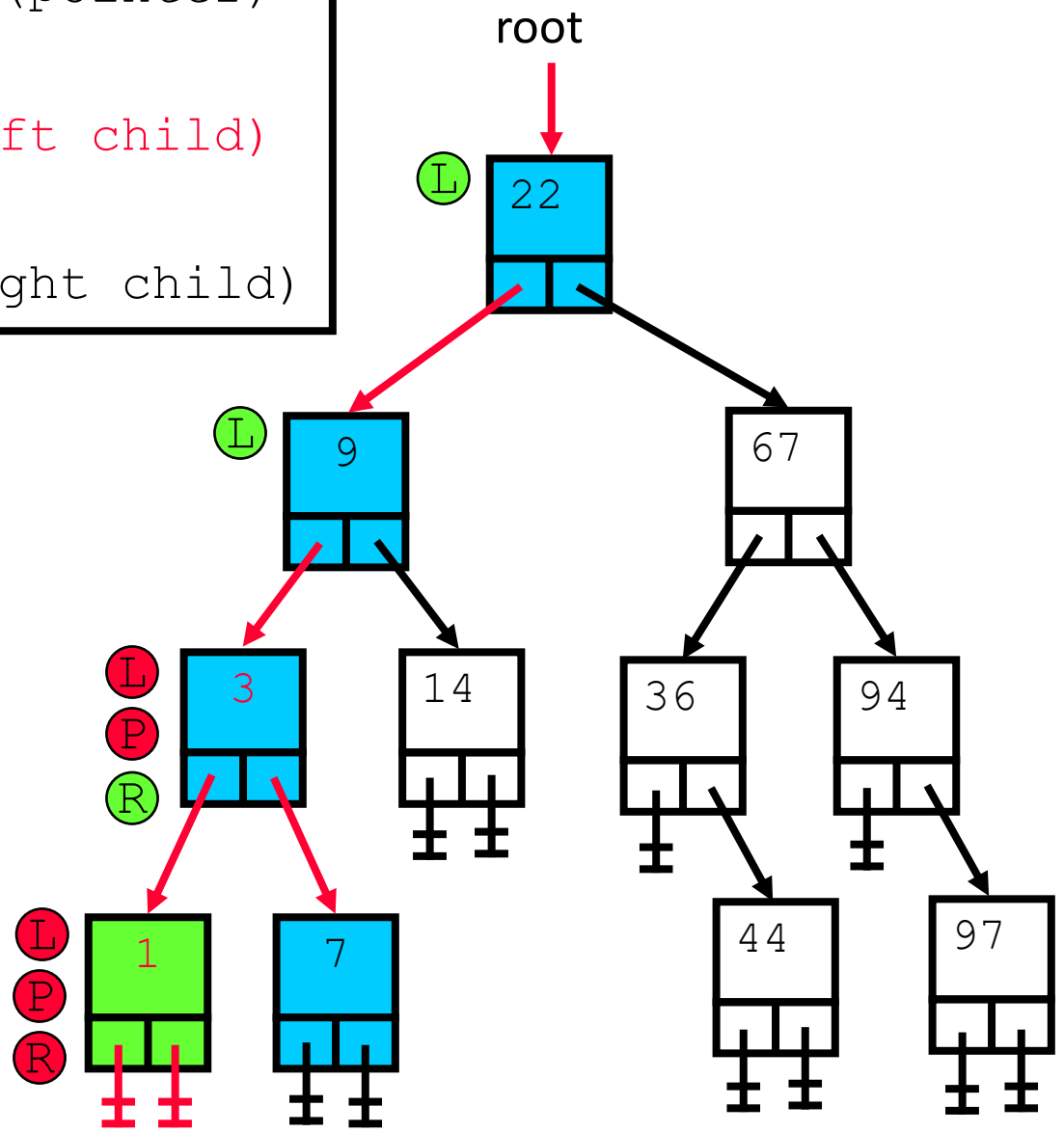

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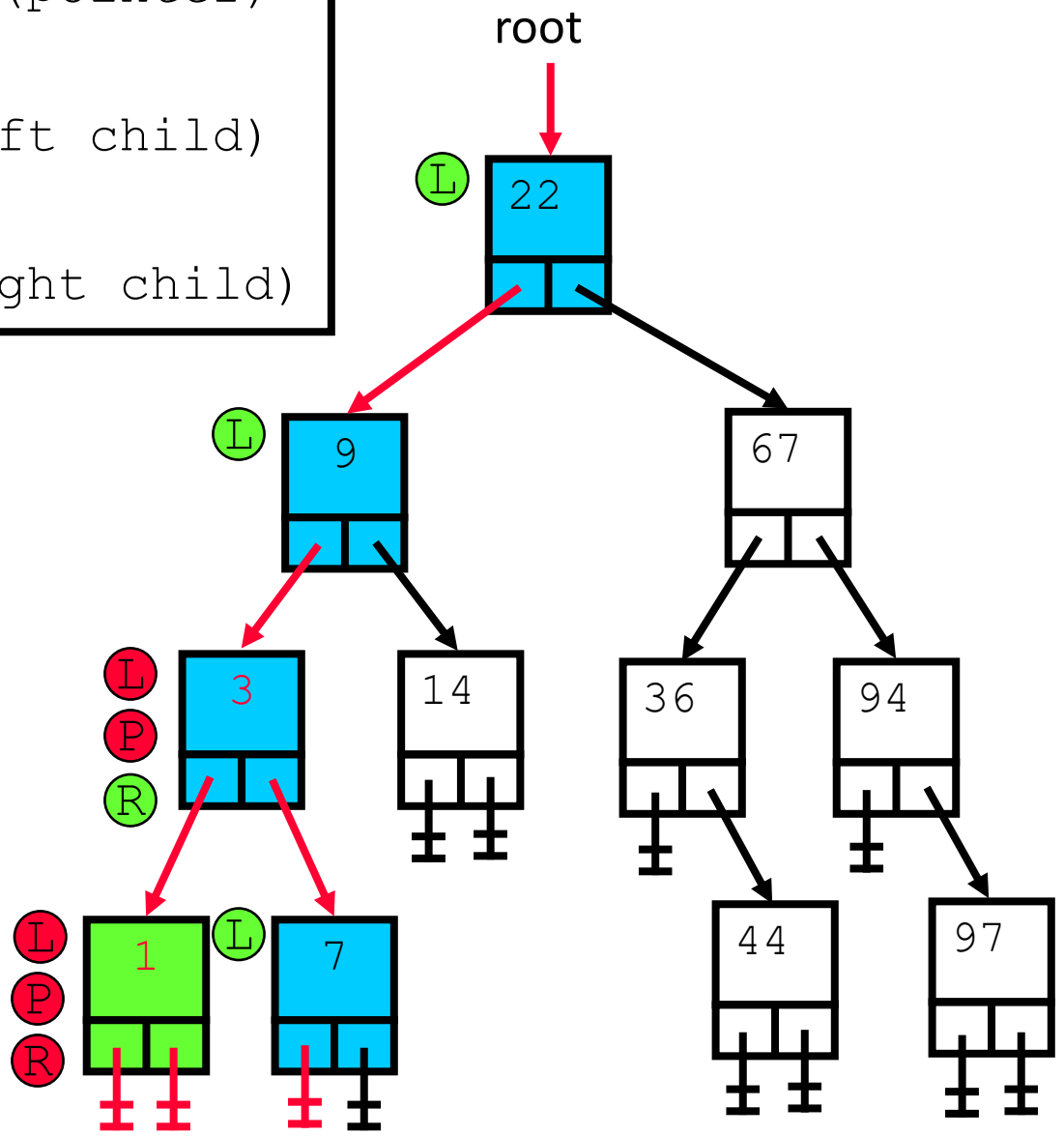

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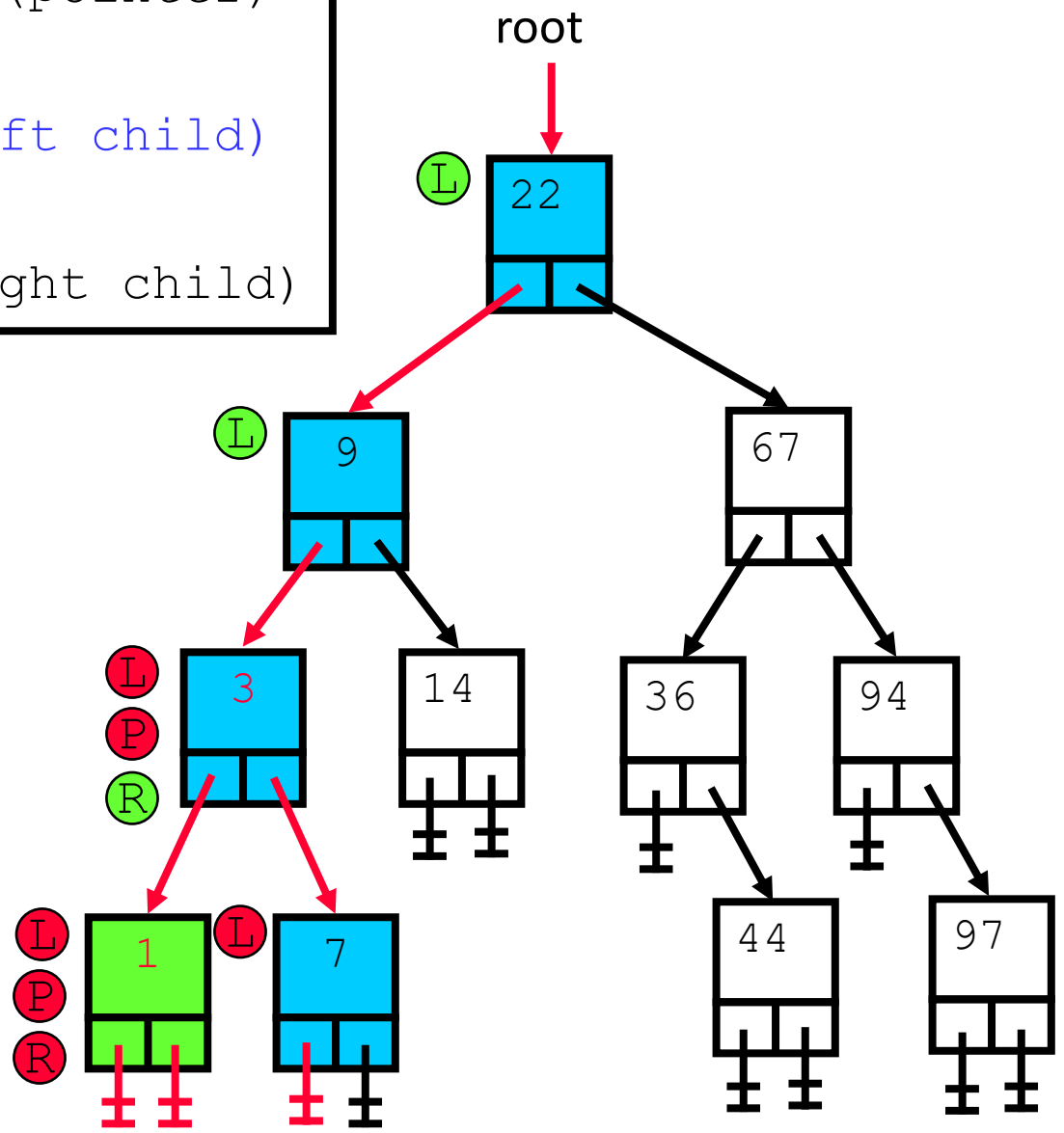

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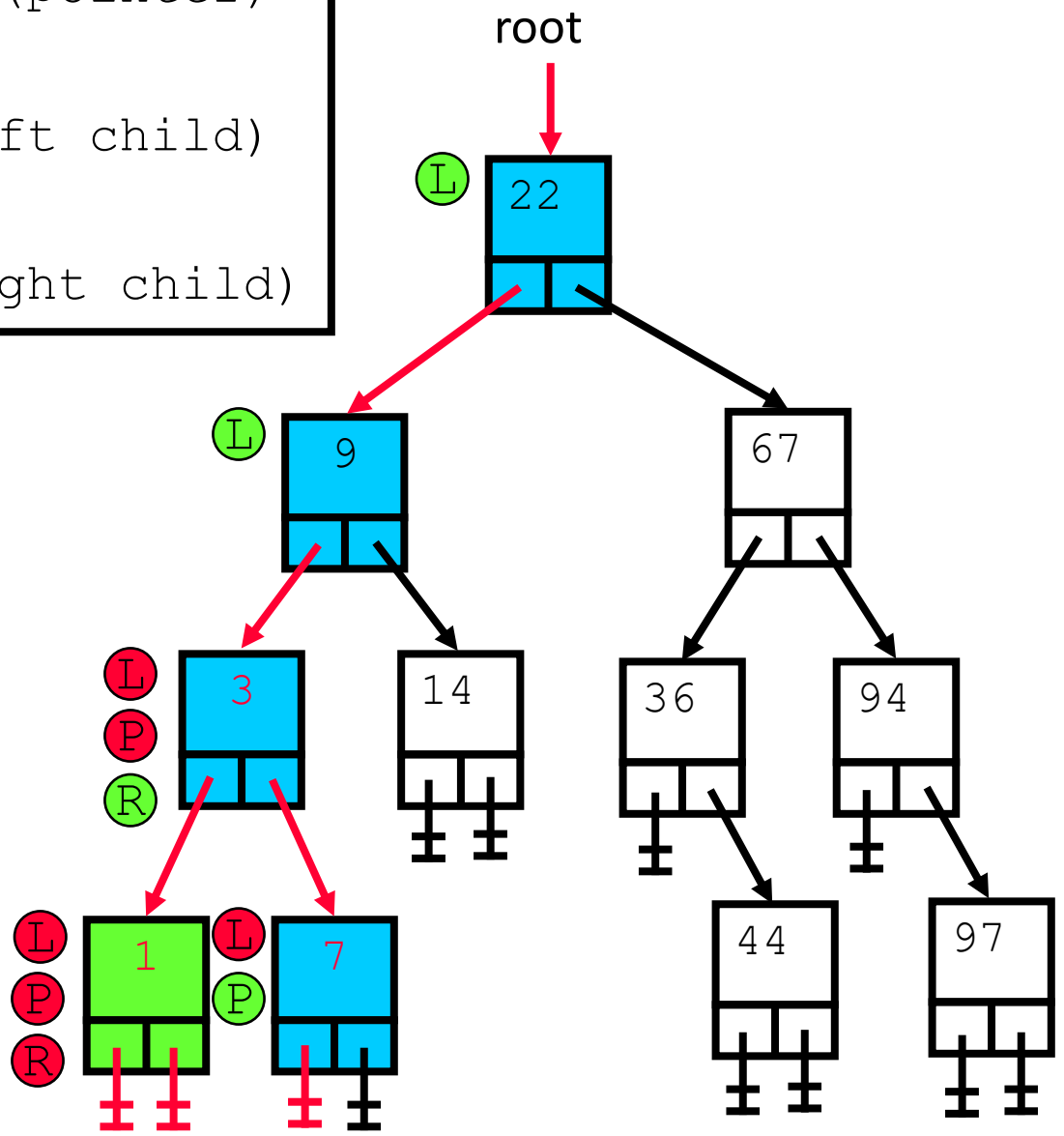
```
Output: 1 3 7
```



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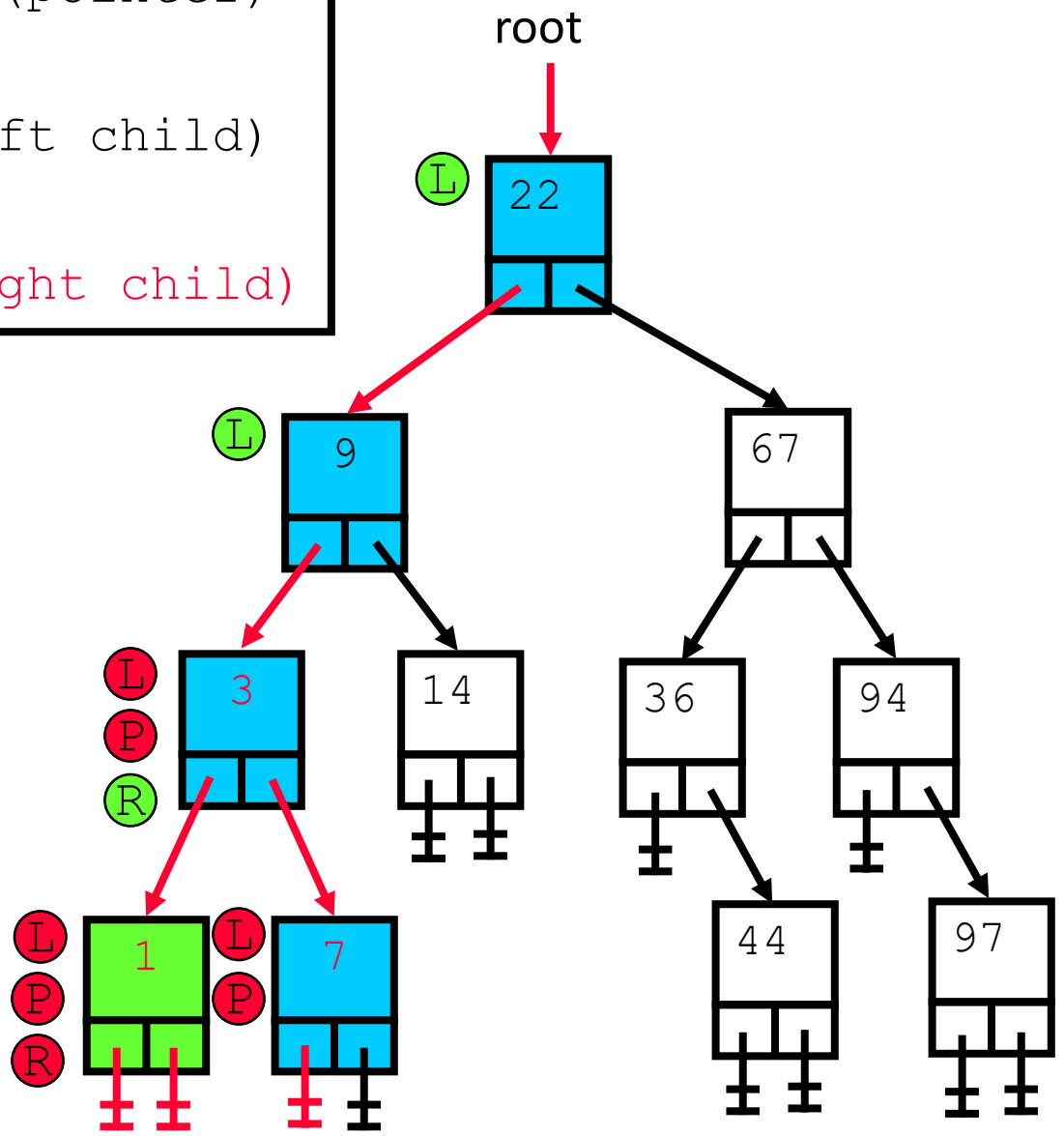

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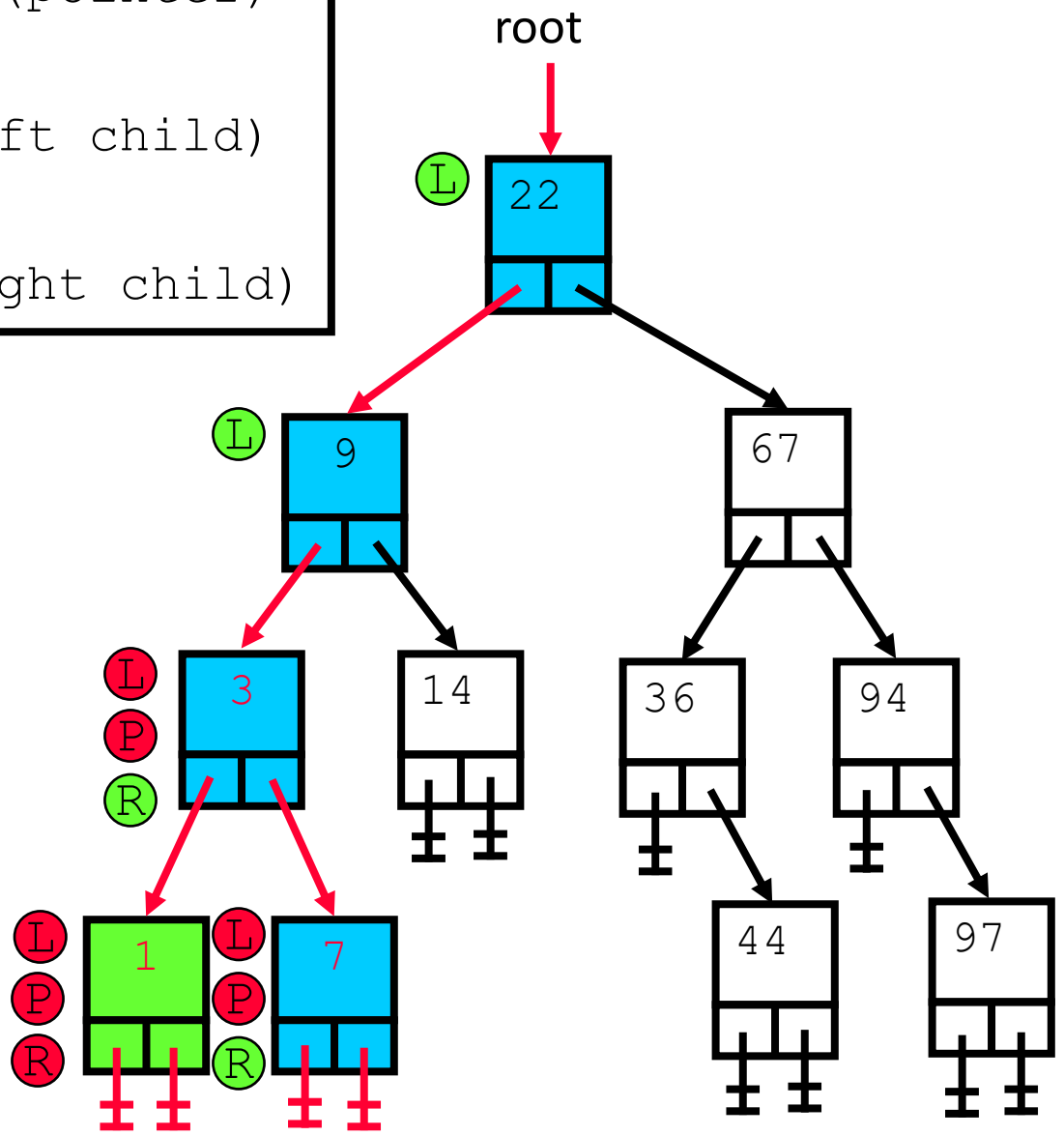

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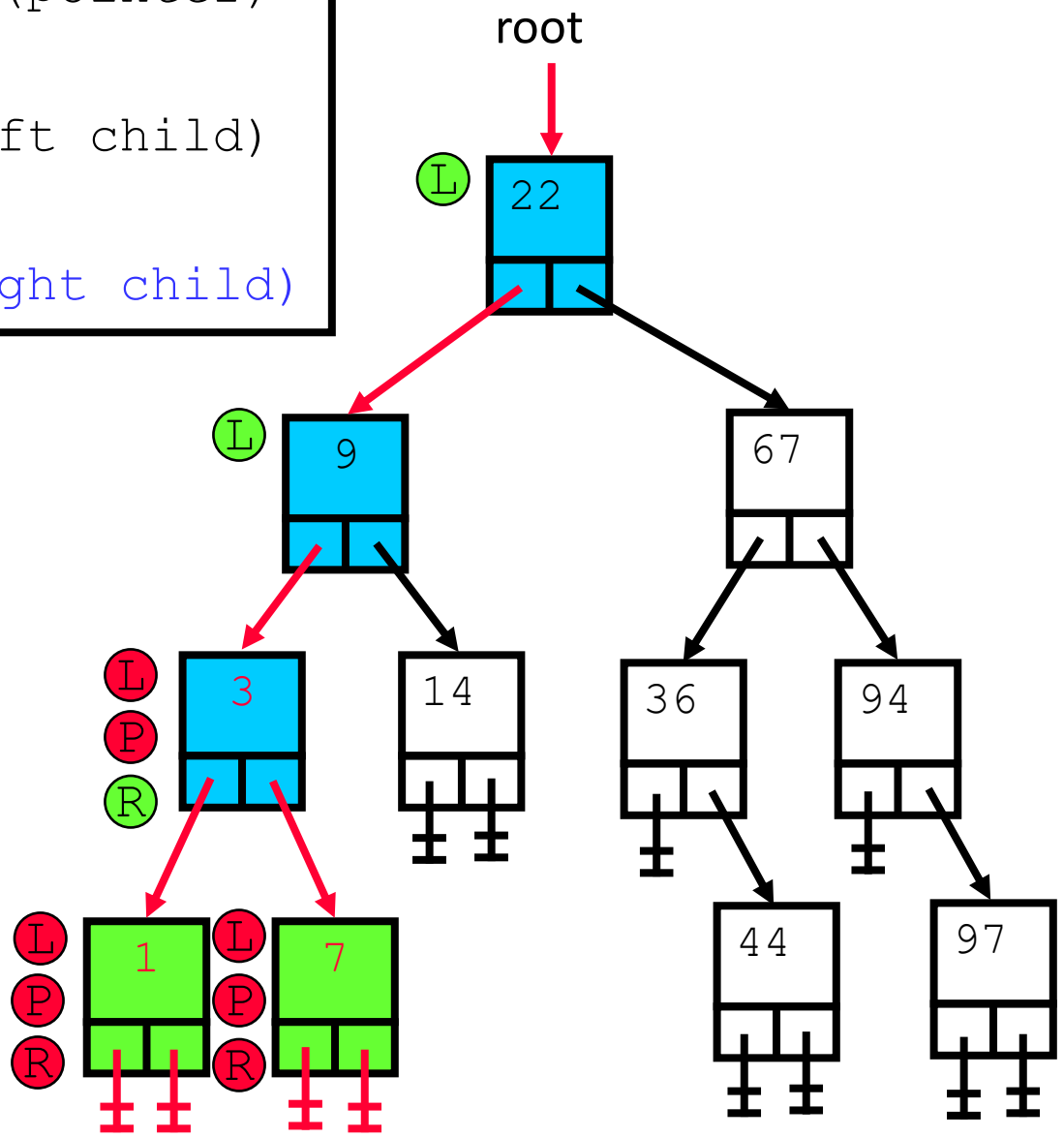

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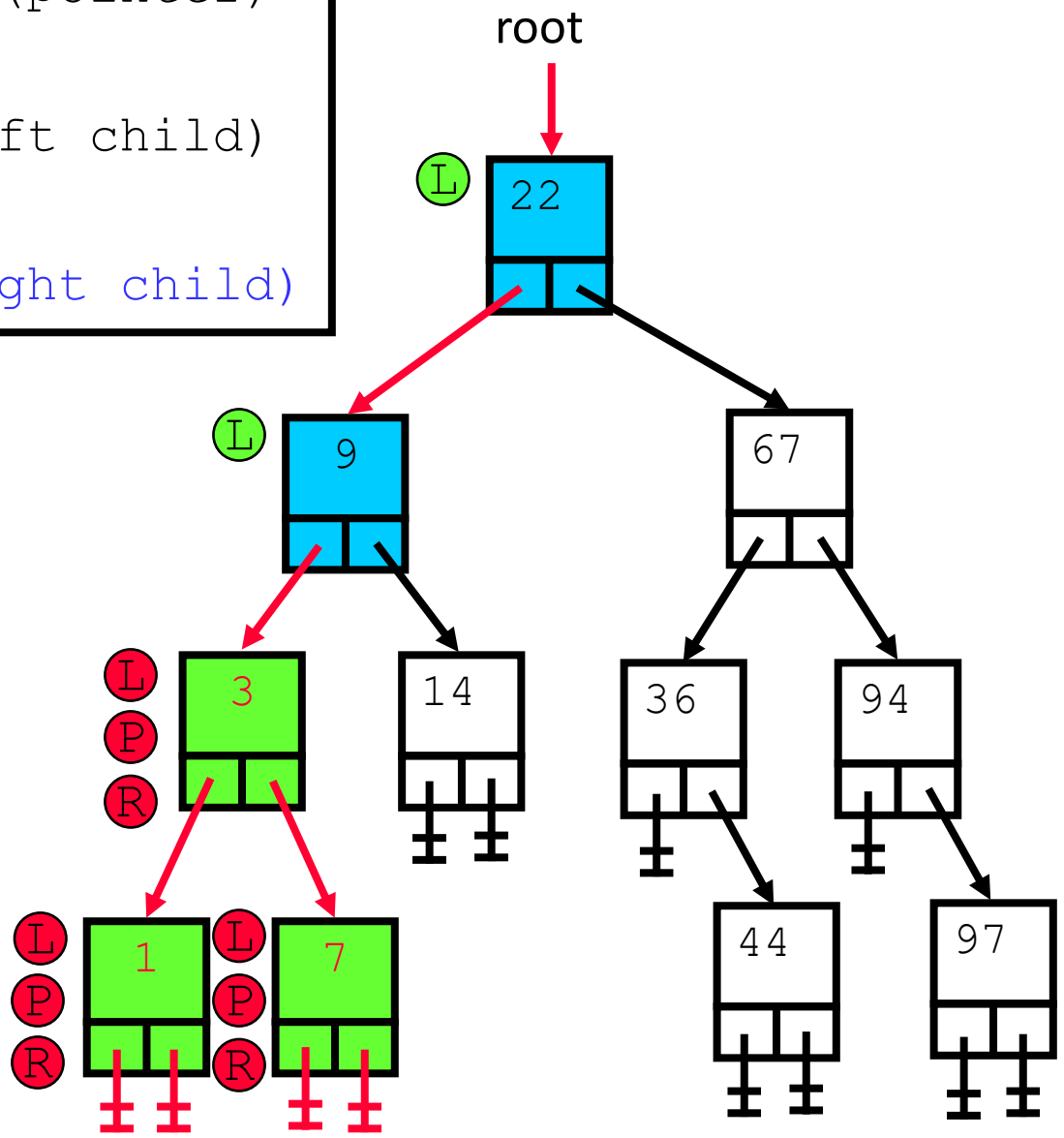

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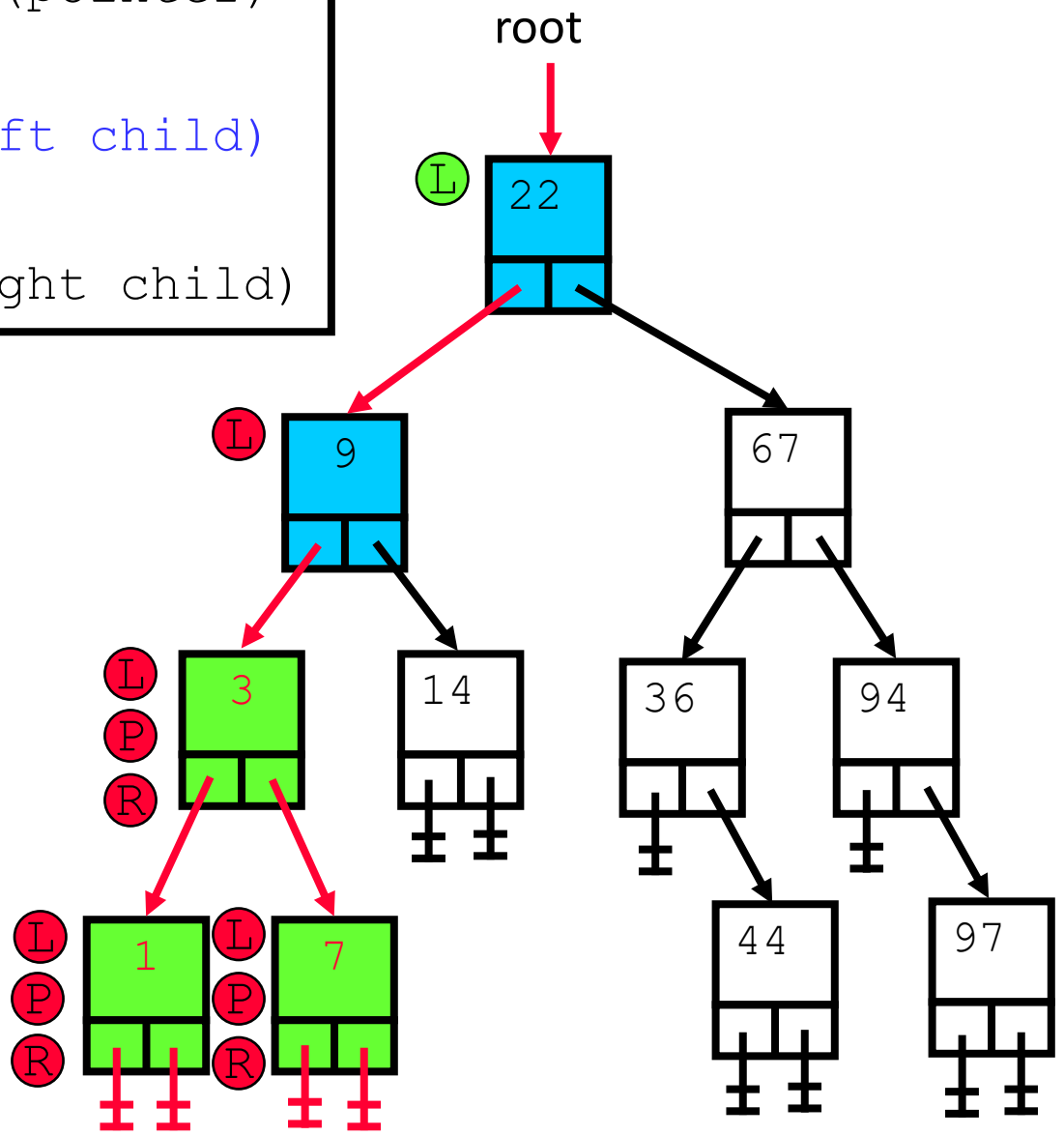

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Proc InOrderPrint(pointer)
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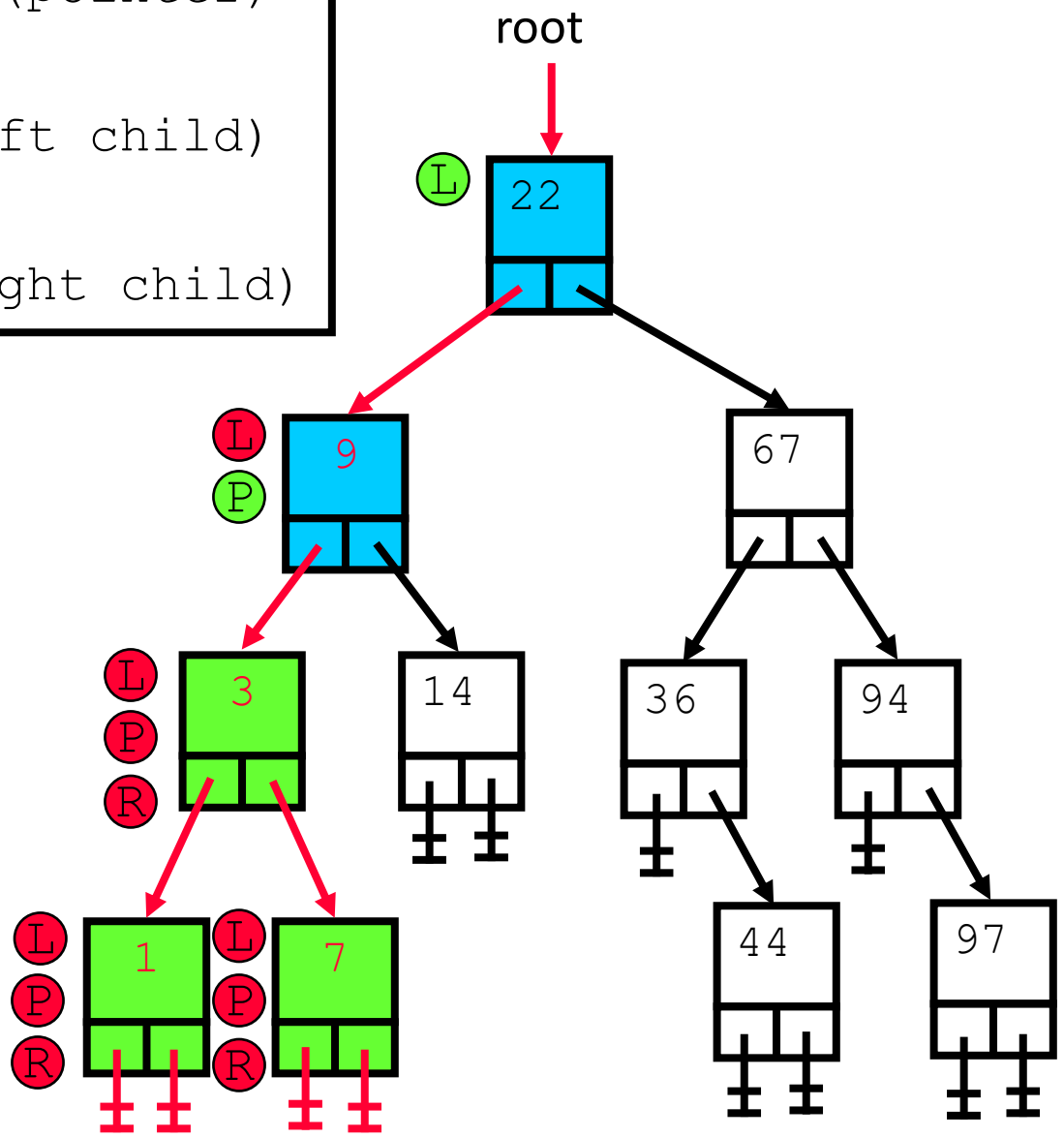
```
Output: 1 3 7 9
```



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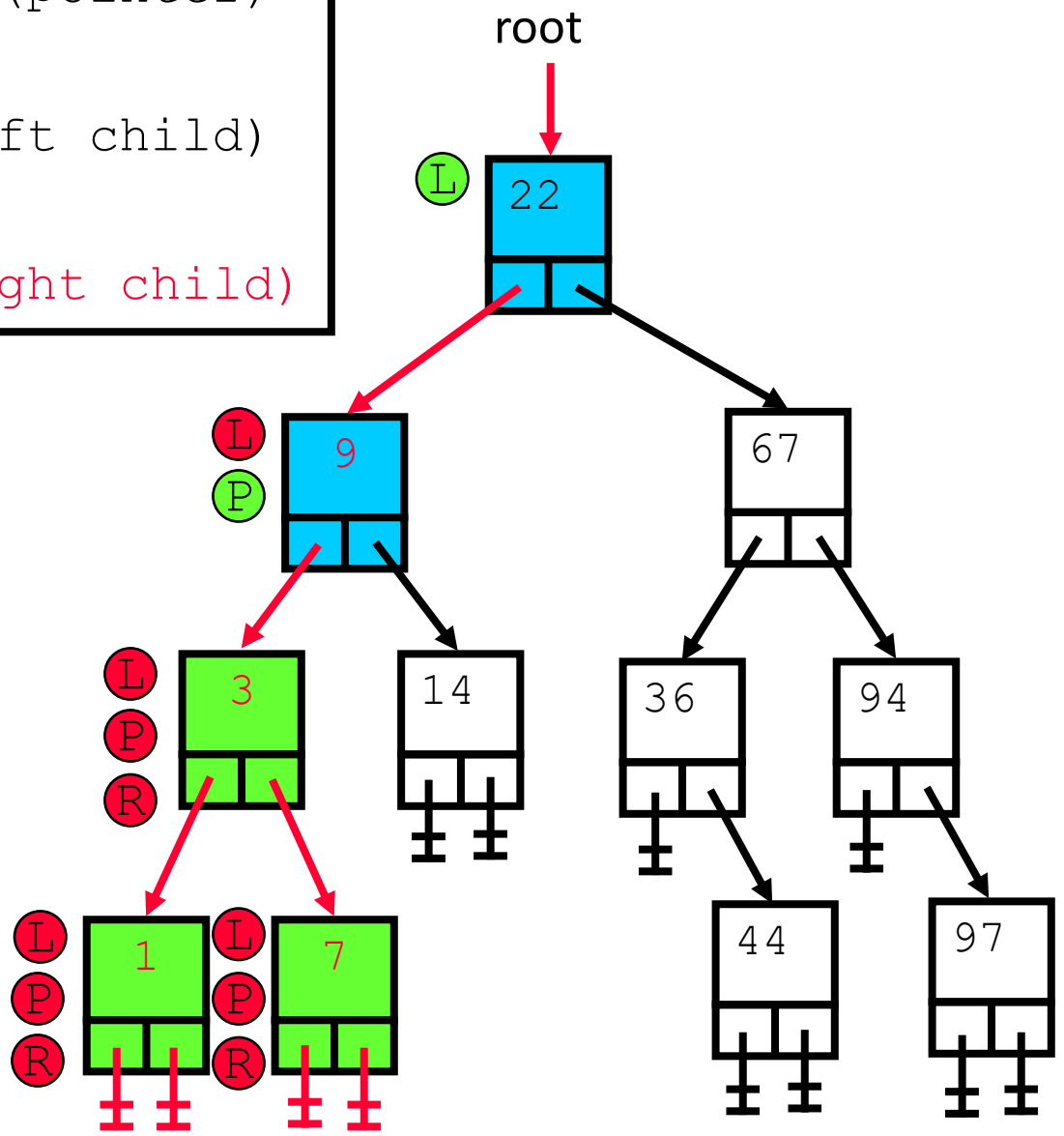

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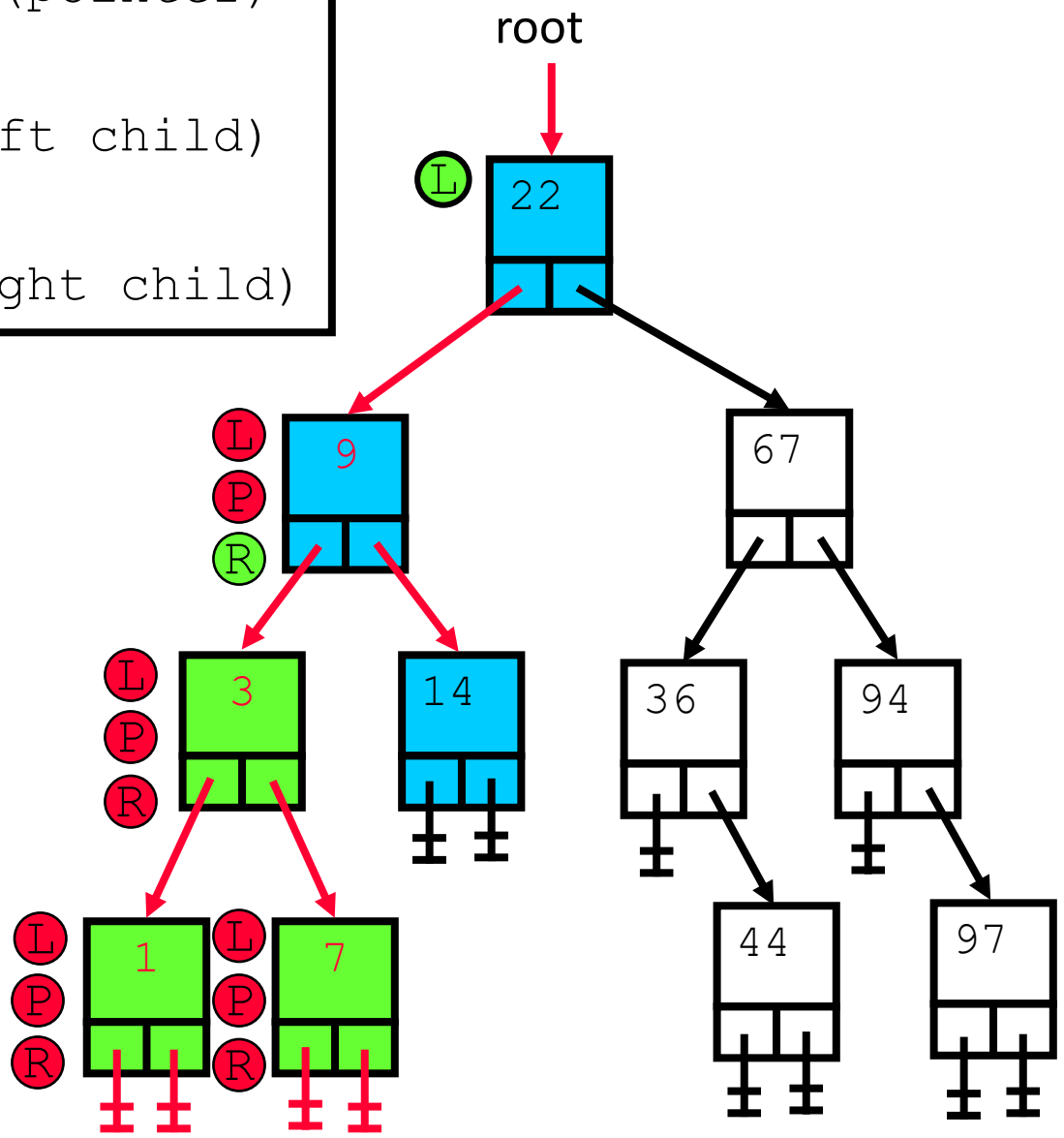

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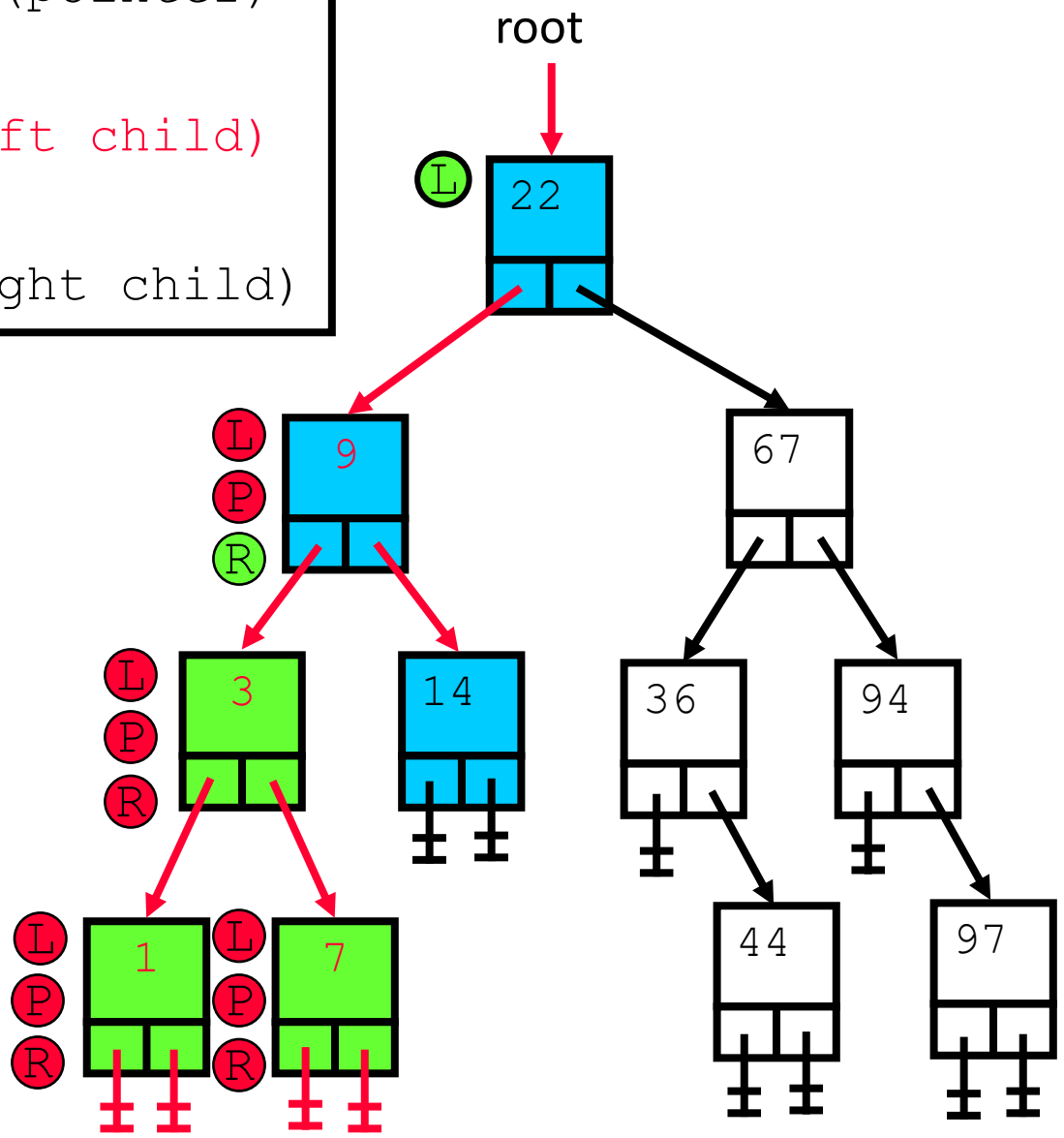

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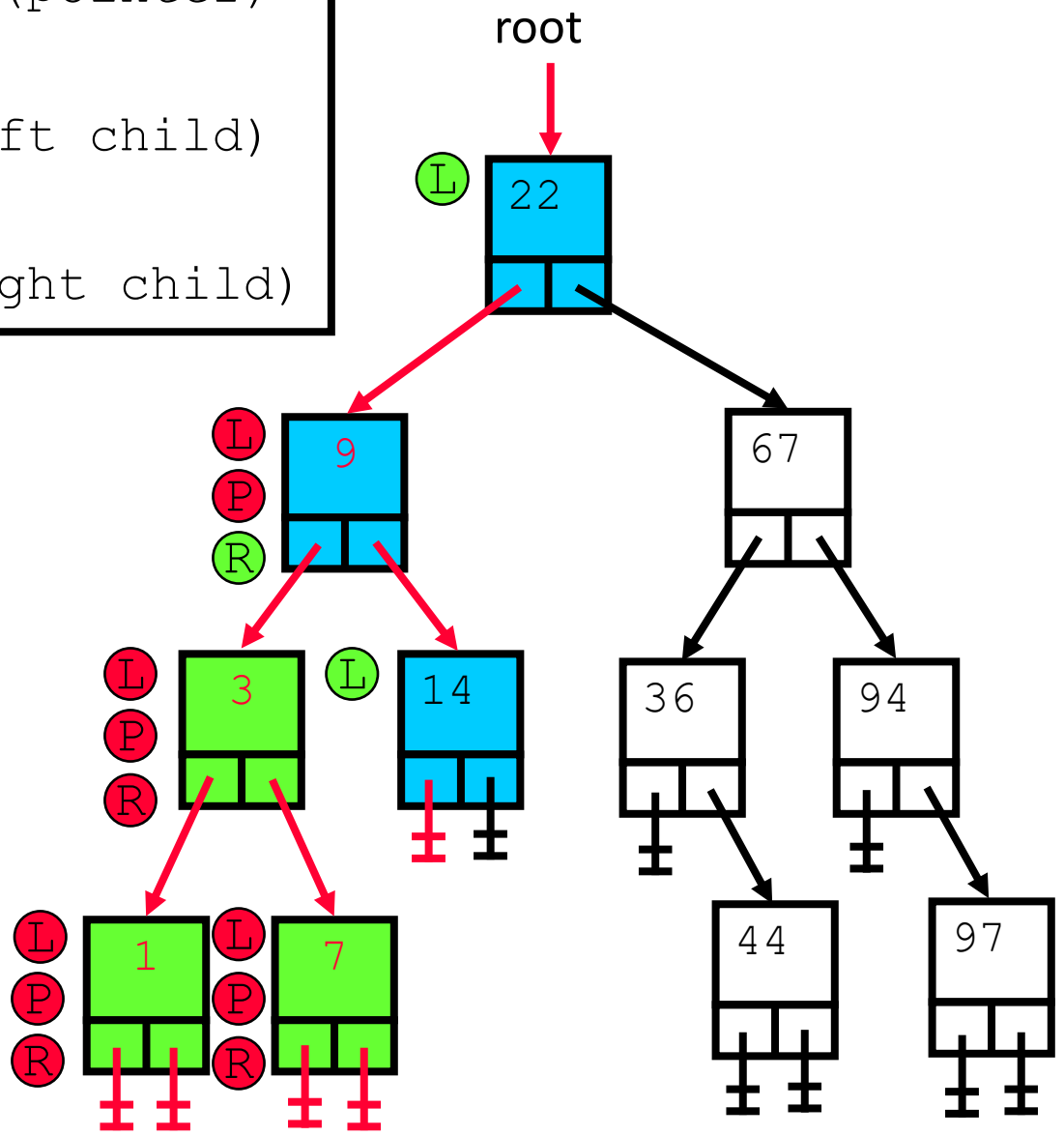

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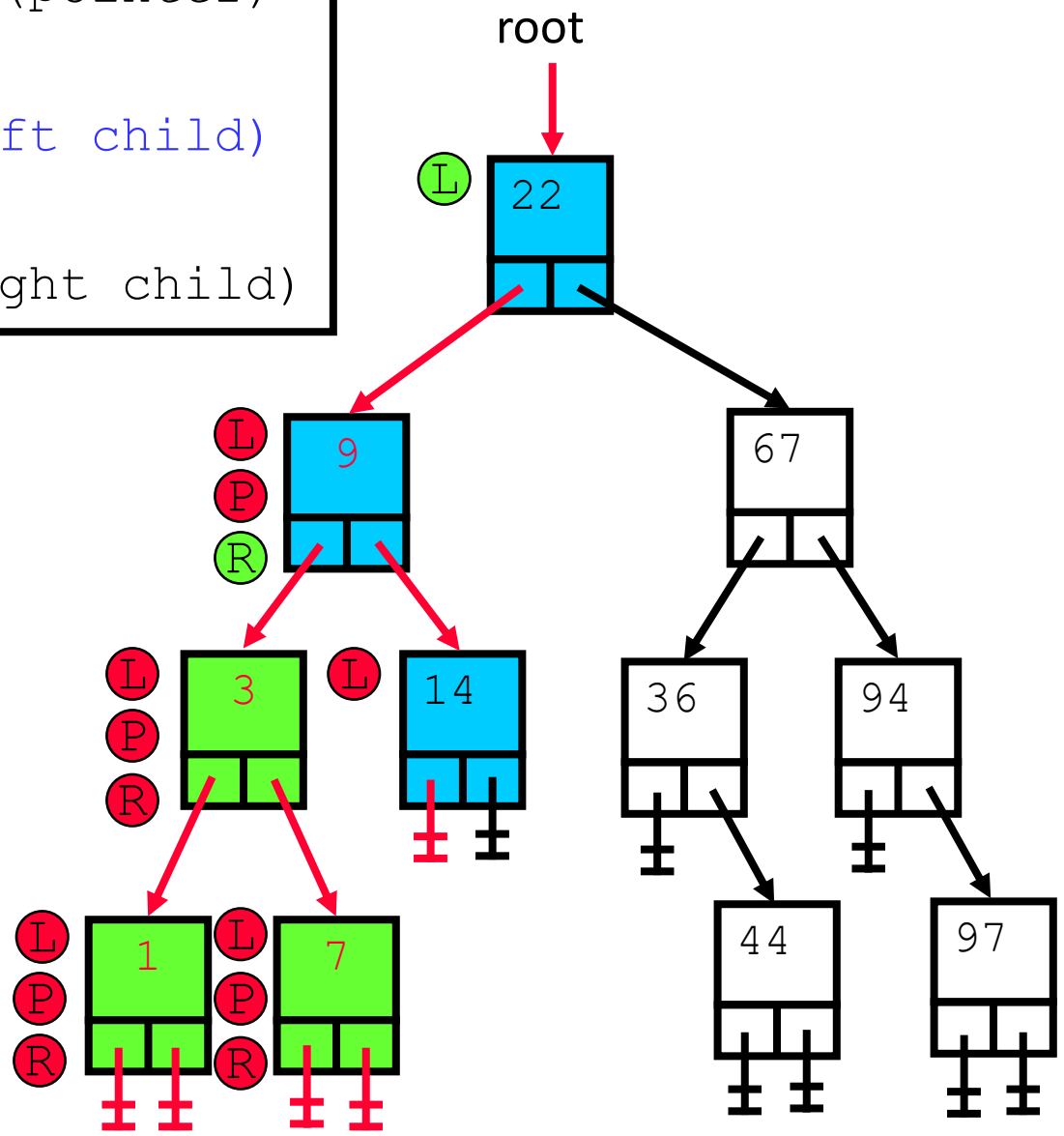

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Proc InOrderPrint(pointer)
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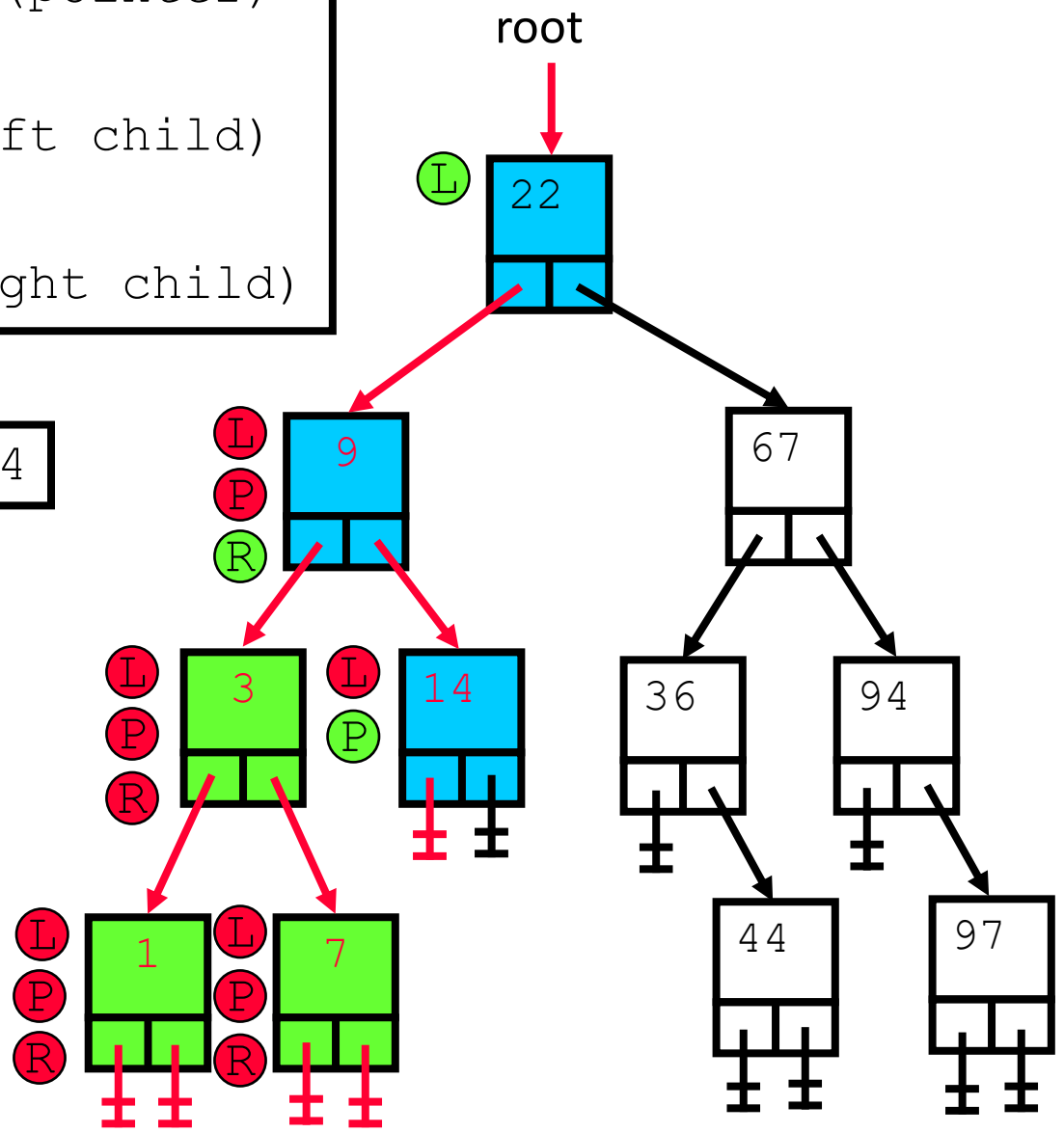
```
Output: 1 3 7 9 14
```



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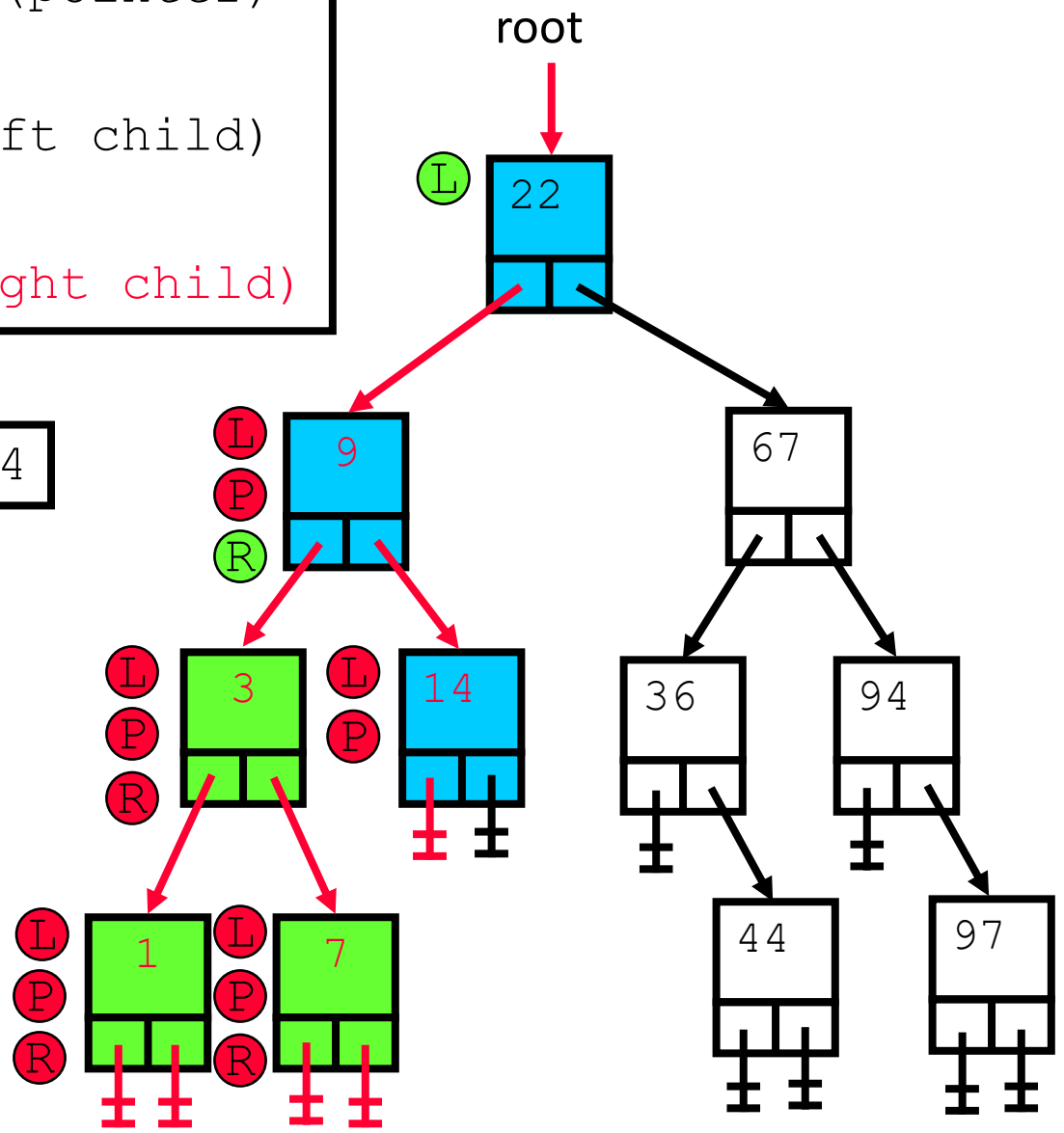

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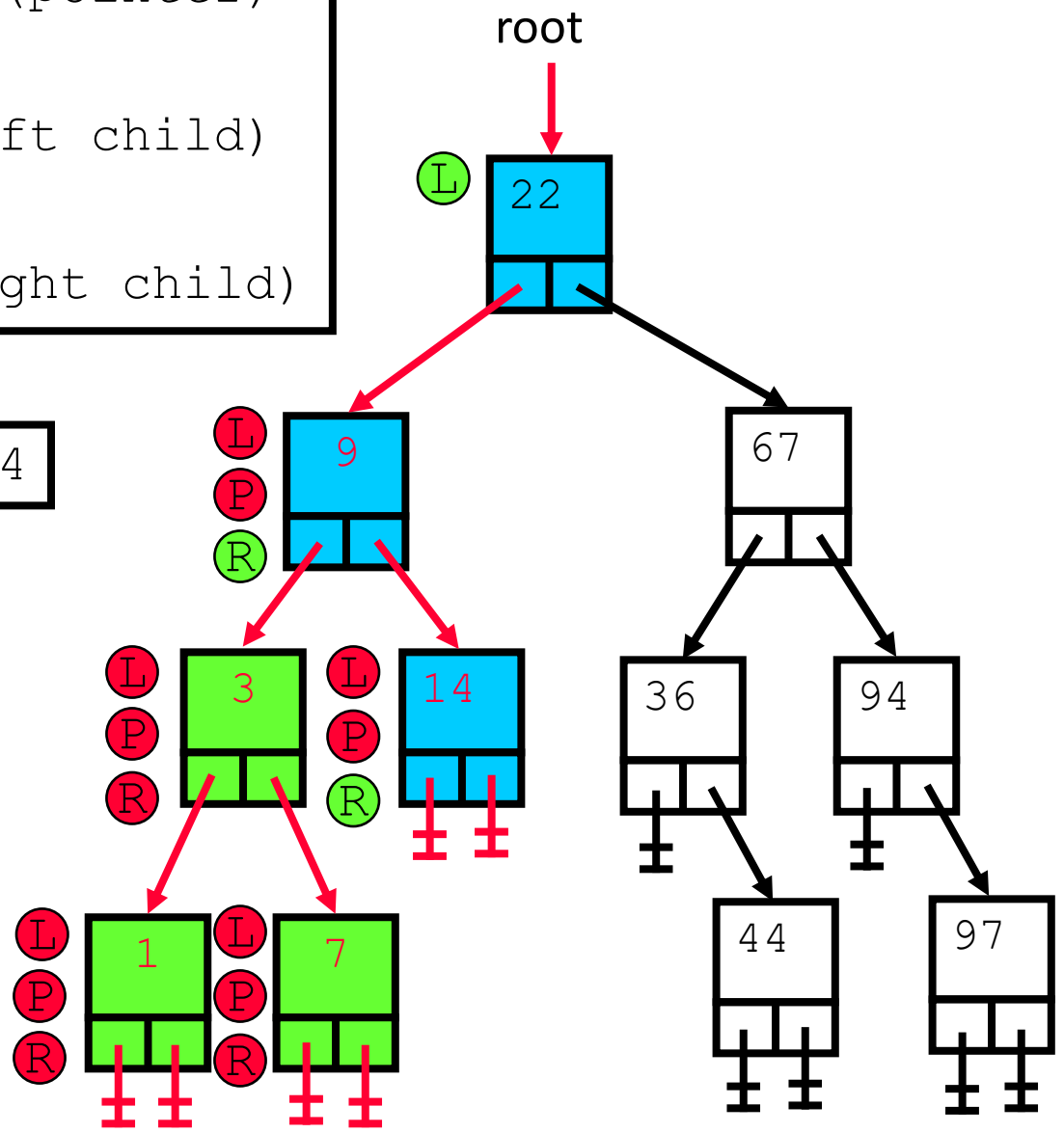

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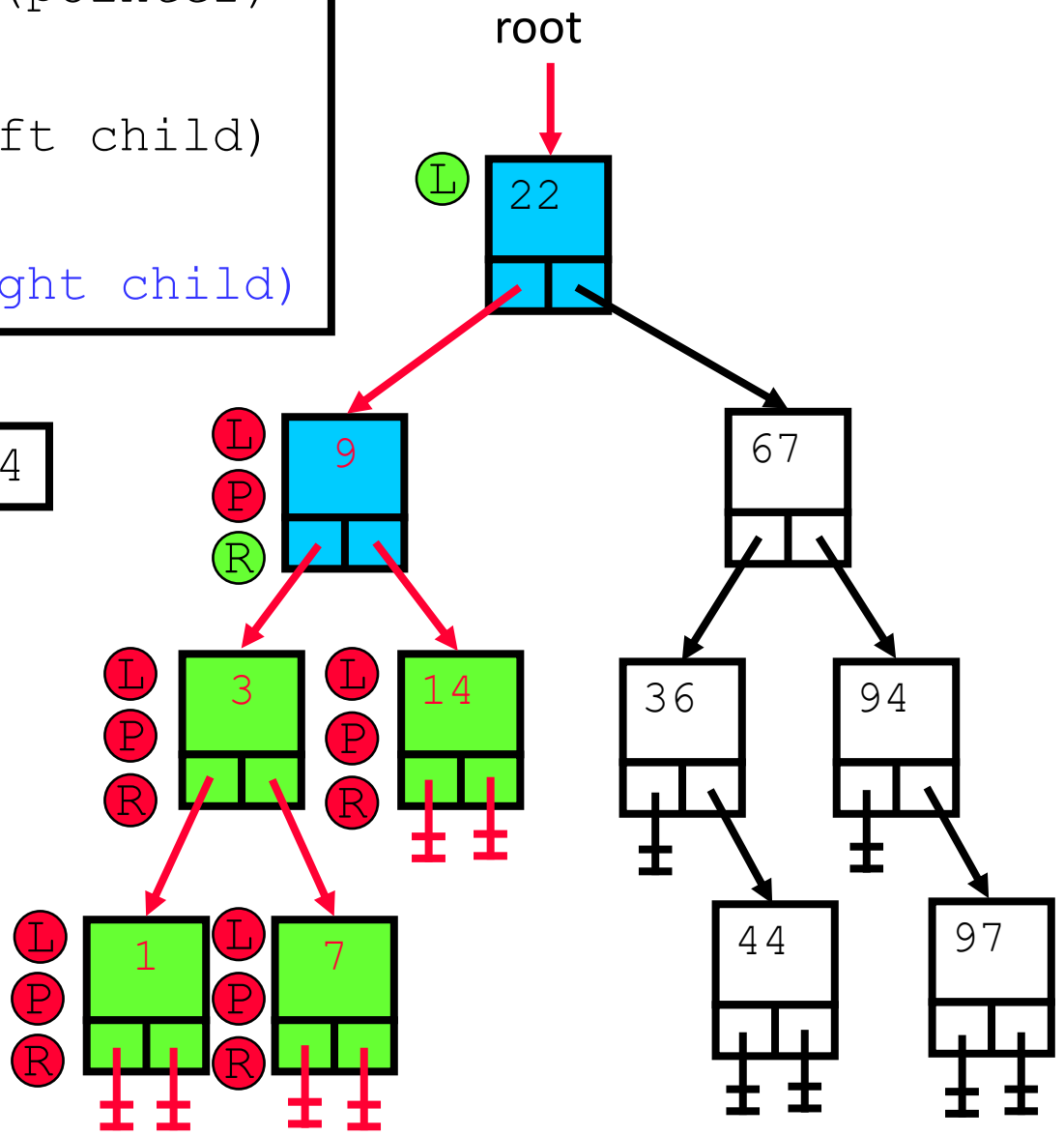

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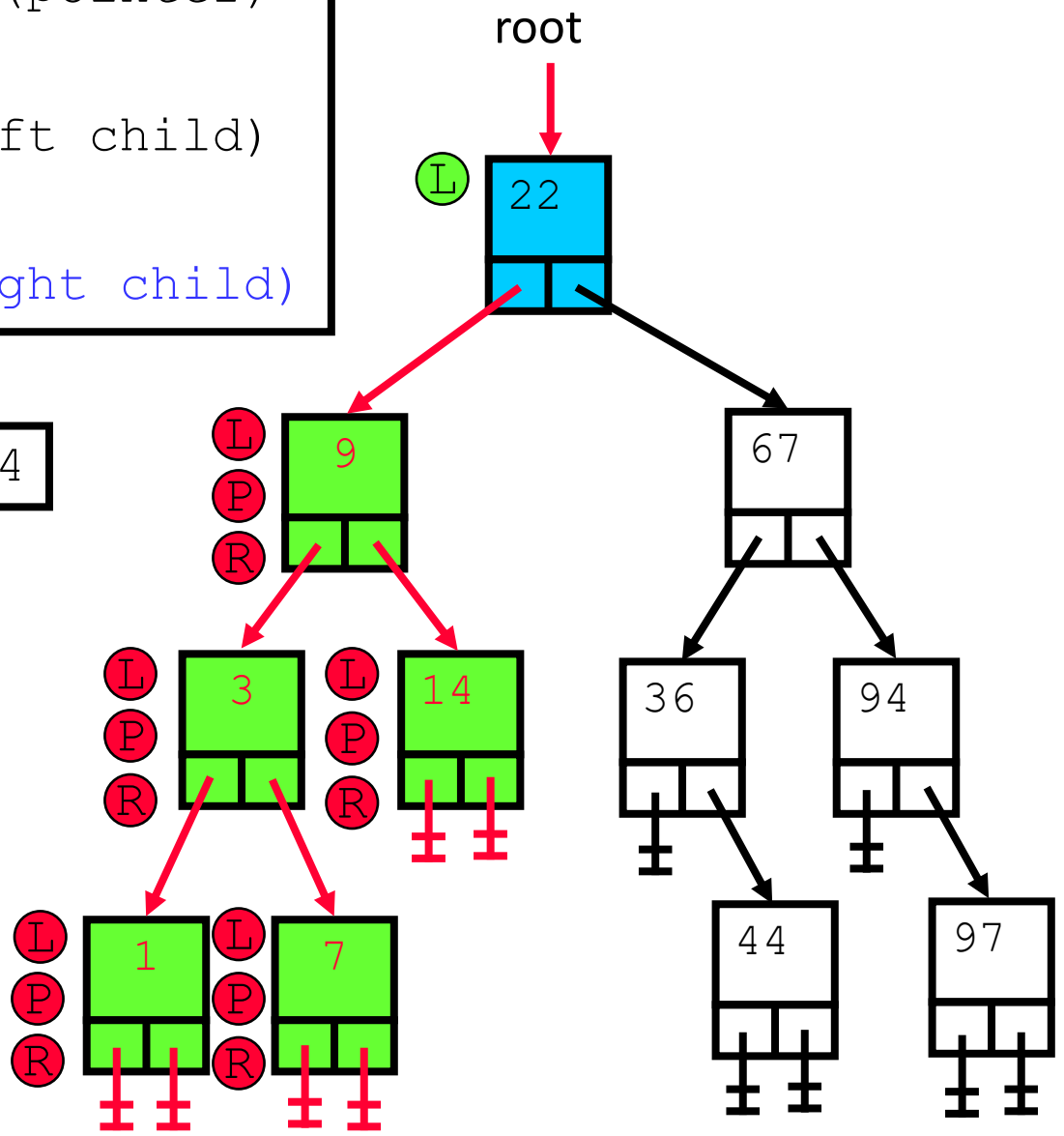
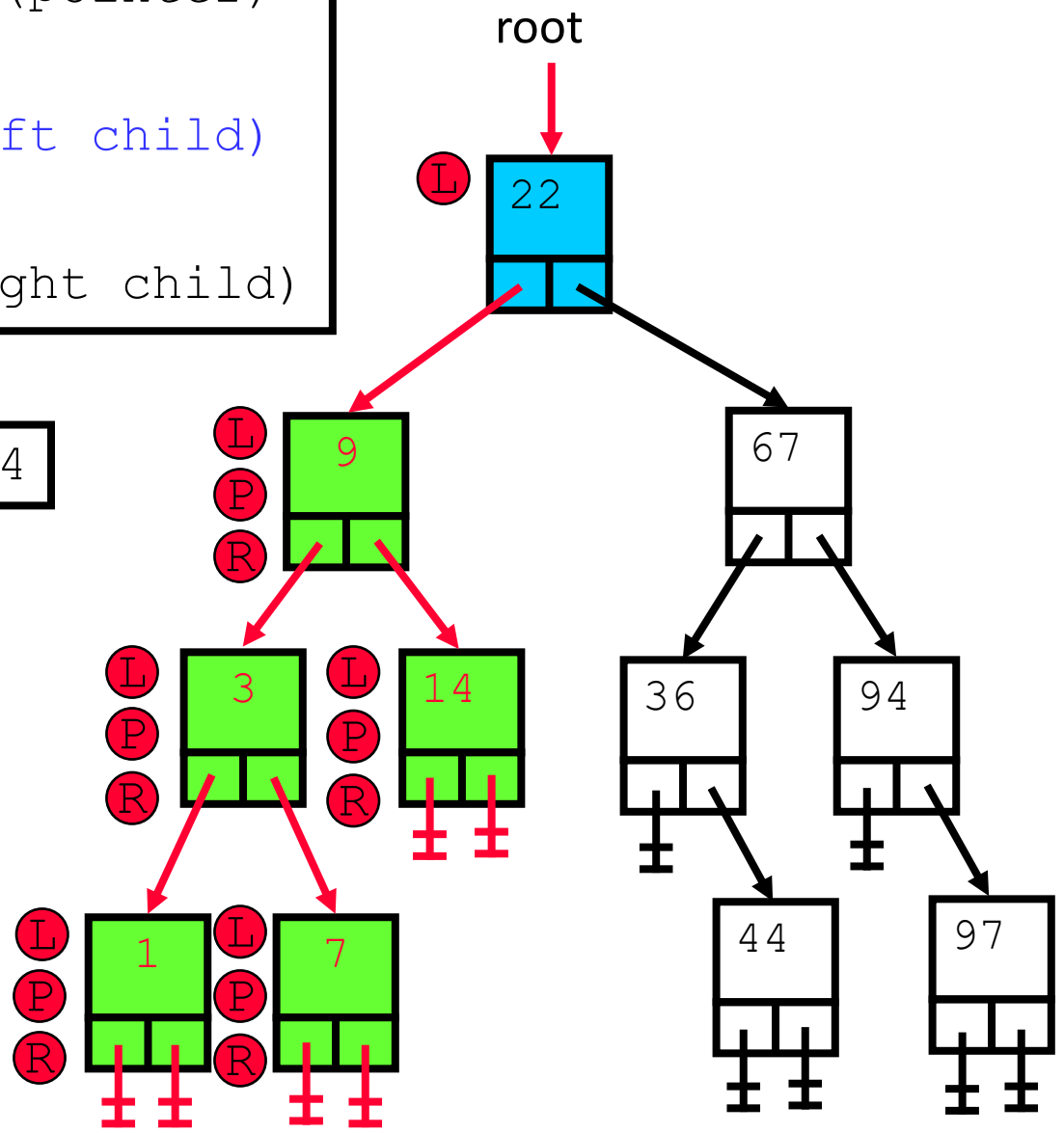


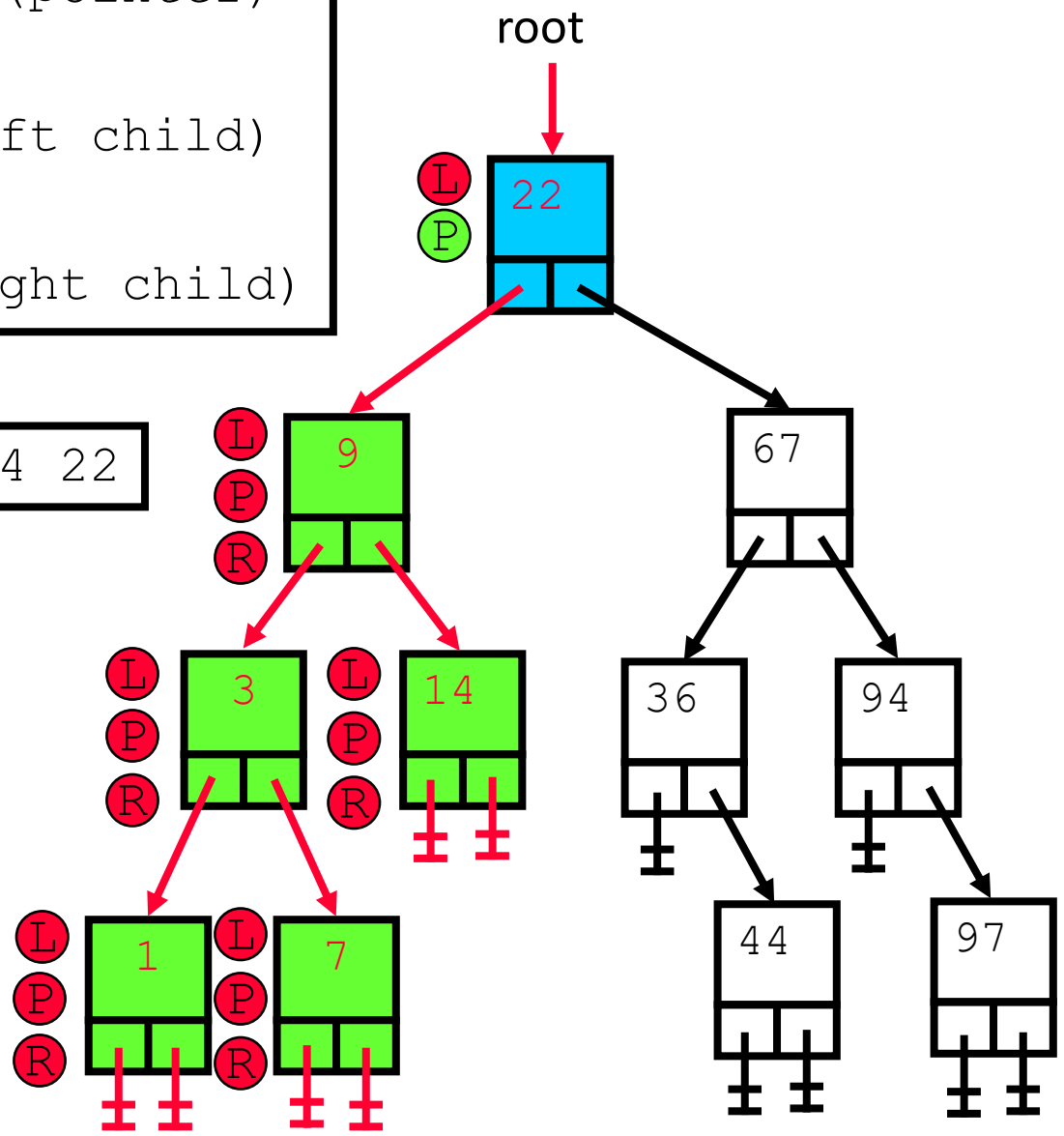
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14
```



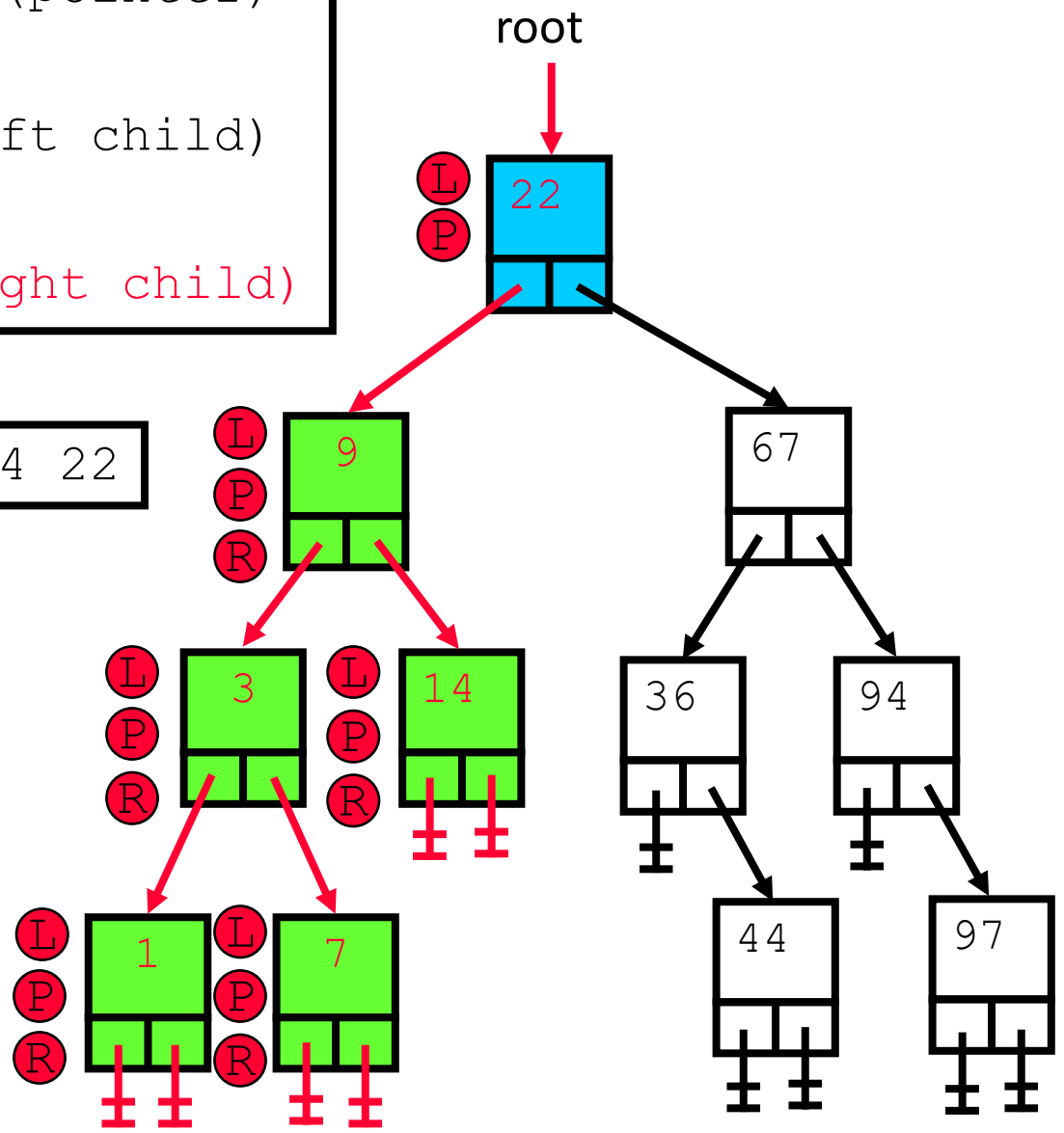
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
```



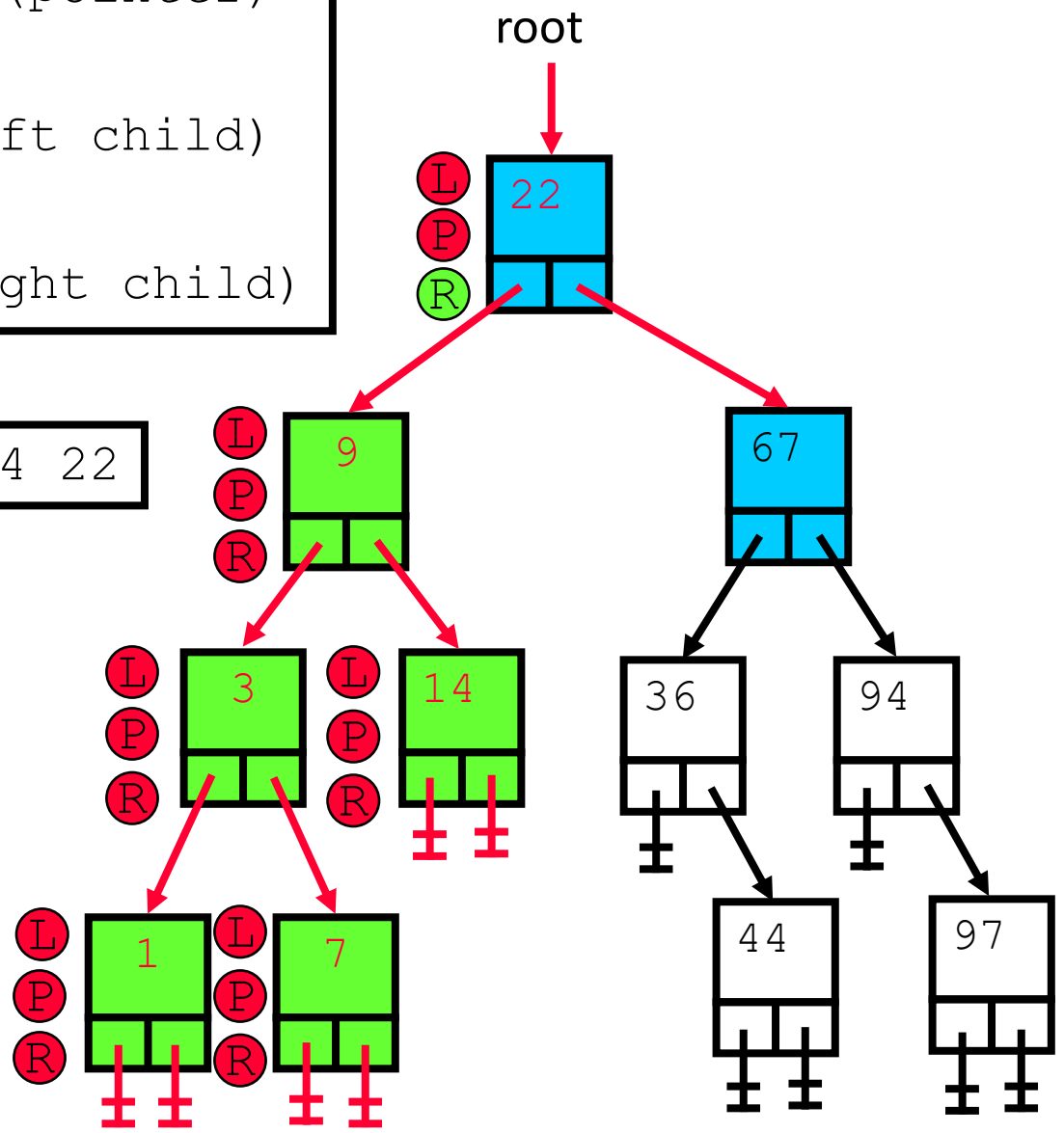
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
```



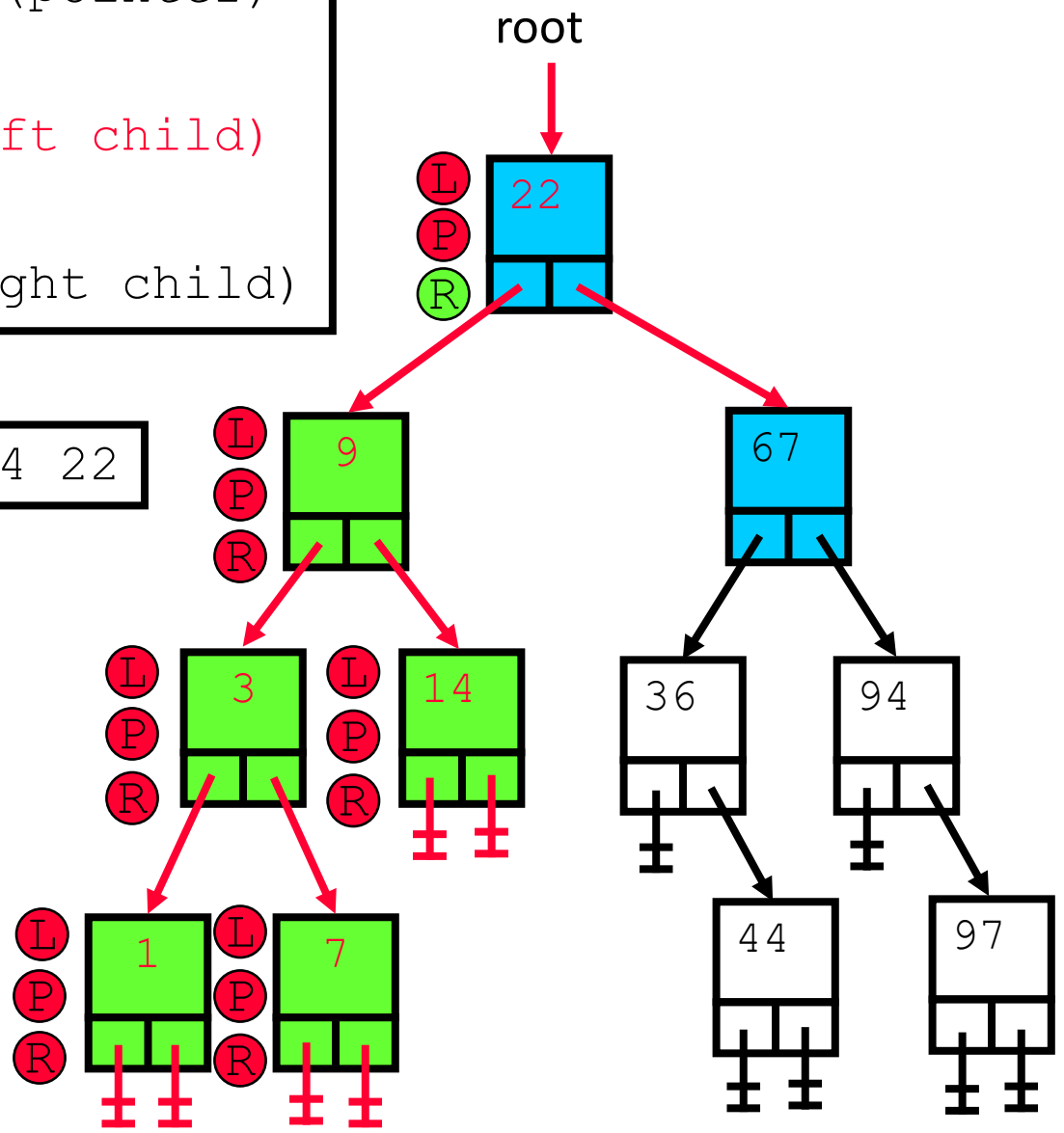
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
```



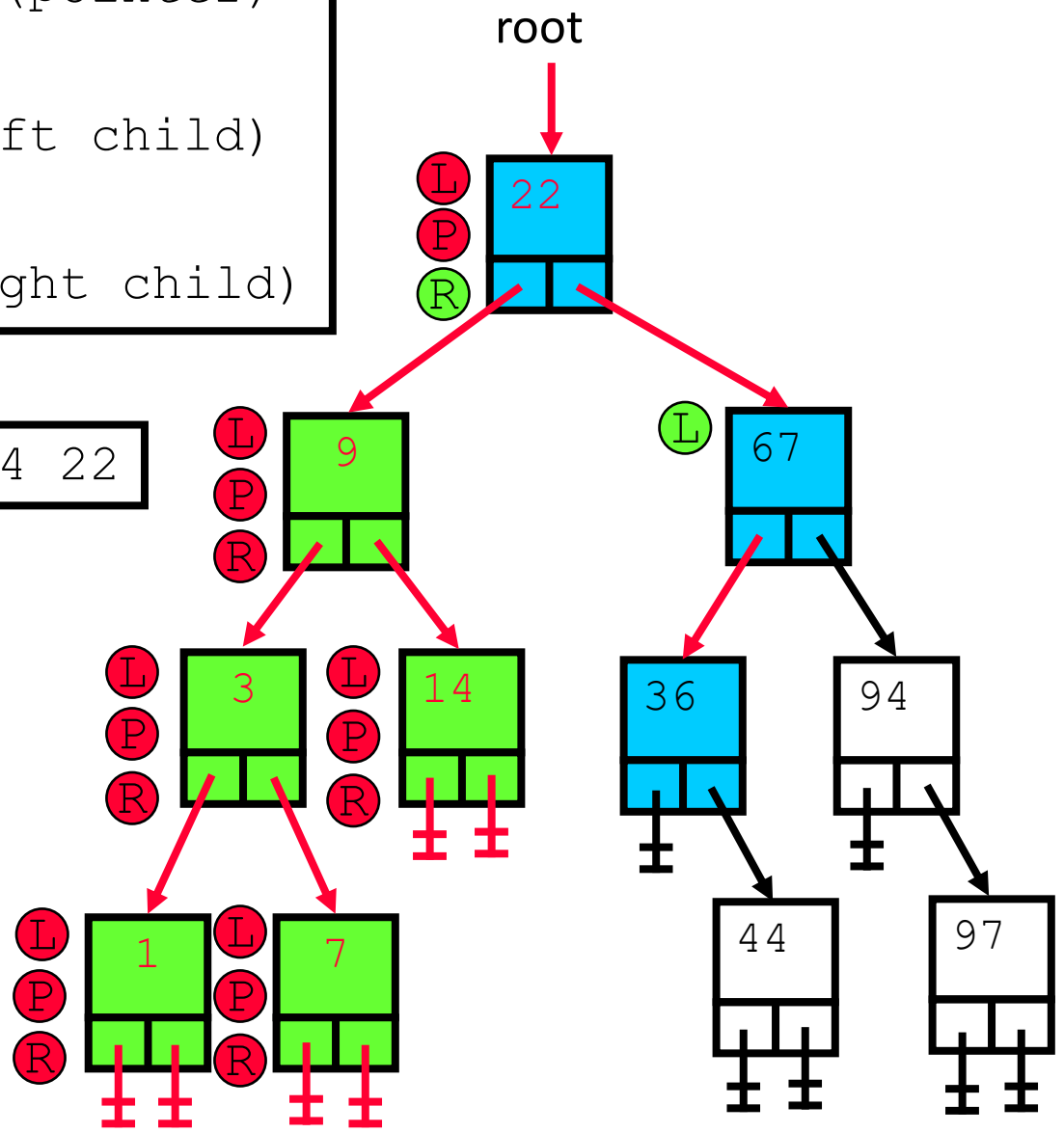
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
```



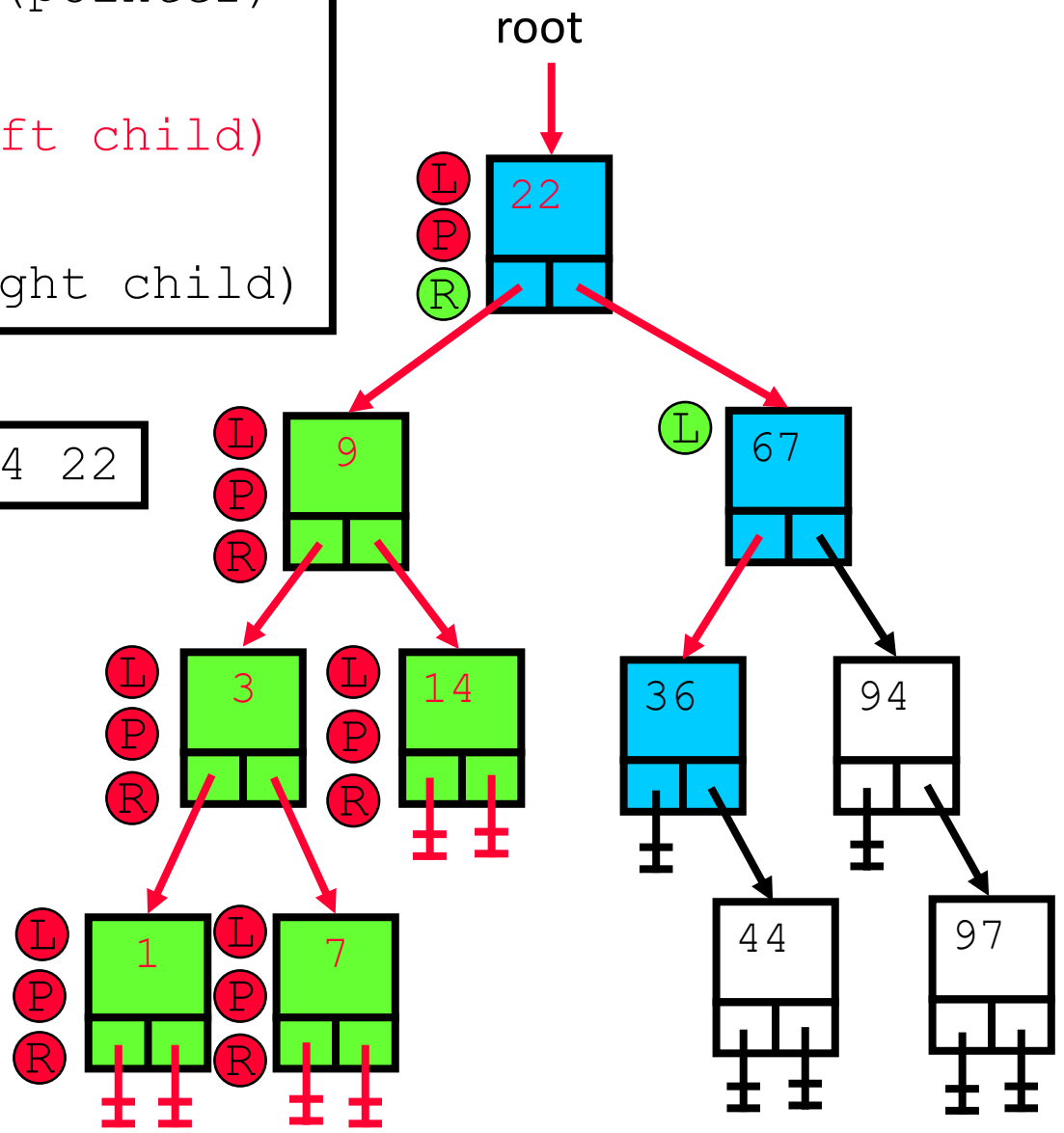
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
```



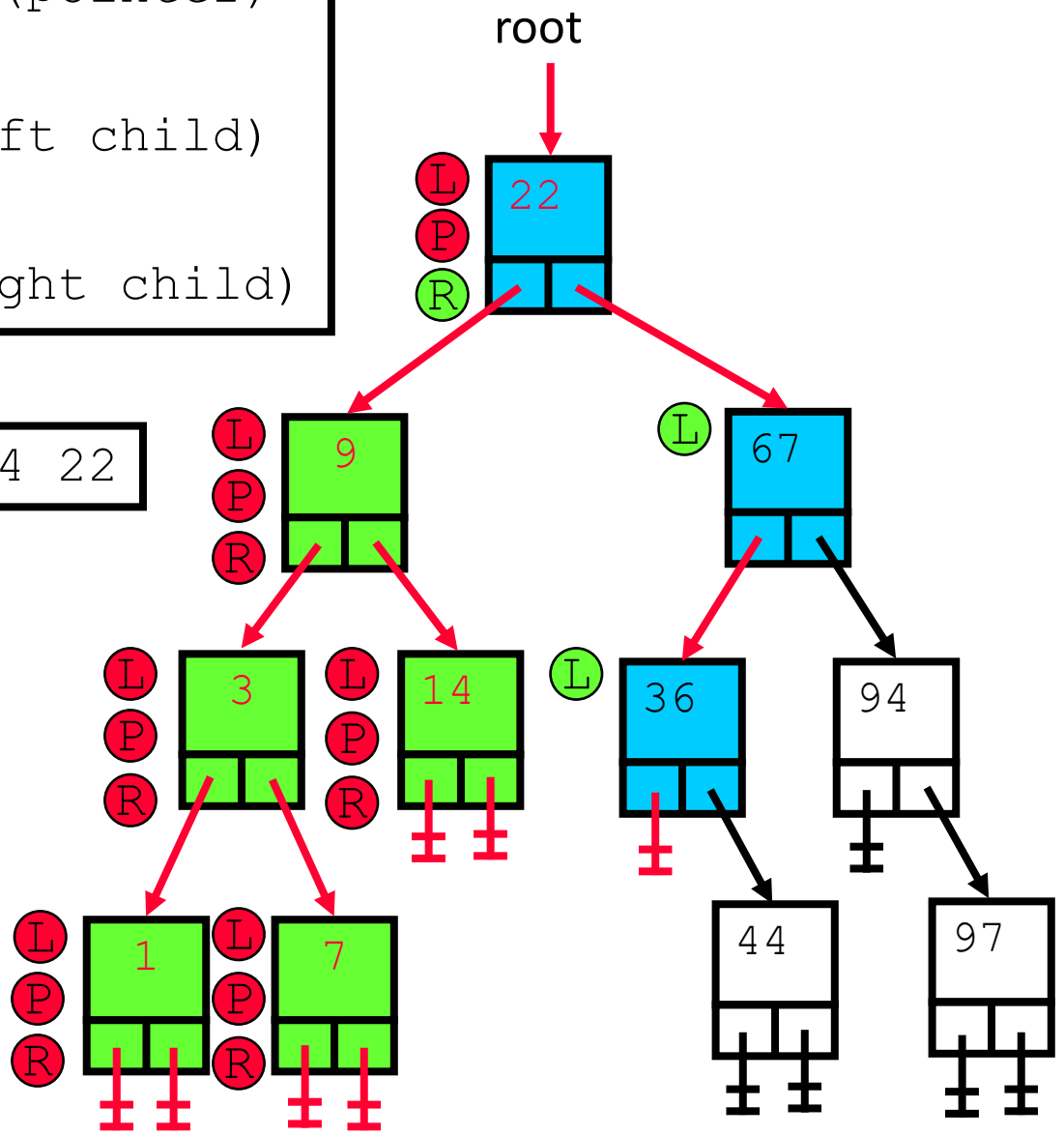
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
```



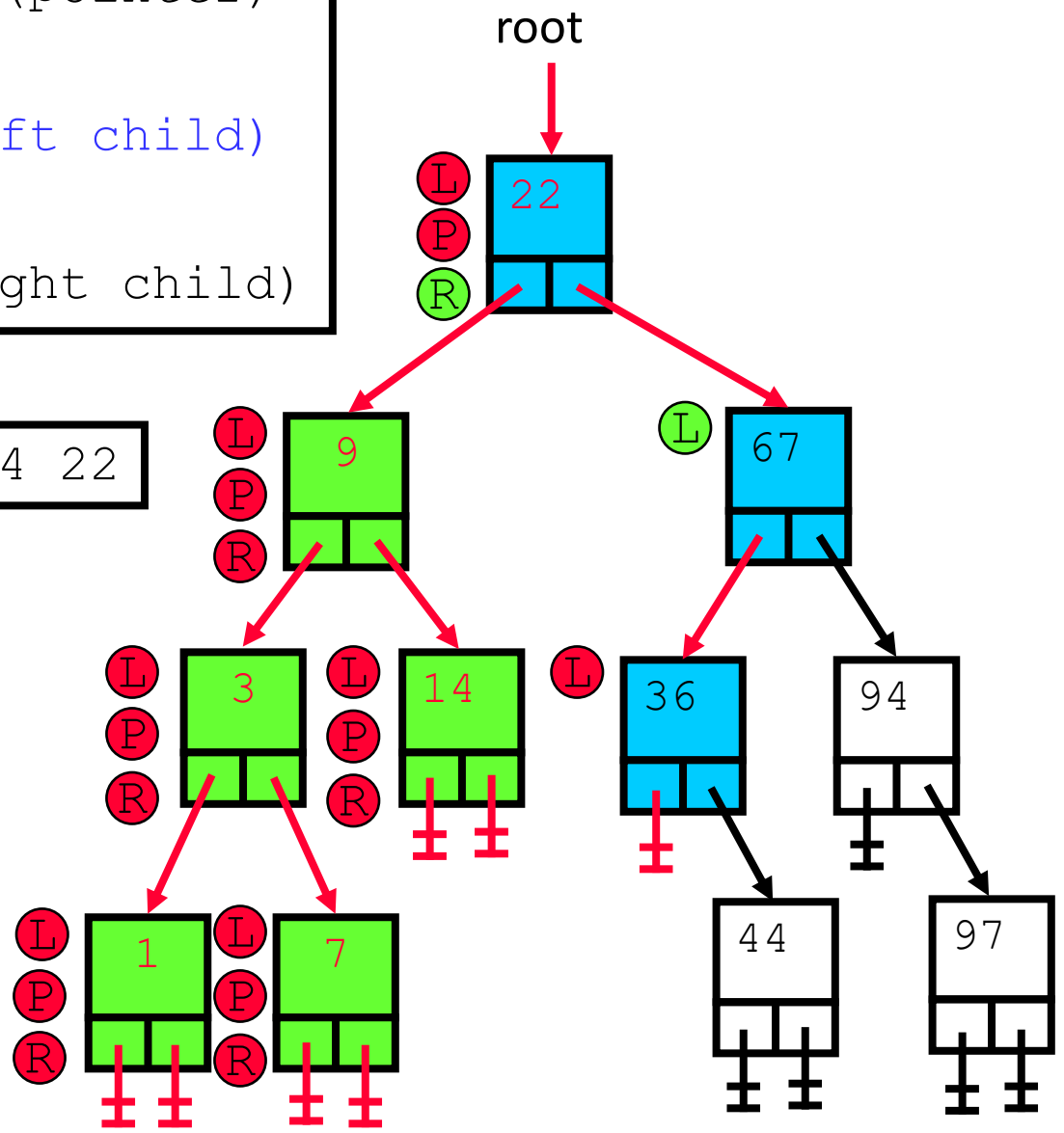
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
```



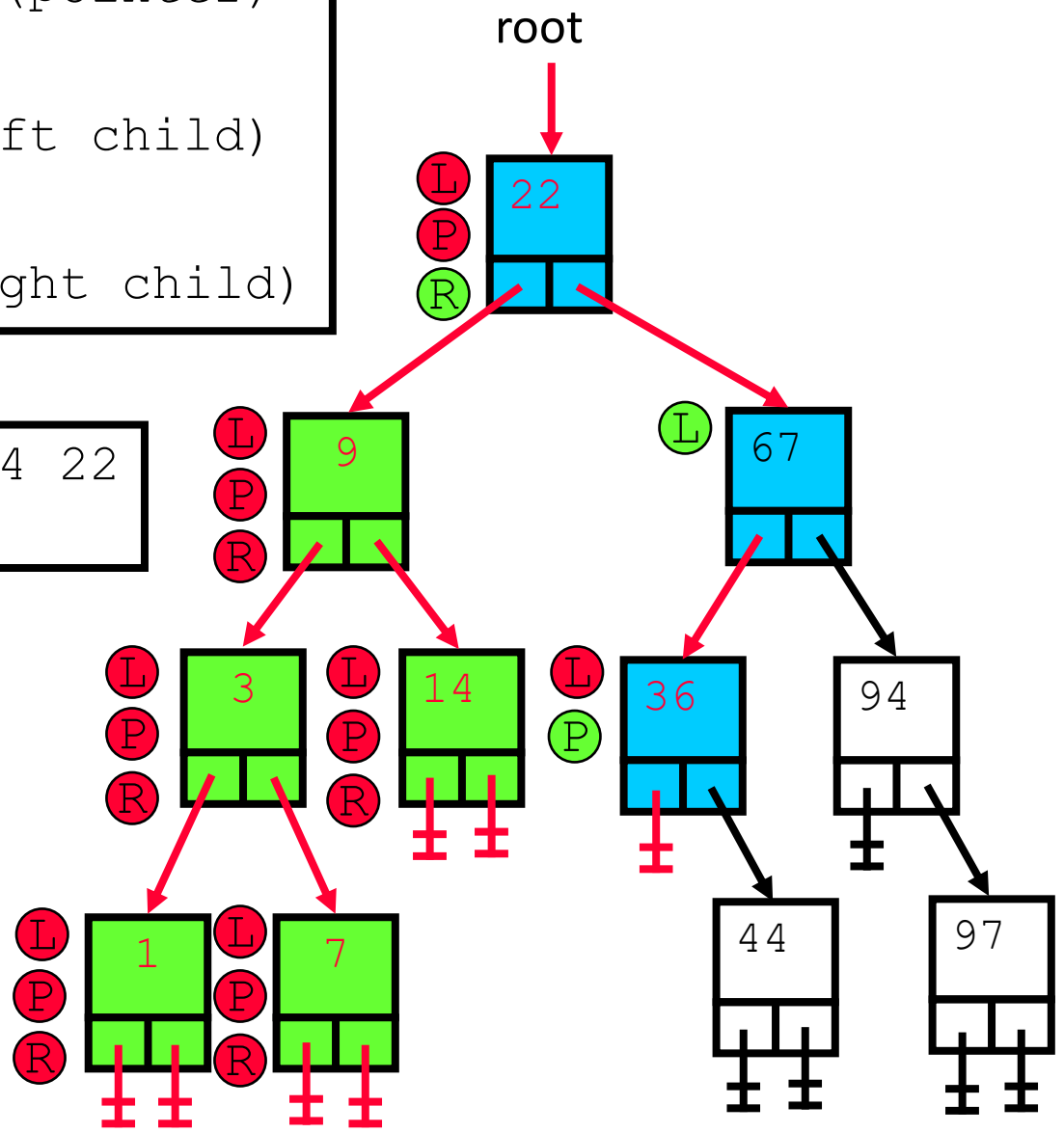
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
```



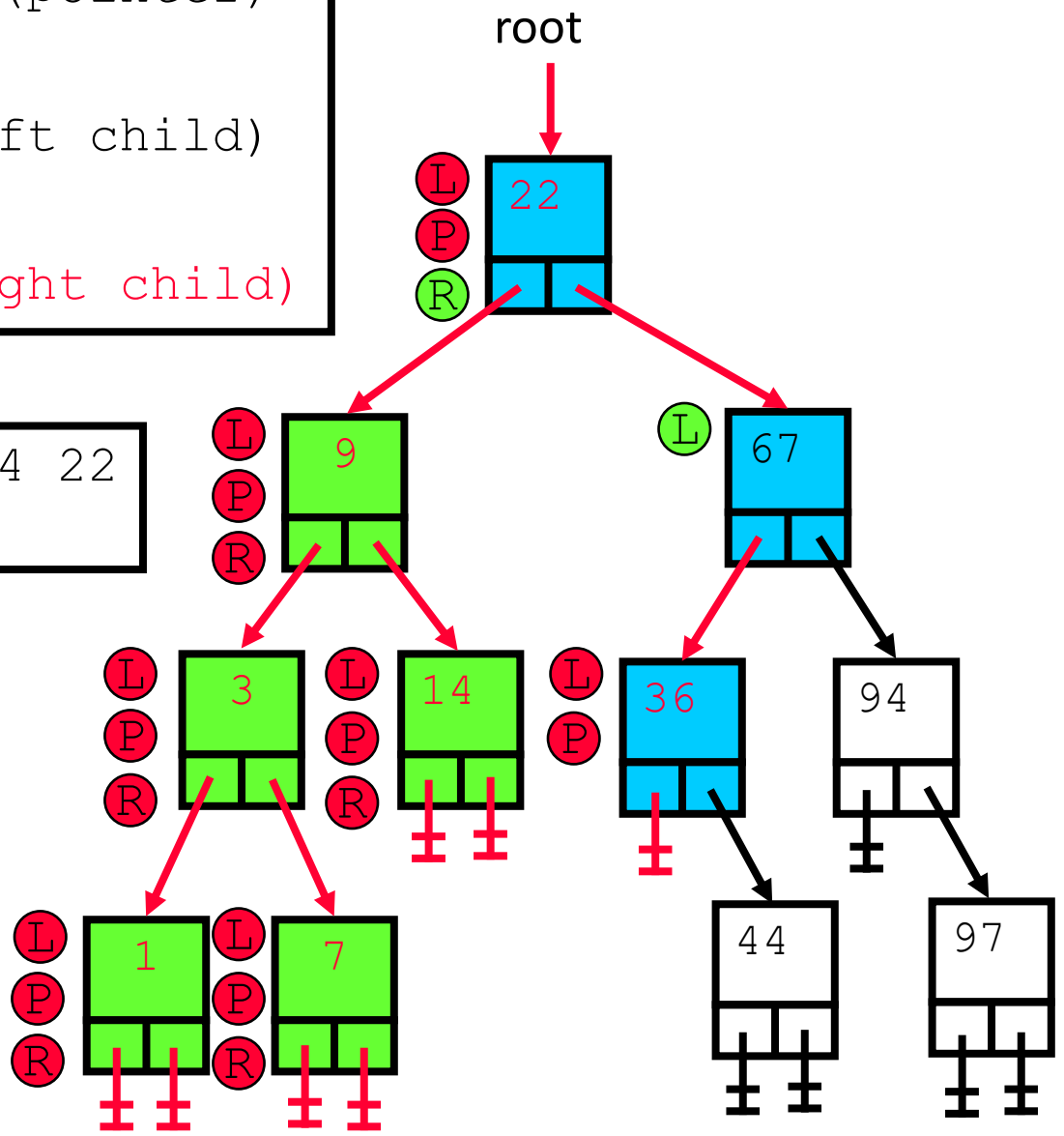
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36
```



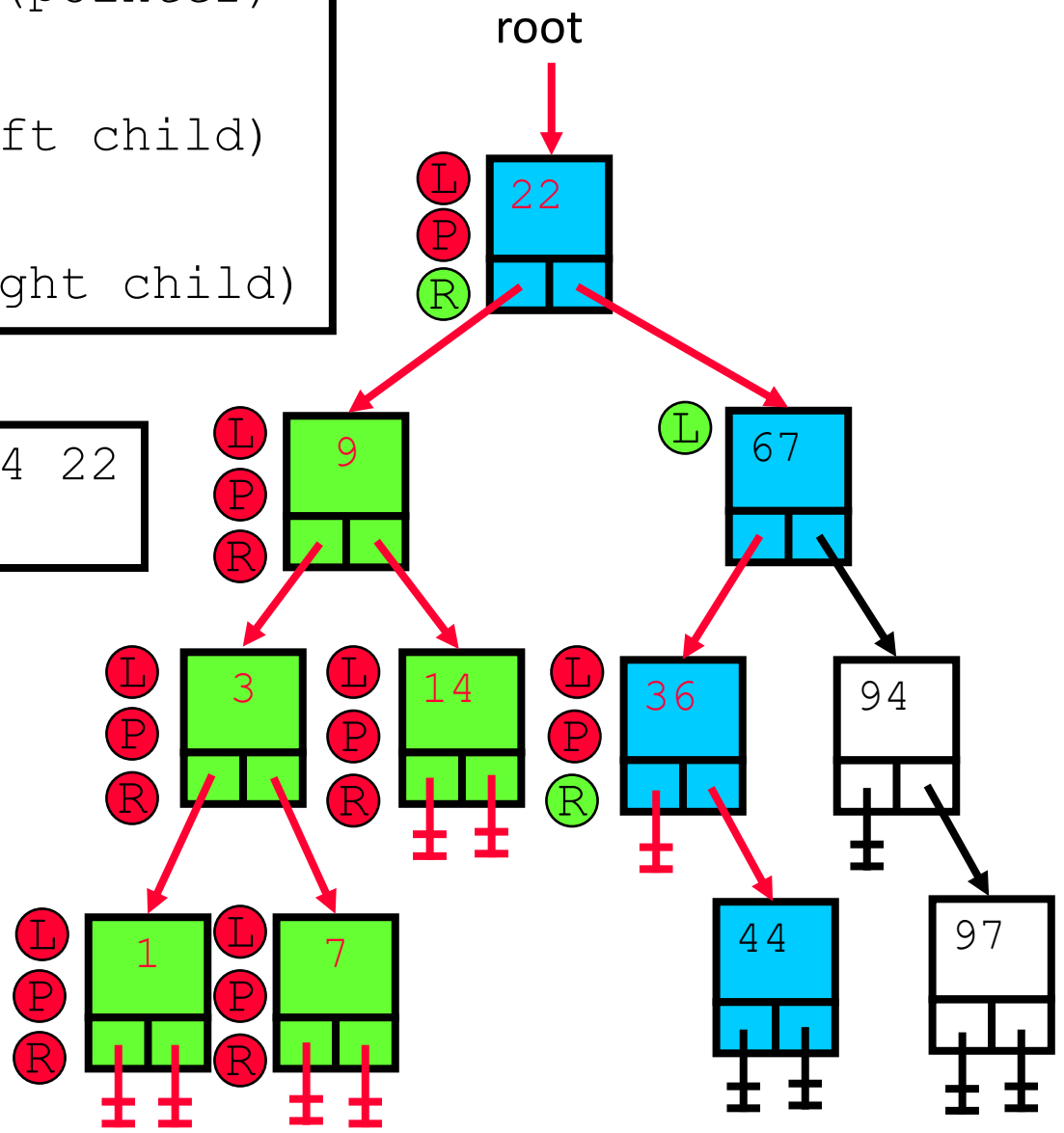
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36
```



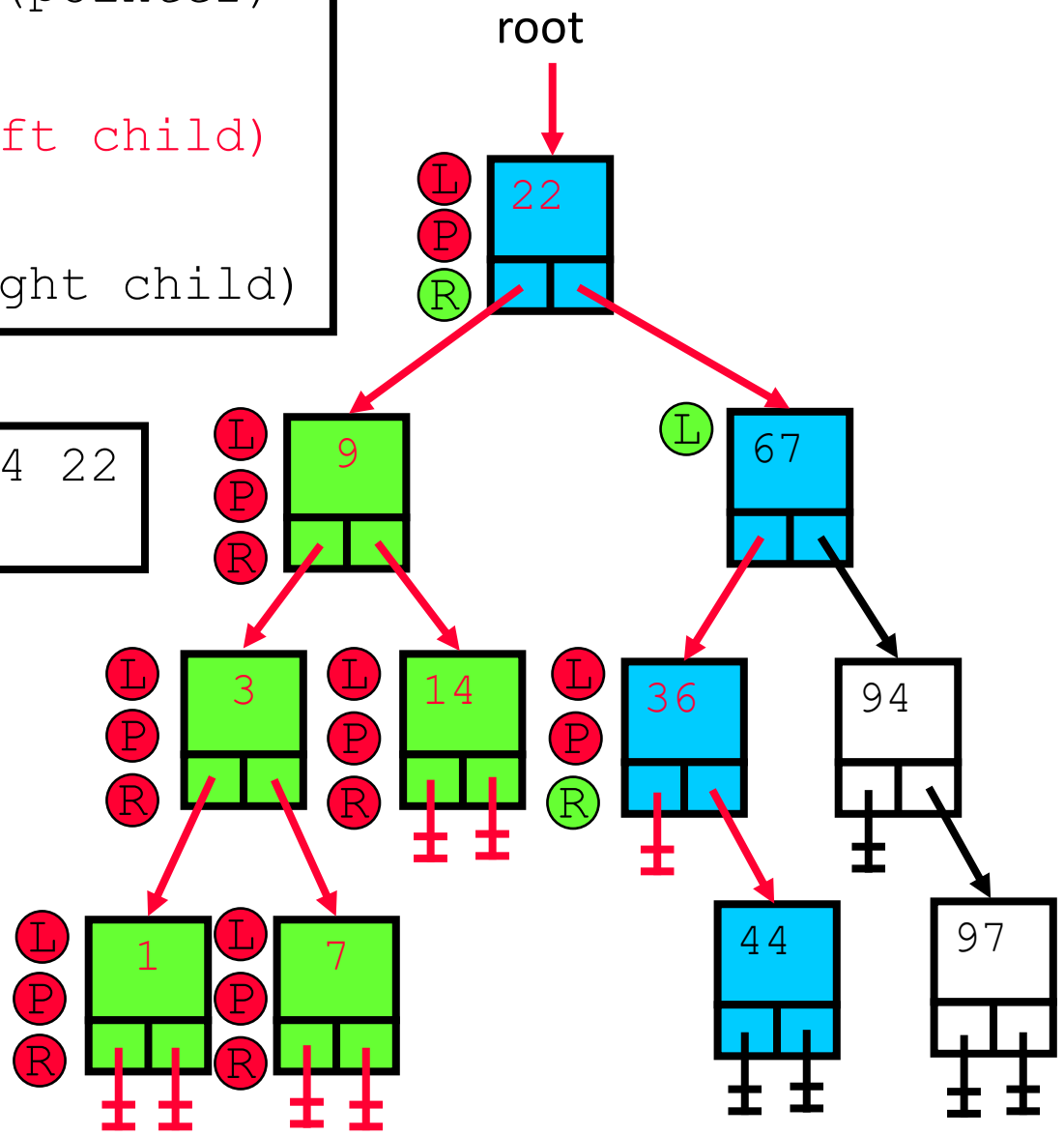
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36
```



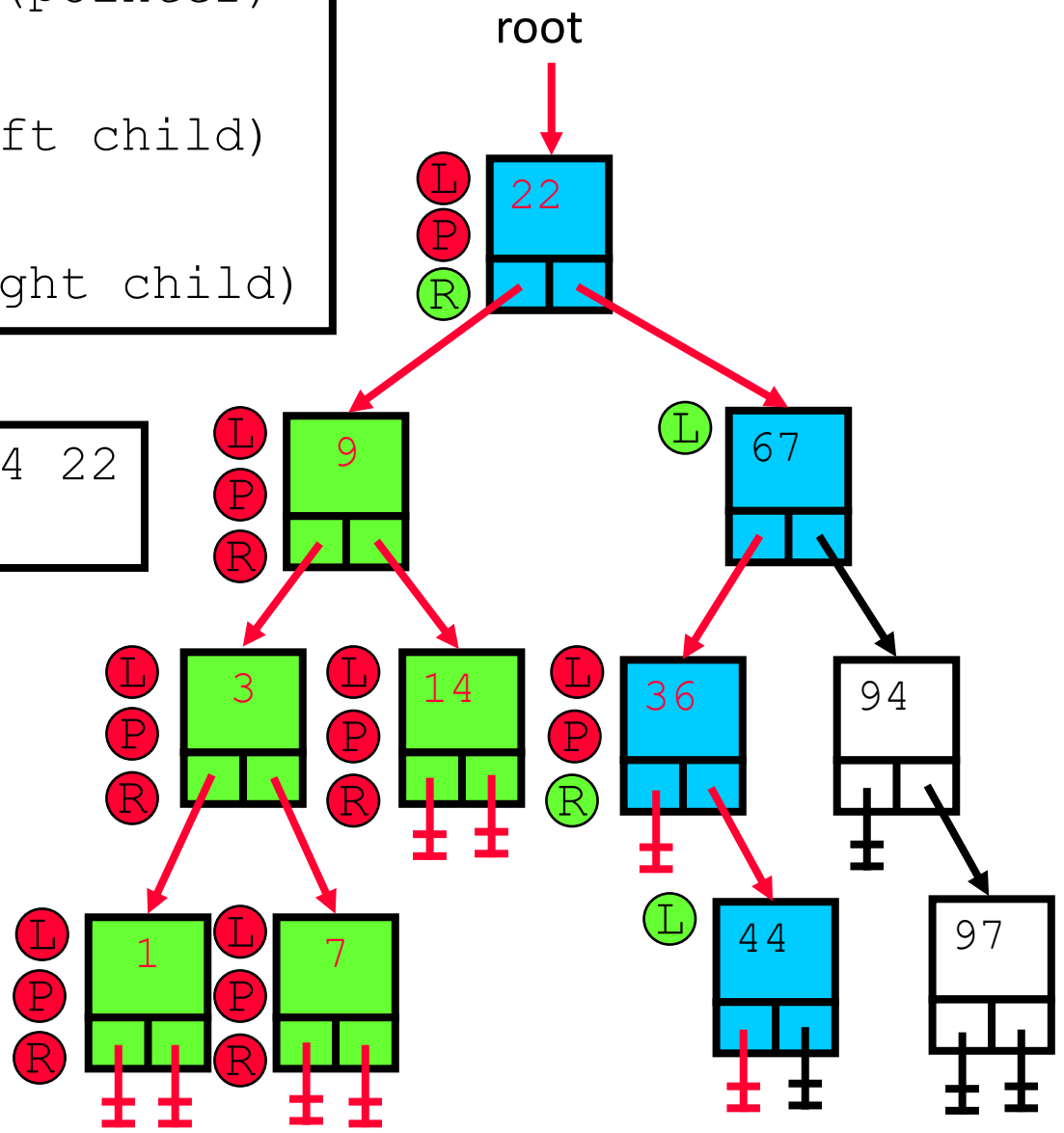
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36
```



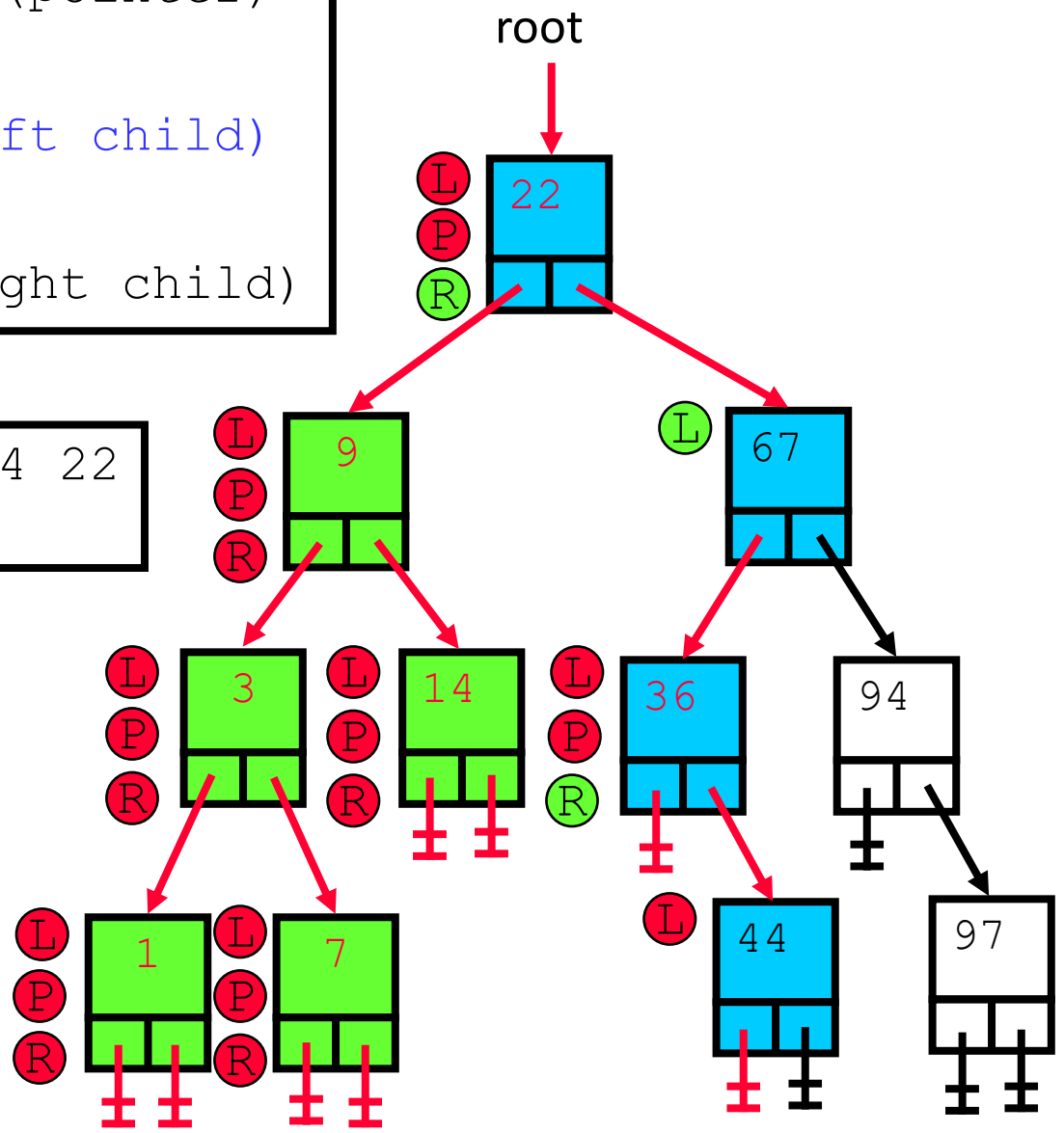
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36
```



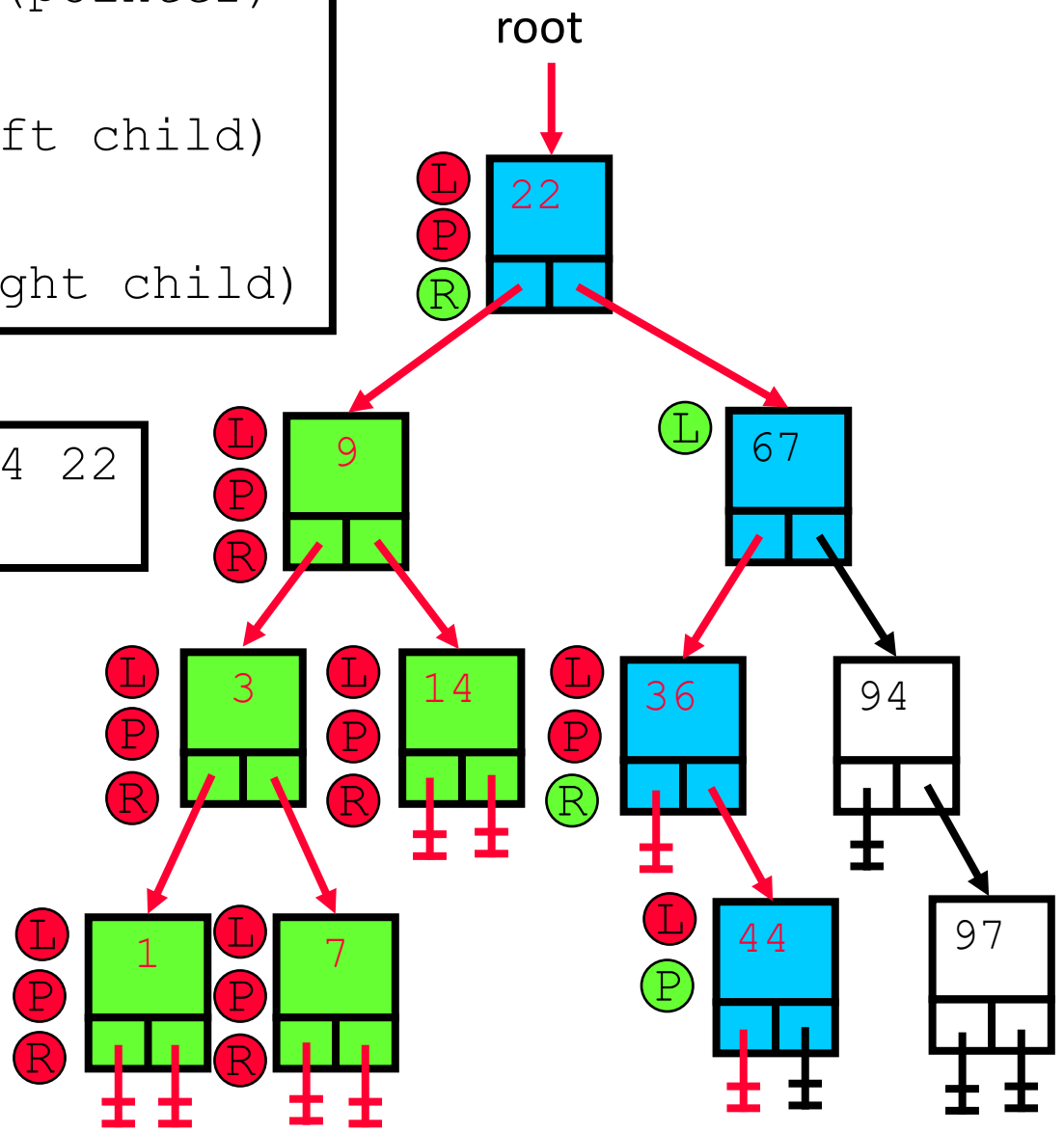
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36
```



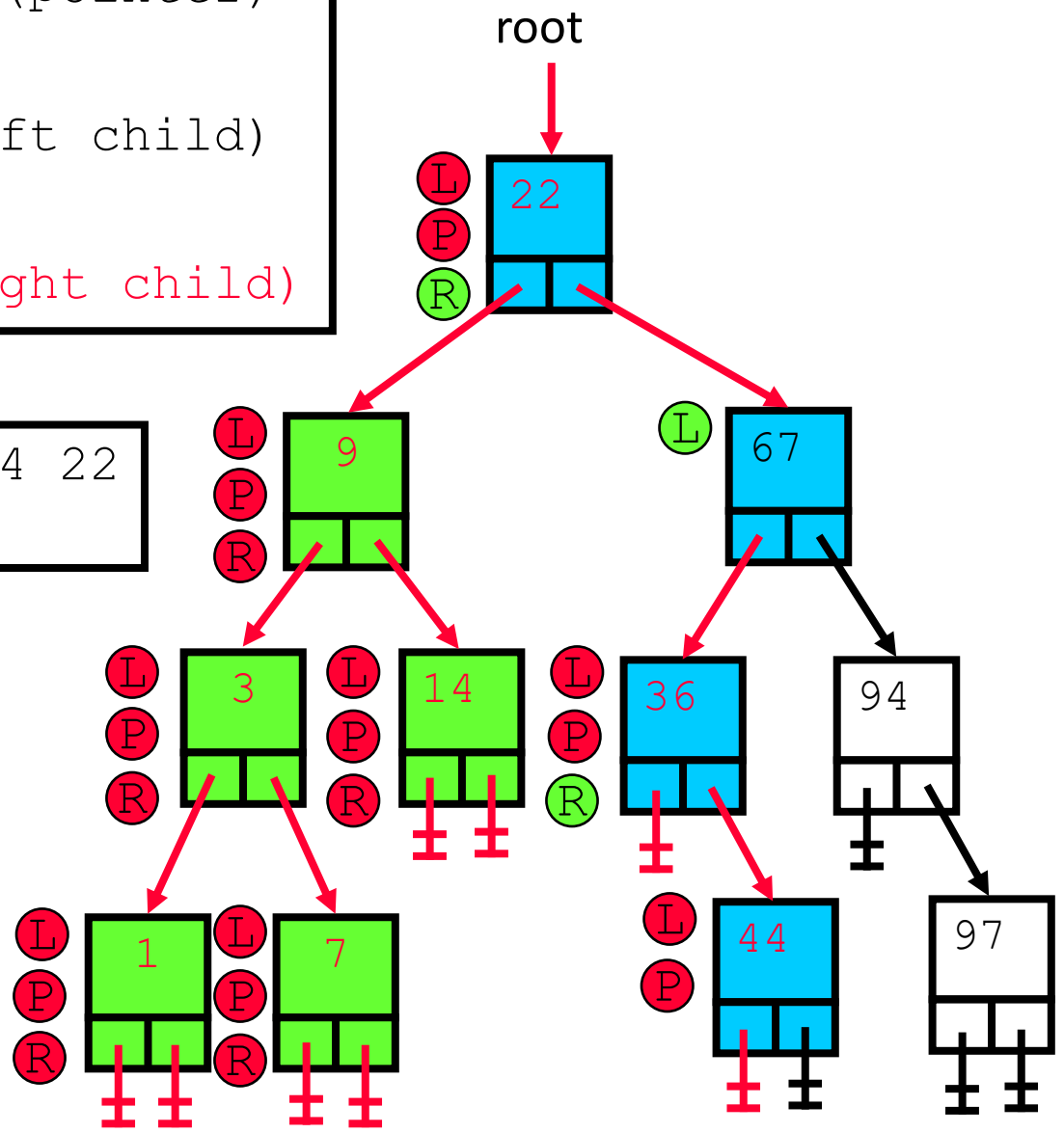
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44
```



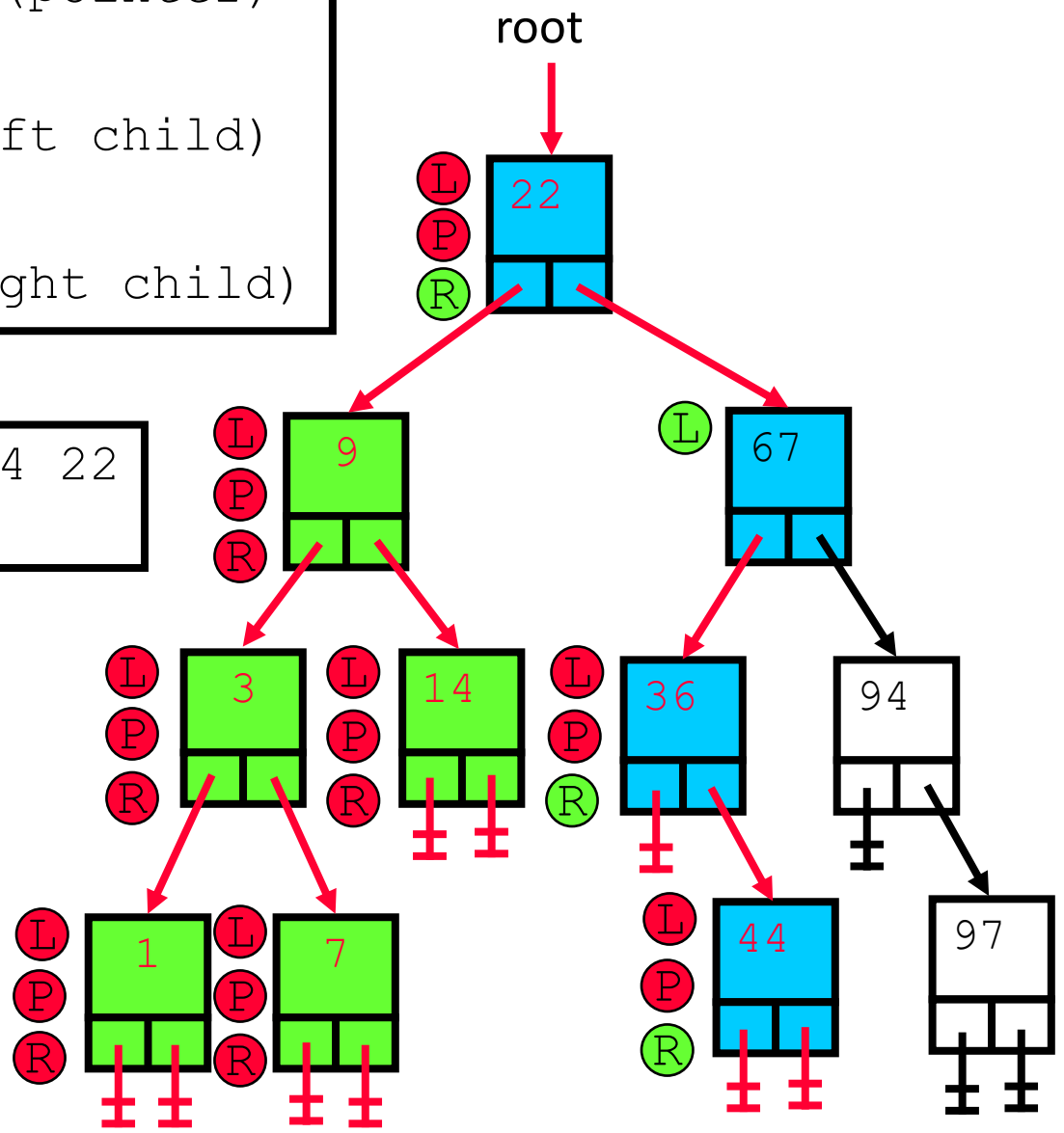
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44
```



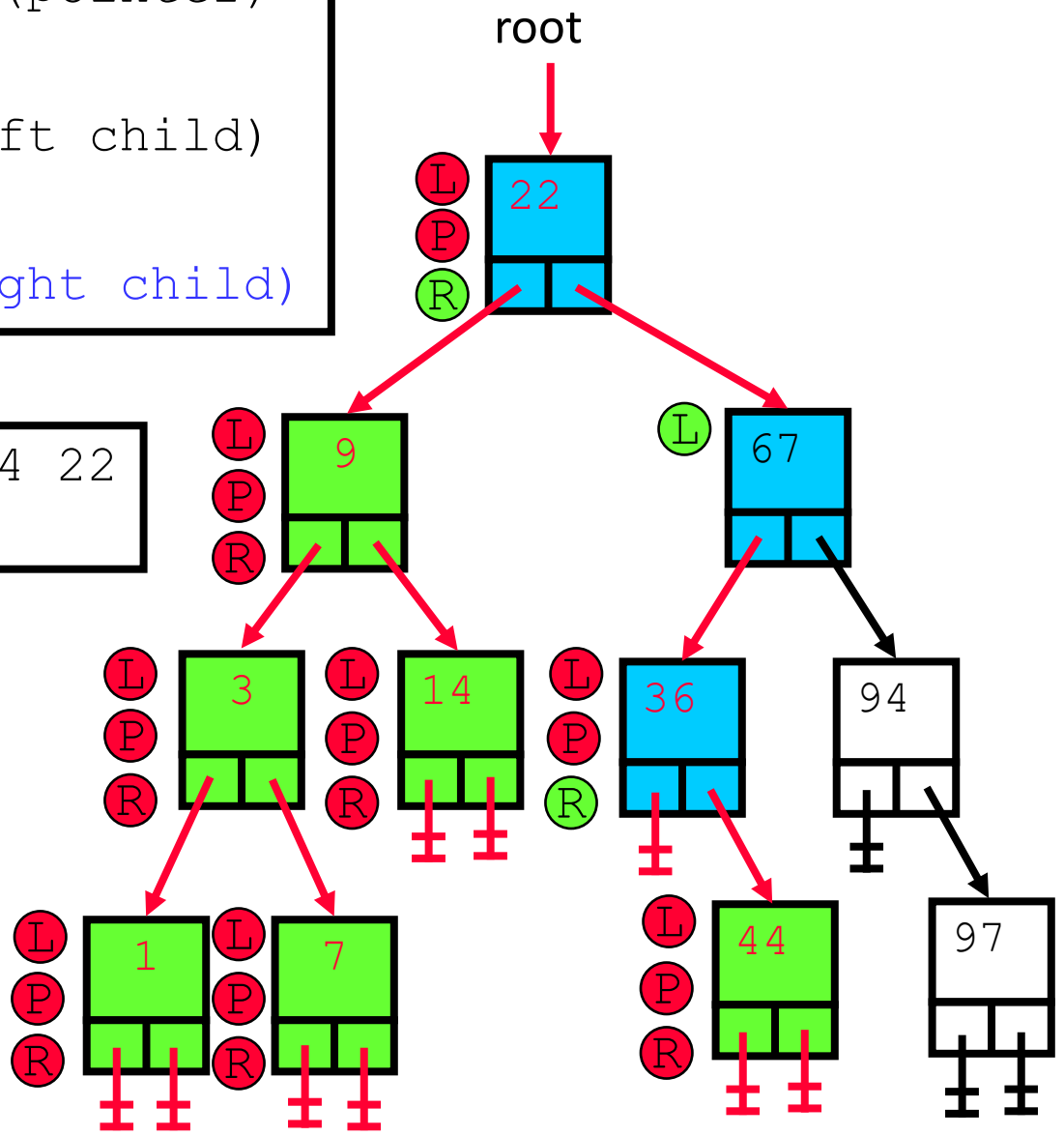
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44
```



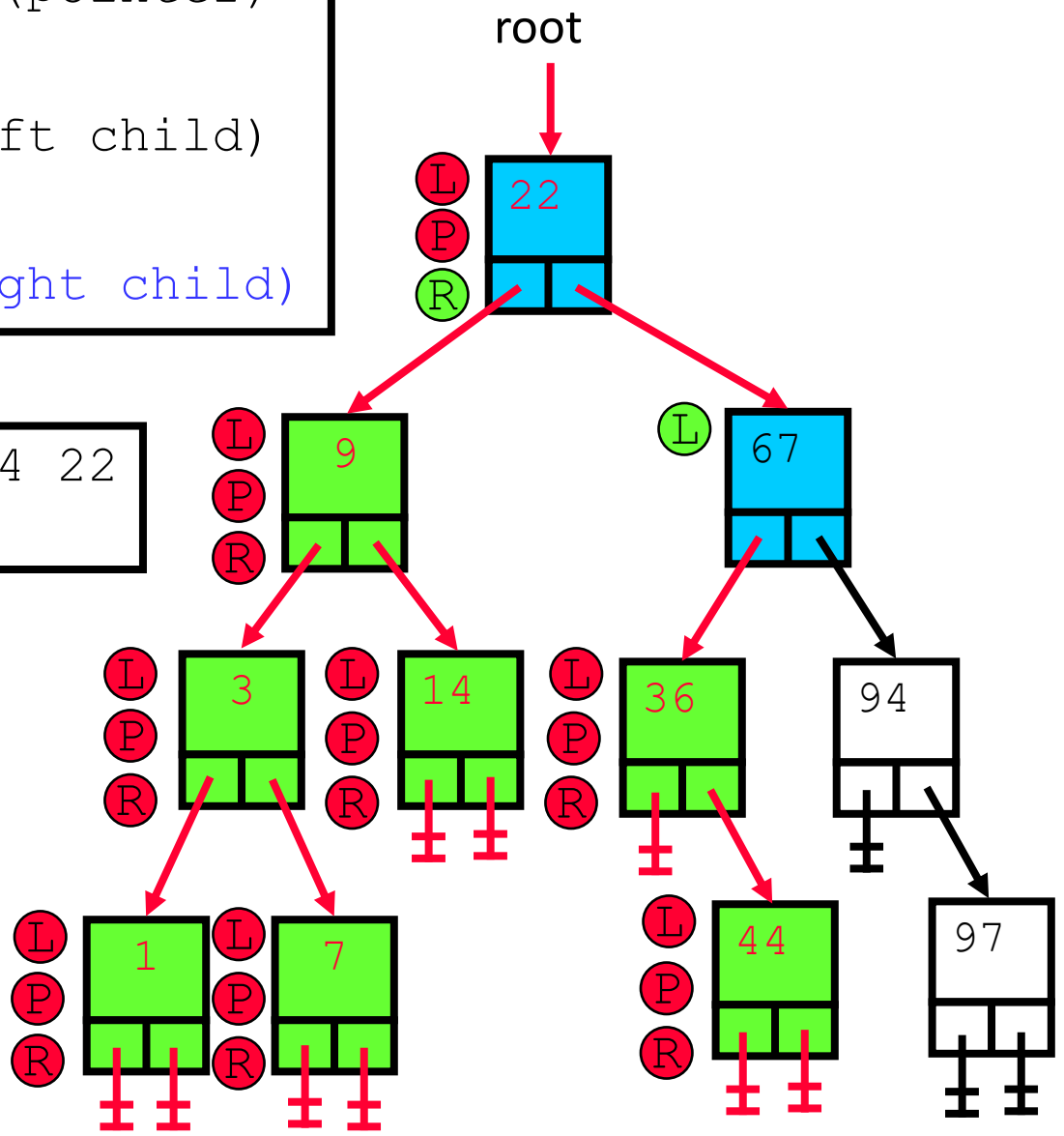
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44
```



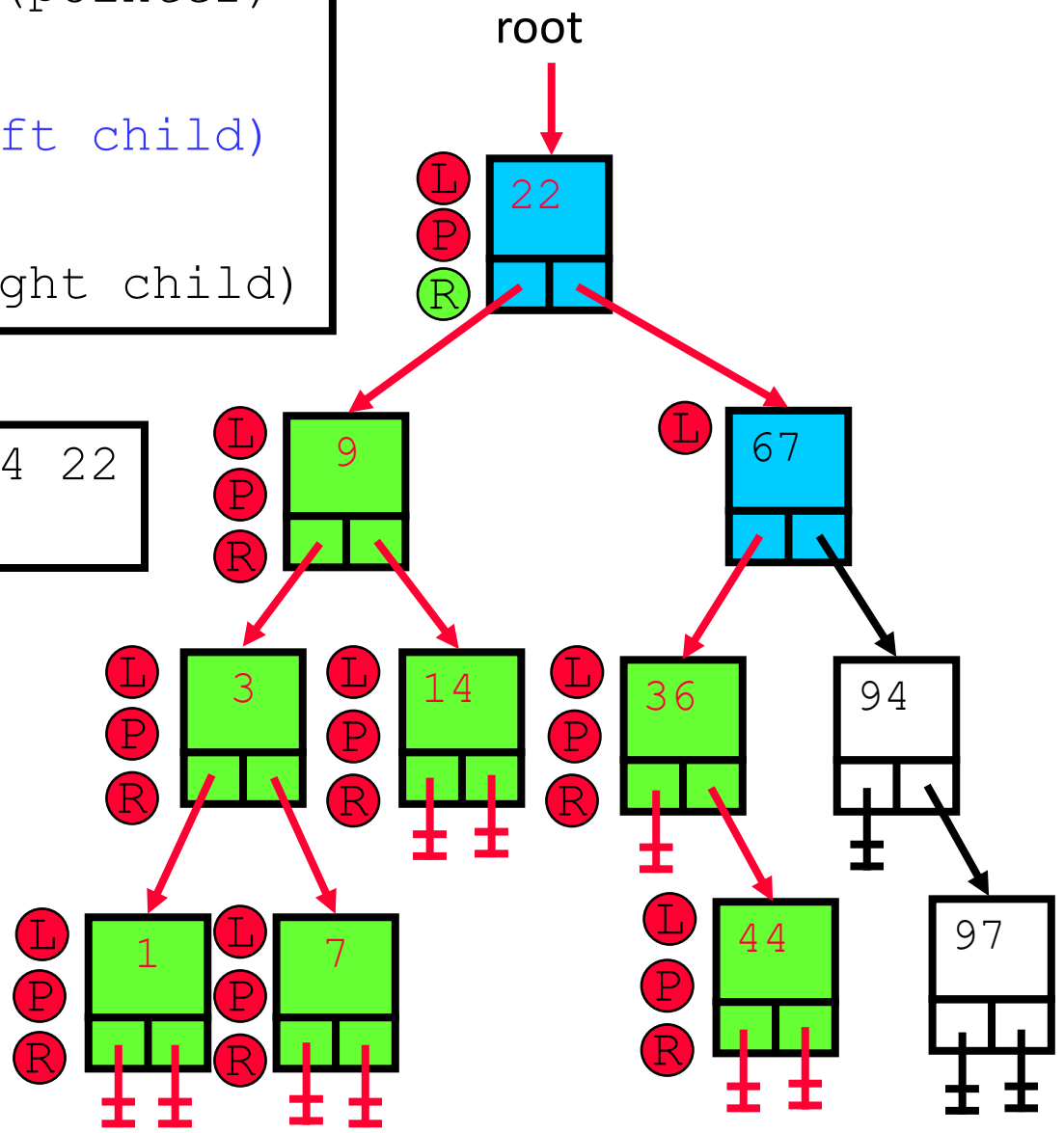
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44
```



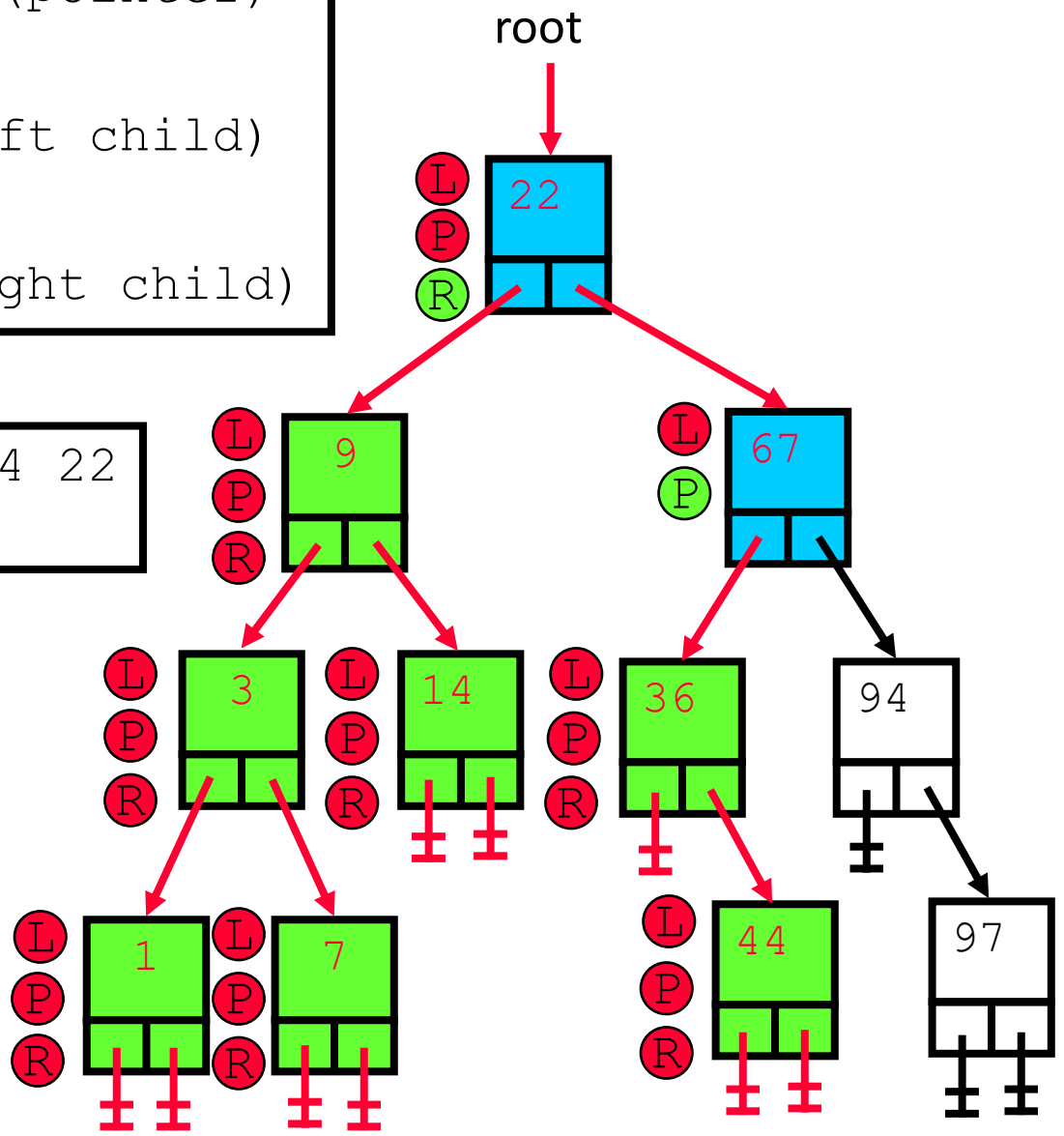
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44
```



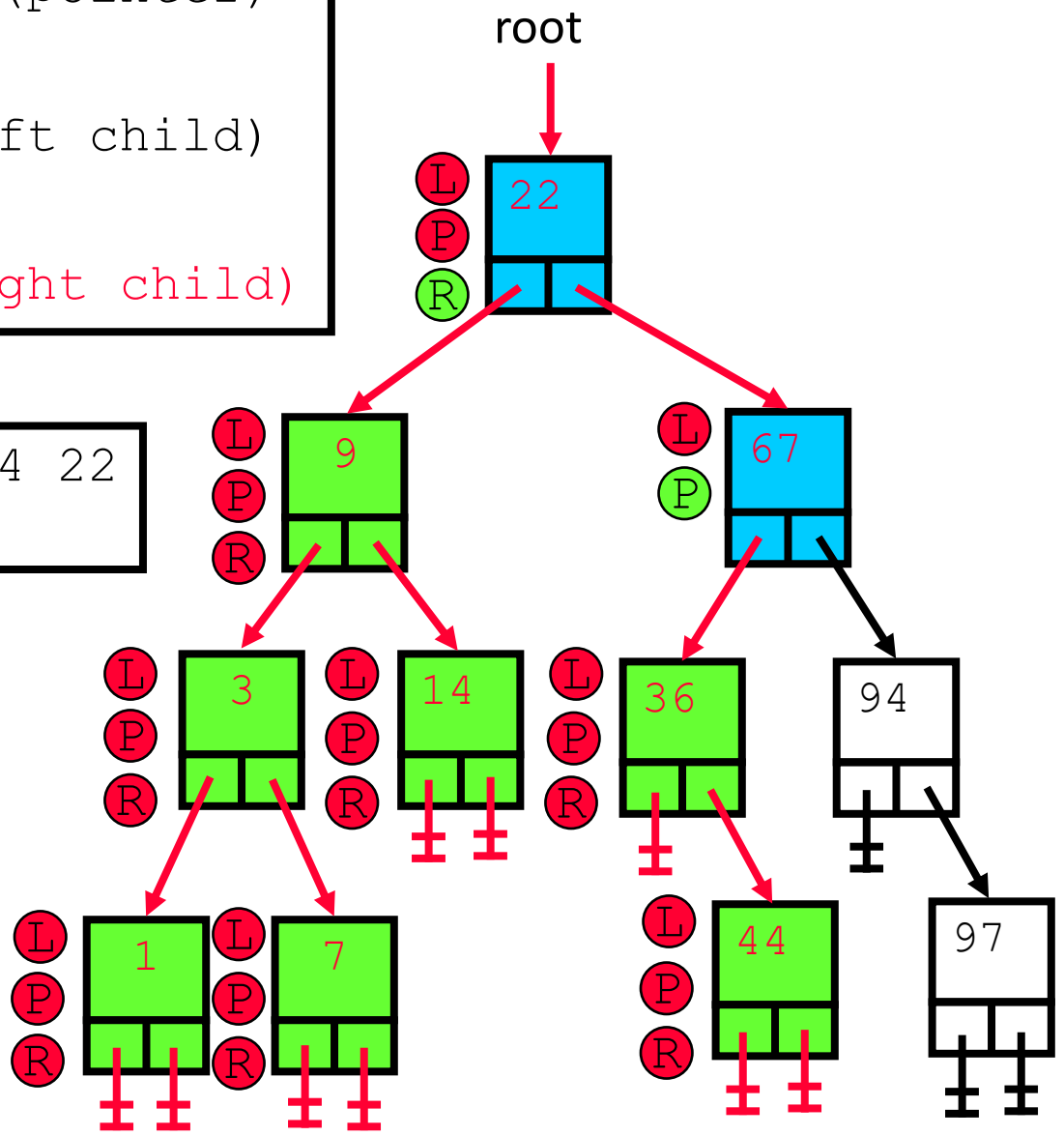
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67
```



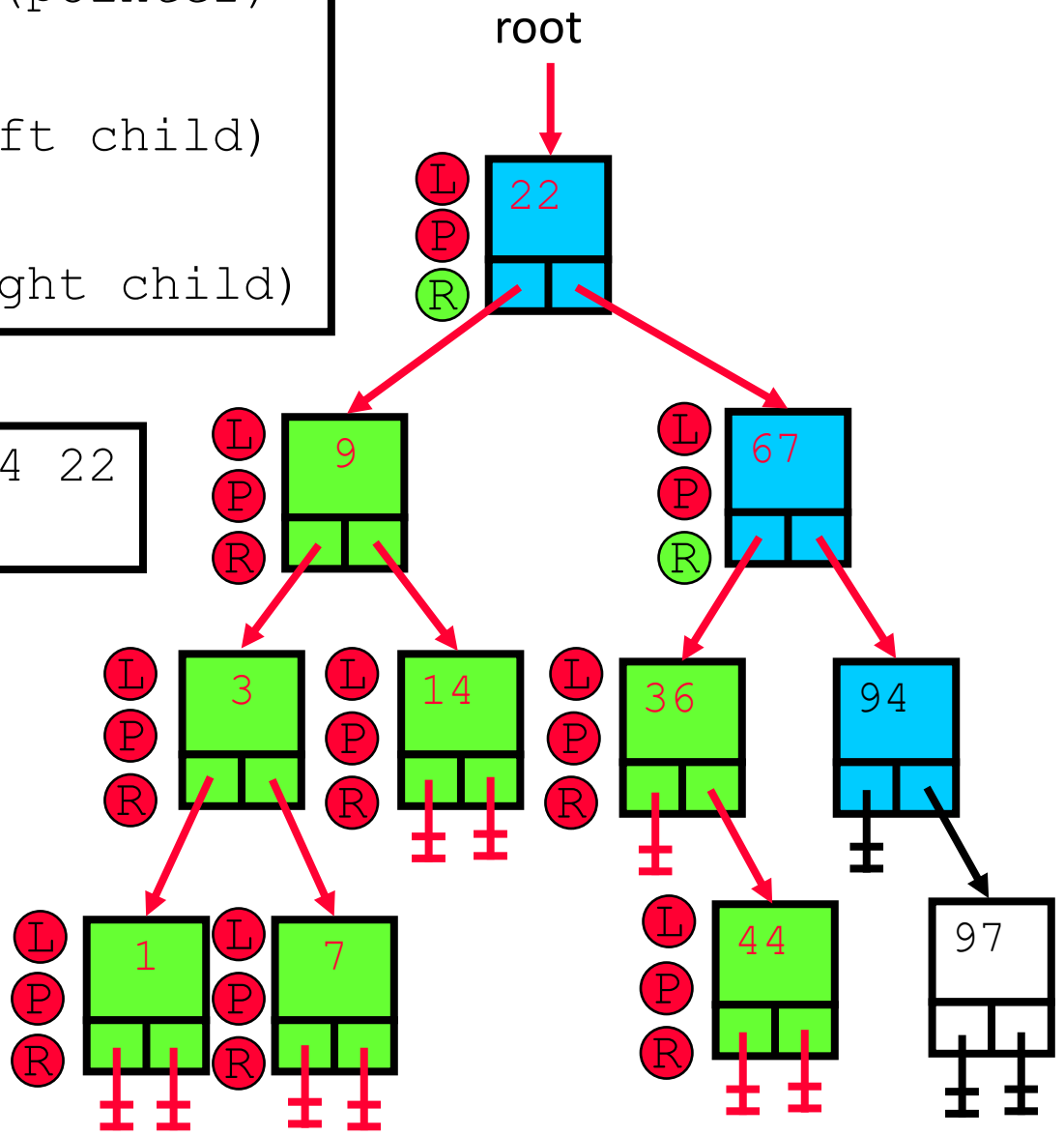
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67
```



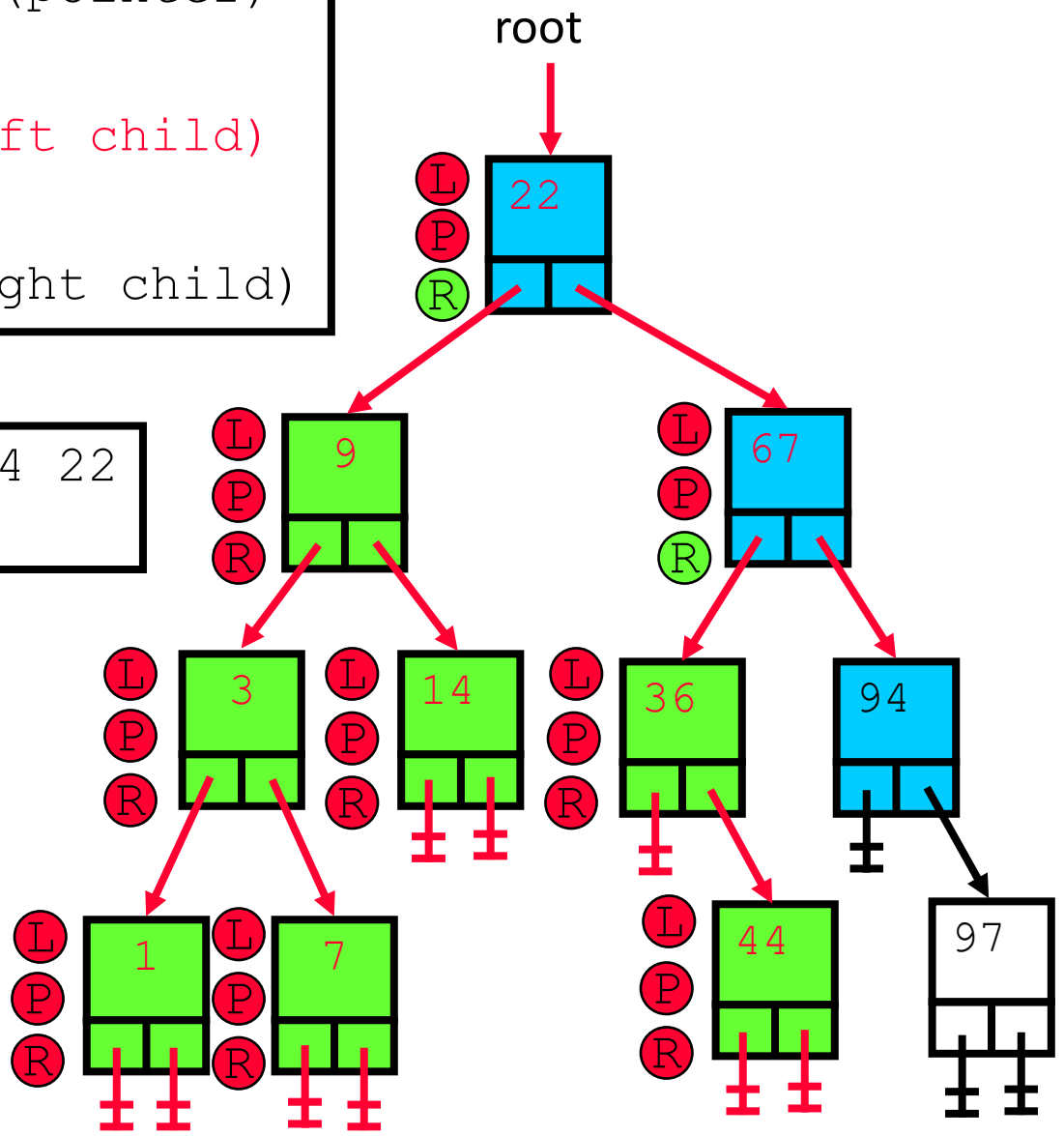
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67
```



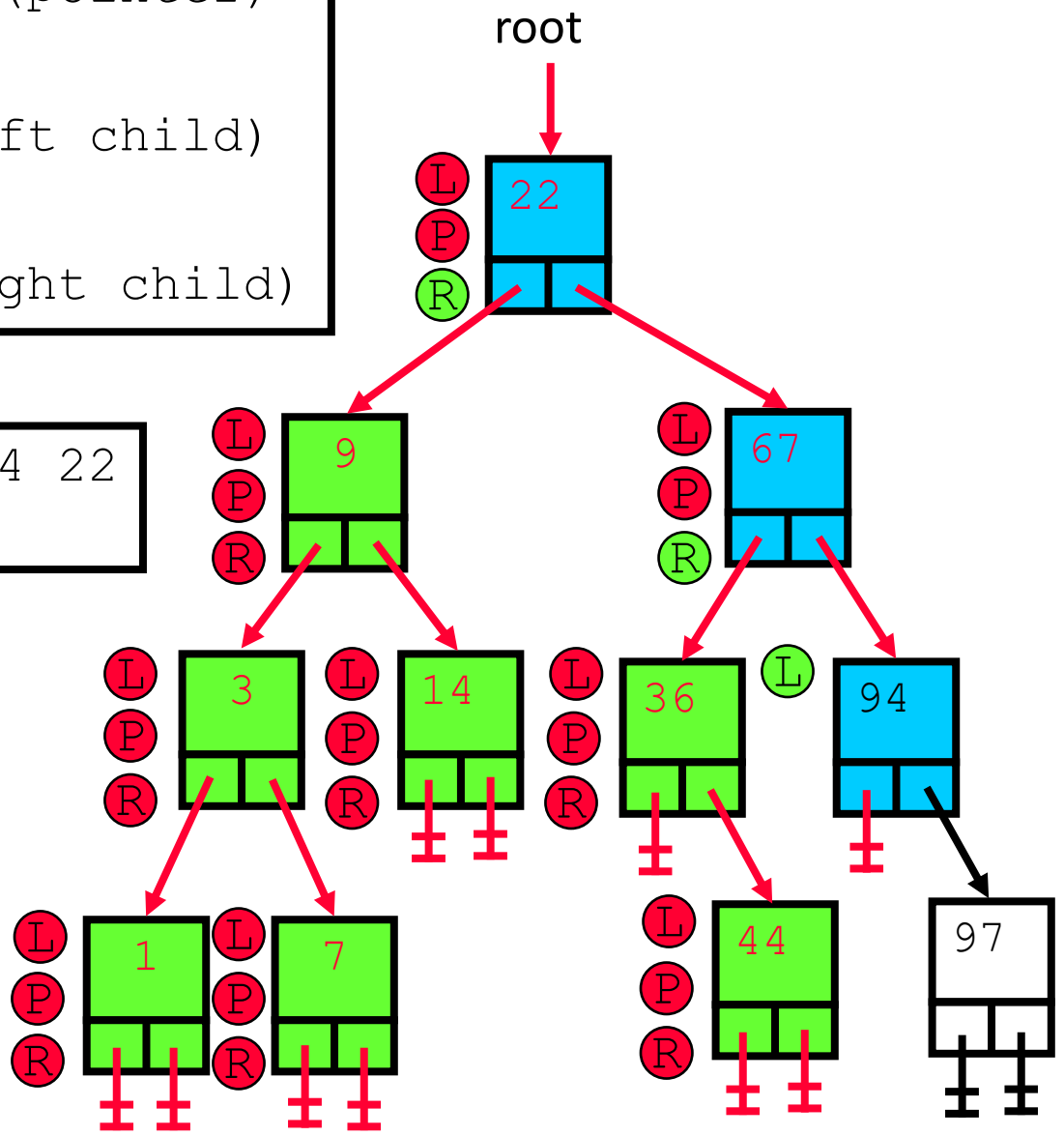
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67
```



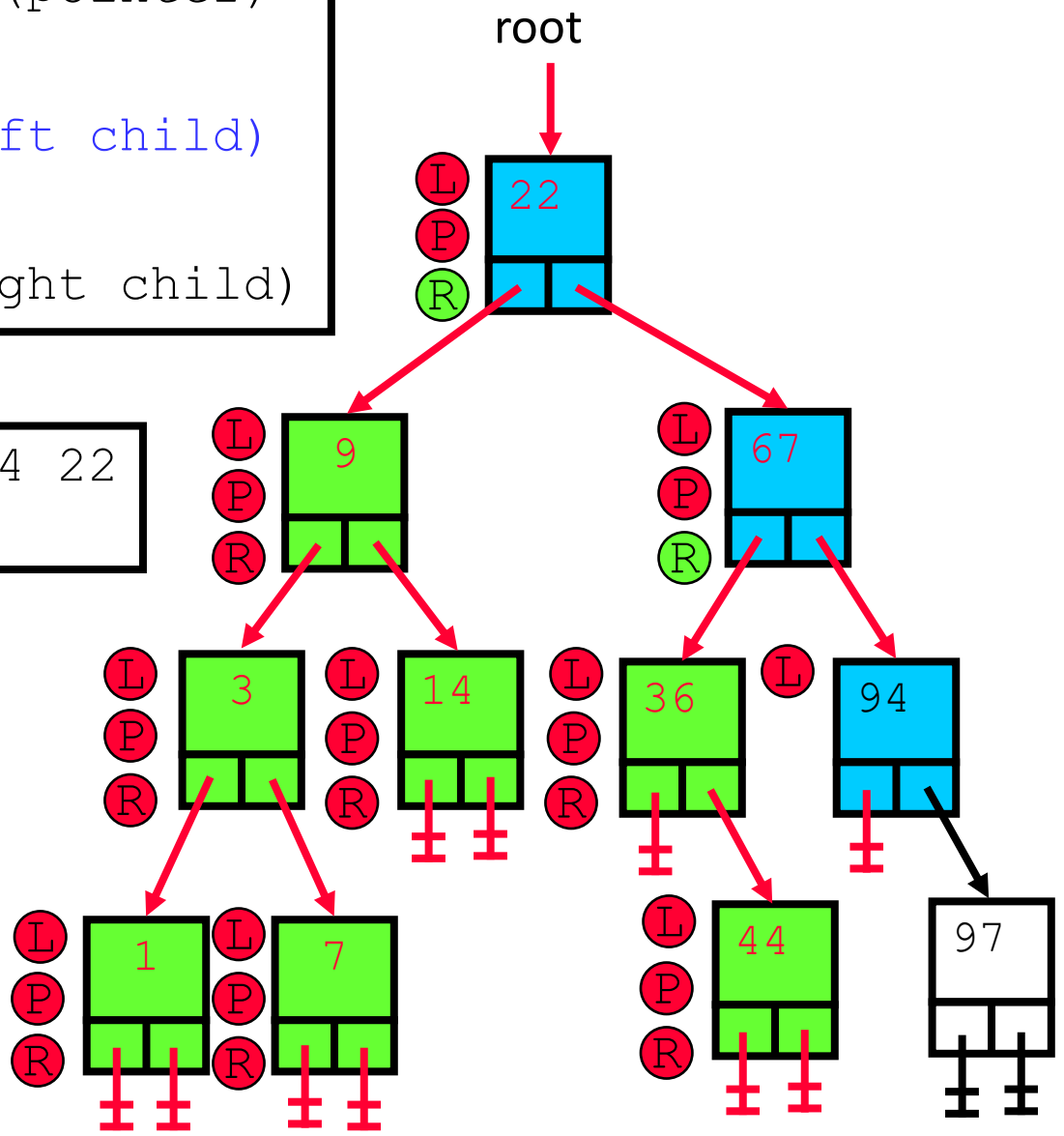
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67
```



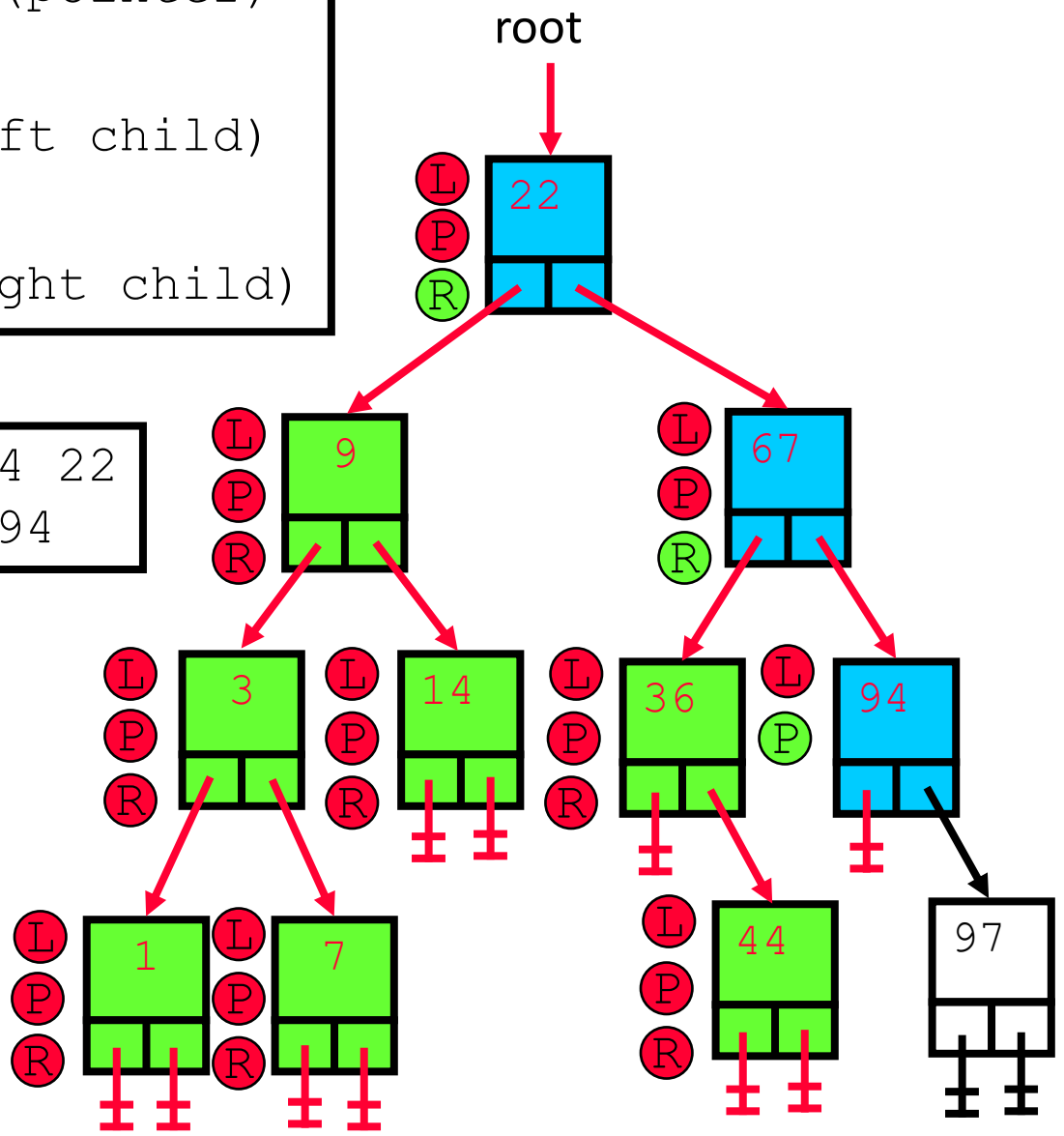
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67
```



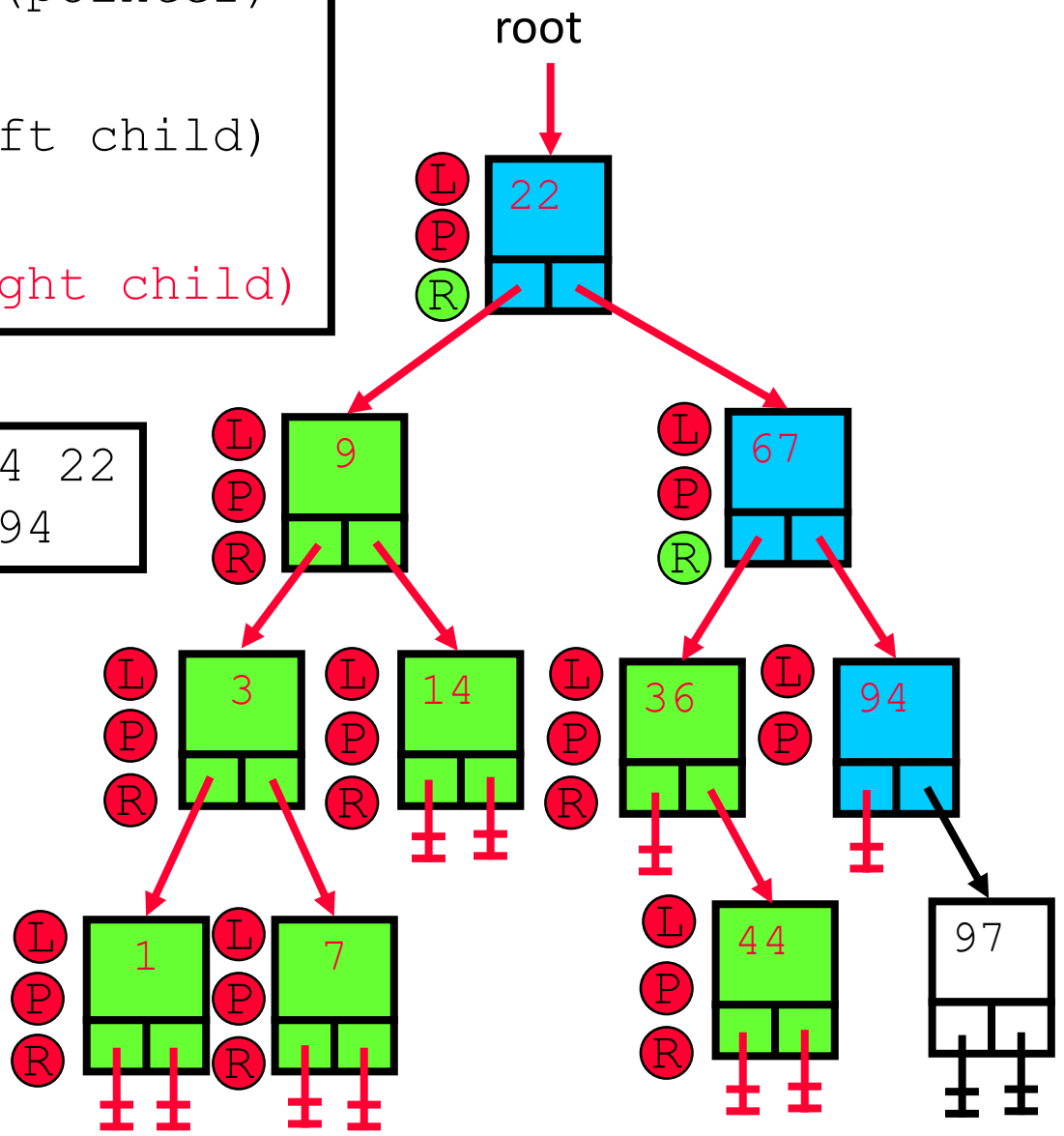
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94
```



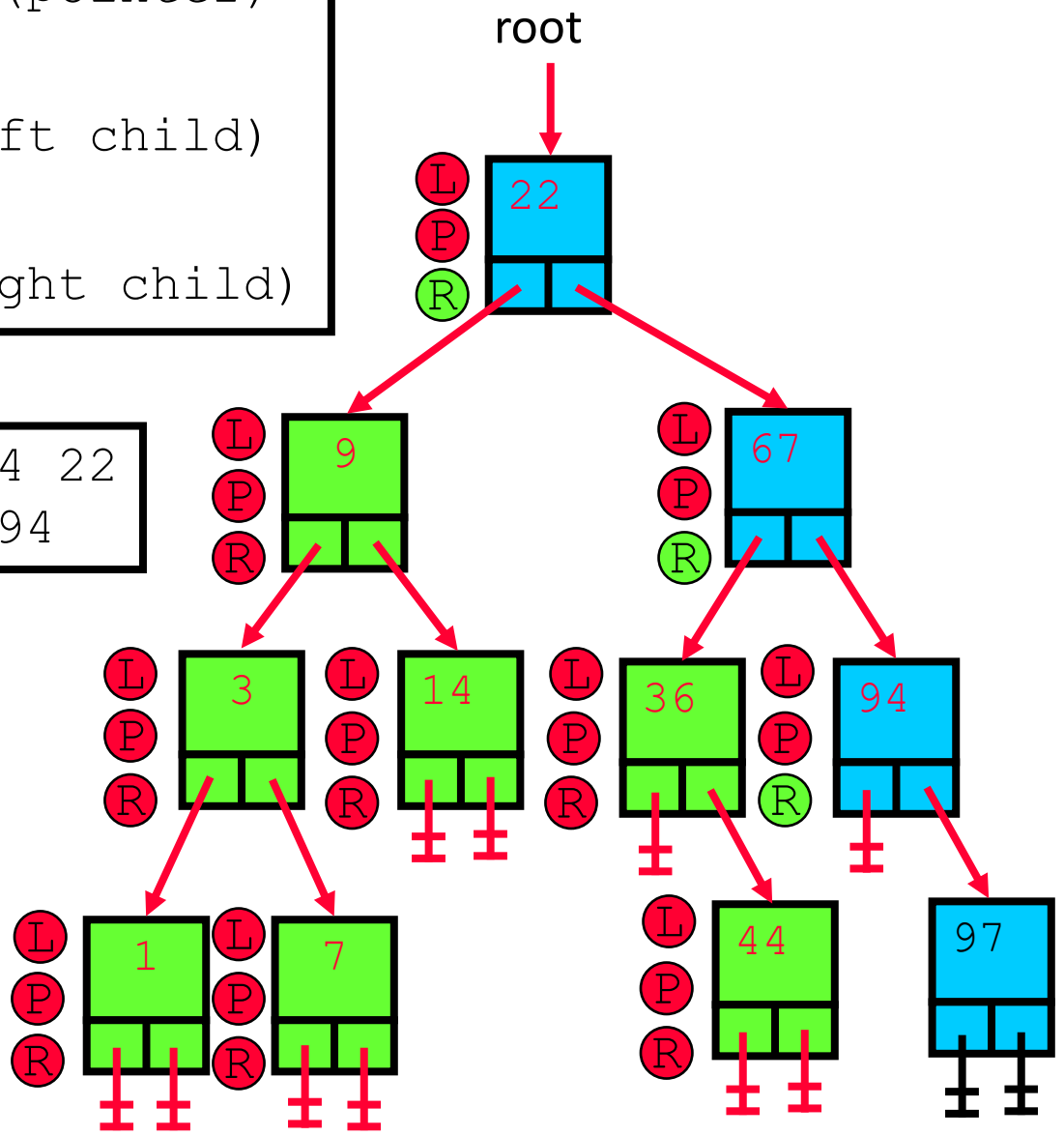
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94
```



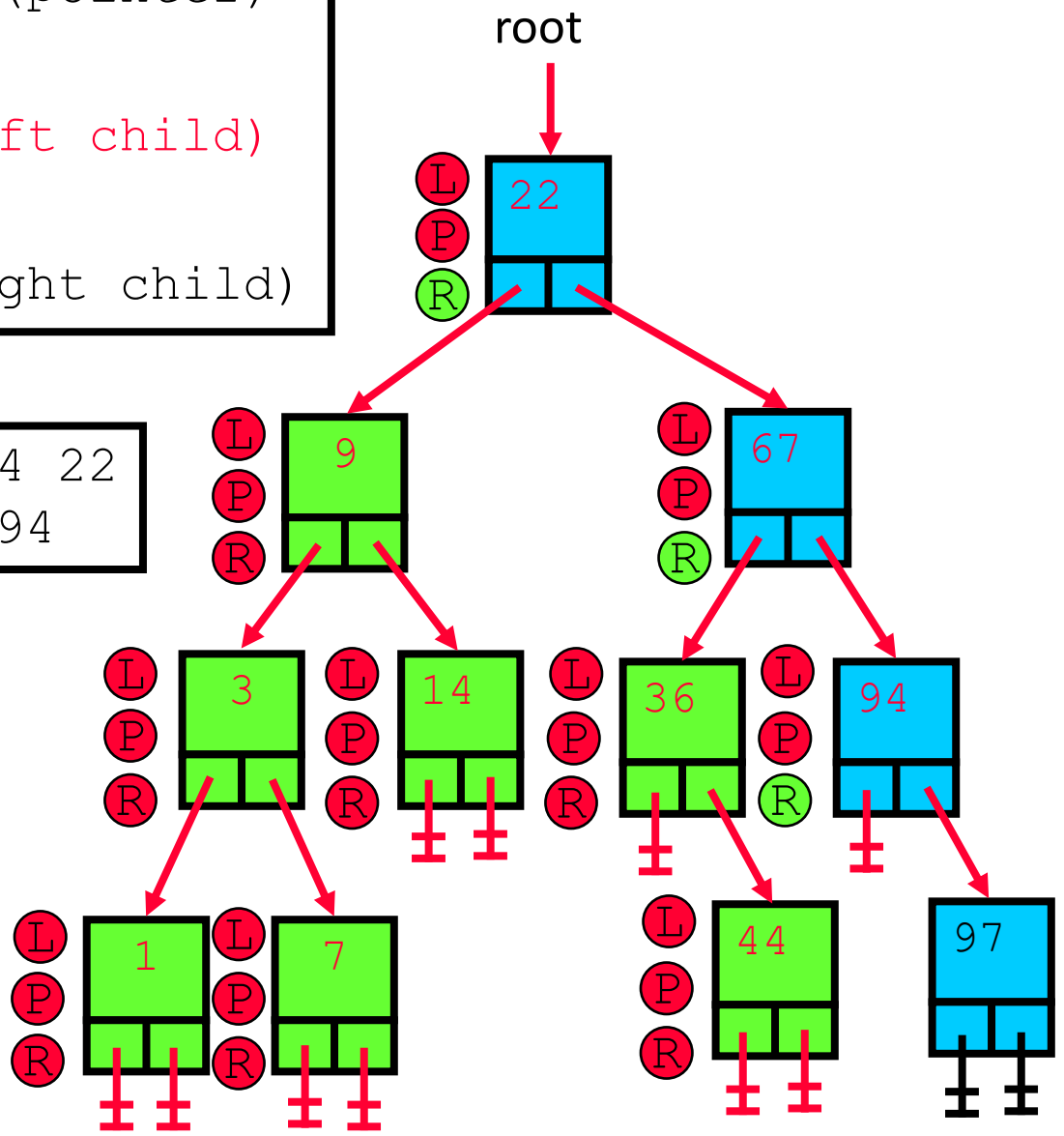
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94
```



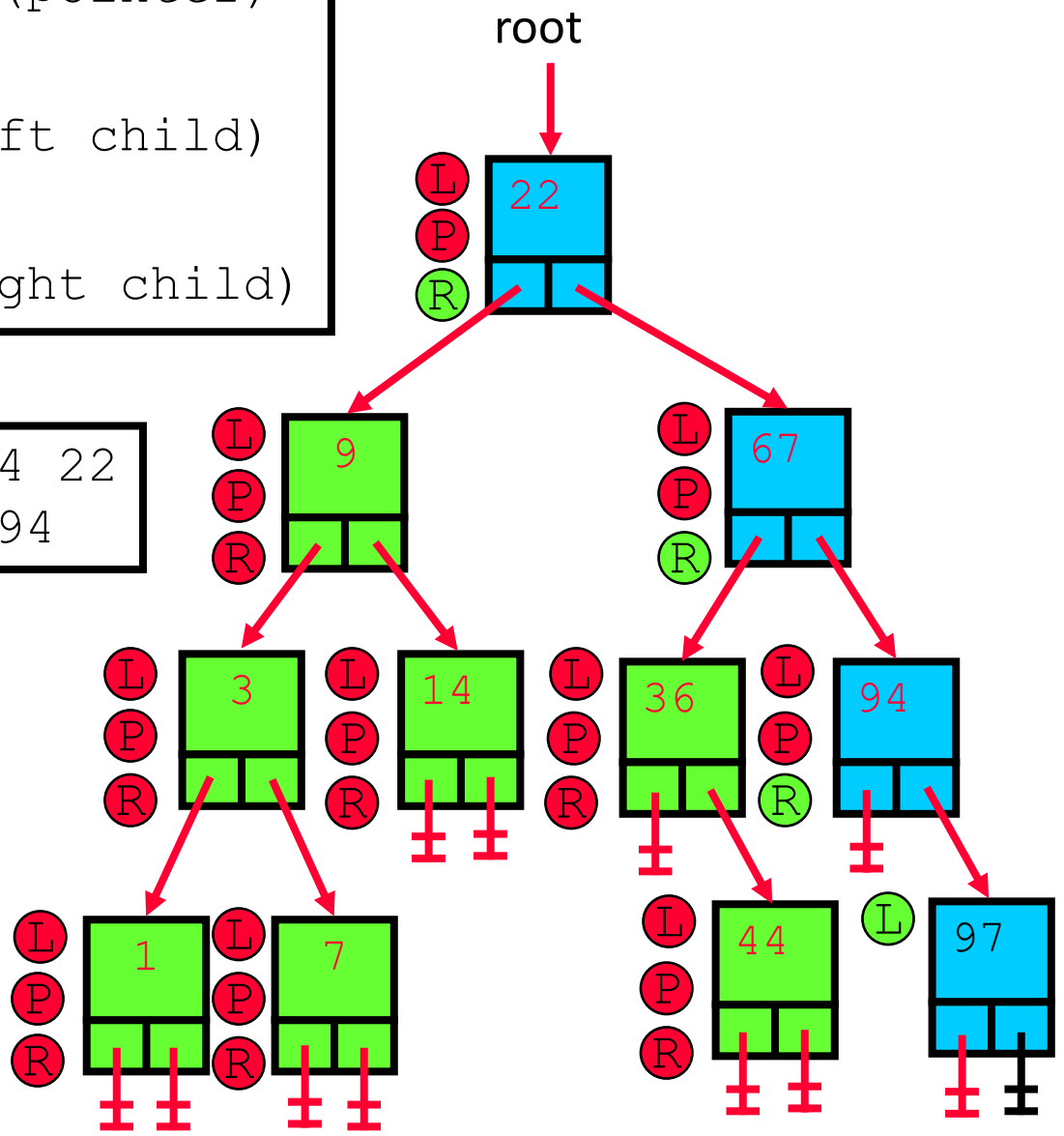
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94
```



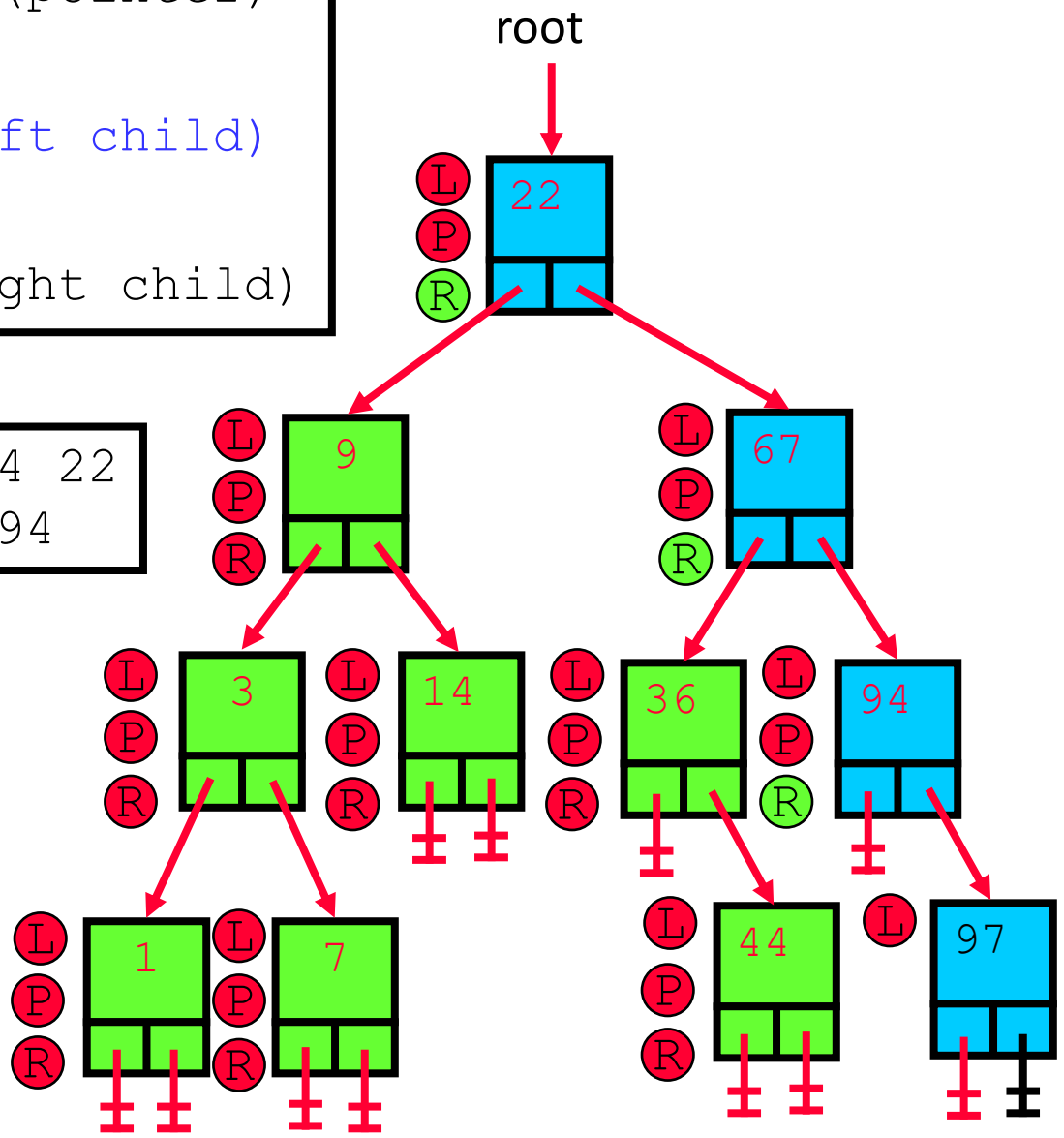
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94
```



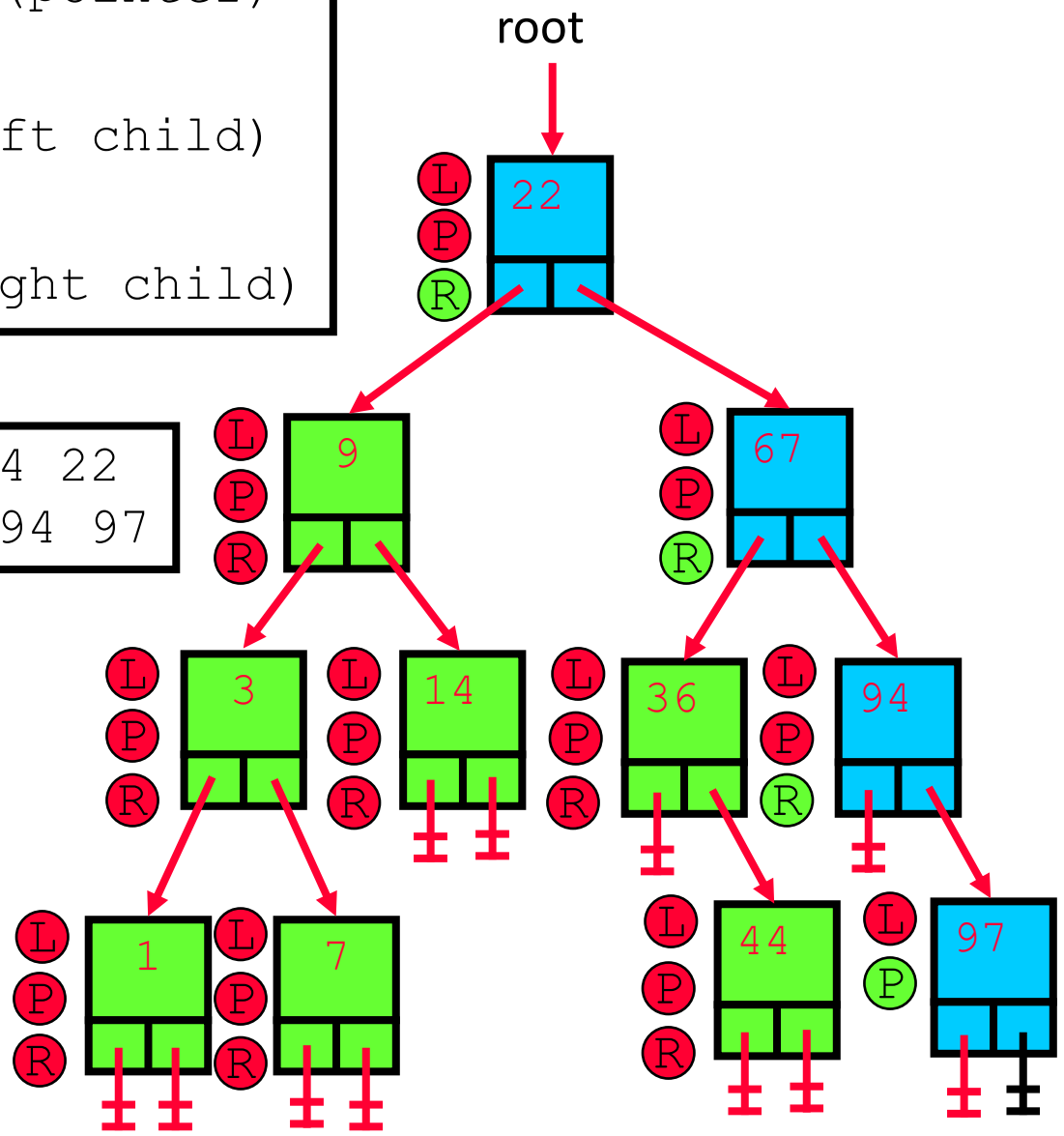
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94
```



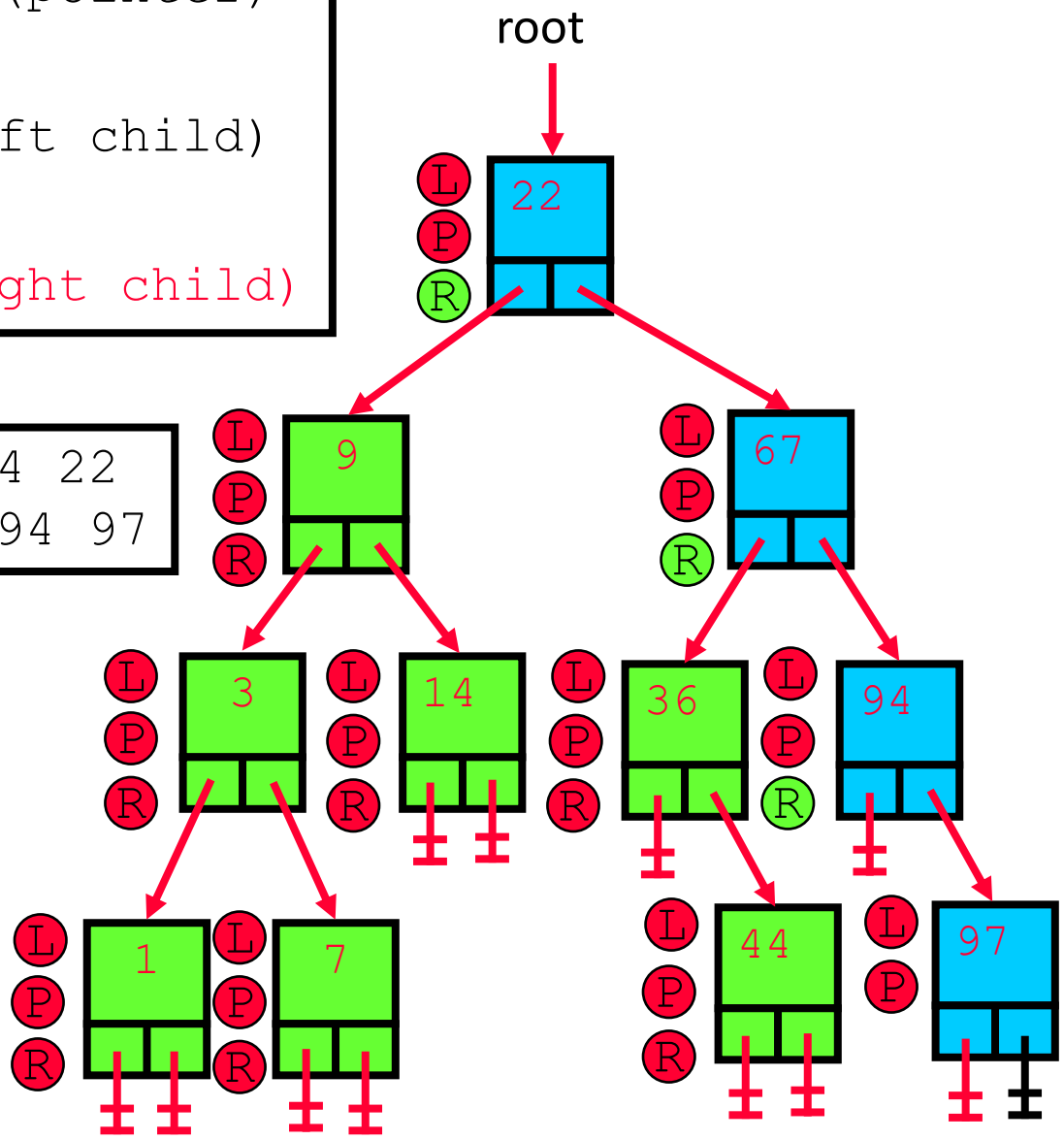
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94 97
```



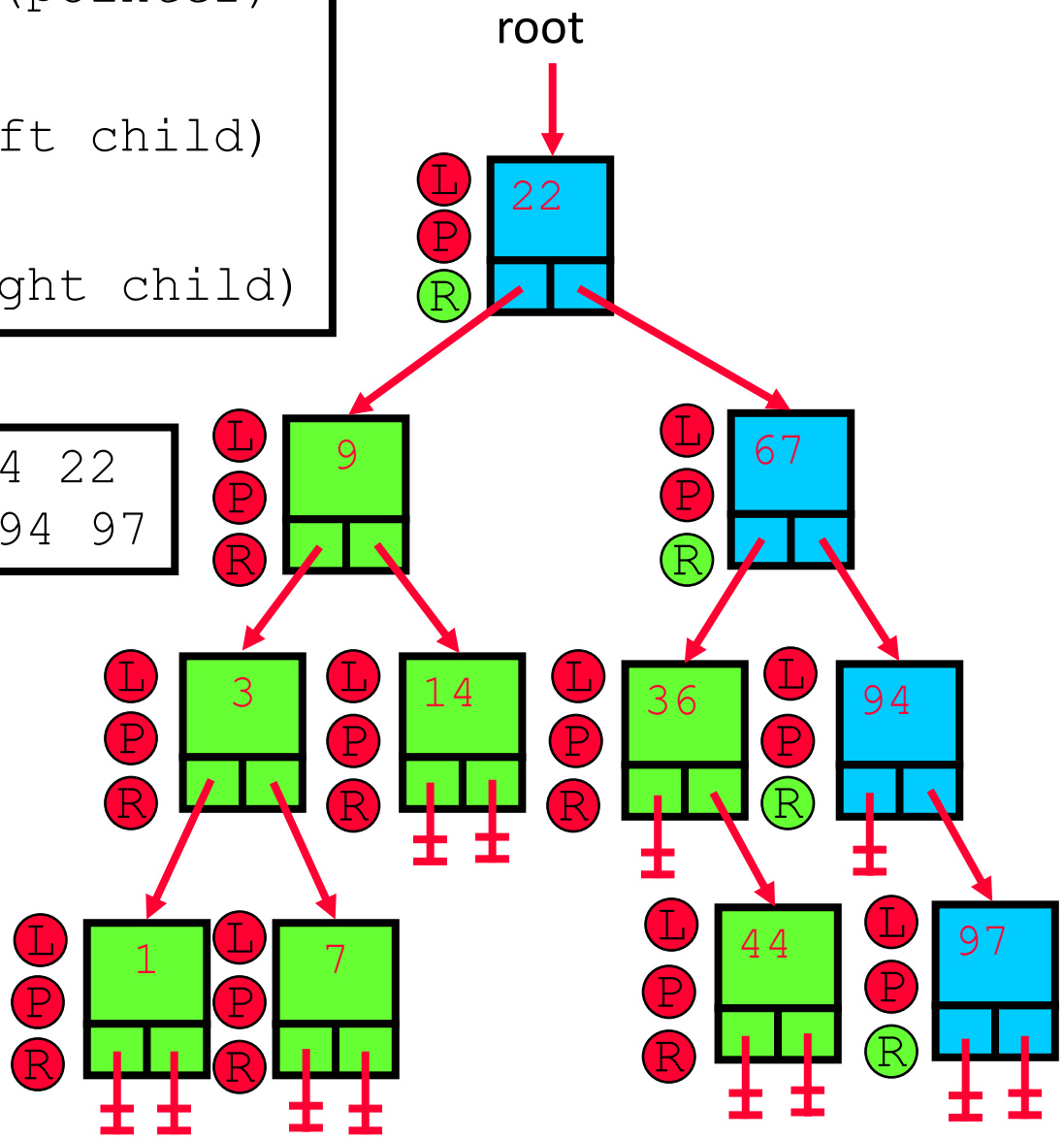
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94 97
```



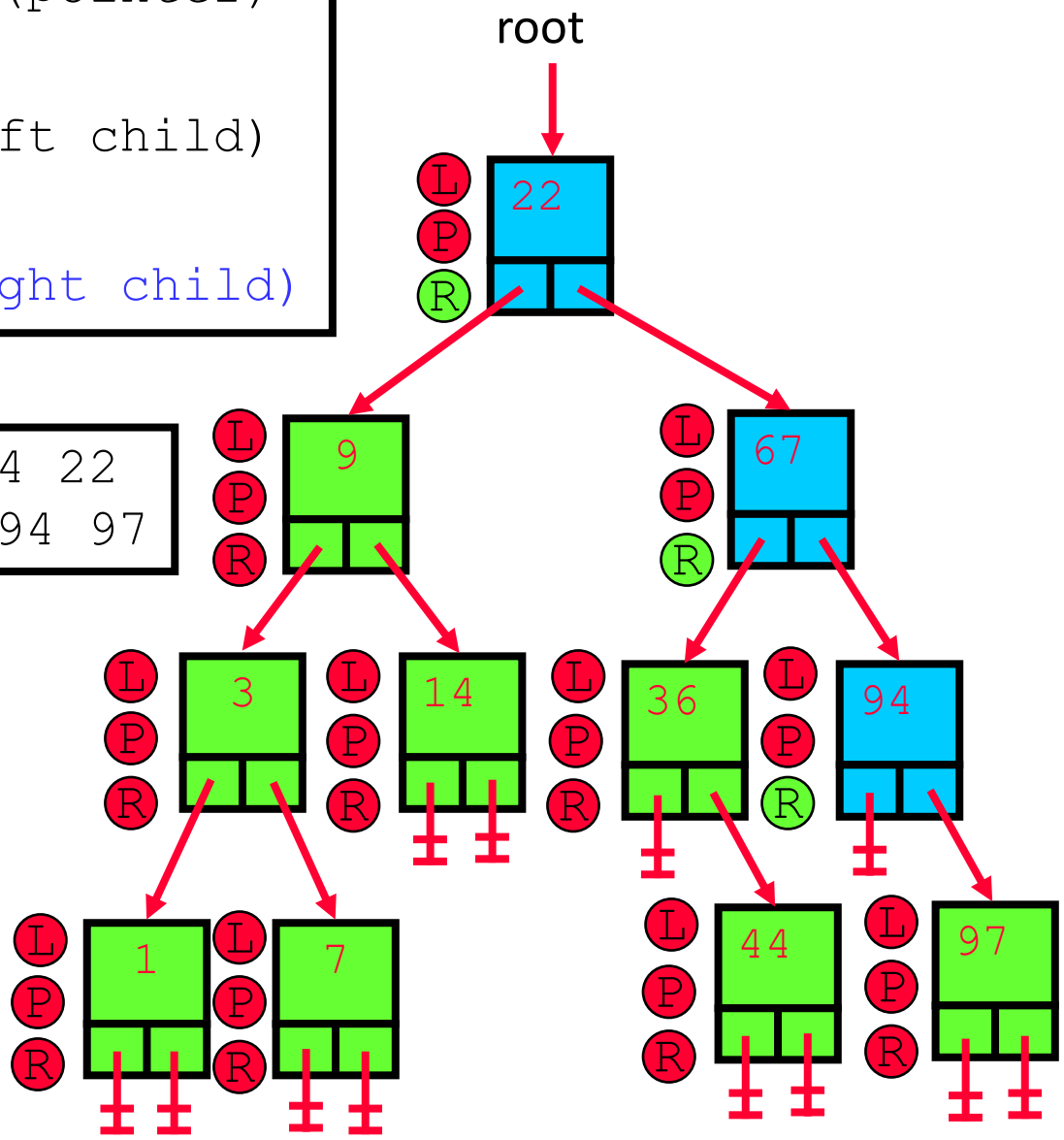
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94 97
```



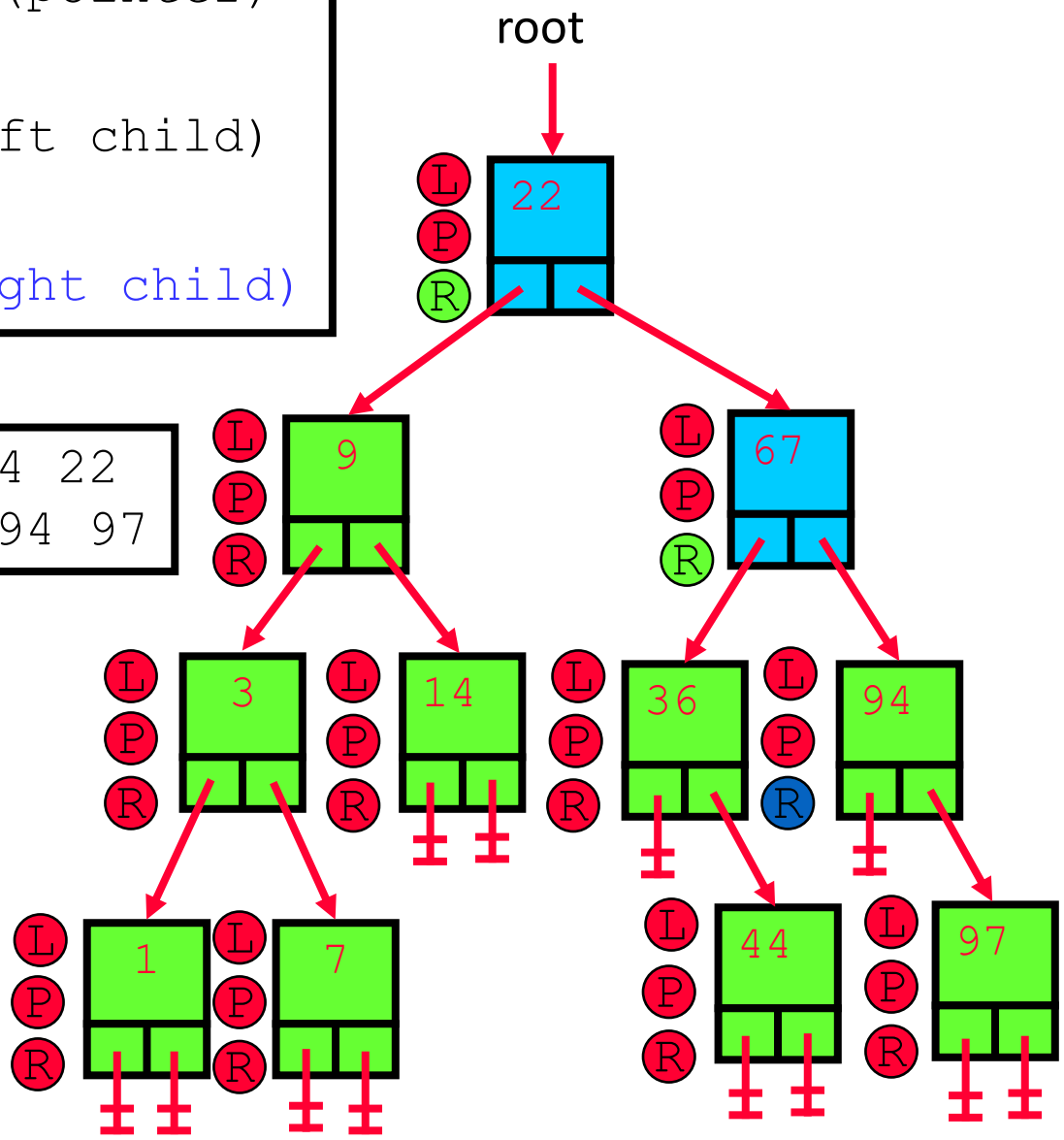
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94 97
```



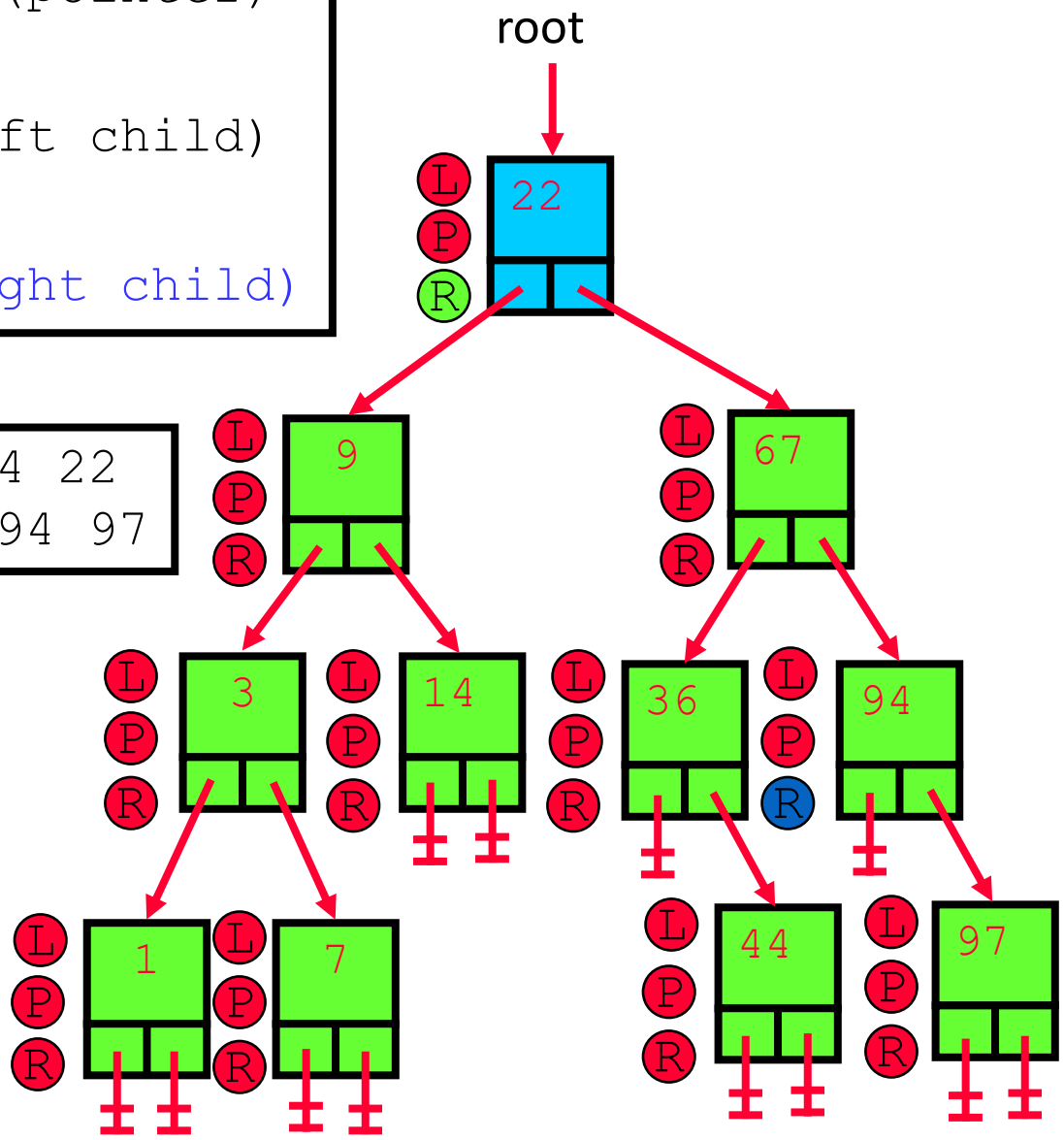
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94 97
```



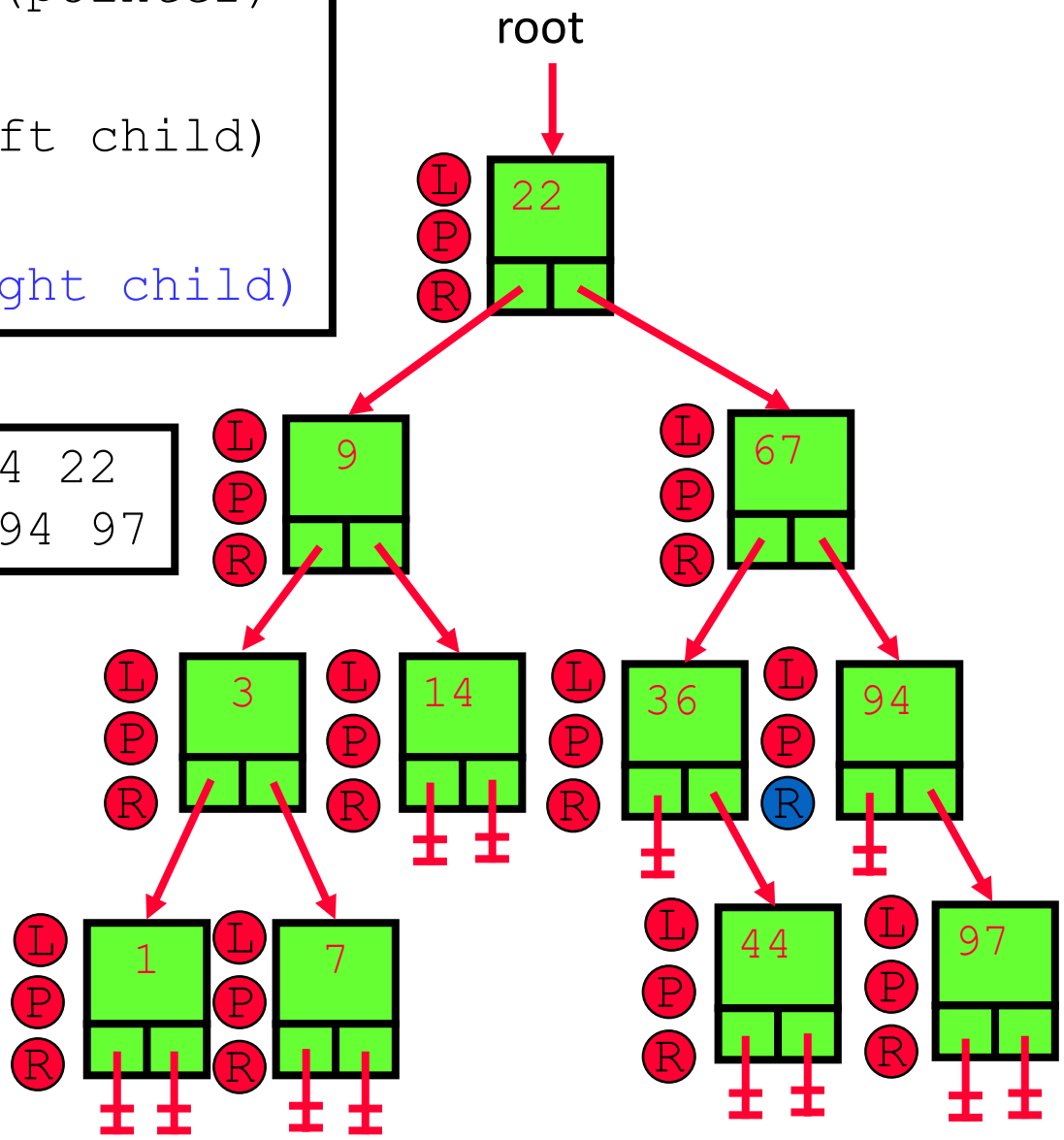
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94 97
```



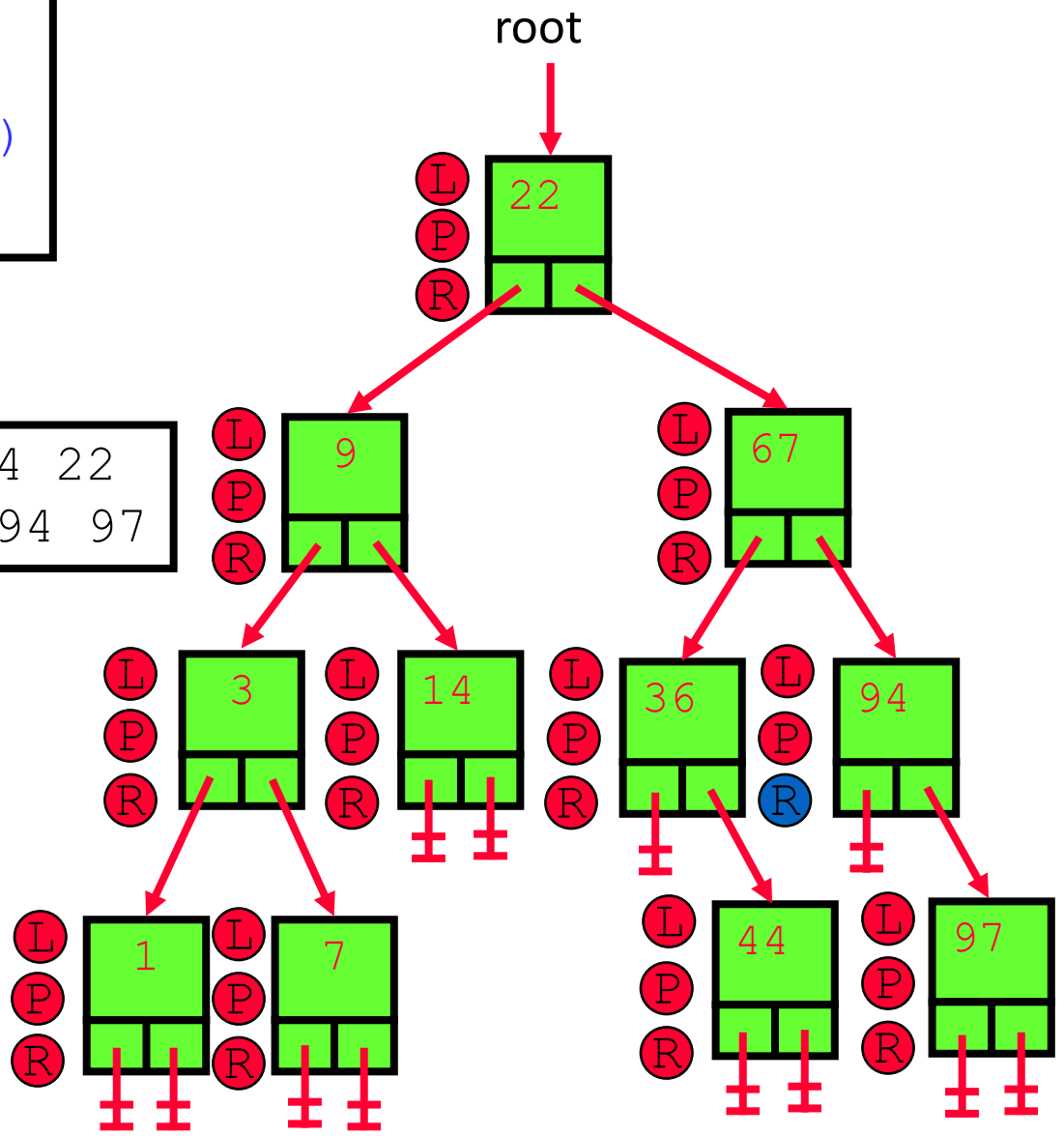
```
Proc InOrderPrint(pointer)
 pointer NOT NIL?
L InOrderPrint(left child)
P print(data)
R InOrderPrint(right child)
```

```
Output: 1 3 7 9 14 22
        36 44 67 94 97
```



```
Algorithm Example
. . .
InOrderPrint(root)
. . .
```

```
Output: 1 3 7 9 14 22
        36 44 67 94 97
```



Summary

- **An In-Order traversal visits every node**
  - **Recurse left first**
  - **Do something with current**
  - **Recurse right last**

- **The “left, current, right” logic is repeated recursively at every node.**

- **For a BST, an in-order traversal accesses the elements in ascending order.**