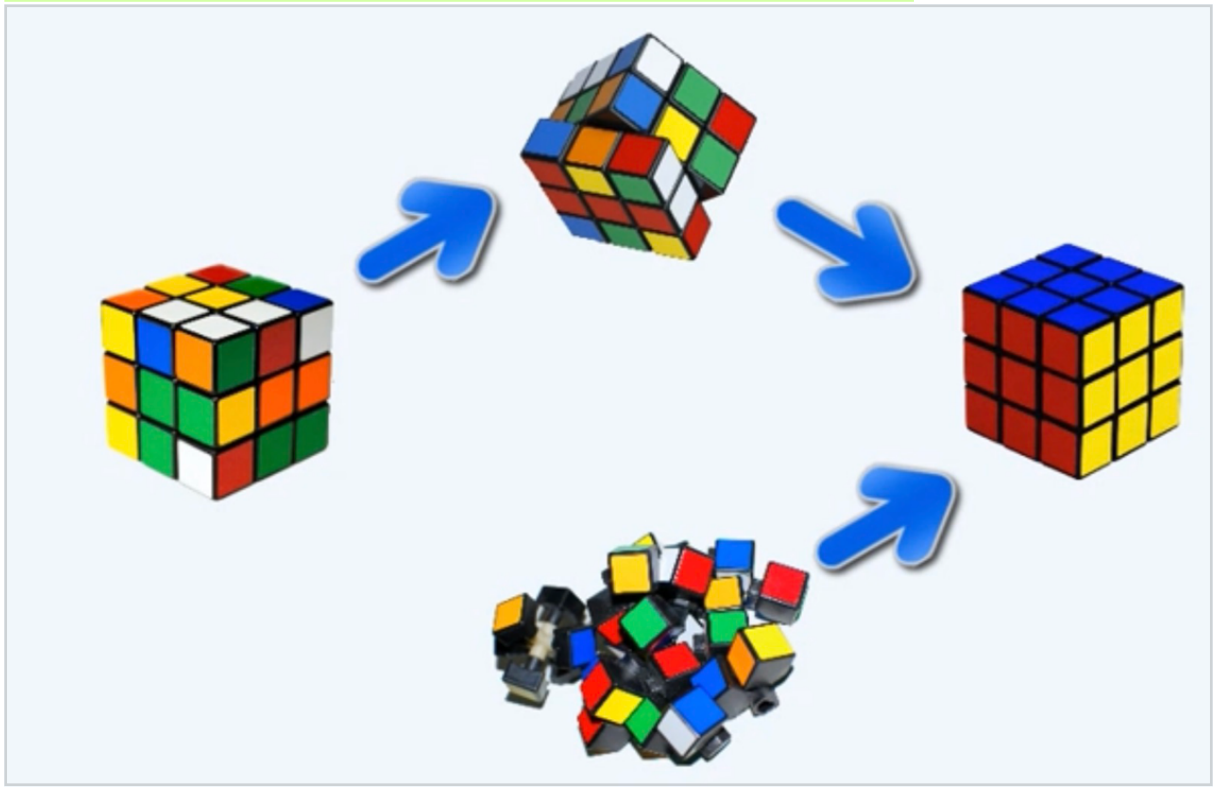
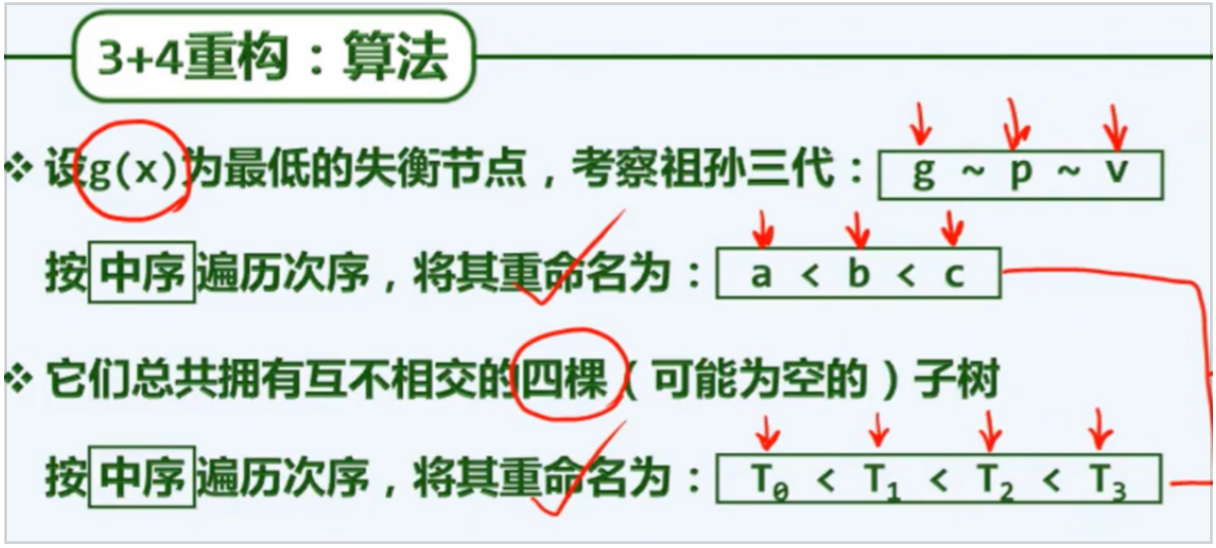
(3+4)重构

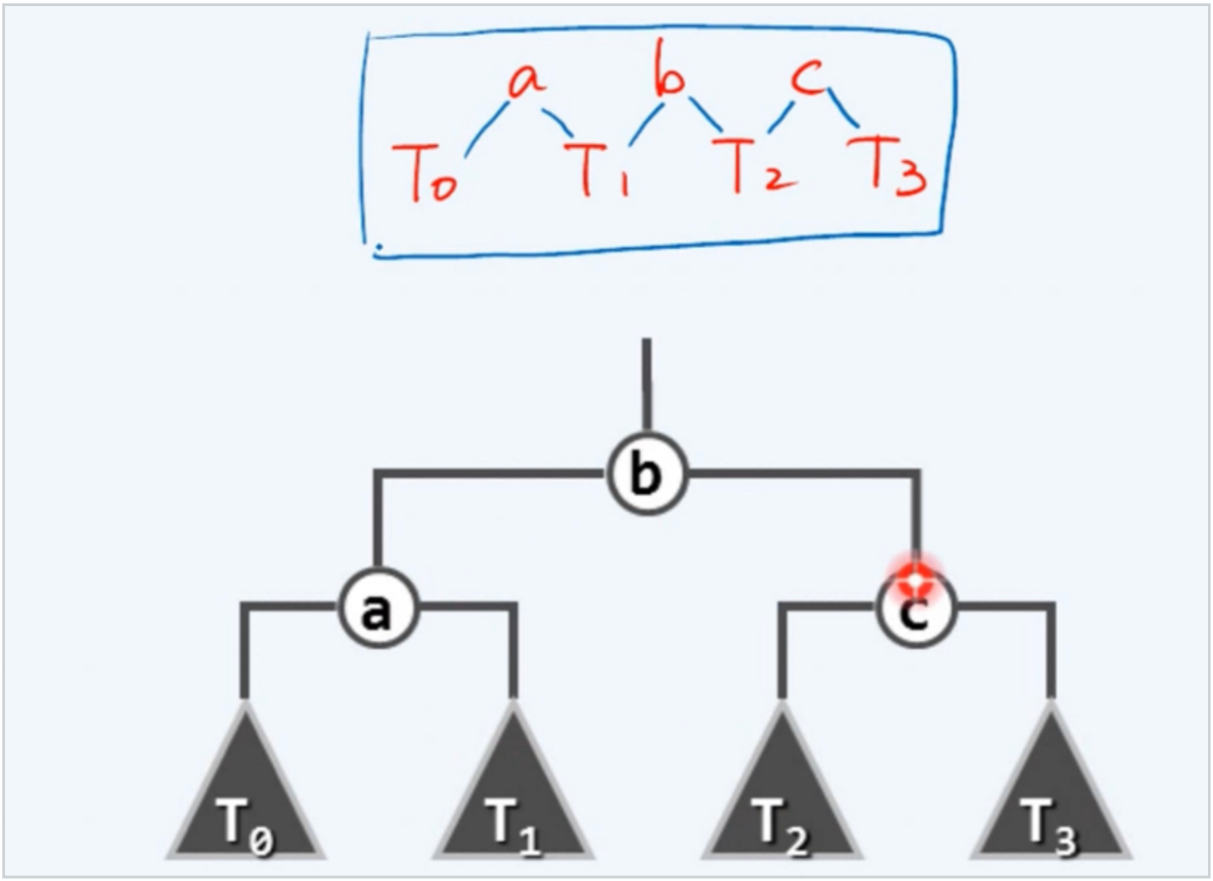
#数据结构邓神

算法

根据我们之前在插入中提出的方法，因为节点左右相对次序不变而且，永远都是把中间的向上提升，我们不妨把所有联系都切断，然后把所有节点摆好位置重新组合







实现

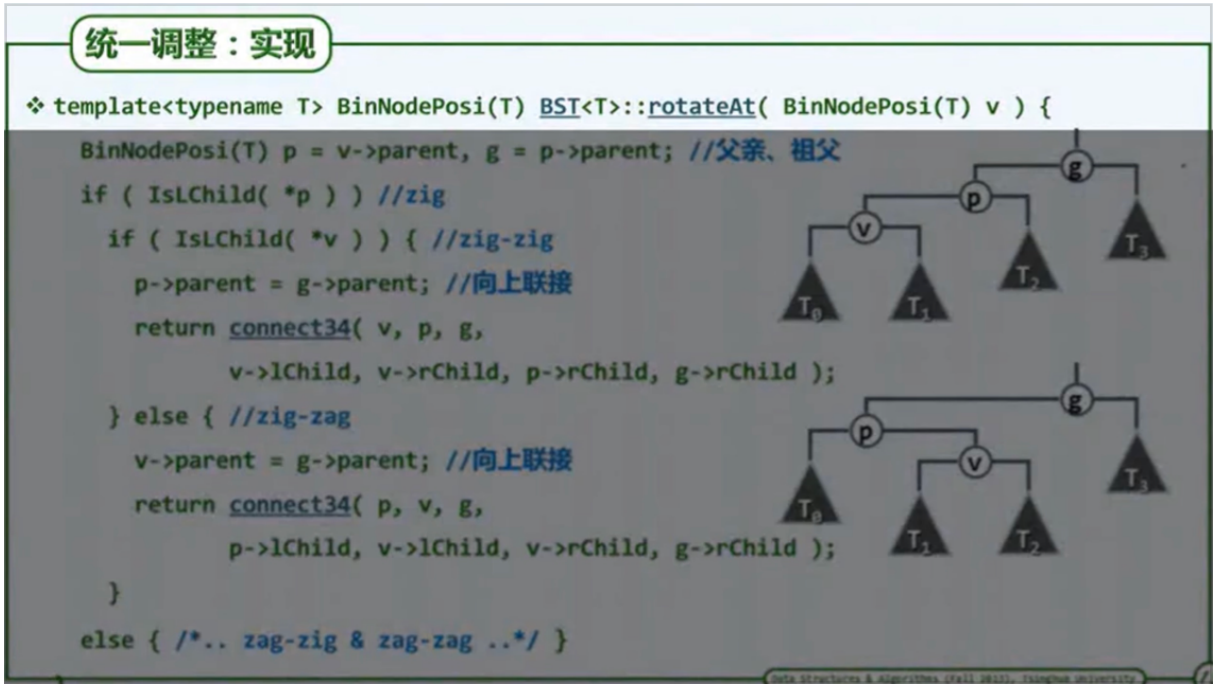
3+4重构：实现

```
template <typename T> BinNodePosi(T) BST<T>::connect34(
    BinNodePosi(T) a, BinNodePosi(T) b, BinNodePosi(T) c,
    BinNodePosi(T) T0, BinNodePosi(T) T1, BinNodePosi(T) T2, BinNodePosi(T) T3
 {
    a->lChild = T0; if (T0) T0->parent = a;
    a->rChild = T1; if (T1) T1->parent = a; updateHeight(a);
    c->lChild = T2; if (T2) T2->parent = c;
    c->rChild = T3; if (T3) T3->parent = c; updateHeight(c);
    b->lChild = a; a->parent = b;
    b->rChild = c; c->parent = b; updateHeight(b);
    return b; //该子树新的根节点
 }
```

```
template <typename T> BinNodePosi<T> BST<T>::connect34(
        BinNodePosi<T> a, BinNodePosi<T> b, BinNodePosi<T>c,
        BinNodePosi<T> T0,BinNodePosi<T> T1, BinNodePosi<T> T2, BinNodePosi<T>
T3){
    a->lChild = T0;
```

```
    if (T0){
        T0->parent = a;
    }
    a->rChild = T1;
    if (T1){
        T1->parent = a;
    }
    updateHeight(a);
    c->parent = T2;
    if (T2){
        T2->parent = c
    }
    c->rChild = T3;
    if (T3){
        T3->parent = c;
    }
    updateHeight(c);
    b->lChild = a;
    a->parent = b;
    b->rChild = c;
    c->parent = b;
    updateHeight(b);
    return b;
}
```

rotateAt




```
template <typename T> BinNodePosi<T> BST<T>::rotateAt(BinNodePosi<T> v){
    BinNodePosi<T> p = v->parent;
    BinNodePosi<T> g = p->parent;
    if (IsLChild(*p)){//zig
        if (IsLChild(*v)){//zig-zig
            p->parent = g->parent;
            return connect34(g,p,v,v->lChild,v->rChild,p->lChild,g->rChild);
        }
    }
    else {// zig-zag
        v->parent = g->parent;
        return connect34(p,v,g,p->lChild,v->lChild,v->rChild,g->rChild);
    }
    else
    {
        /* zag-zig zag-zag 不再复述*/
    }
}
```

综合评价

综合评价

- 优点　无论查找、插入或删除，最坏情况下的复杂度均为O(logn)

  O(n)的存储空间

- 缺点　借助高度或平衡因子，为此需改造元素结构，或额外封装

  实测复杂度与理论值尚有差距

  插入/删除后的旋转，成本不菲

  删除操作后，最多需旋转Ω(logn)次（Knuth：平均仅0.21次）

  若需频繁进行插入/删除操作，未免得不偿失

  单次动态调整后，全树拓扑结构的变化量可能高达Ω(logn)