8.高级搜索树

(xa1) 红黑树：动机

As she looks at the blood on the snow, she says to herself, "Oh, how I wish that I had a daughter that had skin WHITE as snow, lips RED as blood, and hair BLACK as ebony".

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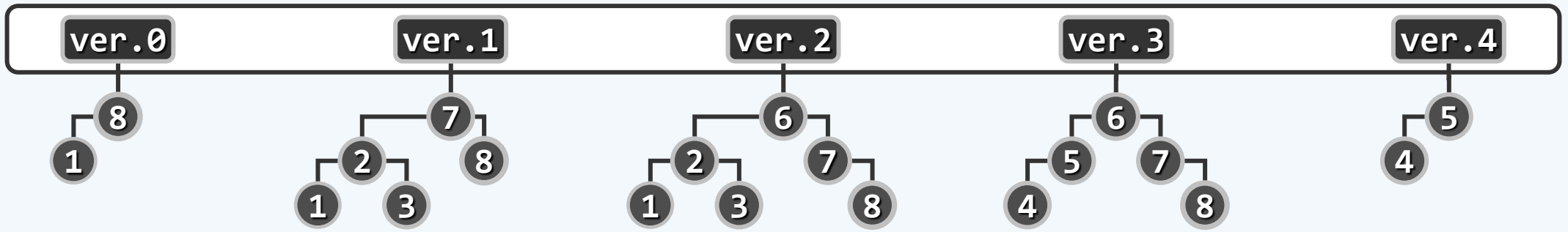
一致性结构

❖ Persistent structure：支持对历史版本的访问 //ephemeral

T.search(ver, key); T.insert(ver, key); T.remove(ver, key)

❖ 蛮力实现：每个版本独立保存；各版本入口自成一个搜索结构



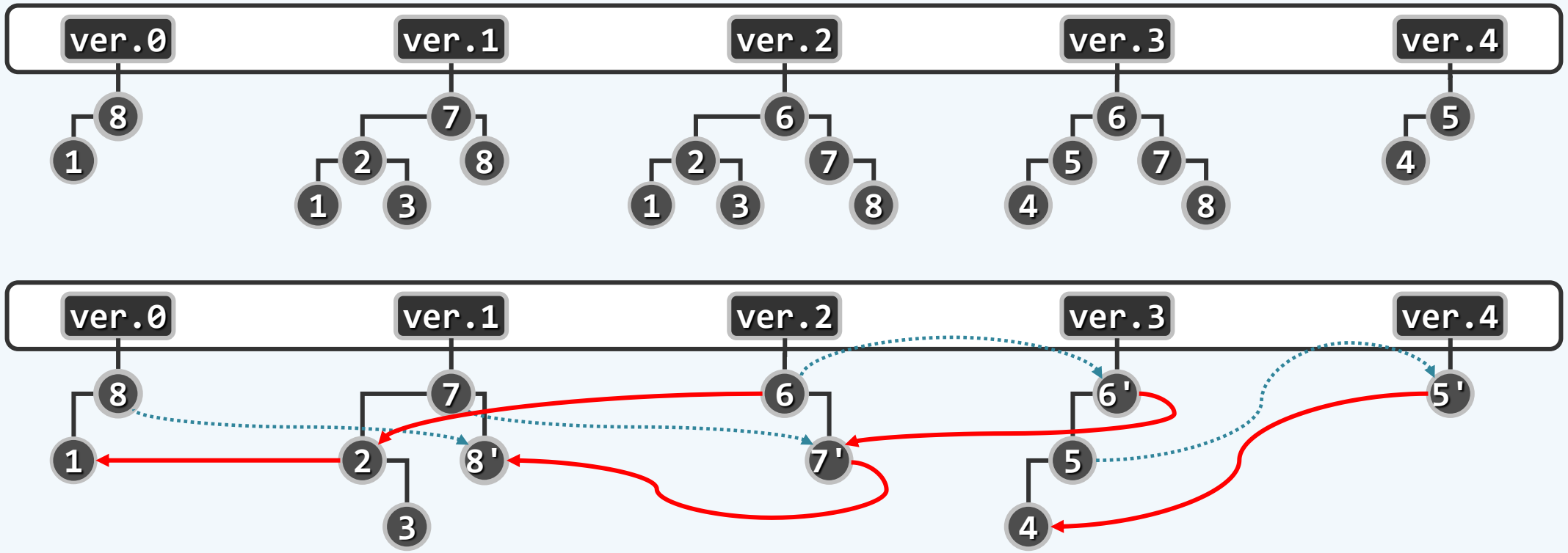
❖ 单次操作O(logh + logn)，累计O(h*n)时间/空间 //h = |history|

❖ 挑战：可否将复杂度控制在O(n + h*logn)内？

❖ 可以！为此需利用相邻版本之间的关联性...

O(1)重构

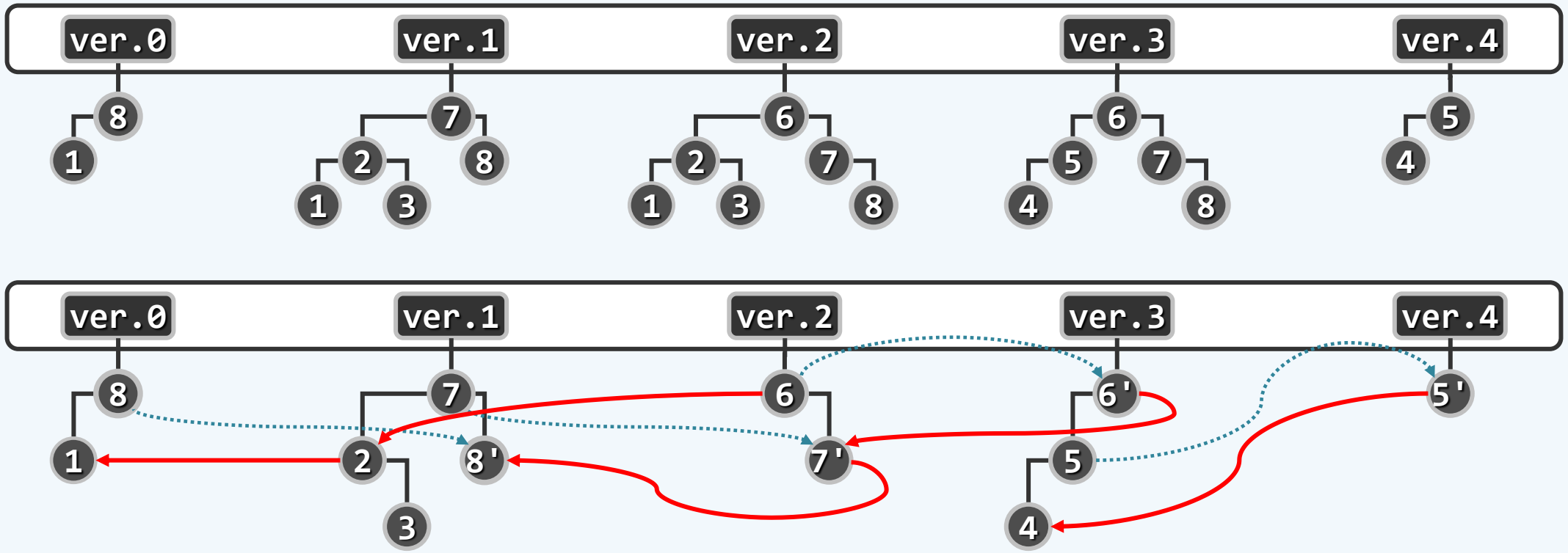
❖ 大量共享，少量更新：每个版本的新增复杂度，仅为O(logn)



❖ 能否进一步提高，比如总体O(n + h)、单版本O(1)？可以！

O(1)重构

❖ 为此，就树形结构的拓扑而言，相邻版本之间的差异不能超过O(1)



❖ 很遗憾，AVL、Splay等BBST均不具备这一性质；须另辟蹊径...

java.util.TreeMap

```
import java.util.*;

public class TestTreeMap {
    public static void main( String[] args ) {
        TreeMap scarborough = new TreeMap();
        scarborough.put( "P", "parsley" );
        scarborough.put( "S", "sage" );
        scarborough.put( "R", "rosemary" );
        scarborough.put( "T", "thyme" );
        System.out.println( scarborough );
    }
}
```