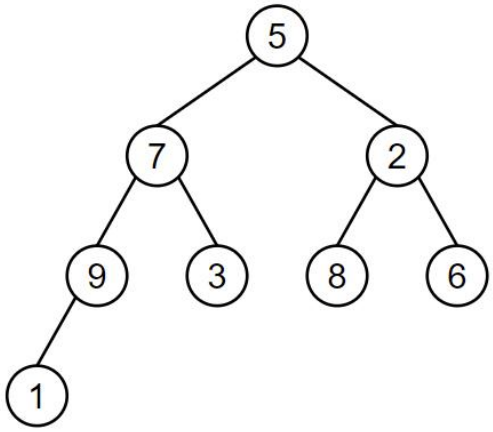
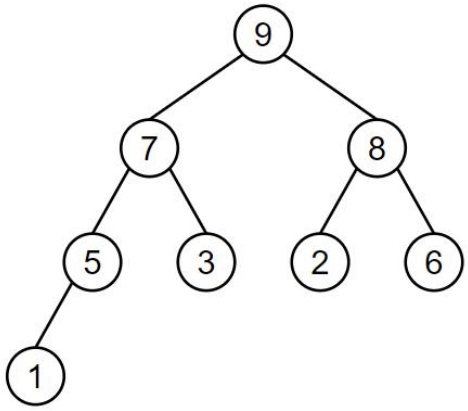
作业 8 参考答案（by 况鸿翔）

P320-26

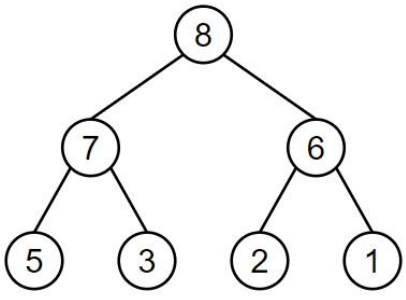
1° 原序列对应的完全二叉树



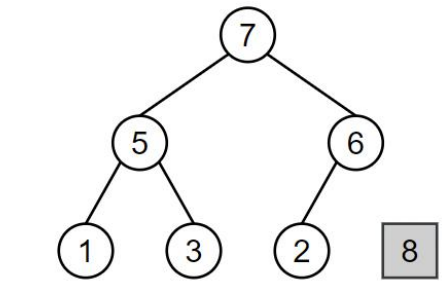
2° 堆化后的树



3° 大根堆的删除



9



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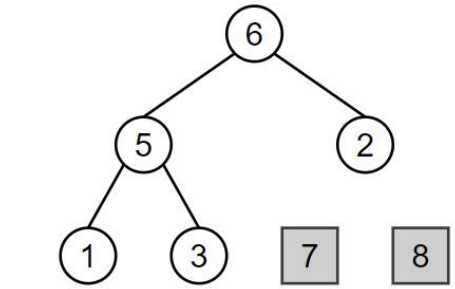

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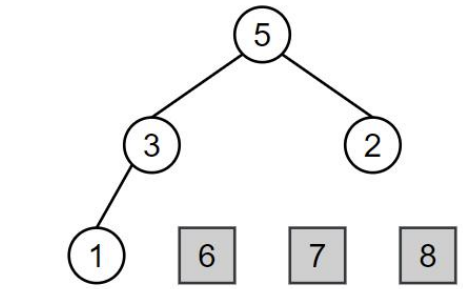
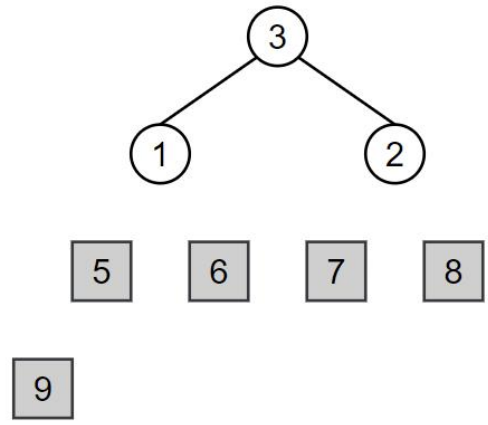


9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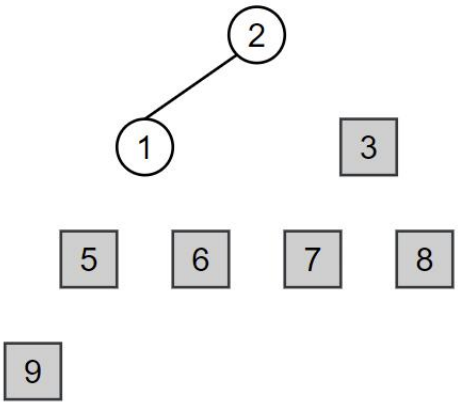
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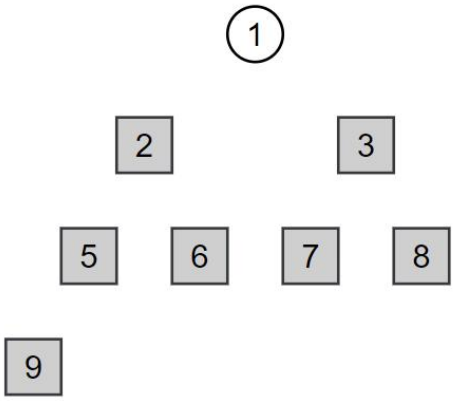
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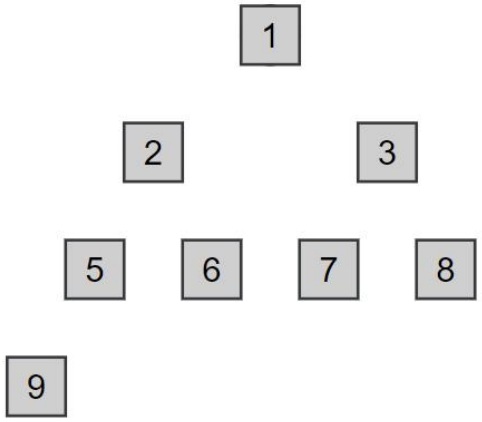

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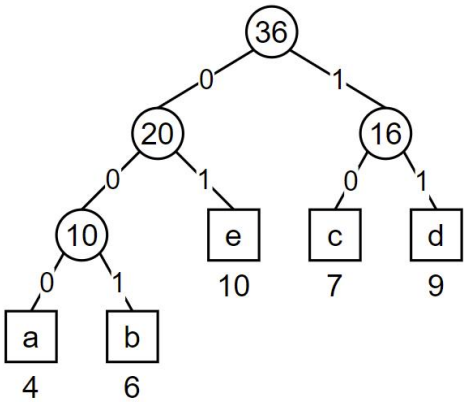
（1）

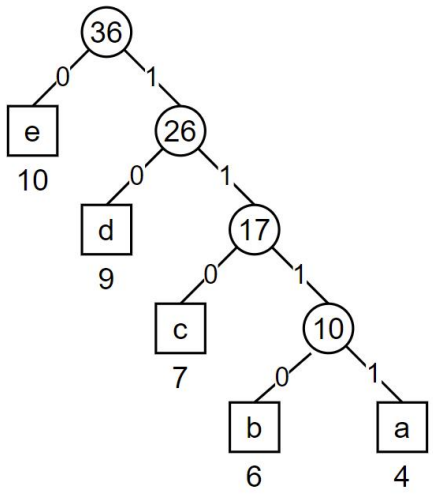
1° 霍夫曼树



代码：a＝000，b＝001，c＝10，d＝11，e＝01

长度：WEP＝3×4＋3×6＋2×10＋2×7＋2×9＝82

2° 右偏树



代码：a＝1111，b＝1110，c＝110，d＝10，e＝0
长度：WEP＝4×4＋4×6＋3×7＋2×9＋1×10＝89

（2）

设每个符号的频率为 p.

一方面，n 为 2 的幂时，霍夫曼树是一颗高度为 $\log_2 n$的满二叉树，故每个符号的霍夫曼编码长度均为 $\log_2 n$，于是有

$$\mathrm{WEP_{Huffman}}=\mathrm{p}\cdot\mathrm{n}\cdot\log_2 n$$

另一方面，右偏树的高度为 n－1，最低层有 2 个外部节点，其余各层中除最高层外每层有 1 个外部节点，于是有

$$\mathrm{WEP_{RBT}}=\mathrm{p}\cdot[\sum_{\mathrm{i}=1}^{\mathrm{n}-2}\mathrm{i}+2(\mathrm{n}-1)]=\mathrm{p}\cdot\frac{n^2+n-2}{2}$$

所以 Huffman 编码和 RBT 编码的 WEP 比率为

$$\mathrm{r}=\frac{2\mathrm{n}\log_2 n}{n^2+n-2}$$