

$h(3) = 3 = 011$ $h(8) = 1 = 001$ $h(11) = 4 = 100$ $h(14) = 0 = 000$
 $h(15) = 1 = 001$ $h(16) = 2 = 010$ $h(17) = 3 = 011$ $h(19) = 5 = 101$
 $h(20) = 6 = 110$ $h(33) = 5 = 101$ $h(43) = 1 = 001$ $h(48) = 6 = 110$

(1)

$\boxed{0} \rightarrow 11, 14, 16$

$\boxed{1} \rightarrow 3, 8, 15$

最后能添加的元素是16

(2) 扩展成二位

$\boxed{00} \rightarrow 11, 14$

$\boxed{10} \rightarrow 16, 20$

$\boxed{01} \rightarrow 8, 15, 19$

$\boxed{11} \rightarrow 3, 17$

最后添加的元素是20

(3) 最终索引结构:

$\boxed{1000} \rightarrow 11, 14$

$\boxed{1010} \rightarrow 16, 20, 48$

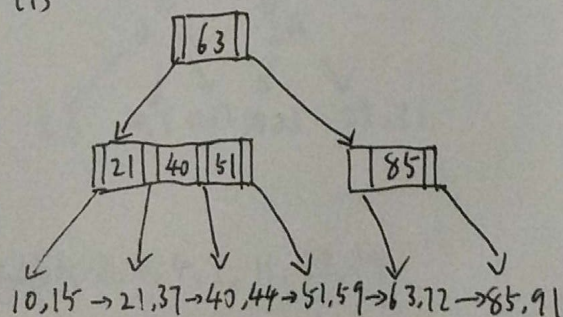
$\boxed{1001} \rightarrow 8, 15, 43$

$\boxed{1101} \rightarrow 19, 33$

$\boxed{1011} \rightarrow 3, 17$

$\boxed{1111} \rightarrow 3, 17$

二, (1)

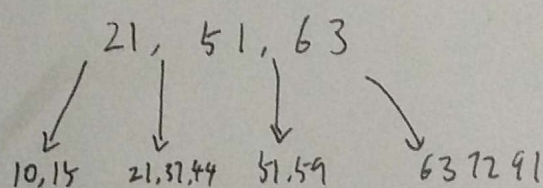


(2) 删除叶节点85, 合并两个叶节点

删除 - 两个叶节点的父节点中的85

之后的操作有点疑惑...

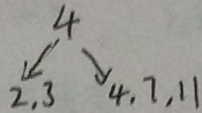
结果图示



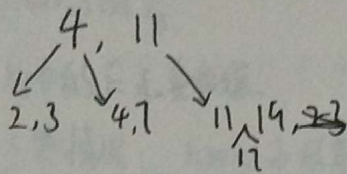
三, (1) ①插入 2, 3, 4

2, 3, 4

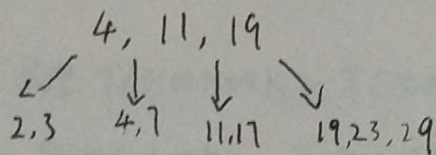
②插入 7, 11



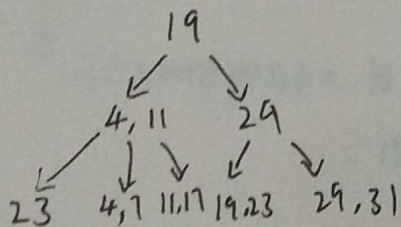
③插入 ~~19, 23~~ 17, 19



④插入 ~~29, 31~~ 23, 29



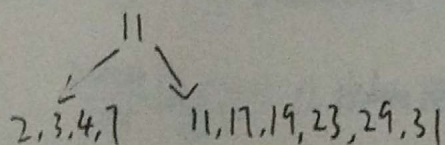
⑤插入 31



(2) ①插入 2, 3, 4, 7, 11, 17, 19

2, 3, 4, 7, 11, 17, 19

②插入 23, 29, 31



四, (1) 连接满足交换律, 结合律, r_1, r_2, r_3 无论怎样连接 得到的结果大小都一致

由于 A, C, E 分别是 r_1, r_2, r_3 的主码, 满足约束, 无重复值

计算 $T((r_1 \bowtie r_2) \bowtie r_3)$ 的大小

① $r_1 \bowtie r_2$, r_2 中的 C 无重复

上界情况: r_1 中的每个元组 t_1 在 r_2 中都有等值的元组 t_2 , 满足 $t_1.C = t_2.C$

$$\text{则 } T(r_1 \bowtie r_2) = 1000$$

② $(r_1 \bowtie r_2) \bowtie r_3$

r_3 中的 E 无重复值

上界情况: $r_1 \bowtie r_2$ 中的每个元组 t 在 r_3 中都有元组 t_3 , 满足 $t.E = t_3.E$

$$\text{则 } T((r_1 \bowtie r_2) \bowtie r_3) = T(r_1 \bowtie r_2 \bowtie r_3) = 1000$$

(2) 同理 $T(r_1 \bowtie r_2 \bowtie r_3) = T((r_1 \bowtie r_2) \bowtie r_3)$

$$\begin{aligned} \text{① } T(r_1 \bowtie r_2) &= T(r_1) \cdot T(r_2) / \max(V(C, r_1), V(C, r_2)) \\ &= 1000 \times 1500 / 1000 \approx 1363.6 \end{aligned}$$

$$\begin{aligned} \text{② } T((r_1 \bowtie r_2) \bowtie r_3) &= T(r_1 \bowtie r_2) \cdot T(r_3) / \max(V(E, r_2), V(E, r_3)) \\ &= 1363.6 \times 750 / 100 \approx 10227 \end{aligned}$$

五, (1).

a, nest-loop

$$\begin{aligned} & \frac{3000}{60} \text{ (外层)} + \frac{3000}{10 \times 60} \text{ (内层)} \times \frac{20000}{200} \text{ (L表)} \\ &= 50 + 5 \times 100 = 550 \text{ 块} \end{aligned}$$

sort-merge: B在B#上有序

$$\begin{aligned} & \frac{20000}{200} \log_{10} \frac{20000}{200} \text{ (L按B#排序)} + \frac{3000}{60} + \frac{20000}{200} \text{ (扫描一遍)} \\ &= 100 \times 6.643 + 50 + 100 = 350 \text{ 块} \end{aligned}$$



b, nest-loop

(组L) 一无

$$\text{无索引: } \frac{20000}{200} (\text{选择}) + 1 + 1 \text{ (L表中前跳过的元组又需要一眼扫描)} \times \frac{3000}{60} (\text{扫描表}) \\ = 100 + 1 + 1 \times 50 = 151$$

$$\text{有索引: } 1 (\text{索引选择}) + 1 \times \frac{3000}{60} \\ = 51$$

sort-merge:

$$\text{无索引: } \frac{20000}{200} (\text{选择}) + 1 \log 1 (\text{排序L表}) + \frac{3000}{60} (\text{扫描B表}) + 1 (\text{扫描L表}) - 1 \text{ 元} \\ = 100 + 0 + 50 + 1 = 151$$

$$\text{有索引: } 1 (\text{索引选择}) + 1 \log 1 + \frac{3000}{60} + 1 (\text{L表, 一无}) \\ = 1 + 0 + 50 + 1 = 52$$

(c) 设B表投影后, 于容纳 每个缓存表能存放 120条元组
L表投影后, 每个缓存块能存放 600条元组

nest-loop:

$$\text{无索引: } \frac{20000}{200} (\text{选择}) + 1 \times \frac{3000}{120} + 1 \\ = 100 + 25 = 125$$

$$\text{有索引: } 1 (\text{选择}) + 1 \times \frac{3000}{120} = 1 + 25 = 26$$

sort-merge:

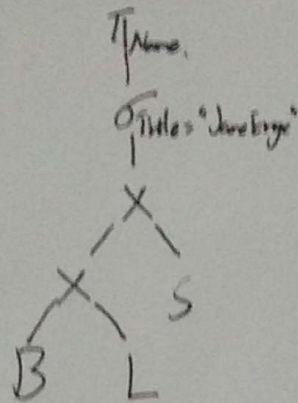
$$\text{无索引: } \frac{20000}{200} (\text{选择}) + 1 \log 1 (\text{排序}) + \frac{3000}{120} (\text{扫描B表}) + 1 (\text{扫描L表}) \\ = 100 + 0 + 25 = 125$$

$$\text{有索引: } 1 (\text{选择}) + 1 \log 1 (\text{排序}) + \frac{3000}{120} * \\ = 1 + 0 + 25 = 26$$

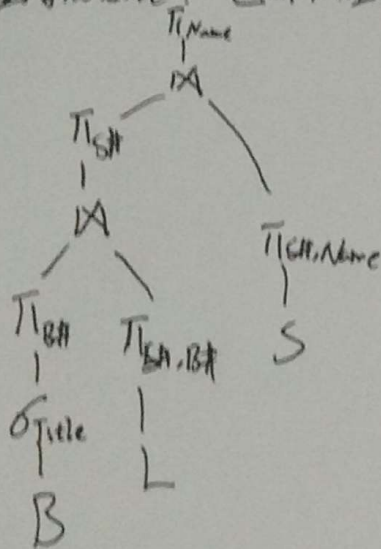


(2) 6. 原始关系代数表达式: $\pi_{Name}(\sigma_{Title="Jane Eyre"}(B \times S \times L))$

逻辑查询计划树如下:



启发式查询优化: 选择下推, 投影下推, 增加投影, 笛卡尔积替换为连接



$$b. \sigma(B \times L) = 10000 \times 2000 = 2 \times 10^7$$

$$T(B \times L \times S) = 2 \times 10^7 \times 1000 = 2 \times 10^{10}$$

$$\textcircled{2} \quad T(\pi(B)) = 50$$

$$T(\pi(B) \bowtie L) = 50$$

$$T(\text{total}) = 50$$

