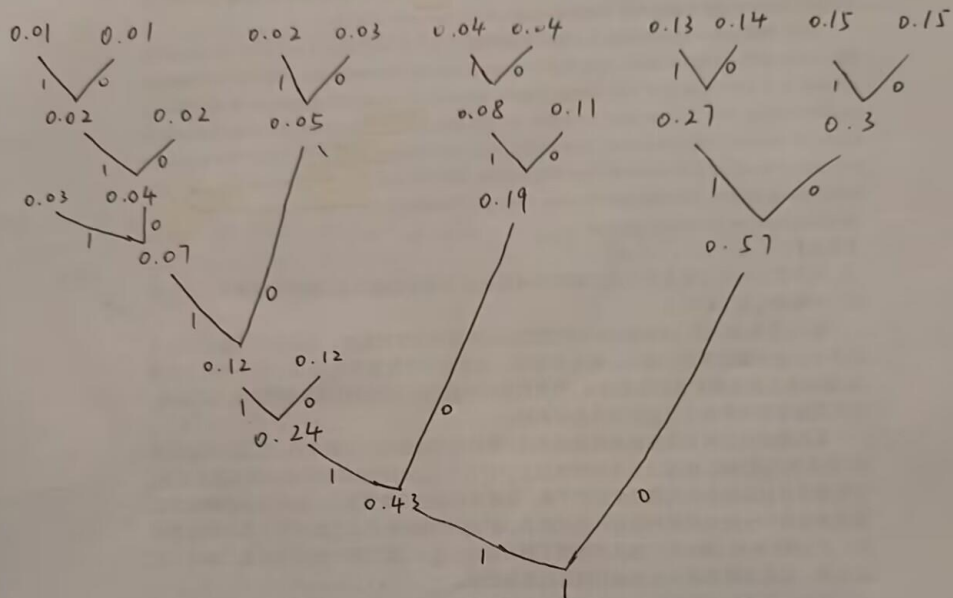


1. 把14条指令编号为1-14

则指令操作码的变长编码为:

1: 0000 2: 0001 3: 0010 4: 0011 5: 0100 6: 0101 7: 0110
8: 0111 9: 1000 10: 1001 11: 1010 12: 1011 13: 1100 14: 1101

Huffman 编码为:



∴ 1: 1111011 2: 001 3: 110 4: 11100 5: 111100 6: 1011 7: 11101
8: 1010 9: 1111010 10: 011 11: 000 12: 010 13: 100 14: 11111

扩展编码:

排序: 1: 0.01 9: 0.01 5: 0.02 7: 0.02 4: 0.03 14: 0.03 6: 0.04

8: 0.04 13: 0.11 3: 0.12 10: 0.13 12: 0.14 2: 0.15 11: 0.15

采用等长扩展(3-6)7/7 编码

1: 111000 9: 111001 5: 111010 7: 111011 4: 111100 14: 111101 6: 111110
8: 000 13: 001 3: 010 10: 011 12: 100 2: 101 11: 110

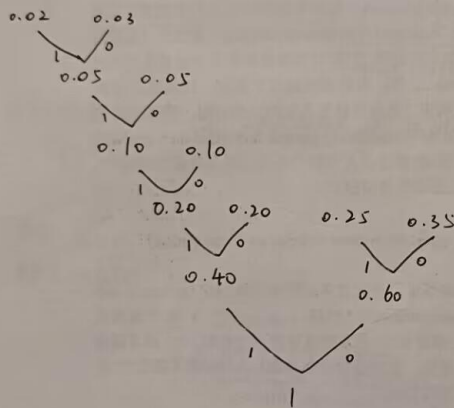
平均码长

定长编码: 4

Huffman 编码: $7 \times 0.01 + 0.15 \times 3 + 0.12 \times 3 + 0.03 \times 5 + 0.02 \times 6 + 0.04 \times 4 + 0.02 \times 5 + 0.04 \times 4 + 0.01 \times 7 + 0.13 \times 3 + 0.15 \times 3 + 0.14 \times 3 + 0.11 \times 3 + 0.03 \times 5$
 $= 3.38$

扩展编码: $(0.01 + 0.01 + 0.02 + 0.02 + 0.03 + 0.03 + 0.04) \times 6 + (0.04 + 0.11 + 0.12 + 0.13 + 0.14 + 0.15 + 0.15) \times 3$
 $= 3.48$

2. (1) 1: 0.35 2: 0.25 3: 0.20 4: 0.10 5: 0.05 6: 0.03 7: 0.02



∴ 编码为: 1: 00 2: 01 3: 10 4: 110 5: 1110 6: 11110 7: 11111

平均长度为: $2 \times 0.35 + 2 \times 0.25 + 2 \times 0.20 + 3 \times 0.10 + 4 \times 0.05 + 5 \times 0.03 + 5 \times 0.02$
 $= 2.35$

(2) RR型: 01 XXX XXX
 10 XXX XXX
 11 XXX XXX
 0P R₁ R₂

RS型: 0000 - XXX P AAAAAAAAAA
 0001 - XXX P AAAAAAAAAA
 0010 - XXX P AAAAAAAAAA
 0011 - XXX P AAAAAAAAAA
 0P R 变址

3. (1) 双地址: 操作码长度: $16 - 2 \times 6 = 4$

单地址: 操作码长度: $16 - 6 = 10$

零地址: 操作码长度: $16 - 0 = 16$

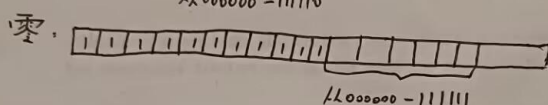
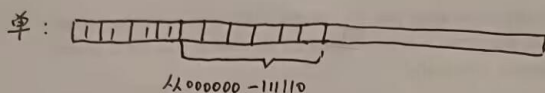
设单地址有 x 条:

$$\text{零地址的条数为 } y = (2^4 - 15) \times (2^{10} - x) \times 2^{16/10}$$

$\because x$ 与 y 大致相等

$$\therefore x = 63 \quad y = 64$$

操作码分配:



(2) 设双地址有 a 条, 单地址有 b 条, 零地址有 c 条

$$c = (2^4 - a) \times (2^6 - b) \times 2^6$$

$$a : b : c = 1 : 9 : 9$$

角4 $a = 14, b = 126, c = 126$

操作码分配: 双: 