

计算机组成原理

作业 6

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6.27. 假设阶码取 3 位，尾数取 6 位（均不包括符号位），计算下列各题。

- (1) $\left[2^5 \times \frac{11}{16}\right] + \left[2^4 \times \left(-\frac{9}{16}\right)\right]$
- (2) $\left[2^{-3} \times \frac{13}{16}\right] - \left[2^{-4} \times \left(-\frac{5}{8}\right)\right]$
- (3) $\left[2^3 \times \frac{13}{16}\right] \times \left[2^4 \times \left(-\frac{9}{16}\right)\right]$
- (4) $\left[2^6 \times \left(-\frac{11}{16}\right)\right] \div \left[2^3 \times \left(-\frac{15}{16}\right)\right]$
- (5) $[2^3 \times (-1)] \times \left[2^{-2} \times \frac{57}{64}\right]$
- (6) $[2^{-6} \times (-1)] \div \left[2^7 \times \left(-\frac{1}{2}\right)\right]$
- (7) $3.3125 + 6.125$
- (8) $14.75 - 2.4375$

解.

设 x 表示 lhs, y 表示 rhs, r 表示 result

- (1) $[x]_{\text{补}} = 0, 101; 0.101100, [y]_{\text{补}} = 0, 100; 1.011100$

$$[\Delta_j]_{\text{补}} = [j_x]_{\text{补}} - [j_y]_{\text{补}} = 0, 001$$

$$S_y \gg 1 \Rightarrow y' = 0, 101; 1.101110$$

$$[x + y']_{\text{补}} = 0, 101; 0.011010$$

$$\text{规格化: } S \ll 1 \Rightarrow 0, 100; 0.110100$$

- (2) $[x]_{\text{补}} = 1, 101; 00.110100, [y]_{\text{补}} = 1, 100; 11.011000$

$$[\Delta_j]_{\text{补}} = 0, 001$$

$$S_y \gg 1, j_y + 1 \Rightarrow y' = 1, 101; 11.101100$$

$$[x - y']_{\text{补}} = 1, 101; 01.011100$$

$$\text{规格化: } 1, 110; 00, 101110$$

$$\frac{13}{16} = \frac{1}{16} + \frac{1}{4} + \frac{1}{2} = 0.1101$$

$$\frac{5}{8} = \frac{1}{8} + \frac{1}{2} = 0.101, \quad -\frac{5}{8} = 1.011$$

$$00.010100 + 00.110100 = 01.001000$$

$$1, 110; 00.100100$$

- (3) $[x]_{\text{补}} = 00, 011; 00.110100, [y]_{\text{补}} = 00, 100; 11.011100$

$$[j_x]_{\text{移}} = 11, 011$$

$$[j_y]_{\text{补}} = 00, 100$$

$$[j_x + j_y]_{\text{移}} = 11, 111 = [7]_{\text{dec}}$$

尾数相乘:

$$00.110100 \times 11.011100 = 11.100010110000$$

左规:

$$S \ll 1, j-1 \Rightarrow 00, 110; 11.000101100000$$

舍入:

$$00, 110; 11.000101$$

$$(4) [x]_{\text{补}} = 00, 110; 11.010100, [y]_{\text{补}} = 00, 011; 11.000100$$

$$[j_x - j_y]_{\text{补}} = 00, 011$$

尾数相除:

$$11.010100 \div 11.000100 = 00.101111$$

无需规格化/舍入, 结果:

$$[z]_{\text{补}} = 00, 011; 00.101111$$

$$(5) [x]_{\text{补}} = 00, 011; 11.000000, [y]_{\text{补}} = 11, 110; 00.111001$$

$$[j_x + j_y]_{\text{补}} = 00, 001$$

尾数相乘:

$$[S_x]_{\text{补}} \times [S_y]_{\text{补}} = 11.000111$$

无需规格化/舍入, 结果:

$$00, 001; 11.000111$$

$$(6) [x]_{\text{补}} = 11, 010; 1.000000, [y]_{\text{补}} = 00, 111; 1.100000$$

$$[j_x - j_y]_{\text{补}} = 10, 011 \text{ 下溢}$$

结果: 00, 000; 00.000000

$$(7) [x]_{\text{补}} = 0, 010; 00.110101, [y]_{\text{补}} = 0, 011; 00.110001$$

$$[\Delta_j]_{\text{补}} = 1, 111 = [-1]_{\text{dec}}$$

$$S_x \gg 1, j_x + 1 \Rightarrow x' = 0, 011; 00.011010$$

$$[x' + y]_{\text{补}} = 01.001011$$

规格化 $S_z \gg 1, j_z + 1 \Rightarrow z = 0, 100; 0.100101$

$$(8) [x]_{\text{补}} = 0, 100; 0.111011, [y]_{\text{补}} = 0, 010; 0.100111$$

$$[\Delta_j]_{\text{补}} = 0, 010$$

$$S_y \gg 2; j_y + 2 \Rightarrow y' = 0, 100; 0.001010 \text{ (入)}$$

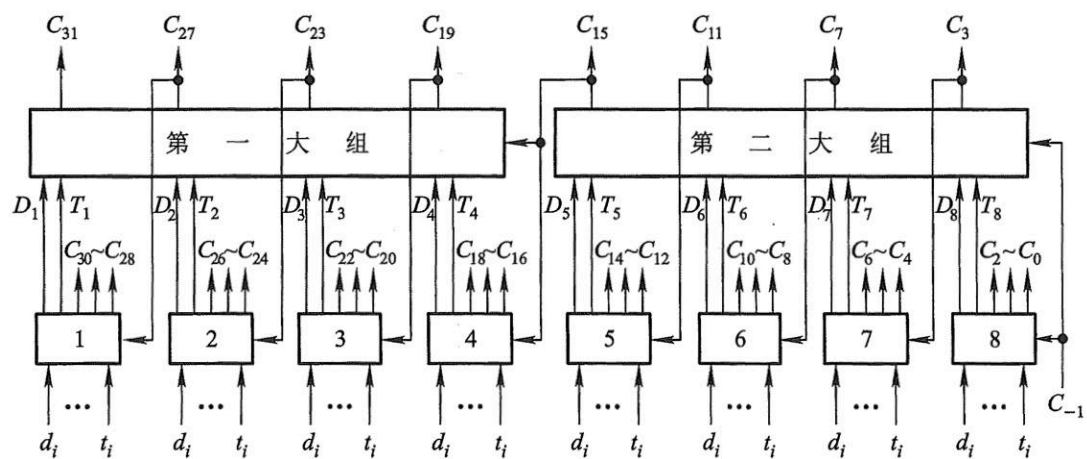
$$[x + y']_{\text{补}} = 0, 100; 01.000101$$

右规: 0, 101; 0.100011 (入)

6.31. 设机器字长为 32 位, 用与非门和与或非门设计一个并行加法器 (假设与非门延迟时间为 30ns, 与或非门延迟时间为 45ns) 要求完成 32 位加法时间不得超过 0.6μs

解. 使用两级并行进位, $T = 4 \times (30 + 45)\text{ns} = 300\text{ns} < 600\text{ns}$ 还要加上算 $d_i = A_i B_i, t_i = A_i + B_i$ 的时间 45ns

进位链图：



加法器逻辑：

