计组 第一章作业 信息安全 申宗尚

1.2. a: 通过流水线提高性能

b: 通过冗余提高可靠性

c: 通过预测提高性能

d: 加速大概率事件

e: 存储层次

f: 通过并行提高性能

g: 使用抽象简化设计

1.5 (a) 由性能公式 $CPUtime = IC \times CPI \times T = IC \times CPI / f$

~~t_{P1}~~ 设每秒执行指令数为 C

~~t_{P2}~~ $C_1 = 3G / 1.5 = 2 \times 10^9$

~~t_{P3}~~ $C_2 = 2.5G / 1.0 = 2.5 \times 10^9$ ∴第2个处理器性能最高

$C_3 = 4G / 2.2 = 1.82 \times 10^9$

(b): $T_1 = 3G \cdot 10 = 3 \times 10^{10}$ $I_1 = T_1 / 1.5 = 2 \times 10^{10}$

$T_2 = 2.5G \cdot 10 = 25 \times 10^{10}$ $I_2 = T_2 / 1.0 = 2.5 \times 10^{10}$

$T_3 = 4G \cdot 10 = 4 \times 10^{10}$ $I_3 = T_3 / 2.2 = 1.82 \times 10^{10}$

∴执行的时钟周期数分别为 3×10^{10}, 2.5×10^{10}, 4×10^{10} 个.

执行的指令数分别为 2×10^{10}, 2.5×10^{10}, 1.82×10^{10} 条

(c) 对~~第1处理器~~. 设初始执行时间为 t, 有.

$t \cdot f / CPI = I$ ①

在 I 不变的情况下. $t' = 0.7t$, 则 CPI 变为 ~~1.2~~ 1.2CPI, f 变为 f'

$0.7t \cdot f' / 1.2CPI = I$ ②

由①. ②. 可得 $f' = \frac{12}{7} f \approx 1.71 f$ ∴时钟频率应变为约 1.71 倍.

1.8 (a) 由 CPI = 周期数/指令数 得.

A: $CPI = 1.1 / 1 \times 10^{-9} / 1 \times 10^9 = 1.1$

B: $CPI = 1.5 / 1 \times 10^{-9} / 1.2 \times 10^9 = 1.25$

(b) ~~由题 $1 \times 10^9 \cdot CPI_A = 1.2 \times 10^9 \cdot CPI_B$~~ ~~由题设执行时间为 t.~~

∴ $CPI_A = 1.2 CPI_B$ ~~则有 $T_A = 1 \times 10^9 \cdot CPI_A \cdot T_A = 1.2 \times 10^9 \cdot CPI_B \cdot T_B = t$.~~

~~$\frac{t \cdot 1 \times 10^9}{T_A} \cdot T_A = 1.2 \cdot \frac{t \cdot 1 \times 10^9}{T_B} \cdot$~~

∴ ~~$\frac{t \cdot 1}{T_A / 1 \times 10^9}$~~

则对A. 周期数 $= CPI_A \times IC = 1.1 \times 10^9$

B. 周期数 $= CPI_B \times IC = 1.25 \cdot 1.2 \times 10^9 = 1.5 \times 10^9$

∴ $\frac{1.5 \times 10^9}{1.1 \times 10^9} \approx 1.3636$ ∴约快 1.3636 倍.

(c) 加速比 $_{CA} = \frac{\text{性能C}}{\text{性能A}} = \frac{\text{~~CPI~~}_A \cdot 1.1}{6 \times 10^8 \cdot 1.1 \cdot 1 \times 10^{-9}} = \frac{5}{3} \approx 1.67$ 加速比 $_{CB} = \frac{1.5}{6 \cdot 18 \cdot 1.1 \cdot 1 \times 10^{-9}} \approx 2.27$

1.10 (1) $t_1 = (2.56\times10^9\times1 + 1.28\times10^9\times12 + 2.56\times10^9\times5)/2\times10^9 = 15.36s$

$t_2 = (2.56\times10^9\times1/1.4 + 1.28\times10^9\times12/1.4 + 2.56\times10^9\times5)/2\times10^9 = 12.8s$

$t_4 = (2.56\times10^9\times1/2.8 + 1.28\times10^9\times12/2.8 + 2.56\times10^9\times5)/2\times10^9 = 9.6s$

$t_8 = (2.56\times10^9\times1/5.6 + 128\times10^9\times12/5.6 + 256\times10^9\times5)/2\times10^9 = 8s$

加速比$_{2-1} = \frac{15.36}{12.8} = 1.2$

加速比$_{4-1} = \frac{15.36}{9.6} = 1.6$

加速比$_{8-1} = \frac{15.36}{8} = 1.92$

(2) 均会增多.

$t_1' = (2.56\times10^9\times2 + 1.28\times10^9\times12 + 2.56\times10^9\times5)/2\times10^9 = 16.64s$

$t_2' = (2.56\times10^9\times2/1.4 + 1.28\times10^9\times12/1.4 + 256\times10^9\times5)/2\times10^9 = 13.71s$

$t_4' = (2.56\times10^9\times2/2.8 + 1.28\times10^9\times12/2.8 + 256\times10^9\times5)/2\times10^9 = 10.06s$

$t_8' = (2.56\times10^9\times2/5.6 + 1.28\times10^9\times12/5.6 + 2.56\times10^9\times5)/2\times10^9 = 8.23s$

(3) 由题得.

$2.56\times10^9\times1 + 1.28\times10^9\times x + 256\times10^9\times5 = 2.56\times10^9\times1/1.4 + 1.28\times10^9\times12/1.4 + 2.56\times10^9\times5$

$\therefore \quad 256\times\frac{2}{7} + 1.28(x - \frac{60}{7}) = 0 \quad \therefore x = 8 \quad \therefore$ CPI应降为8

1.13.

(1) 不正确: 性能$P_1 = \frac{1}{CPU\,time} = \frac{4\times10^9}{0.9\cdot5\cdot10^9} = 0.89$

性能$P_2 = \frac{1}{CPU\,time} = \frac{3\times10^9}{0.75\cdot1\cdot10^9} = 4$

P_1数字 > P_2数字. 但性能显然P_2更快

(2) $CPU\,time = 0.9\cdot1\times10^9/4\times10^9 = 0.225s$ 由 $CPU\,time = IC\cdot CPI/f$.

$IC = \frac{CPU\,time\cdot f}{CPI} = \frac{0.225\cdot3\cdot10^9}{0.75} = 0.9\times10^9$ 可执行0.9×10^9条指令.

(3). $MIPS_{P_1} = IC/CPU\,time\times10^6 = f/CPI\times10^6 = 4\times10^9/0.9\times10^6 = 4.44\times10^3$

$MIPS_{P_2} = 3\times10^9/0.75\times10^6 = 4\times10^3$

$MIPS_{P_1} > MIPS_{P_2}$, 但P_2性能更快. 故该说法不正确.

(4). $CPU\,time\,P_1 = 1.125s$

$CPU\,time\,P_2 = 0.25s$

$\therefore MFLOPS_{P_1} = \frac{5\cdot10^9\cdot\frac{2}{5}}{1.125\times10^9} \approx 1777.78$

$MFLOPS_{P_2} = \frac{1\cdot10^9\cdot\frac{2}{5}}{0.25\cdot10^9} = 1600$

$\therefore MFLOPS_{P_1} > MFLOPS_{P_2}$. 但$P_2$更快