

HW1

$$1.4 a. 1280 \times 1024 \times 3 = 3932160 \text{ bytes}$$

$$b. 3932160 \times 8 \leftarrow 100 M = 0.3146 s$$

$$1.5 a. P1: 3 \text{ GHz} / 1.5 = 2 \text{ GHz}$$

$$P2: 2.5 \text{ GHz} / 1 = 2.5 \text{ GHz}$$

$$P3: 4 \text{ GHz} / 2.2 = 1.8 \text{ GHz}$$

$\therefore P2$ 性能最高

$$b. P1: 3 \text{ GHz} \times 10 = 3 \times 10^{10} \text{ cycles}$$

$$3 \times 10^{10} / 1.5 = 2 \times 10^{10} \text{ instructions}$$

$$P2: 2.5 \text{ GHz} \times 10 = 2.5 \times 10^{10} \text{ cycles}$$

$$2.5 \times 10^{10} / 1 = 2.5 \times 10^{10} \text{ instructions}$$

$$P3: 4 \text{ GHz} \times 10 = 4 \times 10^{10} \text{ cycles}$$

$$4 \times 10^{10} / 2.2 = 1.8 \times 10^{10} \text{ instructions}$$

$$c. CPI_1' = 1.8 \text{ CPI}_1 = 1.8$$

$$CPI_2' = 1.2 \text{ CPI}_2 = 1.2$$

$$CPI_3' = 1.2 \text{ CPI}_3 = 2.64$$

$$\cancel{f_1 = 2 \times 10^{10} \times 1.8} \quad T = 10 \times 0.7 = 7s$$

$$f_1 = 2 \times 10^{10} \times 1.8 / 7 = 5.14 \text{ GHz}$$

$$f_2 = 2.5 \times 10^{10} \times 1.2 / 7 = 4.28 \text{ GHz}$$

$$f_3 = 1.8 \times 10^{10} \times 2.64 / 7 = 6.75 \text{ GHz}$$

$$1.6 \quad a. \quad CPI_1 = 1 \times 10\% + 2 \times 20\% + 3 \times 50\% + 3 \times 20\% \\ = 2.6$$

$$CPI_2 = 2$$

$$b. \quad P1: 2.6 \times 10^6 \text{ instructions}$$

$$P2: 2 \times 10^6 \text{ instructions}$$

$$1.8.1 \quad P_d = V^2 C f \\ C = \frac{P_d}{V^2 f}$$

$$\text{Pentium: } C = 1.6 \times 10^{-8} \text{ F}$$

$$\text{Core i5: } C = 1.45 \times 10^{-8} \text{ F}$$

$$1.8.2 \quad \text{Pentium: } 10/(10+90) = 10\%$$

$$\text{i5: } 30/(30+40) = 42.9\%$$

$$1.8.3 \quad V' = V_s + V_d = (V_s + V_d) 0.9 = 0.9 V$$

$$1.8.3 \quad P_s = VI \quad P_s' = V' I$$

$$P_d = V^2 C f, \quad P_d' = V'^2 C f$$

$$0.9(P_d + P_s) = P_d' + P_s'$$

$$0.9(V'^2 C f + V' I) = V^2 C f + V I$$

$$\text{Pentium: } 0.9(V'^2 \times 1.6 \times 10^{-8} \times 3.6 \times 10^9 + V' \times \frac{10}{1.25}) =$$

$$\text{Pentium: } V'^2 \times \frac{P_d}{V^2} + V' \times \frac{P_s}{V}$$

1.8.3 $P_s = VI$ $P_d = V^2 Cf$

$0.9(P_d + P_s) = P_d' + P_s'$

$V'^2 Cf + V'I = 0.9(V^2 Cf + VI)$

$V'^2 \cdot \frac{P_d}{V^2} + V' \cdot \frac{P_s}{V} = 0.9(P_d + P_s)$

Pentium: $V'^2 \cdot \frac{90}{1.25^2} + V' \cdot \frac{10}{1.25} = 0.9 \times 100$

$V' = 1.18 V$ $\Delta V = 0.07 V$

i5: $V'^2 \cdot \frac{40}{0.9^2} + V' \cdot \frac{30}{0.9} = 0.9 \times 70$

$V' = 0.815 V$ $\Delta V = 0.085 V$

1.10.1 $\eta_1 = 1 - \frac{\pi \times (\frac{15}{2})^2 \times 0.02}{84} = 95.79\%$

$\eta_2 = 1 - \frac{\pi \times 10^2 \times 0.031}{100} = 92.52\%$

1.10.2 $price_1 = \frac{12}{(84 \times 95.79\%)} = 0.149$

$price_2 = \frac{15}{(100 \times 92.52\%)} = 0.162$

1.10.3 $S_1 = \frac{\pi \times 7.5^2}{(84 \times 1.1)} = 6.91 \text{ cm}^2$

$\eta_1 = 1 - \frac{0.02 \times 1.15 S_1}{84} = 95.61\%$

$S_2 = \frac{\pi \times 10^2}{(100 \times 1.1)} = 2.86 \text{ cm}^2$

$\eta_2 = 1 - \frac{0.031 \times 1.15 S_2}{100} = 99.80\%$

1.10.4 ~~$d_1 = \frac{1 - 0.92}{2} = 0.04$~~ ~~$(1 - 0.92) \times 200 / 100$~~

$200 \text{ mm}^2 = 2 \text{ cm}^2$

$d_1 = (1 - 0.92) \times \frac{1}{2} = 0.04 \text{ } \mu\text{m}^2$

$d_2 = (1 - 0.95) \times \frac{1}{2} = 0.025 \text{ } \mu\text{m}^2$

No.

Date

Instruction rate:

1.12.1

$$f_{i1} = 46 \text{ Hz} / 0.9 = 4.49 \text{ GHz}$$

$$f_{i2} = 36 \text{ Hz} / 0.75 = 46 \text{ Hz}$$

$$T_1 = \frac{5 \times 10^9}{f_{i1}} = 1.125 \text{ s}$$

$$T_2 = \frac{1 \times 10^9}{f_{i2}} = 0.25 \text{ s}$$

$$T_2 < T_1, \quad P_1 < P_2 \quad \therefore T_1 \text{ is the bottleneck}$$

1.12.2

$$T_1 = 1.125 / 5 = 0.225 \text{ s}$$

$$N_2 = T_1 f_{i2} = 9 \times 10^8 \text{ instructions}$$

1.12.3

$$\text{MIPS}_1 = \frac{f_{i1}}{10^6} = 4440$$

$$\text{MIPS}_2 = \frac{f_{i2}}{10^6} = 4000$$

$$\text{MIPS}_1 > \text{MIPS}_2, \quad P_1 < P_2, \quad T_1 \text{ is the bottleneck}$$

1.12.4

$$\text{MFLOPS}_1 = 0.4 \text{ MIPS} = 1776$$

$$\text{MFLOPS}_2 = 1600$$

$$\text{MFLOPS}_1 > \text{MFLOPS}_2, \quad P_1 < P_2$$

		执行时间	加速比	实际/理想
1.15	2核	54	1.85	0.926
	4	29	3.44	0.862
	8	16.5	6.06	0.758
	16	10.25	9.76	0.610
	32	7.125	14.03	0.439
	64	5.5625	17.98	0.281
	128			