استاد رضایی 98411387 . گروه چهارم

①

$1280 \times 720 = 921'600$ pixels $\longrightarrow$ $921'600 \times 3 = 2'764'800$ (bytes/frame)

(R, B, G)

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$8 = 2^3$

$$\frac{2'764'800 \times 8}{10^8} \simeq 0.22 \text{ (s)}$$

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②

	A	B	C	D
IC	0.4×10^6	0.1×10^6	0.3×10^6	0.2×10^6
CPI_1	1	2	3	3
CPI_2	2	2	2	2

$$\text{clock cycles} = \sum_{i=1}^{n} (CPI_i \times \text{Instruction Count})$$ (آ و ب)

P_1:

$\text{clock cycles}_1 = 0.4 \times 10^6 + 0.2 \times 10^6 + 0.9 \times 10^6 + 0.6 \times 10^6 = \boxed{2.1 \times 10^6}$

$\text{Average } CPI_1 = \dfrac{2.1 \times 10^6}{10^6} = \boxed{2.1}$

P_2:

$\text{clock cycles}_2 = 0.8 \times 10^6 + 0.2 \times 10^6 + 0.6 \times 10^6 + 0.4 \times 10^6 = \boxed{2 \times 10^6}$

$\text{Average } CPI_2 = \dfrac{2 \times 10^6}{10^6} = \boxed{2}$

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③ Execution time = 100 (s) زمان اجرای T

$\frac{t}{P}$ (s) , 8 (s) زمان اجرای P

n processors	$P_{Ex.time}$	time	Normal speed up	Ideal speed up
2	50	58	$\frac{100}{58} = 1.72$	$\frac{1.72}{2} = 0.86$
4	25	33	$\frac{100}{33} = 3.03$	$\frac{3.03}{4} = 0.76$
8	12.5	20.5	$\frac{100}{20.5} = 4.88$	$\frac{4.88}{8} = 0.61$
16	6.25	14.25	$\frac{100}{14.25} = 7.02$	$\frac{7.02}{16} = 0.44$
32	3.125	11.125	$\frac{100}{11.125} = 8.99$	$\frac{8.99}{32} = 0.28$

④

الف)

$$CPI_1 = 1 \times 0.6 + 2 \times 0.3 + 4 \times 0.1 = 1.6$$

$$CPI_2 = 2 \times 0.6 + 3 \times 0.3 + 4 \times 0.1 = 2.5$$

ب)

$$MIPS_1 = \frac{80 \times 10^6 \times 10^{-6}}{1.6} = 50$$

$$MIPS_2 = \frac{100 \times 10^6 \times 10^{-6}}{2.5} = 40$$

ج)

$$\frac{\text{Instruction count}_1}{S} > \frac{\text{Instruction count}_2}{S} \rightarrow \text{performance}_1 > \text{performance}_2$$

⑤

Instruction Count = 2.389×10^{12} , Execution Time = 750 (s)

reference time = 9650 (s)

clock cycle = 1 (ns) clock Rate = $\frac{1}{\text{clock cycle}}$ = 1 GHz (الف)

$$CPI = \frac{\text{CPU Time} \times \text{Clock Rate}}{\text{Instruction Count}} = \frac{750 \times 1 \times 10^{+9}}{2.389 \times 10^{12}} = 0.31$$

$$\text{SPEC Ratio} = \frac{\text{reference time}}{\text{Execution time}} = \frac{9650}{750} = 12.86$$ (ب)

$$\text{CPU Time} = \frac{\text{Instruction count} \times CPI}{\text{clock Rate}}$$ (ج)

$$\frac{\text{CPU Time}'}{\text{CPU Time}} = \frac{\text{Instruction count}'}{\text{Instruction count}} = \frac{1.05}{1}$$ ← 5% افزایش یابد CPU Time

clock Rate = 4 GHz , Execution Time = 700 ns (د

Instruction count = $0.85 \times 2.389 \times 10^{12} = 2.03 \times 10^{12}$

SPEC ratio = 13.7 $CPI = \frac{\text{CPU Time} \times \text{clock Rate}}{\text{Instruction Count}}$

$$CPI = \frac{700 \times 10^{-9} \times 4 \times 10^{9}}{2.03 \times 10^{12}} = 13.8 \times 10^{-10}$$

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⑥

Program $\xrightarrow{\text{compiled}}$ assembly language $\xrightarrow{\text{assembled}}$ machine language program

⑦

$$\text{Power} = \frac{1}{2} \text{ capacitive load} \times \text{voltage}^2 \times \text{frequency}$$

$$\frac{\text{Power}_2}{\text{Power}_1} = \frac{0.8\ P_1}{P_1} = \left(\frac{V_2}{V_1}\right)^2 \rightarrow V_2 = 2\sqrt{0.2}\ V_1$$

⑧

P_1 : clock Rate $= 2.5$ GHz , CPI $= 1.2$

P_2 clock Rate $= 2$ GHz , CPI $= 0.9$

P_3 clock Rate $= 3.5$ GHz , CPI $= 1.9$

الف) P_2

$$\text{Performance} = \frac{\text{clock Rate}}{\text{CPI}}$$

$$\text{Performance}_{P_1} = \frac{2.5 \times 10^9}{1.2} = 2.08 \times 10^9$$

$$\text{Performance}_{P_2} = \frac{2 \times 10^9}{0.9} = 2.22 \times 10^9$$

$$\text{Performance}_{P_3} = \frac{3.5 \times 10^9}{1.9} = 1.84 \times 10^9$$

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(ب

CPU clock cycles = CPU Time × Clock Rate

$$\text{CPU clock cycles}_{P_1} = 10 \times 2.5 \times 10^9 = 25 \times 10^9 \quad (s)$$

$$\text{CPU clock cycles}_{P_2} = 10 \times 2.0 \times 10^9 = 20 \times 10^9 \quad (s)$$

$$\text{CPU clock cycles}_{P_3} = 10 \times 3.5 \times 10^9 = 35 \times 10^9 \quad (s)$$

$$\text{Instruction Count} = \frac{\text{clock cycles}}{\text{CPI}}$$

$$\text{Instruction count}_{P_1} = \frac{25 \times 10^9}{1.2} = 20.83 \times 10^9$$

$$\text{Instruction Count}_{P_2} = \frac{20 \times 10^9}{0.9} = 22.22 \times 10^9$$

$$\text{Instruction Count}_{P_3} = \frac{35 \times 10^9}{1.9} = 18.42 \times 10^9$$

(ج

$$\text{Clock Rate} = \frac{\text{Instruction count} \times \text{CPI}}{\text{CPU time}} \qquad 0.70 \times 10 = 7s$$

$$\text{clock Rate}_{P_1} = \frac{20.83 \times 10^9 \times 1.2 \times 1.2}{7} = 4.29 \times 10^9 = 4.29\ GHz$$

$$\text{Clock Rate}_{P_2} = \frac{22.22 \times 10^9 \times 0.9 \times 1.2}{7} = 3.43 \times 10^9 = 3.43\ GHz$$

$$\text{clock Rate}_{P_3} = \frac{18.42 \times 10^9 \times 1.9 \times 1.2}{7} = 6 \times 10^9 = 6\ GHz$$

⑨ $$\text{CPU Time} = \frac{\text{Instruction Count} \times \text{CPI}}{\text{clock Rate}}$$

, CPI (با فرض ثابت بودن) . ٪20 کاهش یابد Instruction Count و clock Rate