East West University

Department of Computer Science and Engineering

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Assignment

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Section: 03

Assignment No: 1

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Chaptere 1

"Computere Abstractions and Technology"

Exercise Solution

→ 1.1:

Ans: Four other types of computers:

1. Personal Computers:

- General purpose, variety of software
- Subject to cost/performance tradeoff

2. Server Computers:

- Network based
- High capacity, performance, reliability

3. SuperComputer:

- High-end scientific and engineering calculation.

4. Embedded Computers:

- Hidden as components of systems.

→ A₀ 2

Ans8

a) Assembly lines in automobile manufacturing
↳ Performance via Pipelining

b) Suspension bridge cables
↳ Dependability via Redundancy

c) Aircraft and marine navigation system that incorporate wind information
↳ Performance via prediction

d) Express elevators in buildings
↳ Make the common case fast.

e) Library reserve desk
↳ Hierarchy of memories

f) Increasing the gate area on CMOS transistor to decrease its switching time
↳ Performance via parallelism

g) Adding electromagnetic aircraft catapults, allowed by the increased power generation offered by the new reactor technology

↳ Design for Moore's Law

b) Building self driving cars whose control systems partially rely on existing sensor systems already installed into the base vehicle, such as lane departure systems and smart cruise control systems

↳ Use Abstraction to simplify Design

-> 1.3:

Ans:

Step 1: High level language such as C is compiled into assembly language

Step 2: Assembly language converts into machine language.

→ 1.4:

Ans:

a) The minimum size of fram = frame (pixels) x bytes

$= 1280 \times 1024 \times 3$

$= 3932160$

b) $\text{Time} = \dfrac{\text{Size}}{\text{Speed}}$

here,

Size $= 3932160 \times 8 = 31457280$ bit

speed $= 10^8$ bit/s

$\therefore \text{Time} = \dfrac{31457280}{10^8} = 0.3145\,s.$

→ 1.5:

Ans:

a) We know,

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

$\therefore P_1$ performance $= \dfrac{3 \times 10^9}{1.5} = 2 \times 10^9$

$\therefore P_2$ Performance $= \dfrac{2.5 \times 10^9}{1} = 2.5 \times 10^9$

$\therefore P_3$ performance $= \dfrac{4 \times 10^9}{2.2} = 1.8 \times 10^9$

thus P_2 processor has the highest performance.

b) We know,

Cpu Cycle = execution time x clock rate

$\therefore P_1$ cycle $= 10 \times 3 \times 10^9 = 3 \times 10^{10}$

$\therefore P_2$ Cycle $= 10 \times 2.5 \times 10^9 = 2.5 \times 10^{10}$

$\therefore P_3$ Cycle $= 10 \times 4 \times 10^9 = 4 \times 10^{10}$

Again,

number of instruction $= \frac{\text{Cpu Cycle}}{\text{CPI}}$

$\therefore$ No. of instructions for $P_1 = \frac{3 \times 10^{10}}{1.5} = 2 \times 10^{10}$

$\therefore$ No of instructions for $P_2 = \frac{2.5 \times 10^{10}}{1} = 2.5 \times 10^{10}$

$\therefore$ No of instructions for $P_3 = \frac{4 \times 10^{10}}{2.2} = 1.8 \times 10^{10}$

c) time = 10, then reducing time by 30% $= \frac{10 \times 30}{100} = 3s$

$\therefore$ After reducing time $= 10 - 3 = 7s$

Now,

increasing CPI by 20% ,

We ~~know,~~

~~New clock rate = —— / CPI~~

New CPI for $P_1 = \frac{1.5 \times 120}{100} = 1.8$

New CPI for $P_2 = \frac{1 \times 120}{100} = 1.2$

New CPI for $P_3 = \frac{2.2 \times 120}{100} = 2.6$

Now,

New clock rate $= \frac{\text{cycle} \times \text{New CPI}}{\text{time}}$

$\therefore P_1$ Clock rate $= \frac{2 \times 10^{10} \times 1.8}{7} = 5.14$ GHz

$\therefore P_2$ clock rate $= \frac{2.5 \times 10^{10} \times 1.2}{7} = 4.28$ GHz

$\therefore P_3$ clock rate $= \frac{1.8 \times 10^{10} \times 2.6}{7} = 6.75$ GHz

-1.1.6:

Ans: here,

P_1 total CPU time $= (10^5 + 2\times10^5\times2 + 5\times10^5\times3 + 2\times10^5\times3) / (2.5\times10^9)$

$= 10.4\times10^{-4}$ s

P_2 CPU time $= (10^5 * 2 + 2\times10^5\times2 + 5\times10^5\times2 + 2\times10^5\times2) / (3\times10^9)$

$= 6.66\times10^{-4}$ s

We know,

Global CPI = (CPU time $\times$ clock rate) / IC

P_1 CPI $= 10.4\times10^{-4}\times2.5\times10^9/10^6 = 2.6$

P_2 CPI $= 6.66\times10^{-4}\times3\times10^9/10^6 = 2.0$

b) We know,

CPU clock cycle $= (\Sigma(IC\times CPI))$

$\therefore P_1$ clock cycle $= (10^5\times1) + (2\times10^5\times2) + (5\times10^5\times3) + (2\times10^5\times3) = 26\times10^5$

$\therefore$

$\therefore P_2$ Clock Cycle $= (10^5 \times 2) + (2\times10^5 \times 2) + (5\times10^5 \times 2)$
$+ (2\times10^5 \times 2)$

$= 20 \times 10^5$

1.7:

Ans: a) We know,

$$CPI = \frac{\text{CPU time}}{\text{instructions} \times \text{cycle time}}$$

$$\therefore A\ CPI = \frac{1.1}{1\times10^9 \times 10^{-9}} = 1.1$$

$$\therefore B\ CPI = \frac{1.5}{1.2\times10^9 \times 10^{-9}} = 1.25$$

b) We know,

$$\text{Clock Rate Ratio} = \frac{\text{Execution}_A}{\text{Execution}_B}$$

$$= \frac{1.1}{1.5}$$

$$= 0.7333.$$

$$\therefore \text{Clock Rate Difference} = \frac{1}{\text{Clock Rate Ratio}}$$

$$= \frac{1}{0.733} = 1.36$$

c) Compare with A,

$$\frac{\text{Number of instruction}_A}{\text{Number of instruction}_{(New)}} = \frac{1\times10^{-9}}{6\times10^{-8}} = 1.67$$

Compare with B,

$$\frac{\text{No of instructions}_B}{\text{No of instruction}_{(New)}} = \frac{1.2\times10^{-9}}{6\times10^{-8}} = 2.27$$

→ 1.10.1:

Ans: We know,

$$\text{die area}_{15} = \frac{\text{Wafer area}}{\text{dies per wafer}} = \frac{\pi\times(7.5)^2}{84} = 2.1\text{cm}^2$$

$$\text{yield}_{15} = \frac{1}{\left(1+\left(\text{Defect per area}\times\frac{\text{Die area}}{2}\right)\right)^2}$$

$$= \frac{1}{\left(1+\left(0.02\times\frac{2.1}{2}\right)\right)^2} = 0.9593$$

Again,

$$\text{die area}_{20} = \frac{\pi\times(10)^2}{100} = 3.14\text{ cm}^2$$

$$\text{yield}_{20} = \frac{1}{\left(1+\left(0.03\times\frac{3.14}{2}\right)\right)^2} = 0.9093.$$

→1.10.2 :

Ans: We know,

$$\text{Cost per die} = \frac{\text{Cost per wafer}}{(\text{dies per wafer} \times \text{yield})}$$

$$\therefore \text{Cost per die}_{15} = \frac{12}{84 \times 0.9593} = 0.1489$$

$$\therefore \text{Cost per die}_{20} = \frac{15}{100 \times 0.9093} = 0.1650$$

→1.10.3 :

Ans: Dies per wafer is ~~increased~~ by 10%

Defect per area is increased by 15%

$$\therefore \text{die area}_{15} = \frac{\pi \times (7.5)^2}{92.4} = 1.91 \text{cm}^2$$

$$\therefore \text{yield}_{15} = \frac{1}{(1+(0.023 \times \frac{1.91}{2}))^2} = 0.9574$$

Again,

$$\text{die area}_{20} = \frac{\pi \times (10)^2}{110} = 2.856 \text{ cm}^2$$

$$\text{yield}_{20} = \frac{1}{(1+(0.031 \times \frac{2.85}{2}))^2} = 0.9095$$

→ 1.11.1:

Ans:

$$CPI = \frac{1}{0.333} \times 750 \times (2389 \times 10^{9}) = 0.94$$

→ 1.11.2:

Ans:

$$\text{Spec ratio} = \frac{\text{ref time}}{\text{Exec time}} = \frac{9650}{750} = 12.86$$

→ 1.11.5:

Ans: $$\text{Spec ratio} = \frac{1}{1.156} = 6.86,$$

→ 1.11.6:

Ans: $$CPI = \frac{\text{CPU time} \times \text{clock rate}}{\text{No of Instruction}} = \frac{700 \times 4 \times 10^{9}}{86 \times 2.389 \times 10^{12}}$$

$$= 1.37$$

→ 1.11.9:

Ans: $$\text{No of Instruction} = \frac{\text{CPU time} \times \text{clock rate}}{CPI}$$

$$= \frac{960 \times 0.9 \times 4 \times 10^{9}}{1.61}$$

$$= 2.14 \times 10^{12}$$

→ 1.11.10:

Ans: ~~clock rate = $\frac{1\times 1}{0}$~~

→ 1.12.1:

Ans:

$$P_1 = \frac{5\times10^9 \times 0.9}{4\times10^9} = 1.125$$

$$P_2 = \frac{1\times10^9 \times 0.9}{3\times10^9} = 0.30$$

∴ Clock rate of P_1 > clock rate of P_2

→ 1.12.3:

Ans: We know,

$$MIPS = \frac{\text{clock rate} \times 10^{-6}}{CPI}$$

$$\therefore P_1 \ MIPS = \frac{4\times10^9 \times 10^{-6}}{0.9} = 4.4\times10^3$$

$$\therefore P_2 \ MIPS = \frac{3\times10^9 \times 10^{-6}}{0.75} = 4\times10^3$$

P_1 MIPS > P_2 MIPS