15

BRAC UNIVERSITY
Department of Computer Science and Engineering
Semester: Fall 2023
Section-9

Quiz-1
Duration: 40 minutes

Full Marks: 15

CSE 340: Computer Architecture

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1. Consider three different processors A,B and C executing the same instruction set with the clock rates and CPIs given in the following table.

Processor	CPI	Clock Rate
A	1.5	2GHz
B	1.0	1.5GHz
C	2.5	3GHz

a) Which processor has the highest performance? **[2]**
b) If the processors each execute a program in 10 seconds, find the number of instructions and the number of cycles. **[6]**
c) Now we want to reduce the time by 30% but this results in an increase of 20% in the CPI. What clock rate should we have to achieve this time reduction? **[3]**

21

[C02] 2. Explain the Harvard Model of Computer with a diagram. **[4]**

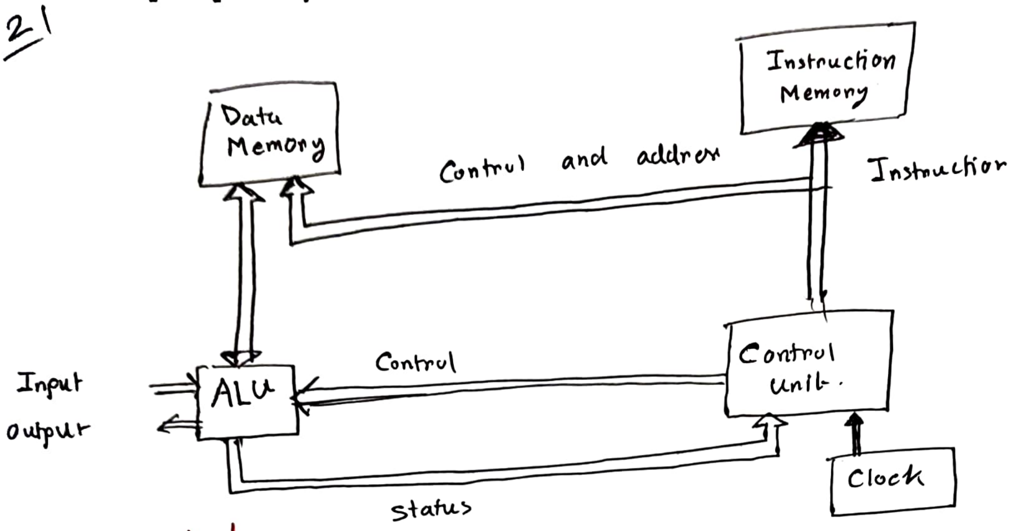

Figure: Harvard Architecture.

From the Harvard Model of computer architecture we can see that We have 2 seperate memories. One for data memory and one for instruction memory. The 2 seperatea Memory fastens of computer operations.. As the data memory and instruction memory are seperated; therefore, we can simultaneously fetch data and do different instructions. Which means we can do read and write operation at the same time ; which was not possible in vhon Neumann architecture.

Answer to the question no 1

(a)

As, all the processors have same instruction set. so, all the processor have same number of instruction set.

Given that,

processor A's $CPI = 1.5$, clock rate = 2 GHz

Processor B's $CPI = 1.0$, clock rate = 1.5 GHz

Processor C's $CPI = 2.5$, clock rate = 3 GHz.

We know,

$$\text{execution time} = \frac{\text{number of instruction set} \times CPI}{\text{clock rate}}$$

$$\therefore \text{execution time}_A = \frac{1 \times 1.5}{2 \times 10^9} = 7.5 \times 10^{-10}\ s \approx 0.75\ ns.$$

2

$$\therefore \text{execution time}_B = \frac{1 \times 1}{1.5 \times 10^9} = 6.67 \times 10^{-10}\ s = 0.667\ ns.$$

$$\therefore \text{execution time}_C = \frac{1 \times 2.5}{3 \times 10^9} = 8.33 \times 10^{-10}\ s = 0.833\ ns.$$

$\therefore$ Processor B has the highest performance

(b)

Given that,

execution time = 10 s.

We know,

$$\text{execution time} = \frac{\text{number of instruction} \times CPI}{\text{clock rate}}$$

and Clock cycles = number of instruction $\times$ CPI.

6

For processor A,

$$10 = \frac{\text{number of instruction} \times 1.5}{2 \times 10^9}$$

$$\therefore \text{number of instruction}_A = 1.33 \times 10^{10}$$

$$\therefore \text{Clock cycles}_A = 1.33 \times 10^{10} \times 1.5$$

$$= 2 \times 10^{10}$$

For processor B,

$$10 = \frac{\text{number of instruction} \times 1}{1.5 \times 10^9}$$

$\therefore$ number of instruction_B

$$= 1.5 \times 10^{10}$$

$\therefore$ clock Cycles_B

$$= 1.5 \times 10^{10} \times 1$$

$$= 1.5 \times 10^{10}$$

For processor C,

$$10 = \frac{\text{number of instruction} \times 2.5}{3 \times 10^9}$$

$\therefore$ number of instruction$_C$ $= 1.2 \times 10^{10}$

$\therefore$ Clock Cycles$_C$ $= 1.2 \times 10^{10} \times 2.5$

$= 3 \times 10^{10}$

(c),

number of instruction$_A$ $= 1.33 \times 10^{10}$

number of instruction$_B$ $= 1.5 \times 10^{10}$

number of instruction$_C$ $= 1.2 \times 10^{10}$

$\therefore$ updated execution time $= 10 - (10 \times 30\%)$

$= 7s$

$\therefore$ updated $CPI_A = 1.5 + (1.5 \times 20\%)$

$= 1.8$.

$\therefore$ updated $CPI_B = 1 + (1 \times 20\%)$

$= 1.2$

$\therefore$ updated $CPI_C = 2.5 + (2.5 \times 20\%)$

$= 3$.

We know,

$$\text{execution time} = \frac{\text{number of instruction count} \times CPI}{\text{clock rate}}.$$

$$\Rightarrow \text{clock rate} = \frac{\text{numbers of instruction count} \times CPI}{\text{execution time}}.$$

$$\therefore \text{required clockrate}_A = \frac{1.33 \times 10^{10} \times 1.8}{7}$$

$= 3.42$ GHz.

$$\therefore \text{required clockrate}_B = \frac{1.5 \times 10^{10} \times 1.2}{7}$$

$= 2.5714$ GHz.

$$\therefore \text{required clockrate}_C = \frac{1.2 \times 10^{10} \times 3}{7}.$$

$= 5.142857$ GHz