BRAC UNIVERSITY
Department of Computer Science and Engineering

Examination: Quiz - 1
Duration: 30 minutes

Semester: Fall 2024
Full Marks: 15

CSE 340: Computer Architecture

Name: Solution	ID:	Section: 07

1. Given that Computer has a MIPS of 5, and it requires 5 seconds to execute a specific program, CPI is 2. **Determine** the number of total clock cycles for that program. [2]

Answer: MIPS = 5; 5M instructions run in 1s.

1s - 5M ins

5s - (5×5)M ins

= 25M ins.

Clock cycle = Instruction Count × CPI

= 25M × 2

= 50M = 50,000000 (Ans)

2. Suppose you have a brand new processor called "ProcessorX " which generates 4.5E12 instructions while executing a program. The instructions are divided into classes as follows: 10% class A, 20% class B, 50% class C, and 20% class D. It comes with a clock rate of 2.5 GHz and CPIs of 1, 2, 3, and 3 respectively for each class of instructions. **Find** the increase in CPU time if the number of instructions is increased by 10% and the average CPI is increased by 5%. [5]

Answer:

	A	B	C	D
IC	4.5×10^{11}	9×10^{11}	2.25×10^{12}	9×10^{11}
CPI	1	2	3	3

Avg. CPI = $(4.5\times10^{11}\times1 + 9\times10^{11}\times2 + 2.25\times10^{12}\times3 + 9\times10^{11}\times2) / 4.5\times10^{12} = 2.6$

CPU time = $\frac{4.5\times10^{12}\times2.6}{2.5\times10^{9}}$ = ~~4.68×10^{-7}~~ 4680 s

$IC_{new} = 4.95\times10^{12}$

$CPI_{new} = 2.73$

$CPU\ Time_{new} = \frac{4.95\times10^{12}\times2.73}{2.5\times10^{9}}$

= 5405.4 s

Increase = (5405.4 − 4680) s

= 725.4 s.

3. Consider a computer running a program that requires 200 s, with 70 s spent executing R-type instructions, 85 s executed I/S type instructions, and 45 s spent executing branch instructions. Can the total time be reduced by 20% by reducing only the time for branch instructions? If yes, Determine the improvement factor. [3]

Answer:

$T_{old} = 200$ s

$T_{affected} = T_{branch} = 45$ s

$T_{unaffected} = (200 - 45) = 155$ s

$T_{improved} = (200 \times 0.8) = 160$ s

$160 = \frac{45}{n} + 155$

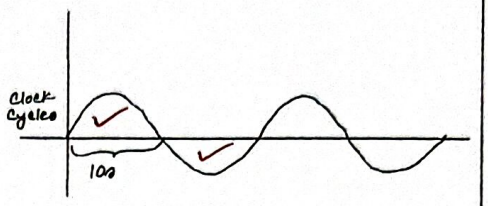
$\Rightarrow \frac{45}{n} = 5$

$\Rightarrow n = 9$

Yes.

Improvement Factor = 9 (Ans)

4.

ADD X_{20}, X_{21}, X_{22} — 1 ADD X_{20}, X_{21}, X_{21} — 2 SUB X_{20}, X_{21}, X_{22} — 3 SUB X_{20}, X_{21}, X_{22} — 4 ADD X_{20}, X_{21}, X_{22} — 5 ADD X_{20}, X_{21}, X_{22} — 6 LD X_{20}, 10(X_{21}) — 7 ADD X_{20}, X_{21}, X_{22} — 8 SD X_{21}, 10(X_{20}) — 9	

CPI for Add, Sub, LD, SD instructions are 3, 2, 4, 5.

a. Find the number of instructions in the above code. [1] — 9
b. Find the average CPI. [1]
c. Find the clock cycle time. [1]
d. Find the time to execute this program. [2]

a) 9 instructions

b)

Ins	Add	Sub	LD	SD
CPI	3	2	4	5
I.C	5	2	1	1

$$\text{Average C.P.I} = \frac{(3\times5)+(2\times2)+(4\times1)+(5\times1)}{9}$$

$$= 3.11$$

c) Clock Cycle Time = Time taken to complete 1 clock

$$= (10 + 10) = 20n.$$

d) CPU time = $9 \times 3.11 \times 20$

$$= 560n.$$