

CSE3038 – Spring 2021- Quiz 1 (35 mins)

1. Assume the following instruction mix

ALU	Load/Store	Branch
20%	30%	50%

Assume the CPI values of the instruction types on two machines are given below:

Machine	Clock Speed	ALU	Load/Store	Branch
A	4.5 Ghz	3	X	3
B	1.5 Ghz	1	1	3

What should be the CPI of Load/store for machine A (i.e. the value of X) so that machine A is two times as fast as machine B.

2. Assume that the variables k, m, are assigned to registers \$t1, \$t2, respectively. Assume that the base address of the arrays A and B are in registers \$s1 and \$s2, respectively. Translate the following C code to MIPS code.

k = A[2+B[m]];

Question 1

$$\frac{\text{Performance}_A}{\text{Performance}_B} = \frac{\frac{1}{\text{CPU time}_A}}{\frac{1}{\text{CPU time}_B}} = \frac{\text{CPU time}_B}{\text{CPU time}_A} = 2$$

$$\text{CPU time}_B = \frac{I \times C \times \text{CPI}}{\text{Clock rate}} = \frac{I (1 \times 0.2 + 1 \times 0.3 + 3 \times 0.5)}{1.5}$$

$$= \frac{2I}{1.5}$$

$$\text{CPU time}_A = \frac{I (3 \times 0.2 + \textcircled{Y} \times 0.3 + 3 \times 0.5)}{4.5}$$

$$\text{CPU time}_A = \frac{I (2.1 + 0.3Y)}{4.5}$$

$$\frac{\text{CPU time}_B}{\text{CPU time}_A} = \frac{2I/1.5}{(2.1 + 0.3Y)I/4.5} = 2$$

$$\frac{2I}{1.5} \times \frac{4.5}{(2.1 + 0.3Y)I} = 2 \quad \frac{6}{2.1 + 0.3Y} = 2 \quad Y = 3$$

Question 2

$k \rightarrow \$t1$ $A(\text{Base}) \rightarrow \$s1$
 $m \rightarrow \$t2$ $B(\text{Base}) \rightarrow \$s2$

sll \$t0, \$t2, 2

$\neq \$t0 = 4 \times m$

add \$t0, \$t0, \$s2

$\neq \text{Addr. } B[m]$

lw \$s3, 0(\$t0)

$\neq \$s3 = B[m]$

addi \$s3, \$s3, 2

$\neq \$s3 = B[m] + 2$

sll \$t0, \$s3, 2

$\neq \text{Addr. } A[2 + B[m]]$

add \$t0, \$t0, \$s1

$\neq k = A[2 + B[m]]$

lw \$t1, 0(\$t0)