

University of Regina, Department of Computer Science, CS 301, Assignment 2

(Please submit one PDF file in UR Courses)

Total: 100 marks

1. [20 marks] Consider two different machines, with two different instruction sets, both of which have a clock rate of 200 MHz. The following measurements are recorded on the two machines running a given set of programs.

Instruction Type	Instruction Count (millions)	Cycles per Instruction
Machine A:		
Arithmetic and logic	8	1
Load and store	4	3
Branch	2	4
Others	4	3
Machine B:		
Arithmetic and logic	10	1
Load and store	8	2
Branch	2	4
Others	4	3

Determine the effective CPI, MIPS rate, and execution time for each machine.

2. [20 marks] Consider the following code:

```
for (i = 0; i < 20; i++)
    for (j = 0; j < 10; j++)
        a[i] = a[i] * j
```

- (i) Give one example of the spatial locality in the code.
- (ii) Give one example of the temporal locality in the code.

3. [20 marks] What do you mean by CPI, average CPI, and MIPS. Derive the formula for MIPS, in terms of clock frequency and average CPI.

4. [20 marks] Explain the fetch-execute cycle of an instruction using a Finite State Machine (FSM).

5. [20 marks] Consider these terms: instruction spatial locality, instruction temporal locality, data spatial locality, data temporal locality. Match each of these terms to one of the following definitions:

(a) Locality is quantified by computing the average distance (in terms of number of operand memory accesses) between two consecutive accesses to the same address, for every unique address in the program. The evaluation is performed in four distinct window sizes, analogous to cache block sizes.

(b) Locality metric is quantified by computing the average distance (in terms of number of instructions) between two consecutive accesses to the same static instruction, for every unique static instruction in the program that is executed at least twice.

(c) Locality for operand memory accesses is characterized by the ratio of the locality metric for window sizes mentioned in (a).

(d) Locality is characterized by the ratio of the locality metric for the window sizes mentioned in (b).