COMP 230: Computer Architecture and Organization

Homework 1

Assigned: August 27, 2018 *Due: September 7, 2018*

1. Answer the following questions given the following information about two processors:

	Processor A	Processor B
Clock Rate	1.25GHz	?
Cycle Time	?	.4 nanoseconds
CPI	3.0	2.5

   (a) What is the clock rate for processor B?

   (b) What is the cycle time for processor A?

   (c) Assuming the ISA of both processor A and B are the same, what is the CPU execution time for a program run on processor A? Since you don't know how many instructions the program has, your answer should be in terms of seconds (or nanoseconds, picoseconds, etc.) per instruction.

   (d) Assume the ISA of both processor A and B are the same, what is the CPU time of processor B? As before, your answer should be in terms of seconds per instruction.

   (e) Which processor is faster, and by how much? (Give the relative performance, i.e. how many times faster is one processor than the other.)

2. You've written two algorithms and want to know which one to use. Algorithm A has 100 instructions, while algorithm B has 120. The mix of instructions for each algorithm, as well as the CPI for each instruction type, is given below. The clock rate of your CPU is 2 GHz.

	Algorithm A	Algorithm B
Integer Math (CPI = 1.2)	50%	25%
Conditionals (CPI = 2.5)	10%	25%
Memory Access (CPI = 3.0)	40%	50%

(a) How long is the cycle time of the CPU?

(b) What is the average CPI for algorithm A?

(c) What is the average CPI for algorithm B?

(d) Which is better? Give the relative performance.

3. A new program you wrote contains four types of instructions: 20% class A, 40% class B, 30% class C, and the remaining 10% class D. You timed the program and its execution time is 100 seconds.

   (a) What would the execution time be if you could improve class D instructions by a factor of 10?

   (b) What about improving class B by a factor of 2?

4. Problem 1.15 from the text. Round any decimals to two decimal places. Note a possible source of confusion between the execution time, the total CPU time, and the *per processor execution time*. A program that finishes execution in 40 seconds on 4 processors has an execution time of 40 seconds, a total CPU time of $40 \times 4 = 160$ seconds, and a per processor execution time of 40 seconds (*not* 10 seconds).