Department of Electrical and Computer Engineering

*University of Wisconsin – Madison*

ECE 552 Introduction to Computer Architecture

Homework #1 (Due Tue. 1/30)

1. *Performance*

Consider two processors, their clock rate and CPIs as follows:

|  |  |  |
| --- | --- | --- |
| Processor | Clock Frequency | CPI |
| P1 | 2.5 GHz | 2 |
| P2 | 1.2 GHz | 3 |

1. Suppose that both P1 and P2 have the same ISA and can execute identical assembly programs. Which of them may execute a program faster?
2. If machine P1 takes 5 seconds to run a program. How long does it take to run the same program at machine P2?
3. A machine P3 is designed that runs the same ISA but CPI is increased to 3.0. It is found that the same program in part (b) takes 5 seconds to run on P3. What is the clock rate P3 is using?
4. *Performance*

COD Section 1.10 (Fallacies and pitfalls) cites as a pitfall the utilization of a subset of the performance equation as a performance metric. To illustrate this, consider the following two processors. P1 has a clock rate of 4 GHz, average CPI of 0.9, and requires the execution of 5.0E9 instructions. P2 has a clock rate of 3 GHz, an average CPI of 0.75, and requires the execution of 1.0E9 instructions.

1. One usual fallacy is to consider the computer with the largest clock rate as having the largest performance. Check if this is true for P1 and P2.
2. Another fallacy is to consider that the processor executing the largest number of instructions will need a larger CPU time. Considering that processor P1 is executing a sequence of 1.0E9 instructions and that the CPI of processors P1 and P2 do not change, determine the number of instructions that P2 can execute in the same time that P1 needs to execute 1.0E9 instructions.
3. A common fallacy is to use MIPS (millions of instructions per second) to compare the performance of two different processors, and consider that the processor with the largest MIPS has the largest performance. Check if this is true for P1 and P2.
4. Another common performance figure is MFLOPS (millions of floating-point operations per second), defined as

MFLOPS = No. FP operations / (execution time x 1E6)

but this figure has the same problems as MIPS. Assume that 40% of the instructions executed on both P1 and P2 are floating-point instructions. Find the MFLOPS figures for the programs.