Name: KEY **Id#**

ICS 233, Term 072

Computer Architecture & Assembly Language

Quiz# 7

Date: Saturday, May 10, 2008

Q.1. Consider two different implementations, M1 and M2, of the same instruction set. There are three classes of instructions (A, B, and C) in the instruction set. M1 has a clock rate of 6 GHz and M2 has a clock rate of 3 GHz. The CPI for each instruction class on M1 and M2 is given in the following table:

Class	CPI on M1	CPI on M2	C1 Usage	C2 Usage
A	2	1	40%	60%
B	3	2	40%	15%
C	5	2	20%	25%

The above table also contains a summary of the usage of instruction classes generated by two different compilers: C1 and C2. Assume that each compiler generates the same number of instructions for a given program. **Which computer and compiler combination give the best performance**?

Execution time based on M1 and C1=ICx(0.8+1.2+1.0)x1/6x10^9=ICx3x1/6x10^9=**ICx0.5ns**.
Execution time based on M2 and C1=ICx(0.4+0.8+0.4)x1/3x10^9=ICx1.6x1/3x10^9=**ICx0.53ns**.
Execution time based on M1 and C2=ICx(1.2+0.45+1.25)x1/6x10^9=ICx2.9x1/6x10^9=**ICx0.48ns**.
Execution time based on M2 and C2=ICx(0.6+0.3+0.5)x1/3x10^9=ICx1.4x1/3x10^9=**ICx0.47ns**.

The best performance is achieved using compiler C2 and machine M2.

Q.2. A benchmark program runs for 100 seconds. We want to improve the speedup of the benchmark by a factor of 3. We enhance the floating-point hardware to make floating point instructions run 6 times faster. How much of the initial execution time would floating-point instructions have to account for to show an overall speedup of 3 on this benchmark?

Speedup = 1 / (f/s + (1-f))=> 3 = 1 / (f/6+(1-f)) => f/6 + 1-f = 1/3 => f + 6 – 6f = 6/3 => 5f = 4 => f =4/5=0.8

Thus, floating-point instructions must account for 80% of the initial execution time, i.e. 80 seconds, to show an overall speedup of 3 on this benchmark.