

Practice for performance

For all questions, please show your computation clearly.

1. Consider the following data:

machine M1: clock rate = 900 MHz
machine M2: clock rate = 800 MHz
running program-1 on M1 takes 20 sec, on M2 takes 15 sec
running program-2 on M1 takes 8 sec, on M2 takes 10 sec

For program-1, assume that the number of instructions executed on M1 and M2 are 500 million and 400 million, respectively.

Find the clock cycles per instruction (CPI) for program-1 on both machines.

2. Assume that the CPI for program-2 on each machine described in #1 is the same as the CPI for program-1 on each machine found in #1.

Find the instruction count (IC) for program-2 running on each machine using the execution times shown in #1.

3. Consider two different implementations, machine M1 and machine M2, of the same instruction set architecture as described below.

Note that there are four types of instructions (A, B, C and D) in the instruction set.

M1: clock rate = 800 MHz,
CPI_A = 1, CPI_B = 2, CPI_C = 3, CPI_D = 4
M2: clock rate = 900 MHz,
CPI_A = 3, CPI_B = 2, CPI_C = 4, CPI_D = 2

Assume that the 'peak performance' is defined as the fastest rate that a machine can execute an instruction sequence chosen to maximize that rate. What are the peak performances of M1 and M2 expressed as instructions per second? Answer with MIPS.

4. If the number of instructions executed in a certain program is divided equally among the four types of instructions shown in #3, which machine is faster? Please show how much times faster than the other machine.

5. Consider the CPI values from #3 and the instruction type distribution from #4.

At what clock rate would M1 have the same performance as the 900 MHz version of M2?

6. Consider the following data for computer C1:

C1: clock rate = 2.5 GHz, running a benchmark program on C1 takes 15 sec.
A design team is developing a new computer C2 aiming the double performance by increasing the clock rate with the cost of increased clock cycles with the factor of 1.5.
What would be the clock rate of computer C2?

- Submission: Please write answers on blank papers and submit a .pdf version (single file).

Please organize your answer sheets in the order of #1,2,3,... and don't forget to write your name on the first page.