Computer System Architecture

Tutorial 2:

1. A benchmark program is run on an 80 MHz processor. The executed program consists of 100,000 instruction execution, with the following instruction mix and clock cycle count:

|  |  |  |
| --- | --- | --- |
| Instruction Type | Instruction Count | Cycle per Instruction |
| Integer Arithmetic | 45000 | 1 |
| Data Transfer | 32000 | 2 |
| Floating Point | 15000 | 2 |
| Control Transfer | 8000 | 2 |

Determine the effective CPI, MIPS rate, and execution time for this program

1. The performance of a 100MHz microprocessor P is measured by executing 10,000,000 instruction of benchmark code, which is found to take 0.25s. What are the values of CPI and MIPS for this performance experiment? Is P likely to be superscalar?
2. Suppose that a single-chip microprocessor P operating at clock frequency of 50MHz is replaced by a new model P’, which has **the same architecture** as P but has a clock frequency of 75MHz.
   1. If P has a performance rating of p MIPS for a particular benchmark program Q, what is the corresponding MIPS rating p’ for P
   2. P takes 250s to execute Q in a particular personal computer system C. On replacing P by P’ in C, the execution time of Q drops only to 220s. Suggest a possible reason for this disappointing performance improvement.
3. Suppose we have two implementations of the same instruction set architecture. Computer A has a clock cycle time of 250 ps and a CPI of 2.0 for a given benchmark program, and computer B has a clock cycle time of 500 ps and a CPI of 1.2 for the same program. Which computer is faster for this program and by how much?

1. A compiler designer is deciding between two codes for a particular machine. Based on the hardware implementation, there are three different classes of instructions: Class A, Class B, and Class C, and they require one, two, and three cycles respectively.

First code has 5 instructions: 2 of A, 1 of B, and 2 of C.

Second code has 6 instructions: 4 of A, 1 of B, and 1 of C.

Which code is faster?

By how much?

What is the CPI for each code?