Computer Organization & Architecture

15B11CI313

**Tutorial-1: Performance Evaluation**

1. A benchmark program is run on a 40 MHz processor. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count:

**Instruction Type Instruction Count Cycles per Instruction**

Integer arithmetic 45,000 1

Data transfer 32,000 2

Floating point 15,000 2

Control transfer 8000 2

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

1. Based on your response to the following questions you have to select a **faster machine** between machine A and machine B which are running different compilers and their characteristics are as follows:

|  |  |  |
| --- | --- | --- |
| **MACHINE A – 3.2 GHz clock rate** | | |
| **Instr. Class** | **CPI for the class** | **Instruction Count (in billions)** |
| A | 1 | 10 |
| B | 4 | 20 |
| C | 2 | 20 |
| D | 4 | 15 |

|  |  |  |
| --- | --- | --- |
| **MACHINE B – 3.6 GHz clock rate** | | |
| **Instr Class** | **CPI for the class** | **Instruction Count (in billions)** |
| A | 4 | 25 |
| B | 2 | 30 |
| C | 3 | 10 |
| D | 3 | 15 |

1. What is the average CPI of machine A and B?
2. On which machine is the program faster with respect to:
3. Execution time
4. MIPS rating
5. M1 and M2 are two machines whose performances have to be compared based on the following measurements.

|  |  |  |
| --- | --- | --- |
| **Program** | **Time on M1 (sec)** | **Time on M2 (sec)** |
| A | 20.0 | 15.0 |
| B | 50.0 | 100.0 |

|  |  |  |
| --- | --- | --- |
| **Program** | **Instructions executed on M1** | **Instructions executed on M1** |
| A | 5000 Millions | 4000 Millions |

1. Which machine is faster for each program and by how many times and by what percentage?
2. Find the instruction execution rate (instructions per second) for each machine for program A?
3. Find the CPI for program A on both machines (M1: 3GHz, M2: 5GHz)?

a)Overall speedup if we make 90% of a program run 10 times faster

b)Overall speedup if we make 80% of a program run 20% faster.

c) You have a system that contains a special processor for doing floating-point operations. You have determined that 50% of your computations can use the floating-point processor. The speedup of the floating pointing-point processor is 15. Calculate overall speedup achieved by using the floating-point processor.

1. A program runs in a thousand seconds on a particular machine, with 75% of the time spent doing multiply/divide operations. We want to redesign the machine to provide it with faster multiply/divide hardware.
   1. How much faster should the multiplier/divider become for the program to run three times as fast?
   2. What if we want the program to run four times as fast?
2. Computer A has an overall CPI of 1.3 and can be run at a clock rate of 600MHz.  
   Computer B has a CPI of 2.5 and can be run at a clock rate of 750 Mhz. We have a particular program wish to run. When compiled for computer A, this program has exactly 100,000 instructions. How many instructions would the program need to have when compiled for Computer B, in order for thetwo computers to have exactly the same execution time for this program?