CE/CZ3001: Advanced Computer Architecture

Tutorial-1

1. Suppose a program P consists of three categories of instructions, where the number of instructions of category-1, category-2, and category-3 are 200, 500, and 300, respectively. Find the execution time of the program P in a machine that has clock period of 100ns, given that the number of clock cycles per instruction (CPI) for the instructions of category-1, category-2, and category-3 are 1, 2, and 3, respectively. Considering that execution time, $T = IC \times Average\ CPI \times Tc$, find the average CPI.

   (Answer: Execution time =210 microsecond)

2. Consider two machines M1 and M2 operating at 200MHz and 300 MHz clock frequency. Execution times of programs P1and P2 when run on M1 and M2 are as follows.

Program	Execution time on M1	Execution time on M2
P1	10 seconds	5 seconds
P2	4 seconds	3 seconds

   (a) The instruction counts of P1 when runs on M1 and M2 are, respectively, 200×10^6 and 160×10^6. Find the average number of clock cycles per instruction (CPI) of P1 when they run on both machines.
   (b) Assuming that the average CPI of the program P2 on each machine is the same as that of program P1(part a), find the instruction count of P2 when runs on M1 and M2.

   (Answer: (a) 10 and 9.375, (b) 80 * 10^6 and 96 * 10^6)

3. Consider three machines M1, M2, and M3, having the same instruction set, which consists of four categories of instructions: A, B, C, and D. Machine M2 is an enhanced version of machine M1. Clock frequency of both M1 and M2 is 500MHz, and that of M3 is 750MHz. Number of clock cycles required on M1, M2, and M3 for each of the four categories of instructions are given in the following table.

Instruction category	CPI on M1	CPI on M2	CPI on M3
A	2	1	2
B	4	2	2
C	3	3	4
D	4	4	4

   (a) If a program P1 which consists of the same number of instructions of each of the four categories of instructions, calculate the speedup of M3 over M2
   (b) If a program P2 consists of instructions of category A only, calculate the speedup of M2, and M3 over M1 for the given program.

   (Answer: (a) 1.25, (b) 2 and 1.5)