Tutorial -1
Performance Metrics

Q1. For the purpose of solving a given problem, you benchmark a program on two computer systems. On system A ,the object code executed 80 million Arithmetic Logic Unit operations(ALU ops),55 million Load instructions,20 million branch instructions. On system B,the object code executed 50 million ALU ops,3 million loads and 5 million branch instructions. In both the systems, each ALU op takes 1 clock cycle ,each load takes 5 clock cycles, and each branch takes 3 clock cycles.

a) Compute the relative frequency of occurrence of each type of instruction executed in both the systems.

b) Find the CPI for each system.

c) Assuming that the clock on system A is 10% faster than the clock on system B, which system is faster for the given application problem and by how much percent?

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Q2) Consider three different processors,p1,p2 and p3,executing the same instruction set.P1 has a 3 GHz clock rate and a CPI of 1.5 .P2 has a 2.5 GHz clock rate and a CPI of 1.0 .P3 has a 4.0 GHz clock rate and a CPI of 2.2.

a) Which processor has the highest performance expressed in instructions per second?

b) If the processors each execute a program in 10 seconds , find the number of cycles and the number of instructions.

c) We are trying to reduce the execution time by 30% but this leads to an increase of 20% in the CPI .What clock rate should we have to get this time reduction ?

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Q3) Utilization of a subset of the performance equation as a performance metric is a fallacy . To illustrate this, consider the following two processors. P1 has a clock rate of 4 GHz, average CPI of 0.9, and requires the execution of 5.0E9 instructions. P2 has a clock rate of 3 GHz, an average CPI of

0.75, and requires the execution of 1.0E9 instructions.

a) One usual fallacy is to consider the computer with the largest clock rate as having the largest performance. Check if this is true for P1 and P2.

b)Another fallacy is to consider that the processor executing the largest number of instructions will need a larger CPU time. Considering that processor P1 is executing a sequence of 1.0E9 instructions and that the CPI of processors P1 and P2 do not change, determine the number of instructions that P2 can execute in the same time that P1 needs to execute 1.0E9 instructions.