2019 Fall Computer Architecture

Homework 1

Due date: 9/25 14:20

Please provide your calculation progress as well as the answer. You will get 0 points if the calculation progress is lacking.

Please upload your homework file on NTU COOL.

1. Consider three different processors P1, P2, and P3 executing the same instruction set. P1 has a 4.0 GHz clock rate and a CPI of 2. P2 has a 2.5 GHz clock rate and a CPI of 1.0. P3 has a 3.5 GHz clock rate and has a CPI of 2.2.

a. (10 points) Which processor has the highest performance expressed in instructions per second?

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

c. (10 points) 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?

2. Consider two different implementations of the same instruction set architecture. The instructions can be divided into four classes according to their CPI (classes A, B, C, and D). P1 with a clock rate of 3.0 GHz and CPIs of 1, 3, 2, and 3, and P2 with a clock rate of 2.8 GHz and CPIs of 2, 2, 2, and 2.

Given a program with a dynamic instruction count of 1.0E6 instructions divided into classes as follows: 15% class A, 18% class B, 45% class C, and 22% class D, which is faster: P1 or P2?

a. (10 points) What is the global CPI for each implementation?

b. (10 points) Find the clock cycles required in both cases.

3. The results of the SPEC CPU2006 bzip2 benchmark running on an AMD Barcelona has an instruction count of 2.389E12, an execution time of 750 s, and a reference time of 9650 s.

a. (10 points) Find the CPI if the clock cycle time is 0.333 ns.

b. (10 points) Find the SPECratio.

c. (10 points) Find the increase in CPU time if the number of instructions of the benchmark is increased by 10% without affecting the CPI.

d. (10 points) Find the increase in CPU time if the number of instructions of the benchmark is increased by 10% and the CPI is increased by 5%.

e. (10 points) Find the change in the SPECratio for the change in 3.d.