

2020 Fall Computer Architecture

Homework 1

Due date: 9/30 14:20

- Please explain how you obtain the answer (MUST)
- Submit your homework via NTUCool

1. Consider three different processors P1, P2, and P3 executing the same instruction set. P1 has a 6.0 GHz clock rate and a CPI of 1.5. P2 has a 7.5 GHz clock rate and a CPI of 3. P3 has a 3.5 GHz clock rate and has a CPI of 1.0.

a. (10 points) Please calculate the IPS(instructions per second) of P1, P2 and P3.

b. (10 points) If the processors each execute a program in 8 seconds, find the number of cycles and the number of instructions.

c. (10 points) We are trying to reduce the execution time by 40%, but this leads to an increase of 80% 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 1.7 GHz and CPIs of 1, 3, 3, and 1, and P2 with a clock rate of 2.3 GHz and CPIs of 2, 4, 1, and 1.

Given a program with a dynamic instruction count of $1.0E6$ instructions divided into classes as follows: 15% class A, 25% class B, 25% class C, and 35% class D.

a. (7 points) What is the global CPI for each implementation?

b. (7 points) Find the clock cycles required in both cases.

c. (6 points) Which is faster: P1 or P2?

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 550 s, and a reference time of 8750 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 15% 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 20%.

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