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### CSE 140 HW2 – Performance

#### 3. (Exercise 1.15.6)

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 has a CPI of 2.2.

- a. Which processor has the highest performance expressed in instructions per second?
  - Processor 2 would have 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.
  - P1: Instructions –  $2 \times 10^{10}$ , Cycles –  $30 \times 10^9$
  - P2: Instructions –  $2.5 \times 10^{10}$ , Cycles –  $25 \times 10^9$
  - P3: Instructions –  $1.818 \times 10^{10}$ , Cycles –  $40 \times 10^9$
- 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?
  - The new clock rate should be around 2.6 GHz for P1, 2.1 GHz for P2, and 3.4 GHz for P3.

#### 4. (Exercise 1.15.7)

Consider two different implementations of the same instruction set architecture. The instructions can be divided into four classes according to their CPI (class A, B, C, and D). P1 with a clock rate of 2.5 GHz and CPIs of 1, 2, 3, and 3, and P2 with a clock rate of 3 GHz and CPIs of 2, 2, 2, and 2.

Given a program with a dynamic instruction count of  $1.0 \times 10^6$  instructions divided into classes as follows: 10% class A, 20% class B, 50% class C, and 20% class D, which is faster: P1 or P2?

- a. What is the global CPI for each implementation?
  - The average CPI for P1 is 2.6 and the average CPI for P2 is 2
- b. Find the clock cycles required in both cases.
  - The clock cycles required for both cases are  $2.6 \times 10^6$  for P1 and  $2 \times 10^6$  for P2

