微算機系統第三次隨堂考 姓名_____ 學號_____

(Exercises 4.8 and 4.9) Consider two different implementations, P1 and P2, of the same instruction set. There are five classes of instructions (A, B, C, D, and E) in the instruction set. P1 has a clock rate of 4 GHz. P2 has a clock rate of 6 GHz. The average number of cycles for each instruction class for P1 and P2 is as follows.

Class	CPI on P1	CPI on P2
A	1	2
B	2	2
C	3	2
D	4	4
E	3	4

(a) (60%) Assume that peak performance is defined as the fastest rate that a computer can execute any instruction sequence. What are the peak performances of P1 and P2 expressed in instructions per second?

(b) (40%) If the number of instructions executed in a certain program is divided equally among the classes of instructions except for class A, which occurs twice as often as each of the others, how much faster is P2 than P1?

Answers: (a) The ideal instruction sequence for P1 is one composed entirely of instructions from class A (which have CPI of 1). So P1's peak performance is $(4\times10^9$ cycles/second)/(1 cycle/instruction) = 4000 MIPS. Similarly, the ideal sequence for P2 contains only instructions from A, B, and C (which all have a CPI of 2). So P2's peak performance is $(6\times10^9$ cycles/second)/(2 cycles/instruction) = 3000 MIPS.

(b) The average CPI of P1 is (1×2 + 2 + 3 + 4 + 3)/6 = 7/3. The average CPI of P2 is (2×2 + 2 + 2 + 4 + 4)/6 = 8/3. P2 then is $(6\times10^9$ cycles/second)/(8/3 cycles/instruction))/(($(4\times10^9$ cycles/second)/(7/3 cycles/instruction)) = 21/16 times faster than P1.