▶Solution◀

Question 1: (15 points)

Consider two different implementations, I_1 and I_2, of the same instruction set. There are three classes of instructions (A, B, and C) in the instruction set. I_1 has a clock rate of 6 GHz, and I_2 has a clock rate of 4 GHz. The average number of cycles for each instruction class on I_1 and I_2 is given in the following table. The table also contains a summary of average proportion of instruction classes generated by two different compilers (C_1 and C_2). Assume each compiler uses the same number of instructions for a given program, but that the instruction mix is as described in the table.

Class	CPI on I_1	CPI on I_2	C_1 Usage	C_2 Usage
A	2	1	40%	50%
B	3	2	20%	25%
C	5	2	40%	25%

a. (5 points) Given the instruction mix of C_1 and C_2, which compiler would you use if you purchased I_1, and why?

Solution: C_2
C_1: $0.4 \times 2 + 0.2 \times 3 + 0.4 \times 5 = 3.4$ CPI
C_2: $0.5 \times 2 + 0.25 \times 3 + 0.25 \times 5 = 3$ CPI

b. (5 points) What if you purchased I_2, and why?

Solution: C_2
C_1: $0.4 \times 1 + 0.2 \times 2 + 0.4 \times 2 = 1.6$ CPI
C_2: $0.5 \times 1 + 0.25 \times 2 + 0.25 \times 2 = 1.5$ CPI

c. (5 points) What is the best combination of (computer + compiler) you could possibly purchase, if all combinations cost the same, and why?

Solution: $I_2 + C_2$
$I_1 + C_2$: $3.0 \times IC/(6 \times 10^9) = 0.5 \times IC \times 10^{-9}$
$I_2 + C_2$: $1.5 \times IC/(4 \times 10^9) = 0.375 \times IC \times 10^{-9}$