1 Homework 1

1.1 Textbook Problem 4.15.5

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.

Processor	Clock Rate	CPI	Performance
P1	3 GHz	1.5	2 GHz
P2	2.5 GHz	1.0	2.5 GHz
P3	4.0 GHz	2.2	1.8 GHz

(a) Which processor has the highest performance expressed in instructions per second?
Answer:
Instructions per Second = Clock Rate/CPI

$$\text{P1} = 3 \text{ GHz}/1.5 = 2 \text{ GHz}$$
$$\text{P2} = 2.5 \text{ GHz}/1.0 = 2.5 \text{ GHz}$$
$$\text{P3} = 4.0 \text{ GHz}/2.2 = 1.8 \text{ GHz}$$

P2 has 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.
Answer:
Number of Cycles = Clock Rate * Execution Time

$$\text{P1} = 3 \text{ GHz} * 10\text{s} = 30 \text{ Billion Cycles}$$
$$\text{P2} = 2.5 \text{ GHz} * 10\text{s} = 25 \text{ Billion Cycles}$$
$$\text{P3} = 4.0 \text{ GHz} * 10\text{s} = 40 \text{ Billion Cycles}$$

Number of Instructions = Instructions per Second * Execution Time

$$\text{P1} = 2 \text{ Hz} * 10\text{s} = 20 \text{ Billion Instructions}$$
$$\text{P2} = 2.5 \text{ GHz} * 10\text{s} = 25 \text{ Billion Instructions}$$
$$\text{P3} = 1.8 \text{ GHz} * 10\text{s} = 18 \text{ Billion Instructions}$$

(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?
Answer:

1.2 Textbook Problem 4.15.8

1.3 Textbook Problem 4.15.10

1.4 Textbook Problem 4.15.13

1.5 Textbook Problem 4.15.14

1.6 Textbook Problem 4.15.15

1.7 Textbook Problem 4.15.16