

HW01 모범답안

답이 틀려도 풀이 과정에 따라 부분 점수 드립니다.

반올림 때문에 발생하는 오차에 대해서는 감점을 하지 않았습니다.

하지만, 반올림의 차이로 보기 어려운 답은 오답처리 하였습니다.

1.3.4

$$\text{IPC}(P1) = \mathbf{1.429}$$

$$\text{IPC}(P2) = \mathbf{2}$$

$$\text{IPC}(P3) = \mathbf{3.333}$$

1.3.5

$$\text{Time}_{\text{new}}/\text{Time}_{\text{old}} = 7/10 = 0.7. \text{ So } f_{\text{new}} = f_{\text{old}}/0.7 = 1.5 \text{ GHz}/0.7 = \mathbf{2.14 \text{ GHz}}.$$

1.3.6

$$\text{Time}_{\text{new}}/\text{Time}_{\text{old}} = 9/10 = 0.9.$$

$$\text{So Instructions}_{\text{new}} = \text{Instructions}_{\text{old}} \times 0.9 = 30 \times 10^9 \times 0.9 = \mathbf{27 \times 10^9}.$$

1.5.4

$$\text{a. } 1000 \times 1 + 400 \times 10 + 100 \times 10 + 50 \times 3 = 6150 \text{ cycles.}$$

$$6150 \text{ cycles}/3 \text{ GHz} = 2050 \text{ ns} = \mathbf{2.05 \mu\text{s}}$$

$$\text{b. } 1500 \times 1 + 300 \times 10 + 100 \times 10 + 100 \times 3 = 5800 \text{ cycles.}$$

$$5800 \text{ cycles}/3 \text{ GHz} = 1933 \text{ ns} = \mathbf{1.93 \mu\text{s}}$$

1.5.5

$$\text{a. } 1000 \times 1 + 400 \times 2 + 100 \times 2 + 50 \times 3 = 2150 \text{ cycles.}$$

$$2150 \text{ cycles}/3 \text{ GHz} = \mathbf{0.717 \mu\text{s}}$$

$$\text{b. } 1500 \times 1 + 300 \times 2 + 100 \times 2 + 100 \times 3 = 2600 \text{ cycles.}$$

$$2600 \text{ cycles}/3 \text{ GHz} = \mathbf{0.867 \mu\text{s}}$$

1.5.6

$$\text{a. } (1000 \times 0.5) \times 1 + 400 \times 2 + 100 \times 2 + 50 \times 3 = 1650 \text{ cycles}$$

$$2150/1650 = 1.303. \mathbf{1.303 \text{ times faster or } 30.3\% \text{ faster}}$$

$$\text{b. } (1500 \times 0.5) \times 1 + 300 \times 2 + 100 \times 2 + 100 \times 3 = 1850$$

$$2600/1850 = 1.405. \mathbf{1.405 \text{ times faster or } 40.5\% \text{ faster}}$$

문제에서 속도에 관해 물어보고 있으므로, 여기서 몇 초 줄었다라는 것은 정확한 답이 아닙니다.
Performance 수업 시간에 배운 ~배, ~% 표현을 사용해주셔야 합니다.
중간고사 때는 오답으로 처리하겠습니다.

1.7.1

$$\text{Geometric mean clock rate ratio} = (1.28 \times 1.56 \times 2.64 \times 3.03 \times 10.00 \times 1.80 \times 0.74)^{1/7} = (212.758)^{1/7} = \mathbf{2.15}$$

$$\text{Geometric mean power ratio} = (1.24 \times 1.20 \times 2.06 \times 2.88 \times 2.59 \times 1.37 \times 0.92)^{1/7} = (28.818)^{1/7} = \mathbf{1.62}$$

1.7.2

$$\text{Largest clock rate ratio} = 2000 \text{ MHz} / 200 \text{ MHz} = \mathbf{10 \text{ (Pentium Pro to Pentium 4 Willamette)}}$$

$$\text{Largest power ratio} = 29.1 \text{ W} / 10.1 \text{ W} = \mathbf{2.88 \text{ (Pentium to Pentium Pro)}}$$

1.7.3

$$\text{Clock rate: } 2.667 \times 10^9 / 12.5 \times 10^6 = \mathbf{213.36}$$

$$\text{Power: } 95 \text{ W} / 3.3 \text{ W} = \mathbf{28.788}$$

1.12.1

$$\text{CPI} = \text{clock rate} \times \text{CPU time} / \text{instr. count}$$

$$\text{clock rate} = 1 / \text{cycle time} = 3 \text{ GHz}$$

$$\text{a. CPI(pearl)} = 3 \times 10^9 \times 500 / (2118 \times 10^9) = \mathbf{0.708}$$

$$\text{b. CPI(mcf)} = 3 \times 10^9 \times 1200 / (336 \times 10^9) = \mathbf{10.714}$$

1.12.2

$$\text{SPECratio} = \text{ref. time} / \text{execution time.}$$

$$\text{a. SPECratio(pearl)} = 9770 / 500 = \mathbf{19.54 \text{ or } 1954}$$

$$\text{b. SPECratio(mcf)} = 9120 / 1200 = \mathbf{7.6 \text{ or } 760}$$

1.12.3

$$(19.54 \times 7.6)^{1/2} = \mathbf{12.19 \text{ or } 1219}$$

3rd 4.10

$$\begin{aligned} \text{Execution time} &= \text{Instructions/Program} \times \text{Cycles/Instructions} \times \text{Seconds/Cycle} \\ &= \text{Instructions/Program} \times \text{CPI}_{\text{AVG}} \times 1/\text{ClockRate} \end{aligned}$$

문제에서 Instructions/Program은 동일하다고 가정되어 있으므로, INSTR이라는 상수로 바꾸겠습니다.

Q1.

$$T_{1C1} = \text{INSTR} \times (2 \times 0.4 + 3 \times 0.4 + 5 \times 0.2) / 6\text{GHz} = \text{INSTR} \times 0.5 \text{ ns}$$

$$T_{2C1} = \text{INSTR} \times (1 \times 0.4 + 2 \times 0.4 + 2 \times 0.2) / 3\text{GHz} = \text{INSTR} \times 0.533 \text{ ns}$$

$$T_{2C1}/T_{1C1} = (\text{INSTR} \times 0.533) / (\text{INSTR} \times 0.5) = 1.066$$

1.066 times faster or 16/15 times faster

Q2.

$$T_{1C2} = \text{INSTR} \times (2 \times 0.4 + 3 \times 0.2 + 5 \times 0.4) / 6\text{GHz} = \text{INSTR} \times 0.567 \text{ ns}$$

$$T_{2C2} = \text{INSTR} \times (1 \times 0.4 + 2 \times 0.2 + 2 \times 0.4) / 3\text{GHz} = \text{INSTR} \times 0.533 \text{ ns}$$

$$T_{1C2}/T_{2C2} = (\text{INSTR} \times 0.567) / (\text{INSTR} \times 0.533) = 1.063$$

1.063 times faster or 17/16 times faster

Q3.

$$\text{CPI}_{\text{AVG}_I1C1} = 2 \times 0.4 + 3 \times 0.4 + 5 \times 0.2 = 3$$

$$\text{CPI}_{\text{AVG}_I1C2} = 2 \times 0.4 + 3 \times 0.2 + 5 \times 0.4 = 3.4$$

$$\text{CPI}_{\text{AVG}_I1C3} = 2 \times 0.5 + 3 \times 0.25 + 5 \times 0.25 = 3$$

C1 또는 C3를 사용하는 것이 가장 빠르다.

Q4.

$$\text{CPI}_{\text{AVG}_I2C1} = 1 \times 0.4 + 2 \times 0.4 + 2 \times 0.2 = 1.6$$

$$\text{CPI}_{\text{AVG}_I2C2} = 1 \times 0.4 + 2 \times 0.2 + 2 \times 0.4 = 1.6$$

$$\text{CPI}_{\text{AVG}_I2C3} = 1 \times 0.5 + 2 \times 0.25 + 2 \times 0.25 = 1.5$$

C3를 사용하는 것이 가장 빠르다.

Q5.

Execution time	C1	C2	C3
I1	INSTR×0.5 ns	INSTR×0.57 ns	INSTR ×0.5 ns
I2	INSTR ×0.53 ns	INSTR ×0.53 ns	INSTR ×0.5 ns

다음과 같은 조합을 하는 것이 가장 빠르다.

I1+C1 or I1+C3 or I2+C3

모든 조합을 쓰라는 조건이 없었기 때문에, 하나라도 쓴 경우 정답처리 하였습니다.