

Name:

KEY

ID#:

Form 1

Computer Organization and Microprocessor- ENCS2380, Quiz#1 (10 points)

Date: Monday, Oct. 14, 2024

Q1 (2pts. each 1pt) Choose the best answer for the following statements from the given options:

1 Which of the following computer memory item(s) is/are fastest to be accessed?
a. Register b. Hard disk c. RAM d. USB e. b+d f. c+d

1 is/are not architectural attribute(s) of the processor.
a. Addressing Modes b. Instructions' Formats c. (I/O)-Mechanisms d. Control signals e. b+d f. c+d

Q2. Solve the following:

Consider two different implementations, M1 and M2, of the same instruction set. There are three classes of instructions (A, B, and C) in the instruction set. M1 has a clock rate of 6 GHz and M2 has a clock rate of 3 GHz. The CPI for each instruction class on M1 and M2 is given in the following table:

Class	CPI on M1	CPI on M2	C1 Usage	C2 Usage	C3 Usage
A	2	1	40%	40%	60%
B	3	2	40%	20%	15%
C	5	2	20%	40%	25%

The above table also contains a summary of the usage of instruction classes generated by three different compilers: C1, C2, and C3. Assume that each compiler generates the same number of instructions for a given program.

a) Using C1 compiler on both M1 and M2, how much faster is M1 than M2?

C1 → Avg. CPI_{M1} = 0.4 × 2 + 0.4 × 3 + 0.2 × 5 = 3

→ Avg. CPI_{M2} = 0.4 × 1 + 0.4 × 2 + 0.2 × 2 = 1.6

→ Ext_{M1} = (I × CPI) / Rate_{M1} = I(3) / (6 × 10⁹) = 0.5 nsec × I

→ Ext_{M2} = (I × CPI) / Rate_{M2} = I(1.6) / (3 × 10⁹) = 0.53 nsec × I

b) Using C2 compiler on both M1 and M2, how much faster is M2 than M1?

C2 → Avg. CPI_{M1} = 2 × 0.4 + 3 × 0.2 + 5 × 0.4 = 3.4

→ Avg. CPI_{M2} = 1 × 0.4 + 2 × 0.2 + 2 × 0.4 = 1.6

→ Ext_{M1} = I(3.4) / (6 × 10⁹) = 0.56 I nsec

→ Ext_{M2} = I(1.6) / (3 × 10⁹) = 0.53 I nsec

c) If you purchase M1, which compiler would you use?

C3, M1 → Avg. CPI_{C3} = 2 × 0.6 + 3 × 0.15 + 5 × 0.25 = 2.9

M1 → Avg. CPI_{C2} = 3.4, Avg. CPI_{C1} = 3

Avg. CPI_{C3} < Avg. CPI_{C1} < Avg. CPI_{C2}

C3 gives the lowest CPI on M1

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Form 2

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Q1. (2pts. each 1pt) Choose the best answer for the following statements from the given options:

1

_____ module(s) is/are not part of the CPU.

- a. Arithmetic unit
- b. Main memory
- c. Control unit
- d. Registers
- e. a+b
- f. b+d

1

_____ affect(s) the instruction count (IC) of the program.

- a. Compiler
- b. Program
- c. Instruction Set Architecture (ISA)
- d. a+b
- e. b+c
- f. a+b+c

Q2. Solve the following:

Consider two different implementations, M1 and M2, of the same instruction set. There are three classes of instructions (A, B, and C) in the instruction set. M1 has a clock rate of 6 GHz and M2 has a clock rate of 3 GHz. The CPI for each instruction class on M1 and M2 is given in the following table:

Class	CPI on M1	CPI on M2	C1 Usage	C2 Usage	C3 Usage
A	2	1	40%	40%	60%
B	3	2	40%	20%	15%
C	5	2	20%	40%	25%

The above table also contains a summary of the usage of instruction classes generated by three different compilers: C1, C2, and C3. Assume that each compiler generates the same number of instructions for a given program.

a) Using C1 compiler on both M1 and M2, how much faster is M1 than M2?

3

Q1
Same Form 1

b) Using C2 compiler on both M1 and M2, how much faster is M2 than M1?

3

Q1
Same Form 1

c) If you purchase M2, which compiler would you use?

M2

2

$$\text{Avg. CPI}_{C1} = 1 \times 0.4 + 2 \times 0.4 + 2 \times 0.2 = 1.6$$

$$\text{Avg. CPI}_{C2} = 1 \times 0.4 + 2 \times 0.2 + 2 \times 0.4 = 1.6$$

$$\text{Avg. CPI}_{C3} = 1 \times 0.6 + 2 \times 0.15 + 2 \times 0.25 = 1.4$$

$\text{Avg. CPI}_{C3} < \text{Avg. CPI}_{C1} / \text{Avg. CPI}_{C2} \rightarrow C3 \text{ gives the lowest CPI on M2.}$
 (0.5) (1)