Quiz 1, CSCIU 210, Fall 2018 **Name: _______Key__________**

Instructions: You must <u>show your work</u> and put your final answers in the blanks. If you round a numerical answer, **you must give at least 3 significant digits**.

1) Two compliers are used to compile the same benchmark program with the same instruction set architecture (ISA) for the same computer (clock rate=1GHz). There are three classes of instructions in this ISA, and each of them takes different numbers of clock cycles to finish. Class A instruction takes 2 clock cycles to finish, Class B instruction takes 3 clock cycles to finish, and Class C instruction takes 4 clock cycles to finish. The numbers of instructions generated by complier 1 and complier 2 are listed below.

	# of Inst. Generated by Compiler 1	# of Inst. Generated by Compiler 2
Class A (CPI = 2)	5 Millions	1 Millions
Class B (CPI = 3)	2 Millions	2 Millions
Class C (CPI = 4)	1 Millions	4 Millions

The following equations might be helpful:

$$\frac{\text{seconds}}{\text{program}} = \frac{\text{Insructions}}{\text{program}} \times \frac{\text{cycles}}{\text{Instructions}} \times \frac{\text{seconds}}{\text{cycle}}$$
$$= \mathit{Instruction\ Count} \times \mathit{CPI} \times \mathit{Clock\ C}\text{ycle Time}$$

Which compiler makes faster machine code (You must write down your calculation)? **[5 pts]**

Compiler 1: $[(2 \times 5) + (3 \times 2) + (4 \times 1)] \times \frac{10^6}{10^9} = 0.02$ second

Compiler 2: $[(2 \times 1) + (3 \times 2) + (4 \times 4)] \times \frac{10^6}{10^9} = 0.024$ second

Compiler 1 is faster

$Final\ Answer =$ **<u>Compiler 1 is faster</u>**

2) Knowing, $Power = Capacitive\ load \times Voltage^2 \times Frequency$, Suppose we have developed new versions of a processor with the following characteristics.

	Version	**Voltage**	**Clock Rate**
a.	Version 1	1.75 V	1.5 GHz
	Version 2	1.2 V	2 GHz
b.	Version 1	1.1 V	3 GHz
	Version 2	0.8 V	4 GHZ

How much has the capacitive load varied between versions for each case if the dynamic power has been reduced by 10%. **[5 pts]**

$$\boldsymbol{a}.\quad \frac{C_2}{C_1} = \frac{0.9 \times 1.75^2 \times 1.5 \times 10^9}{1.2^2 \times 2 \times 10^9} = 1.43$$

$$\boldsymbol{b}.\quad \frac{C_2}{C_1} = \frac{0.9 \times 1.1^2 \times 3 \times 10^9}{0.8^2 \times 4 \times 10^9} = 1.27$$

$Final\ Answer = \frac{C_2}{C_1}\ \boldsymbol{for\ (a) is\ 1.43\ and\ for\ (b) is\ 1.27}$

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Compiler 1 is faster

$Final\ Answer =$ ___ **<u>Compiler 1 is faster</u>**

4) Base on the same assumption in question (1), which compiler generates machine code run at higher MIPS (millions instruction per second) (You must write down your calculation)? [5 pts]

Compiler 1: $\frac{8}{0.02} = 400$ MIPS

Compiler 2: $\frac{7}{0.024} = 291$ MIPS

$Final\ Answer =$ _______________