CMP 334 practice final (Spring 2019)

1) Given: X = 0x6E and Y = 0x9B,

a) Convert X and Y to 8-bit binary numbers.

b) Compute the 8-bit sum $\mathbf{X \dddot{+} Y}$ of X and Y.

c) Compute $\dddot{\mathbf{Y}}$ the 8-bit two's complement of Y.

d) Compute the 8-bit difference $\mathbf{X \ddot{-} Y}$ of X and Y. (Use two's complement addition.)

e) Convert $\mathbf{X \dddot{+} Y}$, $\dddot{\mathbf{Y}}$, and, $\mathbf{X \ddot{-} Y}$ to hexadecimal.

f) What are the values of the condition flags **z n c v** upon computing $\mathbf{X \dddot{+} Y}$?

g) What are the values of the condition flags **z n c v** upon computing $\mathbf{X \ddot{-} Y}$?

h) **T** or **F** The *unsigned* 8-bit sum $\mathbf{X \dddot{+} Y}$ is honest.

i) **T** or **F** The *signed* 8-bit sum $\mathbf{X \dddot{+} Y}$ is honest.

j) **T** or **F** The *unsigned* 8-bit difference $\mathbf{X \ddot{-} Y}$ is honest.

k) **T** or **F** The *signed* 8-bit difference $\mathbf{X \ddot{-} Y}$ is honest.

2) Use the combinational circuit design process:

a) Draw a black box for the circuit that specifies its inputs and output.

b) Formalize the informal semantics of this circuit with a truth table.

c) Construct the boolean formula corresponding to the truth table.

d) Draw the circuit corresponding to the boolean formula.

to design the circuit that takes as input two 2-bit ***signed*** integers **a** and **b** and is **1** if **a•b** > 0

3) Write **TOY** AL subprogram that implements the following subprogram interface:

Label: `ArrayAnd`

On entry:

Register **$1** is the return address of the caller.
A, **B**, and **C** are non overlapping arrays in memory.
Register **$D** contains **n**, the size of all three arrays.

On exit:

C[i] = **A**[i] & **B**[i] for all **i** such that 0 ≤ **i** < **n**.
Otherwise, no values in memory have changed.
Any of the registers may have changed value.

4) Write **TOY** AL subprogram that implements the following subprogram interface:

Label: `Mult`

On entry:

Register **$1** is the return address of the caller.

On exit:

Register **$F** contains the (unsigned) product of the unsigned values in registers **$A** and **$B**. (Note: your result need not be accurate unless these values are less than 256.)
Main memory will not have changed, but any of the registers may have.

Do not write on this exam.

5 a) Computer A had a processor that connects to an L_1 cache with a hit-cost of 1 cycle and a miss-rate of 4%. The L_1 cache connects to a main memory with hit-cost of 600 cycles. What is the ***memory access cost*** of computer A?

b) Computer B is computer A with a L_2 cache between the L_1 cache and main memory with hit-cost of 15 cycles and a miss-rate of 10%. What is the ***memory access cost*** of computer B?

c) Computer C is computer B with an L_3 cache between the L_2 cache and main memory with a hit-cost of 30 cycles and a miss-rate of 20%. What is the ***memory access cost*** of computer C?

d) On program P with an execution consisting of 50% ALU instructions, 20% load instructions, 5% store instructions, and 25% branch instructions, how many memory accesses per instruction are there on computer C? How many ***stall cycles per instruction*** are due to memory accesses on execution of program P on computer C?

6) Consider a disk with the following specifications:

block size	512	bytes
sectors per track	400	
overhead	2.5	ms
seek time	20	ms
rotation speed	12000	RPM

a) How big is a track on this disk in bytes?

b) What is its rotation time in ms?

c) What is its bandwidth in megabytes per second?

d) What would be the data transfer time in ms of a record 768,000 bytes long?

e) What would be the total disk access time in ms for this record?

7) Consider the following TOY Assembly Language instructions:

A)	`add,`	B)	`and,`	C)	`bc,`	D)	`l,`
E)	`lis,`	F)	`nor,`	G)	`st,`	H)	`sub,`

a) Which of these instructions can change the value of a register?

b) Which can change the value of a location in memory?

c) Which can change the program counter?

d) Which can change the value of a condition flag?

e) Which use an immediate value contained in the instruction?

Do not write on this exam.