

QUIZ #04

CSCI-410 Spring 2013

- (12pts) Consider the Hack assembly instruction **D-M**. Show, mathematically, how the ALU configuration that is used to execute this instruction works. **HINT:** Remember the relationships between bitwise inversion and the 1's complement, and 2's complement representations of signed integers.

- (24pts) For each possible bitwise-AND combination of D and M obtainable by selectively inverted inputs and outputs, determine the equivalent bitwise-OR operation, the ALU control signals, and the X-instruction (see extra credit description on ECS 06). The two that are supported by the "official" instruction set are done for you.

AND op	OR op	a	c1	c2	c3	c4	c5	c6	Xnn
D & M	!(!D !M)	1	0	0	0	0	0	0	X40
D & !M									
!D & M									
!D & !M									
!(D & M)									
!(D & !M)									
!(!D & M)									
!(!D & !M)	D M	1	0	1	0	1	0	1	X55

- (4pts) What is the difference in the X-instruction for a particular operation using the contents of memory and the same operation using the contents of the A register? In other words, given an X-instruction that performs an operation using **MEM[A]**, what modification would you need to do so that it used **A** instead?