CS 16 — Sample mid-term exam

1. Use a Karnaugh map to simplify the boolean function described by the truth table below. Draw your rectangles clearly and express your result as a boolean algebraic equation—**do not draw a circuit.**

A	B	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

2. Show that the NAND operator is sufficient to express any combinational logic formula. That is, show that NOR can be used to compute NOT, OR, and AND operators. Present a circuit for each operator, labeling its inputs and outputs clearly.

3. Assume that you have an *addressable memory* that has 8 addressable locations each of which stores 2 bits. Show how this addressable memory can be used to implement the following two combinational formulas:

   - $Y = \bar{A}\bar{B}C + A\bar{B}\bar{C} + A\bar{B}C$
   - $Z = \bar{A}\bar{B}\bar{C} + A\bar{B}C + AB$

4. Recall the basic rules for twos complement addition overflow: If the two inputs have the same sign and the output has a different sign from those two inputs, then overflow has occurred.
   Prove that when the carry-in and carry-out of the most significant bit of a ripple- carry addition differ, that also indicates overflow. That is, show the equivalence of these two methods of overflow detection.