

University of California at Berkeley
College of Engineering
Department of Electrical Engineering and Computer Science

EECS150, Spring 2011

Homework Assignment 9: Combinational Logic
Due April 7th, 2pm

1. DDCA, Problem 2.2
2. DDCA, Problem 2.10
3. DDCA, Problem 2.14
4. DDCA, Problem 2.18
5. DDCA, Problem 2.24
6. Consider the following logic function:

$$F = ab\bar{c} + a\bar{b}\bar{c} + \bar{a}bc + abc$$

- (a) Minimize this logic function using K-maps.
 - (b) Can you further optimize this circuit, for transistor count, beyond your answer in part a? If so, perform these optimizations and report the number of transistors that your solution requires.
7. Consider the following function expressed in two-level *and/or* form.

- (a) Using algebraic manipulation, express the function in three-level *or/and/or* form:

$$F = ac + ad + bc + bd + e$$

- (b) Now assume that you can only use simple logic gates to implement this function (and, or, not, nand, nor). For both the two-level and the three-level forms, determine the cost in transistors, and the delay in terms of “gate delay.” Assume that the gate delay of a given gate is given by the square of the number of inputs.
- (c) Now assume that you only have *2-input gates*. How does that change your answer?

8. Consider the 6 variable K-Map:

ef = 00

		ab			
	cd	00	01	11	10
00		0	1	0	0
01		1	0	0	1
11		1	1	0	0
10		1	1	0	1

ef=01

		ab			
	cd	00	01	11	10
00		0	1	0	1
01		1	0	1	0
11		1	1	0	0
10		0	0	0	1

ef=10

		ab			
	cd	00	01	11	10
00		0	1	1	0
01		0	1	0	1
11		1	1	0	1
10		0	0	0	1

ef=11

		ab			
	cd	00	01	11	10
00		0	1	1	1
01		0	1	1	0
11		1	1	0	1
10		0	0	1	1

Find a minimized boolean expression for this K-Map.

9. **Just for fun. Your answer will not effect your homework score.**

The Evil Cardinal has taken 10 valiant Bears prisoner. He then offers the Bears a game: he will bury them all, in a line, up to their necks in sand so that each Bear will only be able to see the Bears in front of him. He will then place a red or white skullcap on the head of each Bear. Each Bear will then be required to call out the color of the skullcap on his own head. If at least nine of the 10 Bears call out the correct color, the Bears will all be set free; if more than one gets it wrong, they're all dead. Each Bear can only call out "red" or "white"; no other communication is permitted. However, they can confer ahead of time to decide on a strategy. What strategy will permit the Bears to be set free, rather than suffering an ignominious fate (to add insult to permanent injury, the Cardinal is planning to execute the Bears with an Axe)?