Homework 8

Instructor: Sandy Irani

Covers Sections 5.1-5.6
   Please make sure to staple together all the pages of your written homework before putting it in the ICS 6B slot. Also write your student ID number and your name very clearly in the upper right corner of every page. The written portion should be turned into the dropbox labeled "ICS 6B" on the first floor of Bren Hall.

1. Challenge Activities 5.2.1 and 5.6.1.

2. Evaluate the following logical expressions with x = y = 1 and w = z = 0.

   (a) $z\overline{y} + x(\overline{y+z})$

   (b) $\overline{x}y\overline{z}(1+w)$

   (c) $wz\overline{y} + x\overline{z}$

3. Indicate whether the following Boolean expressions are in conjunctive normal form or disjunctive normal form or both or neither.

   (a) $x\overline{y}z + \overline{z}w$

   (b) $\overline{y}x\overline{z}w$

   (c) $(w + \overline{x} + z)(\overline{y} + \overline{w})(x + y + \overline{z})$

   (d) $\overline{x} + (y\overline{z} + zx)w$

   (e) $y(w + \overline{x} + z)(\overline{y} + \overline{w})(x + y + \overline{z})$

   (f) $y(xw + \overline{x} + z)(\overline{y} + \overline{w})(x + y + \overline{z})$

   (g) $(\overline{x+y})(x + \overline{z})$

   (h) $\overline{xy\overline{z}} + \overline{x}w$

   (i) $x + \overline{y} + w$

   (j) $x(w + y)\overline{z} + z\overline{w}$

4. For each function specified by the input/output table, give a Boolean expression that is equivalent to that function. Use the sum of minterm expression discussed in class and described in the text. Then give a CNF Boolean expression equivalent to the expression.

   (a)

x	y	f(x, y)
0	0	0
0	1	1
1	0	1
1	1	1

(b)

x	y	z	f(x, y, z)
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

(c)

x	y	z	f(x, y, z)
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

5. The operation $\rightarrow$ is specified in the table below:

x	y	$x \rightarrow y$
0	0	1
0	1	1
1	0	0
1	1	1

Show that the complement operator along with $\rightarrow$ are functionally complete.

6. For each expression below, give an equivalent expression that only uses the $\downarrow$ operation. Then give an equivalent expression that only uses the $\uparrow$ operation.

(a) $\bar{x} + y$

(b) $\overline{xy}$

7. For each expression below, give an equivalent expression that only uses Boolean addition and complement. Then give an equivalent expression that only uses Boolean multiplication and complement.

(a) $x(w + y)\bar{z} + z\bar{w}$

(b) $\bar{x} + (y\bar{z} + zx)w$

8. Which of the following Boolean expressions are satisfiable? For the expressions that are satisfiable, give a satisfying assignment.

(a) $(\bar{x} + z)(x + y)(\bar{y} + z)$

(b) $(x + z)(x + y)(\bar{y} + \bar{z})\bar{x}$

(c) $(\bar{x} + \bar{z})(x + y)(\bar{y} + z)(x + z)y$

9. Consider a school with four classes and two time slots during which the courses can be scheduled. The classes are named A, B, C, and D. The following pairs of courses can not be scheduled at the same time: (D, C), (A, B), (C, B), (D, A). Express the scheduling problem as a boolean expression.

That is, give a boolean expression that is true if and only if there is a feasible schedule for the courses that satisfies all the constraints.

10. Draw a circuit that computes the function described in the input/output table:

x	y	f(x, y)
0	0	1
0	1	0
1	0	1
1	1	1

11. Draw circuits that compute the following Boolean expressions:
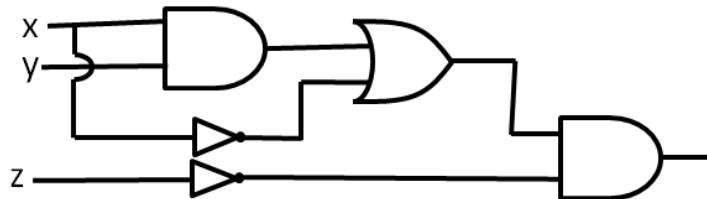
   (a) $(\overline{xy}) + y$

   (b) $\overline{x}(x + y)$

   (c) $(x + y + z)\overline{xyz}$

12. Give a circuit that computes the following function on input variables x, y, and z. If x = 0, the circuit will output y + z. If x = 1, the circuit will output yz. You may need to first construct an input/output table for the function and convert it to a Boolean expression before drawing the circuit.

13. Give equivalent Boolean expressions for the following circuits:

   (a)

   (b)