CSE311 Quiz Section: October 4, 2012

1. Carry look-ahead adder.
2. Find the sum-of-products expansion of the Boolean function $F(w, x, y, z)$ that has the value 1 if and only if an odd number of w, x, y, z have value 1. Standard methodology for sum of products gives us:

   $$F(w,x,y,z) = w^{'}xyz + wx^{'}yz + wxy^{'}z + wxyz^{'} + w^{'}x^{'}y^{'}z + w^{'}x^{'}yz^{'} + wx^{'}y^{'}z^{'} + w^{'}xy^{'}z^{'}$$

3. Construct circuits from inverters, AND gates, and OR gates to produce these outputs.Can you simplify any of them? (Note: A bar above an expression means its negation)
   (a) $\bar{x} + y$
   (b) $xyz + \bar{x}y$

   $$xyz + \bar{x}y = y(xz + \bar{x}) = y((x + \bar{x})(z + \bar{x})) = y((1)(z + \bar{x})) = y(\bar{x} + z)$$

   where in the second step we used the distributive law.
   (c) $(\overline{x+y})(\overline{y+z})(\overline{x+z})$

   Let's calculate the negation of this statement. Then by De Morgan's law:

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

   $$x + y + y + z + x + z = x + y + z$$

   Therefore the initial expression is equal to:

   $$\overline{x + y + z}$$

   This gives a circuit with 3 gates (2 OR, 1 NOT). If we approached this by just applying De Morgan's law, we would get:

   $$\bar{x}\bar{y}\bar{z}$$

   and we would need 5 gates for the circuit (3 NOT, 2 AND).
4. Translate English to logical expressions with nested quantifiers.

   Both editions: 1.5: 9 **The solution is in the book.**