UNIVERSITY OF WESTERN ONTARIO

Computer Science 2209b, Winter 2013-2014

Applied Logic for Computer Science

ASSIGNMENT 3

Given: Monday, March 3, Due: Monday March 10, 5:30pm

1) Use Lipton's DNA algorithm to determine whether the following formula in in the language of propositional calculus is satisfiable.

$$(C \vee \neg G) \wedge (A \vee C \vee G) \wedge (G \vee \neg A) \wedge (A \vee \neg C) \wedge (\neg A \vee \neg C \vee \neg G)$$

Show, in details, the contents of all the intermediate test tubes.

2) Design a combinatorial circuit for a room with four doors, one light and a switch near each door that controls the light. If the position of one switch is changed, the state of the light will change; i.e., if the light is on, it will go off and if it is off, it will go on. Assume that if all switches are closed, the light is on. Use the methodology described in class. Justify your answers.

3) A vending machine is to be designed that will dispense one product that costs 15 cents. The machine will have a sliding bar with three coin positions on it for one quarter (25 cents), one dime (10 cents), and one nickel (5 cents). When the bar is pushed in, a logic network inside the machine will make decisions to dispense the product, alert the change-making device to make change, and/or inform the user that he/she did not insert enough money. (Assume that the change machine inside the vending machine computes and dispenses the correct amount of change.)

Design minimal circuits that will do the following after the bar is pushed in:

(a) If there is no money, turn the insufficient funds light (I).

(b) If there is exactly the right amount of money, dispense the product (P).

(c) If there is too much money, dispense the product (P) and signal the change machine (C).

(d) If there is some money, but not enough, turn on the insufficient funds light (I) and signal the change machine (C).

Use the methodology described in class. Justify your answers.

4) Simplify each of the following formulas using Karnaugh maps. Clearly circle the blocks that you use for simplification in the Karnaugh maps. Use the following standard forms for Karnaugh maps in 3 respectively 4 variables. (It may be necessary to find the full DNF before using a Karnaugh map).

	AB	$A\overline{B}$	$\overline{A}\ \overline{B}$	$\overline{A}B$
C				
$\overline{C}$				

	AB	$A\overline{B}$	$\overline{A}\ \overline{B}$	$\overline{A}B$
CD				
$C\overline{D}$				
$\overline{C}\ \overline{D}$				
$\overline{C}D$				

(i)$ACD \vee \bar{B}CD \vee A\bar{B}\bar{C}\bar{D} \vee AC\bar{D}$

(ii) $ABCD \vee A\bar{B}CD \vee ABC\bar{D} \vee A\bar{B}C\bar{D} \vee \bar{A}B\bar{C}\bar{D} \vee \bar{A}B\bar{C}D$

(iii)$(A \vee B)(B \vee C)(\overline{A} \vee C)$

(iv) $ABCD \vee \overline{(C \vee D)(B \vee C \vee \bar{D})(A \vee C \vee \bar{D})}$

(v) $A\bar{B}CD \vee AB\bar{C}D \vee A\overline{(B \vee C)} \vee \overline{(B \vee C \vee D)} \vee \overline{(A \vee B \vee C)}$