School of Computer Science
Faculty of Science

COMP-2650: Computer Architecture I: Digital Design
Winter 2020

Assignment#	Date	Title	Due Date	Grade Release Date
Lec 08	Week 08	**Karnaugh Map**	March 02, 2021 Tuesday Midnight AoE Wednesday 7 AM EDT	March 08, 2021

The objectives of the lecture (weekly) assignments are to practice on topics covered in the lectures as well as improving the student's critical thinking and problem-solving skills in ad hoc topics that are closely related but not covered in the lectures. Lecture assignments also help students with research skills, including the ability to access, retrieve, and evaluate information (information literacy).

Lecture Assignments Deliverables

You should answer two of the below questions based on your preference using an editor like MS Word, Notepad, and the likes or pen in papers. You have to write and scan the papers clearly and merge them into a single file in the latter case. In the end, you have to submit all your answers in one single pdf file `Lec08_UWinID.pdf` containing the following items:

1. Your name, UWinID, and student number
2. The question Id for each answer. Preferably, the questions should be answered in order of increasing Ids. *Please note that if your answers cannot be read, you will lose marks.*
3. Including the questions in your submission pdf file is optional.

Please follow the naming convention as you lose marks otherwise. Instead of UWinID, use your own UWindsor account name, e.g., mine is hfani@uwindsor.ca, so, my submission would be: `Lec08_hfani.pdf`

Lecture Assignments
(Select Only 2 Questions based on your preference)
Use K-Map method for all simplification tasks!

1. Simplify the following Boolean functions, using three-variable maps:
   a) $F(x, y, z) = \sum(0, 2, 4, 5)$
   b) $F(x, y, z) = \sum(0, 2, 4, 5, 6)$
   c) $F(x, y, z) = \sum(0, 1, 2, 3, 5)$
   d) $F(x, y, z) = \sum(1, 2, 3, 7)$

2. Simplify the following Boolean expressions, using three-variable maps:
   a) $xy + x'y'z' + x'yz'$
   b) $x'y' + yz + x'yz'$
   c) $x'y + yz' + y'z'$
   d) $x'yz + xy'z' + xy'z$

3. Simplify the following Boolean functions, using Karnaugh maps:
   a) $F(A, B, C, D) = \sum(4, 6, 7, 15)$
   b) $F(A, B, C, D) = \sum(3, 7, 11, 13, 14, 15)$
   c) $F(w, x, y, z) = \sum(2, 3, 12, 13, 14, 15)$

d) F (w, x, y, z) = ∑ (11, 12, 13, 14, 15)
e) F (w, x, y, z) = ∑ (8, 10, 12, 13, 14)

4. Simplify the following Boolean expressions, using four-variable maps:
   a) w'z + xz + x'y + wx'z
   b) AD' + B'C'D + BCD' + BC'D
   c) AB'C + B'C'D' + BCD + ACD' + A'B'C + A'BC'D
   d) wxy + xz + wx'z + w'x

5. Find the minterms of the following Boolean expressions by first plotting each function in a map:
   a) xy + yz + xy'z
   b) C'D + ABC' + ABD' + A'B'D
   c) wyz + w'x' + wxz'
   d) A'B + A'CD + B'CD + BC'D'

6. Convert the following Boolean function from a sum-of-products form to a simplified product-of-sums form: F(x, y, z) = ∑(0, 1, 2, 5, 8, 10, 13)

7. Simplify the following Boolean functions:
   a) F(A, B, C, D) = ∏(1, 3, 5, 7, 13, 15)
   b) F(A, B, C, D) = ∏(1, 3, 6, 9, 11, 12, 14)

8. Simplify the following Boolean function F, together with the don't-care conditions d, and then express the simplified function in sum-of-minterms form:
   a) F(x, y, z) = ∑ (0, 1, 4, 5, 62) + d(2, 3, 7)
   b) F(A, B, C, D) = ∑ (0, 6, 8, 13, 14), d(A, B, C, D) = ∑ (2, 4, 10)
   c) F(A, B, C, D) = ∏(5, 6, 7, 12, 14, 15), D(A, B, C, D) = ∏(3, 9, 11, 15)
   d) F(A, B, C, D) = ∏(4, 12, 7, 2, 10) + D(10, 6, 8)

9. Simplify the following functions, and implement them with two-level NOR gate circuits:
   a) F = wx' + y'z' + w'yz'
   b) F(w, x, y, z) = ∑(0, 3, 12, 15)
   c) F(x, y, z) = [(x + y)(x = z)]'

10. Draw the simplified NOR-only circuit for the following expression: CD(B + C) A + (BC' + DE')

11. Draw the simplified NAND-only circuit for the following expression: w(x + y + z) + xyz

12. Obtain the simplified Boolean expressions for output F and G in terms of the input variables in this circuit: