CL=CSCI 160

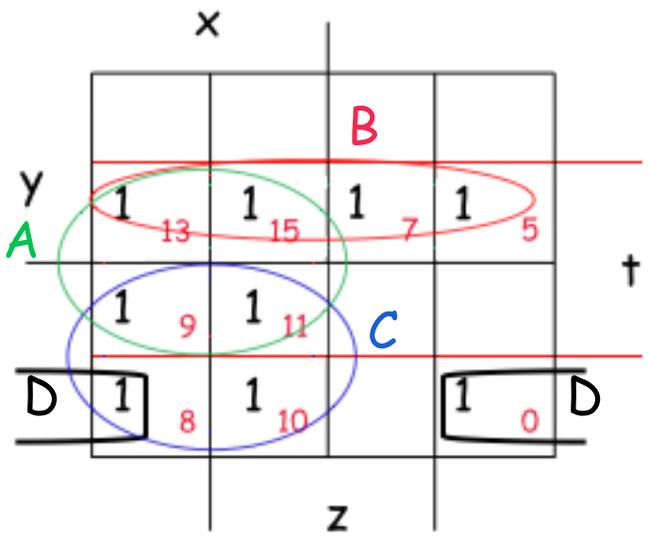
CLASS 14

HW 13.1

$f = \sum (0, 5, 7, 8, 9, 10, 11, 13, 15)$ Give all minimal forms.

Solution - continued from Class 13

We worked up to: $f = x'y'z't' + x'yz't + x'yzt + xy'z't' + xy'z't + xy'zt' + xy'zt + xyz't + xyzt$



Prime implicants: A - D

Essential: B, C, D

It implies all 3 essential prime implicants must be in f:

$f = B + C + D$

All 1's are covered ---> This is the minimal form. What's missing?

Let's write it using variables: $f = yt + xy' + y'z't'$

K map procedure

0) Put the 1's on the K map.
1) Find all prime implicants
2) Find all essentials (implicants)

All essentials are in every minimal form.

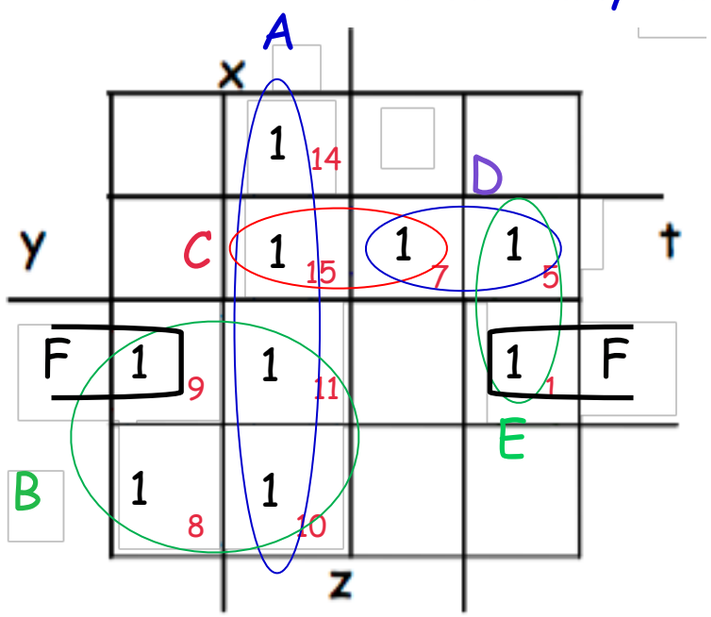
3) **Cover all 1's with the least number of largest (prime) implicants.**
4) Write the minimal form.

HW 13.2 Give all minimal forms for the function:

$$f = \sum(1, 5, 7, 8, 9, 10, 11, 14, 15)$$

Solution

How many variables? 4



Draw 4-variable K map:

Put the 1's on the K map.

Prime implicants: A - F

Essential: A, B

It implies $f = A + B + \ldots$ as A, B do not cover all 1's.

Which 1's (= minterms) still need to be covered? 1, 5, 7

K map procedure

0) Put the 1's on the K map.

1) Find all prime implicants

2) Find all essentials (implicants)

All essentials are in every minimal form.

3) **Cover all 1's with the least number of largest (prime) implicants.**

4) Write the minimal form.

We need at least 2x size-2 implicants to cover the remaining 1's. We must look at them all! Why?

We must be exhaustive in giving all possible minimal coverings.

To list all possibilities, let's take one of these minterms: 7. 7 can only be covered by implicants C and D.

⇨ C or D must be in the minimal form.

Case 1. C is in the minimal form: $f_1 = A + B + C + E$ ⟹ It is a minimal form (has 2x size-2 implicants)

Case 2. D is in the minimal form:

$$f_{2,3} = \begin{cases} A + B + D + E \\ A + B + D + F \end{cases}$$

These are all possible min. forms:

$$\begin{cases} f_1 = xz + xy' + yzt + x'z't \\ f_2 = xz + xy' + x'yt + x'z't \\ f_3 = xz + xy' + x'yt + y'z't \end{cases}$$

We have 3 minimal forms.

HW assigned:

Minimize the functions below, using the K-map method:

HW 14.1

$$f = A'B' + AC' + B'C + A'BC'$$

HW 14.2 - also see next slide!

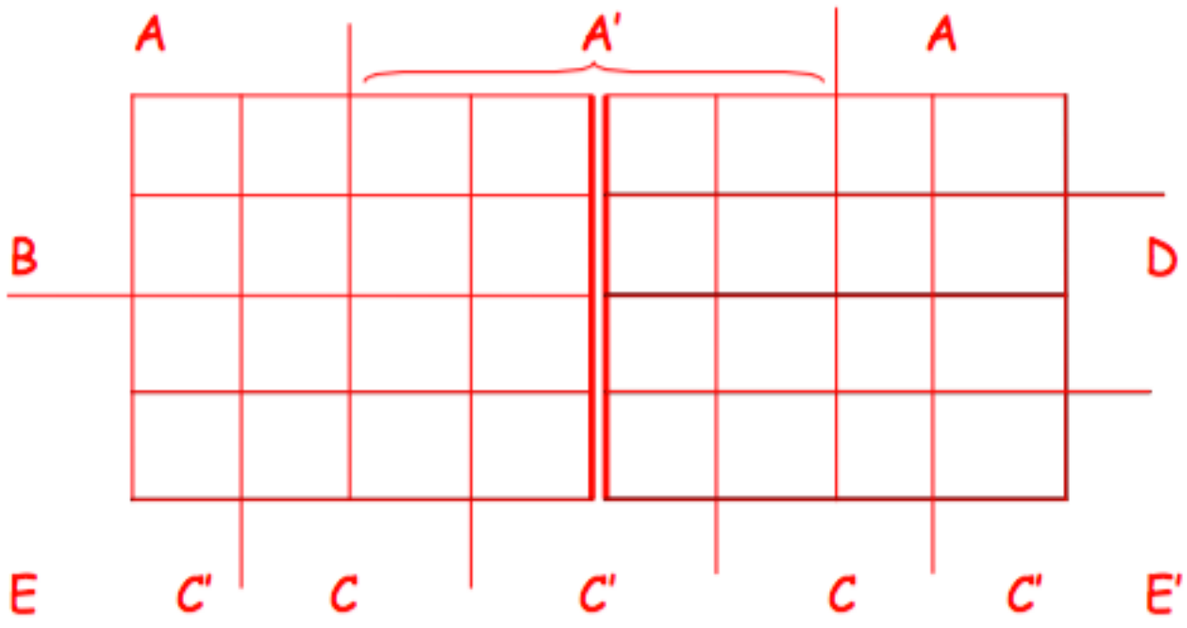
$$f = \sum(0, 1, 4, 5, 16, 17, 21, 25, 29)$$

Note that the variables are named A, B, C, ... for both questions.

For question 14-2, I am also giving you the K-map (for 5 variables) on a separate slide. Use **that** map!

Note that the K-map for 5 variables is formed by putting together (like a book that opens) two adjacent 4-variable maps for A-D; we than just call one of the two maps E, and the other one E'.

Be careful with adjacencies! Note that the prime implicants can only have a size that is a power of 2 (e.g., 1, 2, 4, 8, 16, etc).
The only way to see if an implicant can be formed is to express it as a product of literals, and then, conversely, try to see if that product of literals corresponds to that exact implicant.



5-variable K map:

Use THIS map!

HW assigned - continued

Find all minimal forms of the following functions:

HW 14.3

$f = \Sigma (0, 2 - 7, 11, 15, 16, 18, 19, 23, 27, 31)$

HW 14.4

$f = A'B'CE' + A'B'C'D' + B'D'E' + B'CD' + CDE' + BDE'$