Discussion - Week 3

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(Slides by Behnam Khaleghi)
Outline

• Karnaugh map (K-map) to Boolean expression Conversions
• (Essential) Prime Implicant
• Examples of K-map simplification
• Examples of logic design and simplification using K-maps
Prime Implicant & Essential Prime Implicant

• The prime implicants (PI) of a function can be obtained from the map by combining all possible maximum numbers of squares/cells
• The prime implicant is essential (EPI) if it is the only prime implicant that covers the minterm.
Prime Implicant & Essential Prime Implicant

- Five PI, Two EPI
- EPIs only need to cover solitary “1”s

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Prime Implicant & Essential Prime Implicant

- Seven PI, **Zero** EPI
- EPIs only need to cover solitary “1”s

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For $F(a, b, c, d) = a'b'c'd' + ab'd' + abc'$, find out the minimum number of don’t care minterms that simplifies the F as $ab + b'd'$. 

$F = 0000 + 10x0 + 110x$ \quad \rightarrow \quad F = \sum m(0,8,10,12,13)$

$F_S = 11xx + x0x0$ \quad \rightarrow \quad F_S = \sum m(0,2,8,10,12,13,14,15)$

$\rightarrow D_f = \sum m(2,14,15)$
Operations on K-Maps

- Extendable for other operations:
  - $F_1 \cdot F_2$: The common minterms, $F_1 \cap F_2$
    - $0 \cdot x = 0$
    - $1 \cdot x = x$
  - $F_1 + F_2$: All of occurred minterms, $F_1 \cup F_2$
    - $0 + x = x$
    - $1 + x = 1$
• How many different solutions are there for SOP simplification of
  \( F(a, b, c, d) = \sum m(1,3,5,6,9,10,12,13,14) \)
How about now? $F = \sum m(1,3,5,6,9,10,12,13,14) + d(2)$
Questions?

• Course material
• HW concerns