# CS 362 :: Homework 3
## Karnaugh Maps

Ryan Magdaleno
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References used :: 4-Input Karnaugh Maps (YouTube)

**Problem 1.** Find the simplified expression using the given the K-Maps. Note: the values in $m(\ )$ values are expression are where the minterms have a value of 1. Show your work.

**Solution ::**

a) $F(A, B, C) = \Sigma m(0, 2, 3, 6)$



- $A = 0$, $B = 1$, $C = 0$ or $1$
- $A = 0$, $B = 0$ or $1$, $C = 0$
- $A = 0$ or $1$, $B = 1$, $C = 0$

$$F(A, B, C) = A'B + A'C' + BC'$$

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b) $F(A, B, C) = \Sigma m(0, 1, 2, 4, 5)$



- $A = 0$ or $1$, $B = 0$, $C = 0$ or $1$
- $A = 0$, $B = 0$ or $1$, $C = 0$

$$F(A, B, C) = B' + A'C'$$

c) $F(A, B, C) = \Sigma m(1, 2, 4, 5, 6, 7)$

| | B'C' | B'C | BC | BC' |
|---|---|---|---|---|
| A' | O ⁰ | I ¹ | O ³ | I ² |
| A | I ⁴ | I ⁵ | I ⁷ | I ⁶ |

- $A = 1$, $B = 0$ or $1$, $C = 0$ or $1$
- $A = 0$ or $1$, $B = 1, C = 0$
- $A = 0$ or $1$, $B = 0, C = 1$

$$F(A, B, C) = A + BC' + B'C$$

**Problem 2.** Find the simplified expression using the given the K-Maps. Note: the values in $m(\ )$ values are expression are where the minterms have a value of 1. Show your work.
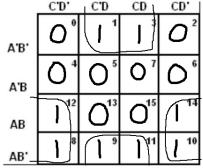
**Solution ::**

a) $F(A, B, C, D) = \Sigma m(0, 2, 8, 9, 10, 13)$



- $A = 0$ or $1$, $B = 0$, $C = 0$ or $1$, $D = 0$
- $A = 1$, $B = 0$ or $1$, $C = 0$, $D = 1$

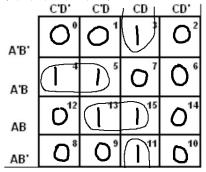$$F(A, B, C, D) = B'D' + AC'D$$

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b) $F(A, B, C, D) = \Sigma m(1, 3, 8, 9, 10, 11, 12, 14)$



- $A = 0$ or $1$, $B = 0$, $C = 0$ or $1$, $D = 1$
- $A = 1$, $B = 0$ or $1$, $C = 0$ or $1$, $D = 0$

$$F(A, B, C, D) = B'D + AD'$$

c) $F(A, B, C, D) = \Sigma m(3, 4, 5, 11, 13, 15)$

|  | C'D' | C'D | CD | CD' |
|---|---|---|---|---|
| A'B' | 0 `0` | 0 `1` | 1 `3` | 0 `2` |
| A'B | 1 `4` | 1 `5` | 0 `7` | 0 `6` |
| AB | 0 `12` | 1 `13` | 1 `15` | 0 `14` |
| AB' | 0 `8` | 0 `9` | 1 `11` | 0 `10` |

- $A = 1$, $B = 1$, $C = 0$ or $1$, $D = 1$
- $A = 0$, $B = 1$, $C = 0$, $D = 0$ or $1$
- $A = 0$ or $1$, $B = 0$, $C = 1$, $D = 1$

$$F(A, B, C, D) = ABD + A'BC' + B'CD$$

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d) $F(A, B, C, D) = \Sigma m(1, 5, 7, 9, 13, 15)$

|  | C'D' | C'D | CD | CD' |
|---|---|---|---|---|
| A'B' | 0 `0` | 1 `1` | 0 `3` | 0 `2` |
| A'B | 0 `4` | 1 `5` | 1 `7` | 0 `6` |
| AB | 0 `12` | 1 `13` | 1 `15` | 0 `14` |
| AB' | 0 `8` | 1 `9` | 0 `11` | 0 `10` |

- $A = 0$ or $1$, $B = 1$, $C = 0$ or $1$, $D = 1$
- $A = 0$ or $1$, $B = 0$ or $1$, $C = 0$, $D = 1$

$$F(A, B, C, D) = BD + C'D$$

**Problem 3.** Find the simplified expression using the given the K-Maps. Note: the values in $m(\ )$ values are expression are where the minterms have a value of 1. The $d(\ )$ values are where the minterms are "don't care" conditions. Show your work.
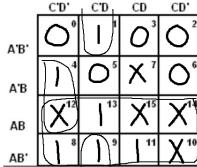
**Solution ::**

a) $F(A, B, C, D) = \Sigma m(1, 5, 7, 11) + \Sigma d(3, 4, 13, 14)$



- $A = 0$, $B = 0$ or 1, $C = 0$ or 1, $D = 1$
- $A = 0$ or 1, $B = 0$, $C = 1$, $D = 1$

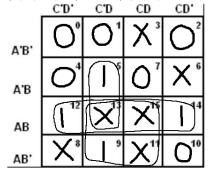$$F(A, B, C, D) = A'D + B'CD$$

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b) $F(A, B, C, D) = \Sigma m(1, 4, 8, 9, 11, 13) + \Sigma d(7, 10, 12, 14, 15)$



- $A = 0$ or 1, $B = 1$, $C = 0$, $D = 0$
- $A = 0$ or 1, $B = 0$, $C = 0$, $D = 1$
- $A = 1$, $B = 0$ or 1, $C = 0$ or 1, $D = 0$ or 1

$$F(A, B, C, D) = BC'D' + B'C'D + A$$

c) $F(A, B, C, D) = \Sigma m(5, 9, 12, 14) + \Sigma d(3, 6, 8, 11, 13, 15)$



| | C'D' | C'D | CD | CD' |
|---|---|---|---|---|
| A'B' | O$^0$ | O$^1$ | X$^3$ | O$^2$ |
| A'B | O$^4$ | I$^5$ | O$^7$ | X$^6$ |
| AB | I$^{12}$ | X$^{13}$ | X$^{15}$ | I$^{14}$ |
| AB' | X$^8$ | I$^9$ | X$^{11}$ | O$^{10}$ |

- $A = 1$, $B = 0$ or $1$, $C = 0$ or $1$, $D = 1$
- $A = 1$, $B = 1$, $C = 0$ or $1$, $D = 0$ or $1$
- $A = 0$ or $1$, $B = 1$, $C = 0$, $D = 1$

$$F(A, B, C, D) = AD + AB + BC'D$$

6