Boolean algebra

4-1. Simplify the following expressions using Boolean algebra.

(a) $x = ABC + \overline{A}C$

(b) $y = (Q + R)(\overline{Q} + \overline{R})$

(c) $w = ABC + A\overline{B}C + \overline{A}$

(d) $q = \overline{RST}\,(\overline{R + S + T})$

(e) $x = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}BC + ABC + A\overline{B}\,\overline{C} + A\overline{B}C$

(f) $z = (B + \overline{C})(\overline{B} + C) + \overline{\overline{A} + B + \overline{C}}$

(g) $y = \overline{(C + D)} + \overline{A}C\overline{D} + A\overline{B}\,\overline{C} + \overline{A}\,\overline{B}CD + AC\overline{D}$

(h) $x = AB(\overline{\overline{C}D}) + \overline{A}BD + \overline{B}\,\overline{C}\,\overline{D}$

K-Map

- Use a K map to simplify (all possible cases)
  1. F(A,B,C) = $\sum(1, 2, 3, 4, 6, 7)$
  2. F(A,B,C,D) = $\sum(1, 3, 4, 5, 6, 7, 12, 13)$
  3. F(A,B,C,D) = $\sum(2, 5, 7, 8, 10, 12, 13, 15)$
  4. F(A,B,C,D) = $\sum(0, 6, 8, 9, 10, 11, 13, 14, 15)$
  5. F(A,B,C,D) = $\sum(0, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15)$
  6. F(D,C,B,A) = $\sum(0, 2, 3, 5, 7, 8, 10, 11, 12, 13, 14, 15)$
  7. F(D,C,B,A) = $\sum(0, 1, 4, 5, 7, 8, 10, 13, 14, 15)$
  8. F(D,C,B,A) = $\sum(1, 2, 5, 10, 12) + \sum d(0, 3, 4, 8, 13, 14, 15)$

K-Map (Cont)

- Use a K map to simplify (all possible cases)
  1. F(A,B,C,D) = $\sum m(0,1,2,5,7,8,10,14,15) + d(3,13)$
  2. F(A,B,C,D) = $\prod M(1,3,4,5,11,12,14,15) \,.\, D(0,6,7,8)$
  3. F(A,B,C,D) = $\sum m(1,3,6,8,11,14) + d(2,4,5,13,15)$
  4. F(A,B,C,D) = $\prod(1,5,6,7,9,11,15) \,.\, D(0,2,3,8,14)$
  5. F(D,C,B,A) = $\prod M(0,3,6,9,11,13,14) . D(5,7,10,12)$
  6. F(D,C,B,A) = $\sum(0,1,4,6,10,14) + d(5,7,8,9,11,12,15)$
  7. F(E,D,C,B,A) = $\sum m(1,3,10,14,21,26,28,30) + d(5,12,17,29)$
  8. F(A,B,C,D) = $\prod M(0,2,3,4,7,8)$

2-input NAND gates

- The following function is in minimum sum of products form. Implement it using only two-input NAND gates. No gate may be used as a NOT gate.
- $G = ABCE' + A'B'E' + B'C'E + A'BCE + AD'$
- $K = x'y'b + x'yb' + xy'b' + xyb$