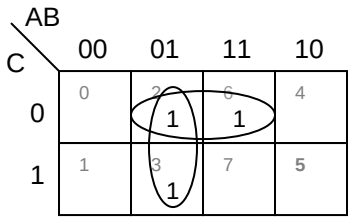
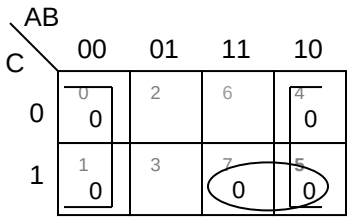
CE-210 Digital Systems I
Assignment #4 – Solution

1- Use K-maps to obtain a minimal SOP and a minimal POS for the following function. Which realization, SOP or POS, is more cost-effective?

$Y = \prod_{A, B, C}(0, 1, 4, 5, 7)$



Y = A'.B + B.C' 2 terms



Less HW Y = B.(A' + C') 2 terms

2- For each of the following functions obtain

all on-set prime implicants and all off-set prime implicants,

all distinguished 1-cells and all distinguished 0-cells,

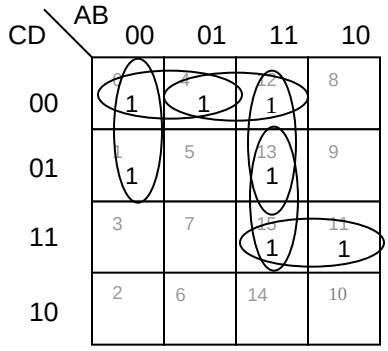
all essential on-set prime implicants and all essential off-set prime implicants,

a minimal SOP and a minimal POS.

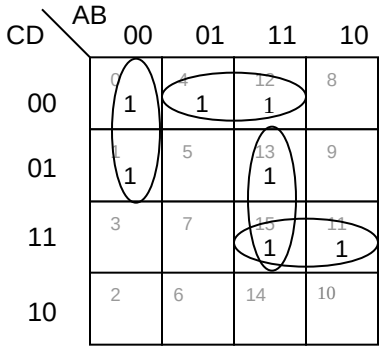
Also determine which realization, SOP or POS, needs less hardware.

Note: For each function, draw a K-map to show all the on-set prime implicants and another K-map to show the minimal SOP. If these two K-maps are identical, then one K-map is sufficient. Similarly, draw a K-map to show all the off-set prime implicants and another K-map to show the minimal POS. Again, if these two K-maps are identical, then one K-map is sufficient.

$Y = \Sigma_{A, B, C, D} (0, 1, 4, 11, 12, 13, 15)$



All the prime implicants

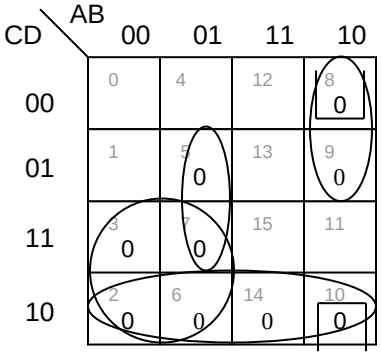


On-set prime implicants (write p-terms) = { ACD, A'B'C', BC'D', ABD, A'C'D', ABC'}

Distinguished 1-cells (write cell numbers) = {1, 11}

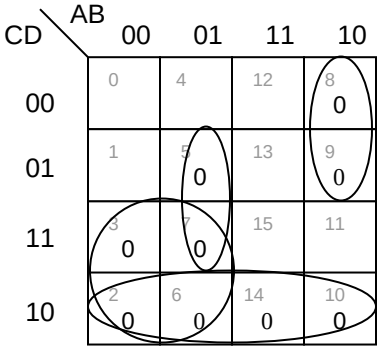
Essential on-set prime implicants (write p-terms) = {A'B'C', ACD}

Minimal SOP = ACD + A'B'C' + BC'D' + ABD 4 terms



All the prime implicants

Less HW



Off-set prime implicants (write s-terms) = {(A+C'), (A+B'+D'), (A'+ B + C),(C' + D), (A' + B + D)}

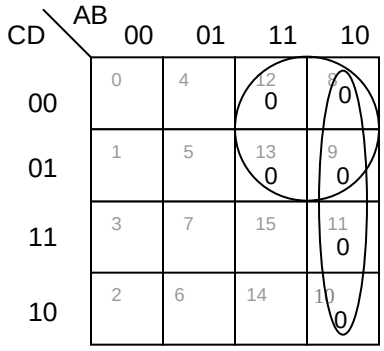
Distinguished 0-cells (write cell numbers) = {3, 5, 9, 14}

Essential off-set prime implicants (write s-terms) = {(A+C'), (A+B'+D'), (A'+ B + C), (C' + D)}

Minimal POS = (A+C') . (A+B'+D') . (A'+ B + C) . (C' + D) 4 terms

Which realization (SOP or POS) needs less hardware? POS.

$Y = \Sigma_{A, B, C, D} (0, 1, 2, 3, 4, 5, 6, 7, 14, 15)$

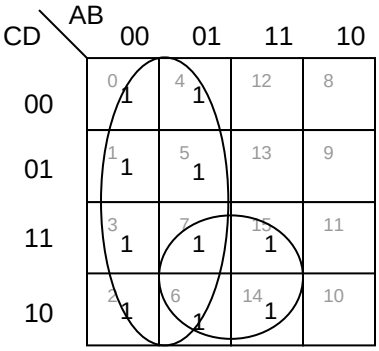


Off-set prime implicants (write s-terms) = {(A' + C), (A' + B)}

Distinguished 0-cells (write cell numbers) = {10, 11, 12, 13}

Essential off-set prime implicants (write s-terms) = {(A' + C), (A' + B)}

Minimal POS = (A' + C) . (A' + B) 2 terms



Less HW

On-set prime implicants (write p-terms) = {A', BC}

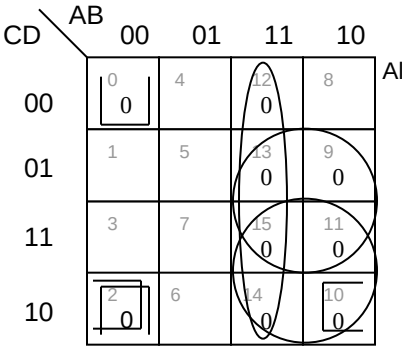
Distinguished 1-cells (write cell numbers) = {0, 1, 2, 3, 4, 5, 14, 15}

Essential on-set prime implicants (write p-terms) = {A', BC}

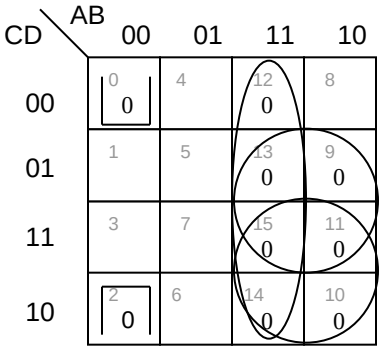
Minimal SOP = A' + BC 2 terms

Which realization (SOP or POS) needs less hardware? SOP

$Y = \prod_{A, B, C, D} (0, 2, 9, 10, 11, 12, 13, 14, 15)$



All the prime implicants

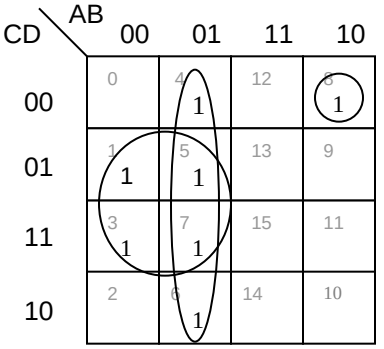


Off-set prime implicants = {(A + B + D), (A’ + D’), (A’ + C’), (B + C’ + D), (A’ + B’)}

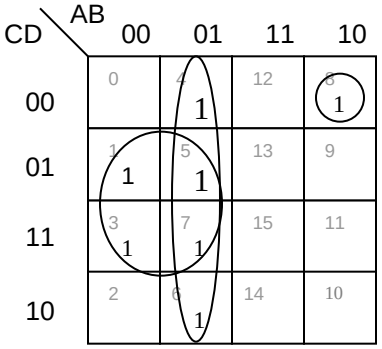
Distinguished 0-cells (write cell numbers) = {0,9,12}

Essential off-set prime implicants (write s-terms) = {(A + B + D), (A’ + B’), (A’ + D’)}

Minimal POS = (A + B + D) . (A’ + B’) . (A’ + D’) . (A’ + C’) 4 terms



All the prime implicants



On-set prime implicants (write p-terms) = {A’D, A’B, AB’C’D’}

Distinguished 1-cells (write cell numbers) = {1, 3, 4, 6, 8}

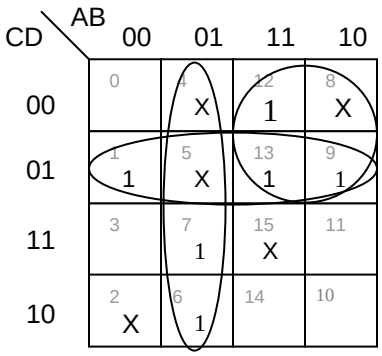
Essential on-set prime implicants (write p-terms) = {A’D, A’B, AB’C’D’}

Minimal SOP = A’D + A’B + AB’C’D’ 3 terms

Which realization (SOP or POS) needs less hardware? SOP; additionally SOP has fewer terms.

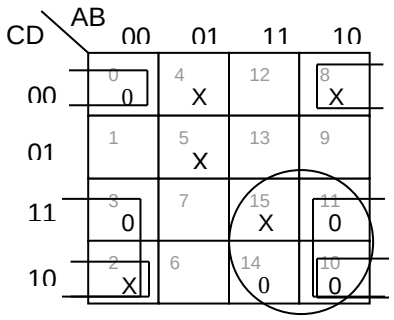
3- Use K-maps to obtain a minimal SOP and a minimal POS for each of the following incompletely specified functions. Which realization, SOP or POS, is more cost-effective?

$Y = \prod_{A, B, C, D} (0, 3, 10, 11, 14) \cdot D(2, 4, 5, 8, 15)$



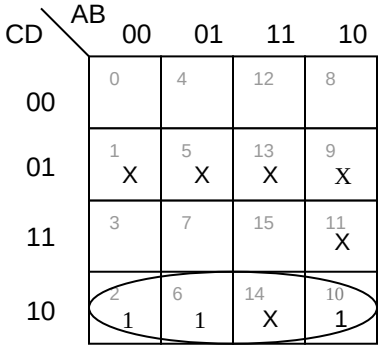
$Y = A'B + C'D + AC'$
3 terms

The same number of terms.



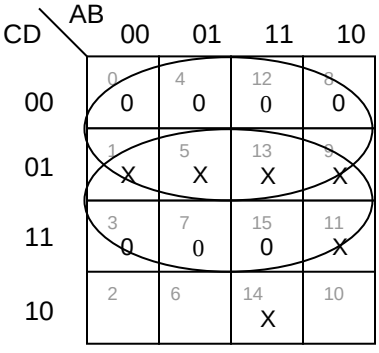
$Y = (B+D) \cdot (A'+C') \cdot (B+C')$
3 terms

$Y = \Sigma_{A, B, C, D} (2, 6, 10) + D(1, 5, 9, 11, 13, 14)$



$Y = CD'$
1 term

SOP & POS are the same



$Y = CD'$
1 term