* Simplify using kmaps
* Ex

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| x\yz | 00 | 01 | 11 | 10 |
| 0 | 111 | 1 |  | 1 |
| 1 | 1 |  | 1 |  |

* + F = x'y' + y'z' + x'z' + xyz
  + 3 var – group of 1 square => 3 var in term
  + 2 var – group of 1 square => 2 var in term
  + " 4 " => 1 var in term
  + " 8 " => 0 var in term
* Simplify using kmap
* EX
  + F(x,y,z) = (sigma) (3,4,6,7)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| x\yz | 00 | 01 | 11 | 10 |
| 0 |  |  | 1 |  |
| 1 | 1 |  | 1 | 1 |

* + F = yz + xz'
* 4 Var kmap

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| wx\yz | 00 | 01 | 11 | 10 |
| 00 | M(0) | M(1) | M(3) | M(2) |
| 01 | M(4) | M(5) | M(7) | M(6) |
| 11 | M(12) | M(13) | M(15) | M(14) |
| 10 | M(8) | M(9) | M(11) | M(10) |

* + Group of 1 square => 4 var in term
  + " 2 " => 3 vars
  + " 4 " => 2 vars
  + " 8 " => 1 var
  + " 16 " => 0 var -> F is always 1
* EX: simplify using kmap
  + F(w,x,y,z) = wyz + w'x + z'

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| wx\yz | 00 | 01 | 11 | 10 |
| 00 | 1 |  |  | 1 |
| 01 | 1 | 1 | 1 | 1 |
| 11 | 1 |  | 1 | 1 |
| 01 | 1 |  | 1 | 1 |

* + F = z' + w'x + wy
* EX: simplify using kmaps
  + F = (sigma)(0,2,3,5,6,7,8,10,11,14,15)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ab\cd | 00 | 01 | 11 | 10 |
| 00 | 1 |  | 1 | 1 |
| 01 |  | 1 | 1 | 1 |
| 11 |  |  | 1 | 1 |
| 10 | 1 |  | 1 | 1 |

* + F = b'd' + c + a'bd
* Ex : simplify using kmaps – 3 var in boolean
  + F(x,y,z) = x'y' + yz + x'yz'

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| x\yz | 00 | 01 | 11 | 10 |
| 0 | 1 | 1 | 1 | 1 |
| 1 |  |  | 1 |  |

* + F = x' + yz
* EX: simplify using kmaps - 4 vars in boolean
  + F(a,b,c,d) = a'b'c'd'+ ac'd' + b'cd' + a'bcd + bc'd

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ab\cd | 00 | 01 | 11 | 10 |
| 00 | 1 |  |  | 1 |
| 01 |  | 1 | 1 |  |
| 11 | 1 | 1 |  |  |
| 10 | 1 |  |  | 1 |

* + F = b'd' + a'bd + abc'
* K-maps are always in the sum of product form (SOP)
  + Obtain the function in the product of sum (POS)
    - Find the SOP of f' => SOP
    - Take the compl of f' => (f')' of (sop)' => POS
    - (f')' = using demorgans thm => SOP => POS
    - Ex: Find F in POS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ab\cd | 00 | 01 | 11 | 10 |
| 00 | 0 | 1 | 1 | 1 |
| 01 | 0 | 1 | 1 | 0 |
| 11 | 0 | 1 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0 |
|  |  |  |  |  |

* + F' = a'c'd' + bd' + ac (SOP)
  + F = (f')' = [a'c'd' + bd' + ac]
    - (a'c'd')' (bd')' (ac)'
    - (a+c+d)(b'+d)(a'+c') (POS)
* Ex : Simplify
  + F = (a+b+c') (a'+c)(a+d) (POS -> SOP)
  + F' = a'b'c + ac' +a'd'

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ab\cd | 00 | 01 | 11 | 10 |
| 00 | 0 | 1 | 0 | 0 |
| 01 | 0 | 1 | 1 | 0 |
| 11 | 0 | 0 | 1 | 1 |
| 10 | 0 | 0 | 1 | 1 |

* + F = a'c'd + a'bd + ac
* EX : F(a,b,c,d) = (pi)(1,3,5,7,13,15) => pos

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ab\cd | 00 | 01 | 11 | 10 |
| 00 |  | 0 | 0 |  |
| 01 |  | 0 | 0 |  |
| 11 |  | 0 | 0 |  |
| 10 |  |  |  |  |

* + F' = a'd + bd
  + (f')' = f = (a'd + bd)'
    - (a'd)' (bd)'
    - (A+d')(b'd')
* Don’t care conditions
  + (x,y,z) go into a sensor and output is F
  + You know these will never happen (101,110,111)

|  |  |
| --- | --- |
| X y z | f |
| 000 | 0 |
| 001 | 1 |
| 010 | 1 |
| 011 | 0 |
| 100 | 1 |
| 101 | x |
| 110 | x |
| 111 | x |

* + X's can be considered 1s or 0s

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| x\yz | 00 | 01 | 11 | 10 |
| 0 |  | 1 |  | 1 |
| 1 | 1 | x | x | x |

* + F = x + y'z + yz'
* PR: simplify with don’t care conditions, express f as (sigma) of minterms
  + A) F(x,y,z) = (sigma) (2,3,4,6) : D(x,y,z) = (sigma) (0,1,5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| x\yz | 00 | 01 | 11 | 10 |
| 0 | x | x | 1 | 1 |
| 1 | 1 | x | 0 | 1 |

* + F = x' + z' (boolean exp)
  + (sigma) (0,1,2,3,4,6) (sum of minterms)
* PR : Simplify with don’t care conditions
  + B) F(a,b,c,d) = (sigma) (0,6,8,13,14) : D(a,b,c,d) = (sigma) (2,4,10)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ab\cd | 00 | 01 | 11 | 10 |
| 00 | 1 |  |  | x |
| 01 | x |  |  | 1 |
| 11 |  | 1 |  | 1 |
| 10 | 1 |  |  | x |

* + Boolean – F = b'd' + cd' + abc'd
  + Sum of min terms = (sigma) (0,2,6,8,10,13,14)