Akmal Ramadhan - PSD B - 2206081534

Tugas Mandiri - 3

Pengantar Sistem Digital
2022/2023 - 1

Petunjuk pengerjaan:

- Kerjakan dengan tulisan tangan atau diketik.
- Tuliskan Nama, Kelas, dan NPM pada setiap lembar jawaban.
- Tuliskan penjelasan dari cara mendapatkan jawaban tersebut.
- Apabila ditulis tangan, hasil pekerjaan di scan / foto dan dimasukan ke dalam satu file berformat .pdf.
- Format nama file (tanpa tanda kurung) : **[KodeAsdos]_TM3_[Nama]_[NPM].pdf**.
- Tugas mandiri dikumpulkan Jumat, 7 Oktober 2022 pukul 17.00 pada slot yang sudah disediakan di SCELE.
- Jika **mengumpulkan telat sebelum pukul 23:59 pada hari yang sama**, akan dikenakan **penalti sebesar 50 poin**. Terlebih dari waktu tersebut, tugas mandiri **tidak akan dinilai**
- Jika perlu pembulatan, bulat ke atas pada digit ke-n! (Dalam kasus pembulatan biner, digit "terakhir" akan selalu 1)

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1) (27 poin) Sederhanakan fungsi berikut menggunakan aljabar boolean, tulis hukum yang digunakan. Dan hitung banyak L, G, GN sebelum dan setelah simplifikasi.
   a) F(A,B,C,D) = $\overline{A}CD + A.(C.D + B) + \overline{B}C\overline{D}$

      Sebelum Simplifikasi

      Literal cost (L): 10

      Gate input cost (G): 15

      Gate input cost with NOTs (GN): 18

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Simplifikasi

F(A,B,C,D) = $\overline{A}CD + A.(C.D + B) + \overline{B}C\overline{D}$

$= \overline{A}CD + ACD + AB + \overline{B}C\overline{D}$ Distributive Law

$= CD(\overline{A} + A) + AB + \overline{B}C\overline{D}$ Distributive Law

$= CD(1) + AB + \overline{B}C\overline{D}$ Inverse Law

$= CD + AB + \overline{B}C\overline{D}$ Identity Law

$= AB + C(D + \overline{BD})$ Distributive Law

$= AB + C(D + \overline{B})$ Absorption Law

Sesudah Simplifikasi

Literal cost (L): 5

Gate input cost (G): 8

Gate input cost with NOTs (GN): 9

b) F(A,B,C,D) = $(\overline{B} + \overline{C}).(\overline{B} + D) + A.C.D$

Sebelum Simplifikasi

Literal cost (L): 7

Gate input cost (G): 11

Gate input cost with NOTs (GN): 14

Simplifikasi

F(A,B,C,D) = $(\overline{B} + \overline{C}).(\overline{B} + D) + A.C.D$

$= \overline{B}(\overline{B} + D) + \overline{C}(\overline{B} + D) + A.C.D$ Distributive Law

$= \overline{B\overline{B}} + \overline{B}D + \overline{B\overline{C}} + \overline{C}D + A.C.D$ Distributive Law

$= \overline{B} + \overline{B}D + \overline{B\overline{C}} + \overline{C}D + A.C.D$ Idempotent Law

$= \overline{B} + \overline{B\overline{C}} + \overline{C}D + A.C.D$ Absorption Law

$= \overline{B} + \overline{C}D + A.C.D$ Absorption Law

$= \overline{B} + AD + \overline{C}D$ Absorption Law

$= \overline{B} + D(A + \overline{C})$ Distributive Law

Sesudah Simplifikasi

Literal cost (L): 4

Gate input cost (G): 6

Gate input cost with NOTs (GN): 8

c) F(A,B,C,D) $= C.\overline{D}.(A + B) + \overline{C} + D$

Sebelum Simplifikasi

Literal cost (L): 6

Gate input cost (G): 8

Gate input cost with NOTs (GN): 10

Simplifikasi

F(A,B,C,D) $= C.\overline{D}.(A + B) + \overline{C} + D$

$= AC\overline{D} + BC\overline{D} + \overline{C} + D$ Distributive Law

$= A\overline{D} + \overline{C} + BC\overline{D} + D$ Absorption Law

$= A\overline{D} + \overline{C} + BC + D$ Absorption Law

$= A\overline{D} + \overline{C} + B + D$ Absorption Law

$= A + B + \overline{C} + D$ Absorption Law

Sesudah Simplifikasi

Literal cost (L): 4

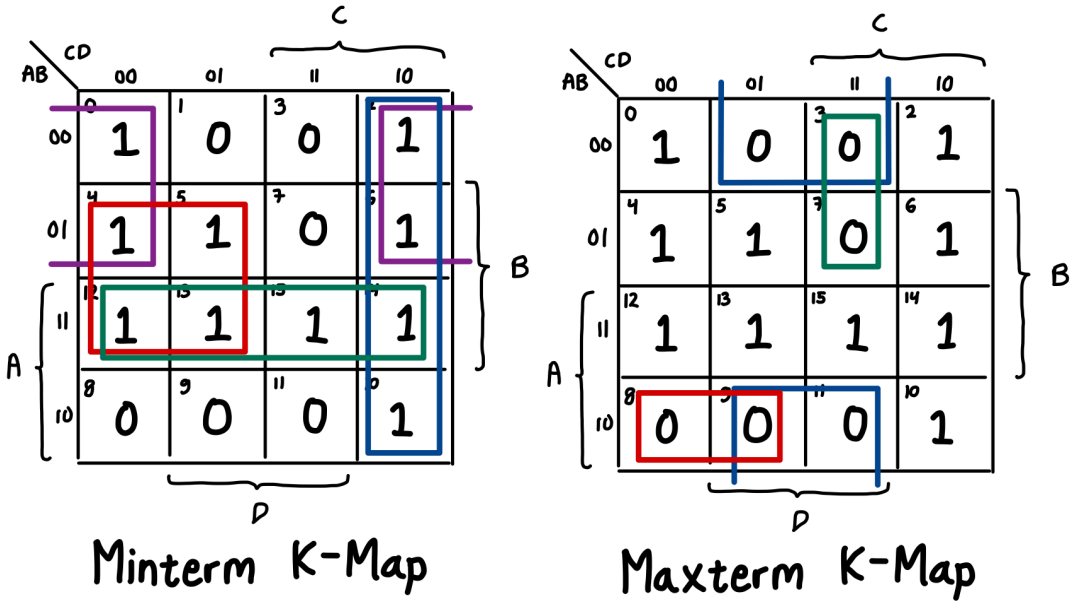
Gate input cost (G): 4

Gate input cost with NOTs (GN): 5

2) (27 poin) Optimalkan fungsi-fungsi berikut menggunakan K-Map dan cari bentuk paling sederhana dari SOP dan POS-nya.

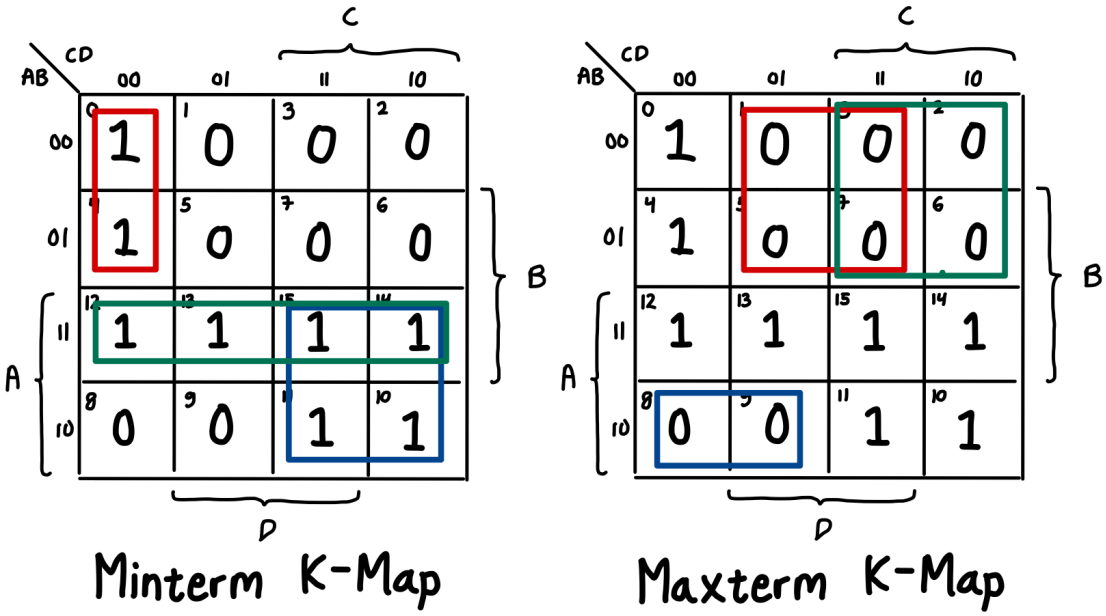
a) F(A,B,C,D) =Σm (0,2,4,5,6,10,12,13,14,15)

K-Map:



SOP: A'D' + BC' + AB + CD'
POS: (AB'C' + B'D + A'CD)' = (A'+B+C)(B+D')(A+C'+D')

b) F(A,B,C,D) =ΠM (1,2,3,5,6,7,8,9)
K-Map:



SOP: A'C'D' + AB + AC
POS: (AB'C' + A'D + A'C)' = (A'+B+C)(A+D')(A+C')

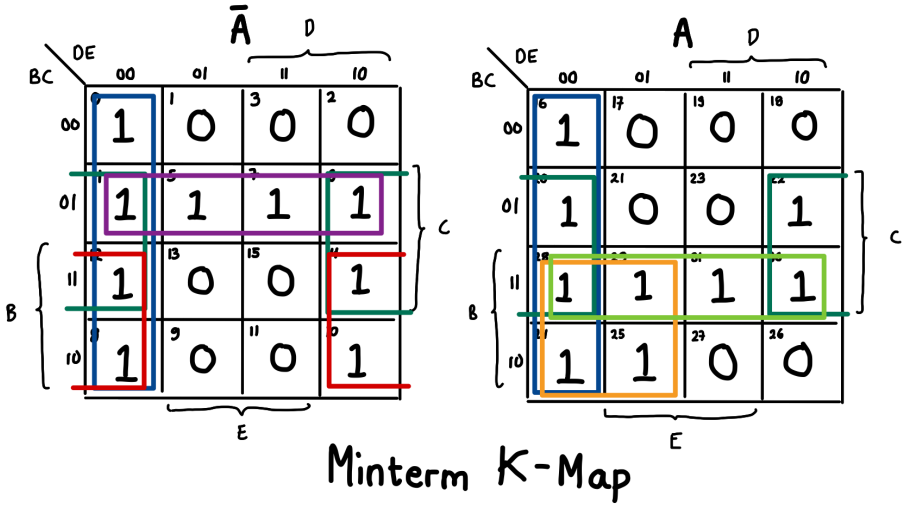
c) F(A,B,C,D,E) $= (\overline{E} + A.B).(C + \overline{D}) + \overline{A}.(\overline{B}.C + B.\overline{E})$

$= (\overline{E} + A.B).(C + \overline{D}) + \overline{A}\overline{B}C + \overline{A}B\overline{E}$ Distributive Law

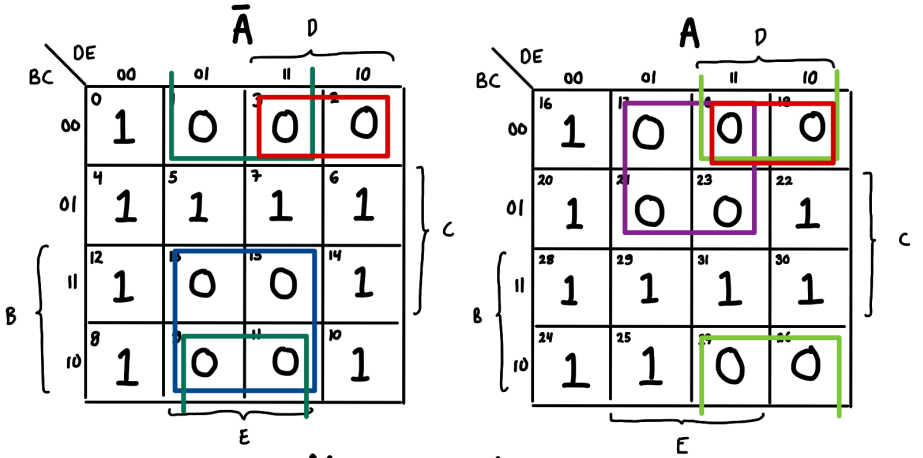
$= \overline{E}(C + \overline{D}) + AB(C + \overline{D}) + \overline{A}\overline{B}C + \overline{A}B\overline{E}$ Distributive Law

$= \overline{E}C + \overline{E}\,\overline{D} + ABC + AB\overline{D} + \overline{A}\,\overline{B}\,C + \overline{A}B\overline{E}$ Distributive Law

K-Map:



Minterm K-Map



Maxterm K-Map

SOP: D'E' + CE' + A'BE' + ABD' + ABC + A'B'C

POS:

$= \overline{\overline{A}BE + \overline{A}\,\overline{C}E + \overline{B}\,\overline{C}\,D + A\overline{B}E + A\overline{C}D}$

$= (A + \overline{B} + \overline{E})(A + C + \overline{E})(\overline{B} + C + \overline{D})(\overline{A} + B + \overline{E})(\overline{A} + C + \overline{D})$

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3) (18 poin) Optimalkan fungsi-fungsi berikut menggunakan aljabar boolean dan buat tabel kebenarannya.

a) F(A,B,C,D) $= A.\overline{B} + \overline{C}.(D + A.B + \overline{A}.B)$

$= A.\overline{B} + \overline{C}.(D + B(A + \overline{A}))$ Distributive Law

$= A.\overline{B} + \overline{C}.(D + B(1))$ Inverse Law

$= A.\overline{B} + \overline{C}.(D + B)$ Identity Law

Truth Table:

A	B	C	D	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

b) F(A,B,C,D) $= A.\overline{B} + D(B.\overline{C} + \overline{A}.\overline{B}) + AB\overline{D}$

$= A(\overline{B} + B\overline{D}) + D(B.\overline{C} + \overline{A}\,\overline{B})$ Distributive Law

$= A(\overline{B} + \overline{D}) + D(B.\overline{C} + \overline{A}\,\overline{B})$ Absorption Law

$= A\overline{B} + A\overline{D} + DB\overline{C} + D\overline{A}\,\overline{B}$ Distributive Law

$= (A + D\overline{A})\,\overline{B} + A\overline{D} + DB\overline{C}$ Distributive Law

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$= (A + D)\,\overline{B} + A\overline{D} + DB\overline{C}$ Absorption Law

$= A\overline{B} + D\overline{B} + A\overline{D} + DB\overline{C}$ Distributive Law

$= A\overline{B} + A\overline{D} + D(\overline{B} + B\overline{C})$ Distributive Law

$= A\overline{B} + A\overline{D} + D(\overline{B} + \overline{C})$ Absorption Law

$= A\overline{B} + A\overline{D} + \overline{B}D + \overline{C}D$ Distributive Law

$= A\overline{D} + \overline{B}D + \overline{C}D$ Consensus Law

$= A\overline{D} + D(\overline{B} + \overline{C})$ Distributive Law

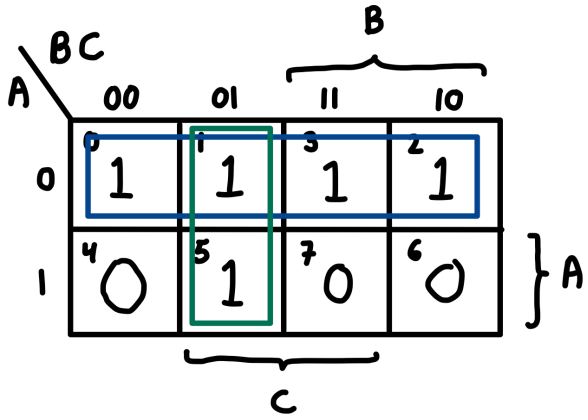
Truth Table:

A	B	C	D	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

4) (18 poin) Optimalkan fungsi-fungsi berikut menggunakan K-Map dan implementasikan dengan NOR atau NAND gate.

a) F(A, B, C) = $\overline{A}\,\overline{B} + \overline{A}B + A\overline{B}C$ (gunakan NAND gate)

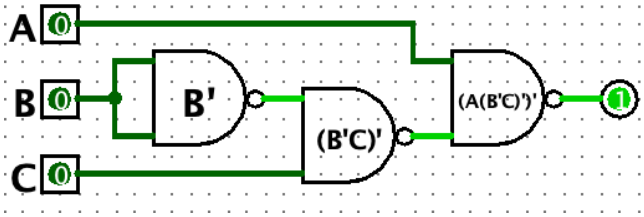
Minterm K-Map:



F(A, B, C) = $\overline{A} + \overline{B}C$

Dengan mengimplementasikan NAND gate:

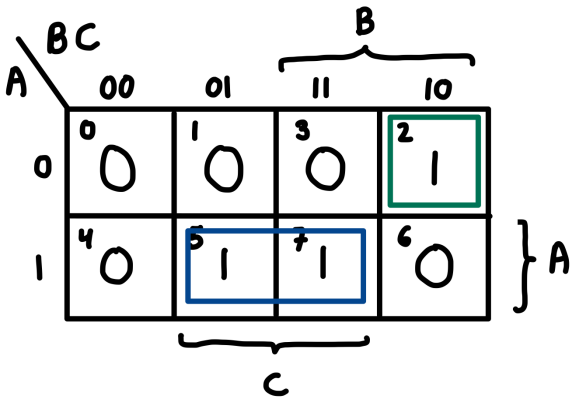
F(A, B, C) = ((A'+B'C)')' = (A (B'C)')' = (A ((B B)' C)')'



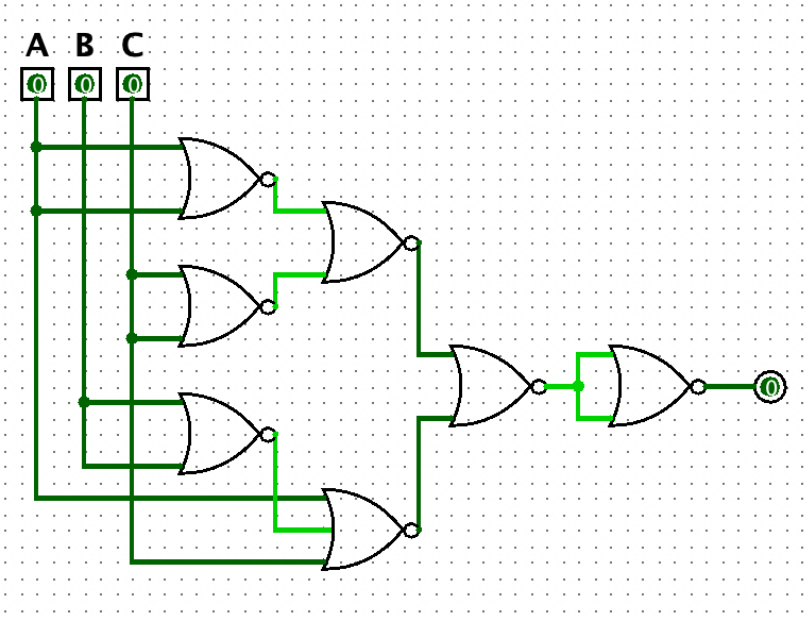
b) F(A, B, C) = $(A + B)(A + \overline{B} + \overline{C})(\overline{A} + B + C)(\overline{A} + \overline{B} + C)$ (gunakan NOR gate)

F(A, B, C) = (A'B')' + (A'BC)' + (AB'C')' + (ABC')'

Minterm K-Map:



F(A, B, C) = $AC + \overline{A}\overline{B}\overline{C} = \overline{(\overline{A} + \overline{C})(A + \overline{B} + C)}$
F(A, B, C) = ((((A' + C')(A + B' + C))')')' = (((A' + C')' + (A + B' + C)')')'
= ((((A+A)'+(C+C)')' + (A + (B+B)' + C)')')'



5) (10 poin) Buat K-Map dari tabel kebenaran dibawah (fungsi F(A, B, C, D, E)) dan tentukan semua *prime implicant* dan *essential prime implicant* nya!

A	B	C	D	E	F
0	0	0	0	0	0
0	0	0	0	1	0
0	0	0	1	0	1
0	0	0	1	1	1
0	0	1	0	0	X
0	0	1	0	1	X
0	0	1	1	0	1
0	0	1	1	1	1
0	1	0	0	0	0

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0	1	0	0	1	X
0	1	0	1	0	X
0	1	0	1	1	0
0	1	1	0	0	1
0	1	1	0	1	0
0	1	1	1	0	1
0	1	1	1	1	0
1	0	0	0	0	X
1	0	0	0	1	1
1	0	0	1	0	X
1	0	0	1	1	0
1	0	1	0	0	1
1	0	1	0	1	1
1	0	1	1	0	X
1	0	1	1	1	X
1	1	0	0	0	0
1	1	0	0	1	1
1	1	0	1	0	0
1	1	0	1	1	1
1	1	1	0	0	1
1	1	1	0	1	X
1	1	1	1	0	1
1	1	1	1	1	X

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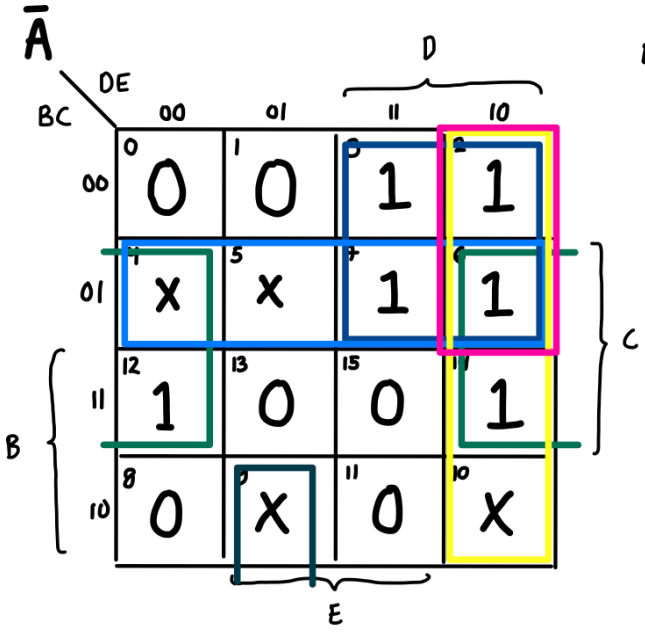

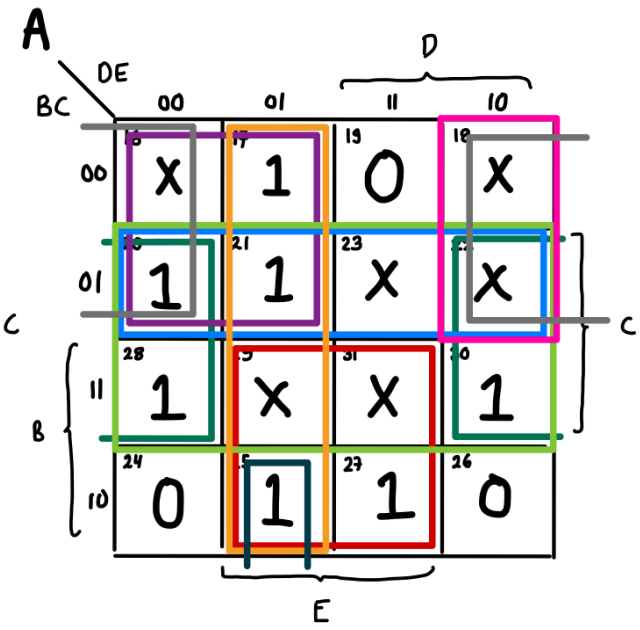

Prime Implicant :

1) $C\bar{E}$
2) $\bar{A}\bar{B}D$
3) $A\bar{B}\bar{D}$
4) ABE
5) $\bar{B}C$
6) $\bar{A}D\bar{E}$
7) AC
8) $A\bar{D}E$
9) $\bar{B}D\bar{E}$
10) $A\bar{B}\bar{E}$
11) $B\bar{C}\bar{D}E$

Essential Prime Implicant :

1) $C\bar{E}$
2) $\bar{A}\bar{B}D$
3) ABE

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