Matúš ILLITH ID: 120811
Utorok: 16:00

SYNTÉZA KOMBINAČNÝCH LOGICKÝCH OBVODOV

Navrhnite prevodník desiatkových číslic 0-9, zakódovaných v kóde Aiken do kódu 2 z 5. Prevodník realizujte s minimálnym počtom členov NAND a NOR.
Navrhnite vlastné riešenie a overte ho programovými prostriedkami ESPRESSO a LogiSim (príp. LOG alebo FitBoard).

Úlohy:

1) Navrhnite vlastné riešenie pre skupinovú minimalizáciu a odvoďte B-funkcie v tvare MDNF.
2) Vytvorte vstupný textový súbor s opisom vstupu pre ESPRESSO.
3) Navrhnuté B-funkcie v tvare MDNF overte programom ESPRESSO. Pri návrhu B-funkcií klaďte dôraz na skupinovú minimalizáciu funkcií.
4) Optimálne riešenie (treba zhodnotiť, ktoré riešenie je lepšie a prečo) vytvorte obvod s členmi NAND (výhradne NAND, t.j. aj negátory nahraďte logickými členmi NAND).
5) Z Karnaughovej mapy odvoďte B-funkcie v tvare MKNF a vytvorte obvod s členmi NOR (výhradne NOR, t.j. aj negátory nahraďte logickými členmi NOR).
6) Výslednú schému nakreslite v simulátore LogiSim (príp. LOG alebo FitBoard) a overte simuláciou.
7) Riešenie vyhodnoťte (zhodnotenie zadania, postup riešenia, vyjadrenie sa k počtu logických členov, vstupov obvodu, vhodnosti použitie NAND alebo NOR realizácie).

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	Aiken				2 Z 5				
#	a	b	c	d	A	B	C	D	E
0	0	0	0	0	0	0	0	1	1
1	0	0	0	1	0	0	1	0	1
2	0	0	1	0	0	0	1	1	0
3	0	0	1	1	0	1	0	0	1
4	0	1	0	0	0	1	0	1	0
5	1	0	1	1	0	1	1	0	0
6	1	1	0	0	1	0	0	0	1
7	1	1	0	1	1	0	0	1	0
8	1	1	1	0	1	0	1	0	0
9	1	1	1	1	1	1	0	0	0

c

d

b \ a				
	00011	00101	01001	00110
	01010	XXXXX	XXXXX	XXXXX
	10001	10010	11000	10100
	XXXXX	XXXXX	01100	XXXXX

A,B,C,D,E

Kaurgnaughove mapy a DNF

C

D

A \ B				
	0	0	0	0
	0	X	X	X
	1	1	1	1
	X	X	0	X

A

C

D

A \ B				
	0	0	1	0
	1	X	X	X
	0	0	1	0
	X	X	1	X

B

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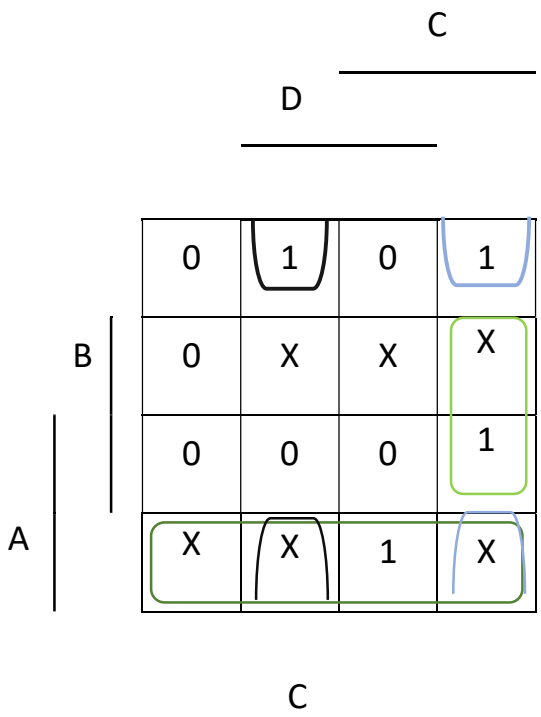

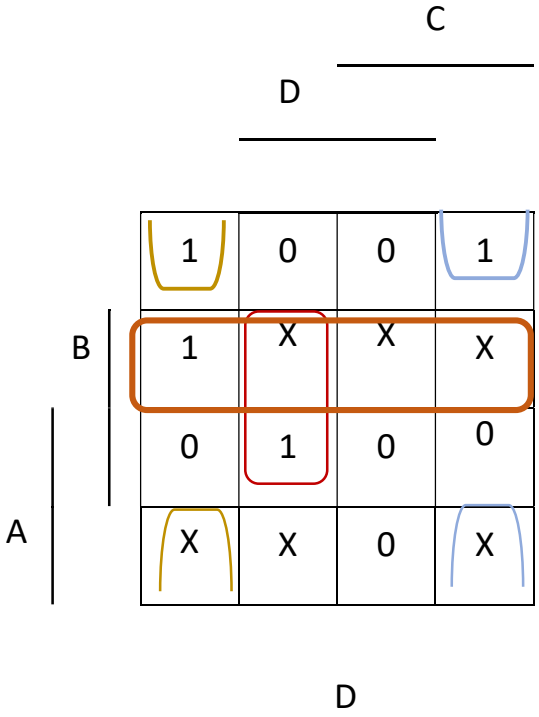

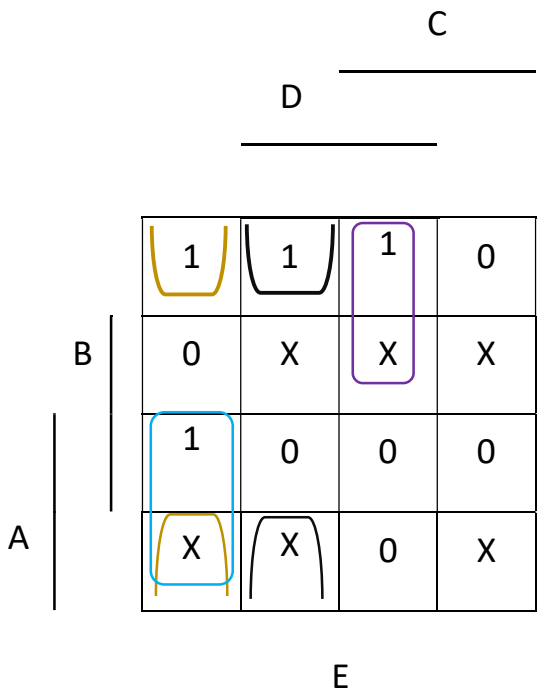

MDNF:

$A = B.C.D + B.C.\bar{D} + B.\bar{C}.D + A.\bar{C}.\bar{D}$

$B = B.C.\bar{D} + \bar{B}.C.\bar{D} + \bar{B}.\bar{C}.D + A.\bar{B}$

$C = B \cdot C \cdot \bar{D} + \bar{B} \cdot C \cdot \bar{D} + \bar{B} \cdot \bar{C} \cdot D + A \cdot \bar{B}$

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$D = B \cdot \bar{C} \cdot D + \bar{B} \cdot C \cdot \bar{D} + \bar{B} \cdot \bar{C} \cdot \bar{D} + \bar{A} \cdot B$

$E = \bar{B} \cdot \bar{C} \cdot \bar{D} + \bar{A} \cdot C \cdot D + \bar{B} \cdot \bar{C} \cdot D + A \cdot \bar{C} \cdot \bar{D}$

Obsah vstupného súbora pre ESPRESSO:

```
# prevodník z Aiken do 2 z 5

.i 4

.o 5

.ilb a b c d

.ob A B C D E

.type fr

.p 10

0000 00011

0001 00101

0010 00110

0011 01001

0100 01010

1011 01100

1100 10001

1101 10010

1110 10100

1111 11000

.e
```

Výstup programu ESPRESSO:

```
2# prevodník z Aiken do 2 z 5

A = (b&c&d) | (b&c&!d) | (b&!c&d) | (a&!c&!d);

B = (b&c&d) | (!a&c&d) | (!a&b) | (a&!b);

C = (b&c&!d) | (!b&c&!d) | (!b&!c&d) | (a&!b);

D = (b&!c&d) | (!b&!c&!d) | (!b&c&!d) | (!a&b);

E = (!b&!c&!d) | (!a&c&d) | (!b&!c&d) | (a&!c&!d);
```

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Prepis na NAND:

$A = B.C.D + B.C.\bar{D} + B.\bar{C}.D + A.\bar{C}.\bar{D}$

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

$=(\bar{B}.\bar{C}.\bar{D}).(\bar{B}.\bar{C}.\bar{\bar{D}}).(\bar{B}.\bar{\bar{C}}.\bar{D}).(\bar{A}.\bar{\bar{C}}.\bar{\bar{D}})$

$=\overline{(\bar{B}.\bar{C}.\bar{D}).(\bar{B}.\bar{C}.\bar{\bar{D}}).(\bar{B}.\bar{\bar{C}}.\bar{D}).(\bar{A}.\bar{\bar{C}}.\bar{\bar{D}})}$

$= (B\uparrow C \uparrow D) \uparrow (B \uparrow C \uparrow (D \uparrow)) \uparrow (B \uparrow (C \uparrow) \uparrow D) \uparrow (A \uparrow (C \uparrow) \uparrow (D \uparrow))$

$B= B.C.\bar{D} + \bar{B}.C.\bar{D} + \bar{B}.\bar{C}.D + A.\bar{B}$

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

$=\overline{(\bar{B}.\bar{C}.\bar{D}).(\bar{\bar{A}}.\bar{C}.\bar{D}).(\bar{\bar{A}}.\bar{B}).(\bar{A}.\bar{\bar{B}})}$

$=(B\uparrow C \uparrow D) \uparrow ((A \uparrow) \uparrow C \uparrow D) \uparrow ((A \uparrow) \uparrow B) \uparrow (A \uparrow (B \uparrow))$

$C= B \cdot C \cdot \bar{D} + \bar{B} \cdot C \cdot \bar{D} + \bar{B} \cdot \bar{C} \cdot D + A \cdot \bar{B}$

$=\overline{\overline{B \cdot C \cdot \bar{D} + \bar{B} \cdot C \cdot \bar{D} + \bar{B} \cdot \bar{C} \cdot D + A \cdot \bar{B}}}$

$=\overline{(\bar{B}.\bar{C}.\bar{\bar{D}}).(\bar{\bar{B}}.\bar{C}.\bar{\bar{D}}).(\bar{\bar{B}}.\bar{\bar{C}}.\bar{D}).(\bar{A}.\bar{\bar{B}})}$

$=(B\uparrow C \uparrow (D\uparrow))\uparrow ((B \uparrow) \uparrow C \uparrow (D \uparrow)) \uparrow((B\uparrow)\uparrow (C \uparrow) \uparrow D)\uparrow (A \uparrow(B\uparrow))$

$D= B \cdot \bar{C} \cdot D + \bar{B} \cdot C \cdot \bar{D} + \bar{B} \cdot \bar{C} \cdot \bar{D} + \bar{A} \cdot B$

$=\overline{\overline{B \cdot \bar{C} \cdot D + \bar{B} \cdot C \cdot \bar{D} + \bar{B} \cdot \bar{C} \cdot \bar{D} + \bar{A} \cdot B}}$

$=\overline{(\bar{B} . \bar{\bar{C}}.\bar{D}).(\bar{\bar{B}}.\bar{C}.\bar{\bar{D}}).(\bar{\bar{B}}.\bar{\bar{C}}.\bar{\bar{D}}).(\bar{\bar{A}}.\bar{B})}$

$=(B\uparrow (C \uparrow) \uparrow D) \uparrow ((B \uparrow) \uparrow C(D \uparrow)) \uparrow ((B \uparrow) \uparrow (C \uparrow) \uparrow (D \uparrow)) \uparrow ((A \uparrow) \uparrow B)$

$E=\bar{B} \cdot \bar{C} \cdot \bar{D} + \bar{A} \cdot C \cdot D + \bar{B} \cdot \bar{C} \cdot D + A \cdot \bar{C} \cdot \bar{D}$

$=\overline{\overline{\bar{B} \cdot \bar{C} \cdot \bar{D} + \bar{A} \cdot C \cdot D + \bar{B} \cdot \bar{C} \cdot D + A \cdot \bar{C} \cdot \bar{D}}}$

$=\overline{(\bar{\bar{B}}.\bar{\bar{C}}.\bar{\bar{D}}).(\bar{\bar{A}}.\bar{C}.\bar{D}).(\bar{\bar{B}}.\bar{C}.\bar{D}).(\bar{A}.\bar{\bar{C}}.\bar{\bar{D}})}$

$=((B \uparrow) \uparrow (C \uparrow) \uparrow (D \uparrow)) \uparrow ((A \uparrow) \uparrow C \uparrow D) \uparrow ((B\uparrow)\uparrow (C \uparrow) \uparrow D) \uparrow (A \uparrow (C \uparrow) \uparrow (D \uparrow))$

Shefferova operácia (NAND)

Počet logických člšnov : 20

Počet vstupov do logických členov obvodu: 55

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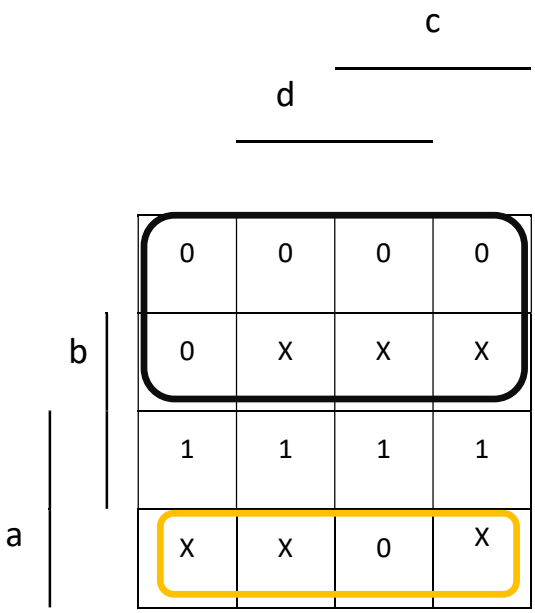
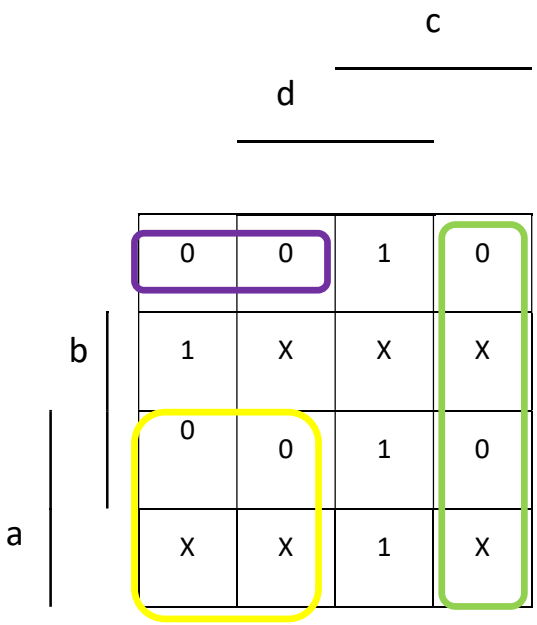
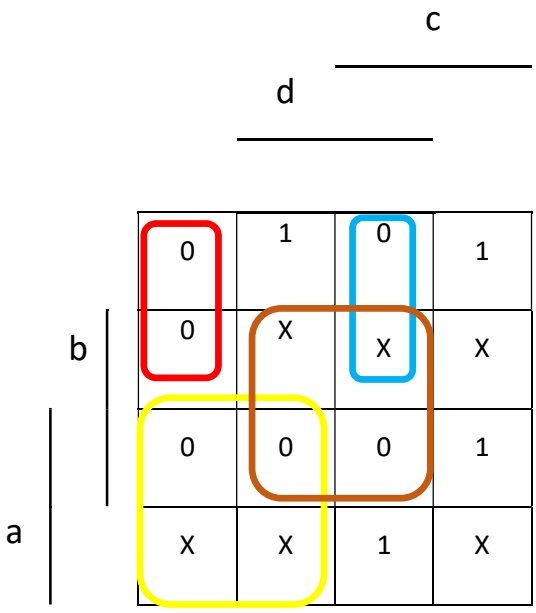
Kaurgnaughové mapy a KNF



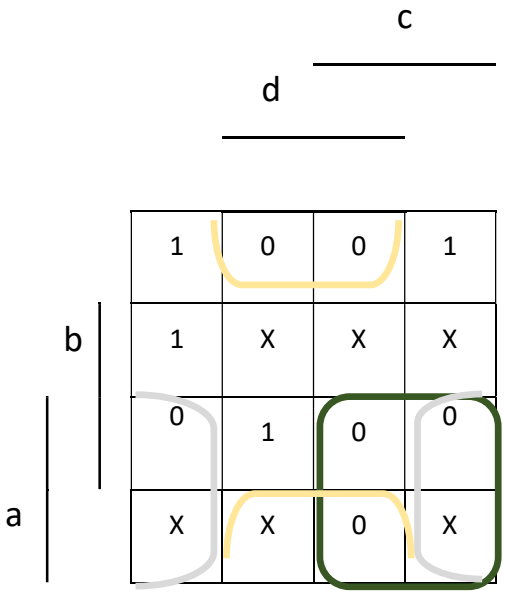
A



B



C



D

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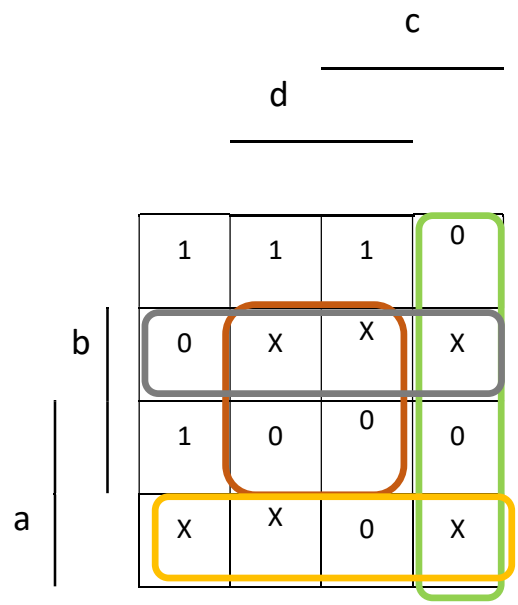

E

MKNF:

A= A.($\bar{A} + B$)

B= $(\bar{A} + C) \cdot (\bar{C} + D) \cdot (A + B + C)$

C=$(\bar{D} + \bar{B}) \cdot (\bar{D} + \bar{C} + A) \cdot (\bar{A} + C) \cdot (D + C + A)$

D=$(\bar{A} + \bar{C}) \cdot (\bar{A} + D) \cdot (\bar{D} + B)$

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

Prepis na NOR:

A= A.($\bar{A} + B$)

$=\overline{\overline{A.\,(\bar{A} + B)}}$

$=\overline{\bar{A} + \overline{(A + B)}}$

$=$ A↓ $((A \downarrow) \downarrow B)$

B= $(\bar{A} + C) \cdot (\bar{C} + D) \cdot (A + B + C)$

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

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

$=((\text{A}\downarrow) \downarrow C) \downarrow ((C \downarrow) \downarrow D) \downarrow (A \downarrow B \downarrow C)$

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

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

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

$=((D\downarrow)\downarrow(B\downarrow))\downarrow((D\downarrow)\downarrow(C\downarrow)\downarrow A)\downarrow((A\downarrow)\downarrow C)\downarrow(D\downarrow C\downarrow A)$

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

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

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

$=((A\downarrow)\downarrow(C\downarrow))\downarrow((A\downarrow)\downarrow D)\downarrow((D\downarrow)\downarrow B)$

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

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

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

$=((A\downarrow)\downarrow B)\downarrow((C\downarrow)\downarrow D)\downarrow((D\downarrow)\downarrow(B\downarrow))\downarrow((B\downarrow)\downarrow A)$

↓ - *Peirceova operácia (NOR)*

Počet členov obvodu : 20

Počet vstupov do logických členov obvodu: 45

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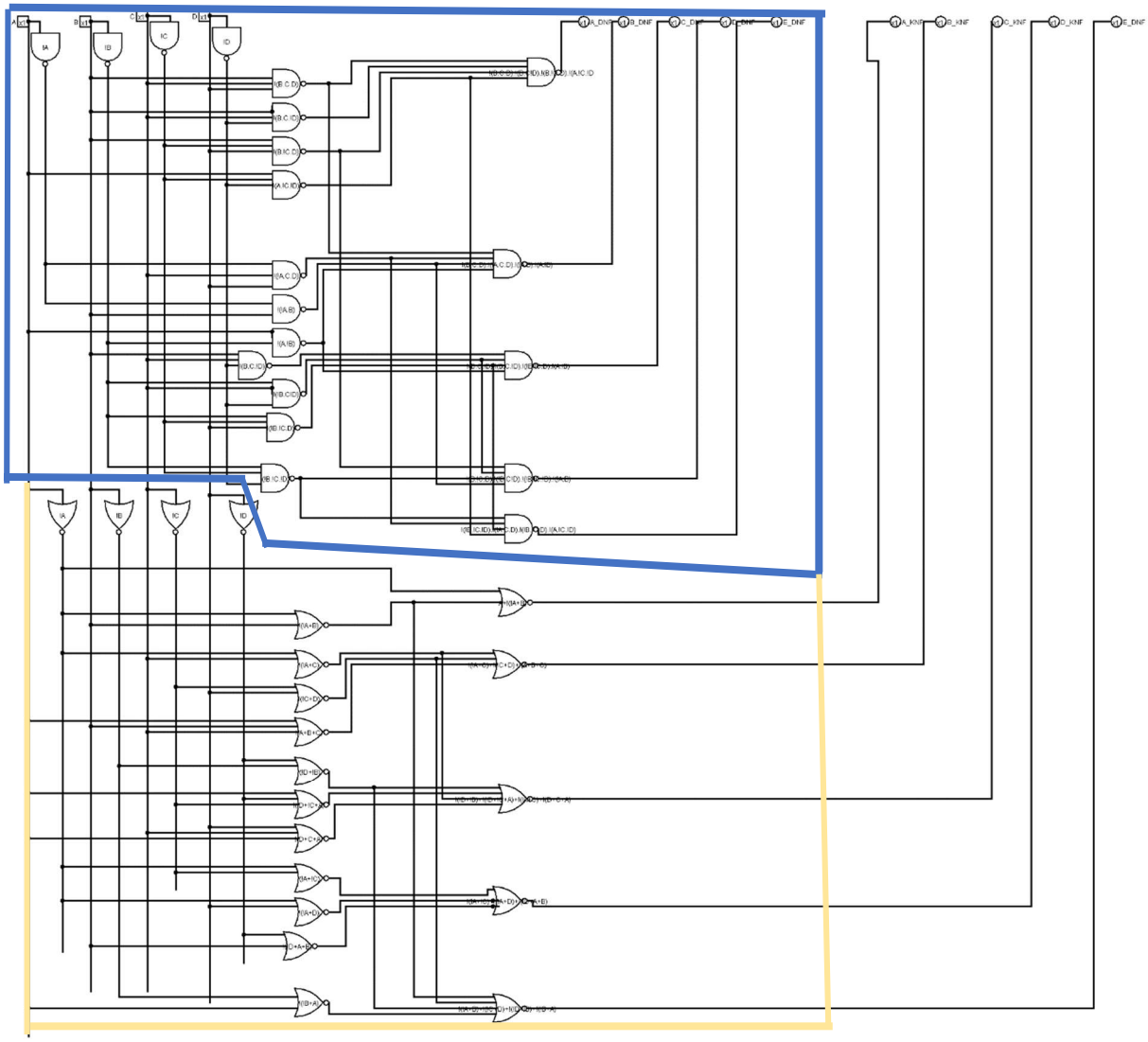

Zhodnotenie :

V tejto úlohe som sa posnažil realizovať pomocou syntézy kombinačných obvodov jednoduchý prevodník číslic od 0-9 z kódu Aiken do kódu 2 z 5. V tomto prípade sa oplatí spraviť obvod pomocou NOR členov pretože je kratší o 10 vstupov do daných logických členov.