# Федеральное государственное автономное образовательное учреждение высшего образования

#### «Национальный исследовательский университет ИТМО»

Факультет программной инженерии и компьютерной техники Направление подготовки 09.03.04 «Программная инженерия» – Системное и прикладное программное обеспечение

## Курсовая работа Часть 2

По дисциплине «Дискретная математика» Вариант: 85

Выполнил: Васильев Артём Евгеньевич Группа: 3119

Преподаватель Поляков Владимир Иванович

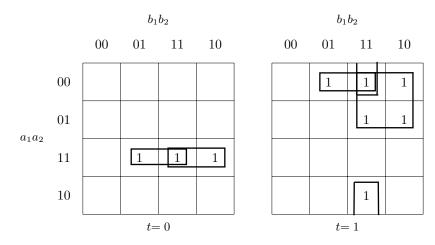
# Задание

Построить комбинационную схему реализующую функцию C = A + 3 (A и C по 4 бита) при t = 0 и C = A - B (A и B по 2 бита) при t = 1. При переносе или заеме устанавливается бит е.

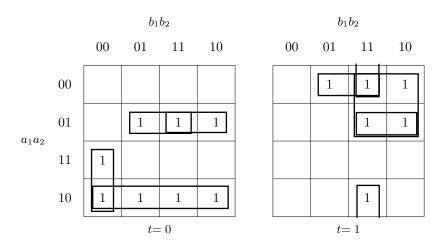
# Таблица истинности

0         0         0         0         0         0         0         0         1         1         1         1         1         0         0         0         1         1         0         0         0         0         0         0         0         1         1         0         0         0         1         0         0         0         1         0         0         0         1         0         0         0         1         1         0         0         0         1         1         0         0         0         1         1         0         0         0         1         1         0         0         0         1         1         1         0         1         1         0         0         0         0         1	No				<b>L</b>	<b>L</b>					
1         0         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         0         1         0         0         1         1         1         0         0         1         1         1         1         0         1         1         1         0         0         1         1         1         1	Nº	t	a <sub>1</sub>	a <sub>2</sub>	b <sub>1</sub>	b <sub>2</sub>	e	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C4
2         0         0         0         1         0         0         1         0         1         0         1         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         0         1         1         1         0         1         0         0         0         1         1         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0											
3         0         0         0         1         1         0         0         1         1         0           4         0         0         0         1         0         0         0         0         0         0         0         0         0         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         0         1         1         0         0         0         0         0         0         1         1         0         0         0         1         1         1         0         0         0         0         0         0         0         0         0         0         0         0         0         0											
4         0         0         1         0         0         0         1         0         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         1         0         0         1         0         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         0         1         1         1         0         0         0         1         1         1         0         0         1         1         1         0         1         1         1         1         1         1         1         1         1         1         1         1											
5         0         0         1         0         1         0         1         0         0         0         0         0         1         0         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         1         0         1         0         1         0         1         0         1         1         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         0         1         1         1         0         0         1         1         1         0         0         0         1         1         1         0         1         1         1         0         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1											
6         0         0         1         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         1         0         0         1         0         1         0         1         0         1         0         1         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         0         1         1         1         0         0         0         1         1         0         0         0         1         1         1         0         0         0         1         1         1         0											
7         0         0         1         1         1         0         1         0         1         0         1         0         1         0         1         1         1         1         1         0         1											
8         0         1         0         0         0         0         1         0         1         1         0         0         1         0         0         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         0         1         1         0         1         1         0         1         1         0         1         1         1         0         1         1         1         0         1         1         1         0         1         1         1         0			0								
9         0         1         0         0         1         0         1         1         0         0         1         1         0         0         1         1         0         1         1         0         1         1         0         1         1         0         1         1         0         1         1         1         0         1         1         1         0         1         1         1         0         1         1         1         0         1	7	0	0	1	1	1	0	1	0	1	0
10         0         1         0         0         1         1         0         1           11         0         1         0         1         1         1         0         1           12         0         1         1         0         0         0         1         1         1         0           13         0         1         1         0 <td>8</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td>	8	0	1	0	0	0	0	1	0	1	1
11         0         1         1         0         1         1         1         0           12         0         1         1         0         0         0         1         1         1         1           13         0         1         1         1         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         1	9	0	1	0	0	1	0	1	1	0	0
12         0         1         0         0         0         0         0         0         1         1         0         0         1         1         0         0         1         1         0	10	0	1	0	1	0	0	1	1	0	1
13         0         1         1         0         1         1         0         0         0         0         0         1         1         1         1         0         0         0         0         0         0         0         1         1         1         0	11	0	1	0	1	1	0	1	1	1	0
14         0         1         1         0         1         0         0         0         1           15         0         1         1         1         1         1         0         0         0         1         0         0         1         0         0         1         0	12	0	1	1	0	0	0	1	1	1	1
15         0         1         1         1         1         1         0         1	13	0	1	1	0	1	1	0	0	0	0
16       1       0       0       0       0       0       0       0       0       0       0       1	14	0	1	1	1	0	1	0	0	0	1
17         1         0         0         0         1         0         0         0         1         1         0         1         1         0         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         0         1	15	0	1	1	1	1	1	0	0	1	0
18         1         0         0         1         1         1         1         1         1         0         1         1         1         1         1         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0	16	1	0	0	0	0	0	0	0	0	0
19       1       0       0       1       1       1       1       1       0       1         20       1       0       1       0       0       0       0       0       0       1         21       1       0       1       0       1       0       0       0       0       0       0         22       1       0       1       1       0       1 <td< td=""><td>17</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></td<>	17	1	0	0	0	1	1	1	1	1	1
20       1       0       1       0       0       0       0       0       0       0       1	18	1	0	0	1	0	1	1	1	1	0
21       1       0       1       0       0       0       0       0       0         22       1       0       1       1       0       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       0       0       0       0       0       0       0       0       1       0 <td>19</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td>	19	1	0	0	1	1	1	1	1	0	1
22     1     0     1     1     0     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     0     1     1     1     1     1     1     1     1     1     0 </td <td>20</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td>	20	1	0	1	0	0	0	0	0	0	1
23       1       0       1       1       1       1       1       1       1       0         24       1       1       0       0       0       0       0       0       1       0         25       1       1       0       0       1       0       0       0       0       0       0       1         26       1       1       0       1       0       0       0       0       0       0       0         27       1       1       0       1	21	1	0	1	0	1	0	0	0	0	0
24     1     1     0     0     0     0     0     0     1     0       25     1     1     0     0     1     0     0     0     0     0     1       26     1     1     0     1     0     0     0     0     0     0       27     1     1     0     1     1     1     1     1     1       28     1     1     1     0     0     0     0     0     1     1       29     1     1     1     0     1     0     0     0     0     0     1       30     1     1     1     1     0     0     0     0     0     0     1	22	1	0	1	1	0	1	1	1	1	1
25     1     1     0     0     1     0     0     0     0     0     1       26     1     1     0     1     0     0     0     0     0     0     0       27     1     1     1     0     1     1     1     1     1     1     1       28     1     1     1     0     0     0     0     0     1     1       29     1     1     1     0     1     0     0     0     0     1     0       30     1     1     1     1     0     0     0     0     0     1	23	1	0	1	1	1	1	1	1	1	0
26     1     1     0     1     0     0     0     0     0     0       27     1     1     0     1     1     1     1     1     1     1       28     1     1     1     0     0     0     0     0     1     1       29     1     1     1     0     1     0     0     0     1     0       30     1     1     1     1     0     0     0     0     0     1	24	1	1	0	0	0	0	0	0	1	0
27     1     1     0     1     1     1     1     1     1     1       28     1     1     1     0     0     0     0     0     1     1       29     1     1     1     0     1     0     0     0     0     1     0       30     1     1     1     1     0     0     0     0     0     1	25	1	1	0	0	1	0	0	0	0	1
27     1     1     0     1     1     1     1     1     1     1       28     1     1     1     0     0     0     0     0     1     1       29     1     1     1     0     1     0     0     0     0     1     0       30     1     1     1     1     0     0     0     0     0     1	26	1	1	0	1	0	0	0	0	0	0
29     1     1     1     0     1     0     0     0     1     0       30     1     1     1     1     0     0     0     0     0     1		1	1	0		1	1	1	1	1	1
30 1 1 1 1 0 0 0 0 1	28	1	1	1	0	0	0	0	0	1	1
30 1 1 1 1 0 0 0 0 1		1	1		0	1	0	0	0		
	31	1	1	1	1	1	0	0	0	0	0

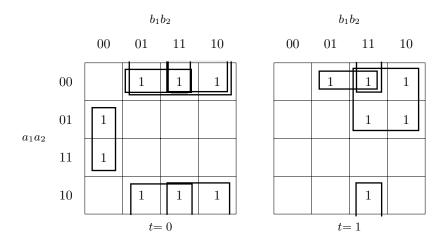
# Минимизация булевых функций на картах Карно



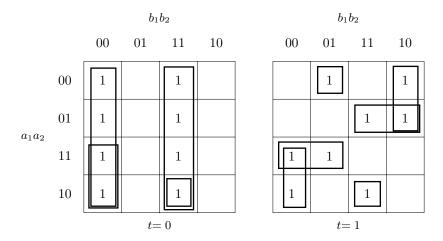
 $e=\overline{a_1}\,b_1\,t\vee\overline{a_1}\,\overline{a_2}\,b_2\,t\vee\overline{a_2}\,b_1\,b_2\,t\vee a_1\,a_2\,b_1\,\overline{t}\vee a_1\,a_2\,b_2\,\overline{t}\quad (S_Q=24)$ 



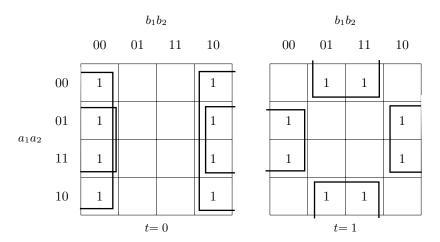
 $c_1 = \overline{a_1} \, b_1 \, t \vee \overline{a_1} \, a_2 \, b_1 \vee a_1 \, \overline{a_2} \, \overline{t} \vee \overline{a_1} \, \overline{a_2} \, b_2 \, t \vee \overline{a_2} \, b_1 \, b_2 \, t \vee a_1 \, \overline{b_1} \, \overline{b_2} \, \overline{t} \vee \overline{a_1} \, a_2 \, b_2 \, \overline{t} \quad (S_Q = 32)$ 



 $c_2 = \overline{a_1}\,b_1\,t \vee \overline{a_1}\,\overline{a_2}\,b_2 \vee \overline{a_2}\,b_1\,b_2 \vee \overline{a_2}\,b_1\,\overline{t} \vee \overline{a_2}\,b_2\,\overline{t} \vee a_2\,\overline{b_1}\,\overline{b_2}\,\overline{t} \quad (S_Q = 25)$ 



 $c_3 = a_1\,\overline{b_1}\,\overline{b_2} \vee b_1\,b_2\,\overline{t} \vee \overline{b_1}\,\overline{b_2}\,\overline{t} \vee a_1\,\overline{a_2}\,b_1\,b_2 \vee a_1\,a_2\,\overline{b_1}\,t \vee \overline{a_1}\,a_2\,b_1\,t \vee \overline{a_1}\,b_1\,\overline{b_2}\,t \vee \overline{a_1}\,\overline{a_2}\,\overline{b_1}\,b_2\,t \quad (S_Q = 38)$ 



$$c_4 = a_2 \, \overline{b_2} \vee \overline{b_2} \, \overline{t} \vee \overline{a_2} \, b_2 \, t \quad (S_Q = 10)$$

### Преобразование системы булевых функций

$$\begin{cases} e = \overline{a_1} \, b_1 \, t \vee \overline{a_1} \, \overline{a_2} \, b_2 \, t \vee \overline{a_2} \, b_1 \, b_2 \, t \vee a_1 \, a_2 \, b_1 \, \overline{t} \vee a_1 \, a_2 \, b_2 \, \overline{t} & (S_Q^e = 24) \\ c_1 = \overline{a_1} \, b_1 \, t \vee \overline{a_1} \, a_2 \, b_1 \vee a_1 \, \overline{a_2} \, \overline{t} \vee \overline{a_1} \, \overline{a_2} \, b_2 \, t \vee \overline{a_2} \, b_1 \, b_2 \, t \vee a_1 \, \overline{b_1} \, \overline{b_2} \, \overline{t} \vee \overline{a_1} \, a_2 \, b_2 \, \overline{t} & (S_Q^{c_1} = 32) \\ c_2 = \overline{a_1} \, b_1 \, t \vee \overline{a_1} \, \overline{a_2} \, b_2 \vee \overline{a_2} \, b_1 \, b_2 \vee \overline{a_2} \, b_1 \, \overline{t} \vee \overline{a_2} \, b_2 \, \overline{t} \vee a_2 \, \overline{b_1} \, \overline{b_2} \, \overline{t} & (S_Q^{c_2} = 25) \\ c_3 = a_1 \, \overline{b_1} \, \overline{b_2} \vee b_1 \, b_2 \, \overline{t} \vee \overline{b_1} \, \overline{b_2} \, \overline{t} \vee a_1 \, \overline{a_2} \, b_1 \, b_2 \vee a_1 \, a_2 \, \overline{b_1} \, t \vee \overline{a_1} \, a_2 \, b_1 \, t \vee \overline{a_1} \, b_1 \, \overline{b_2} \, t \vee \\ \vee \overline{a_1} \, \overline{a_2} \, \overline{b_1} \, b_2 \, t & (S_Q^{c_3} = 38) \\ c_4 = a_2 \, \overline{b_2} \vee \overline{b_2} \, \overline{t} \vee \overline{a_2} \, b_2 \, t & (S_Q^{c_4} = 10) \end{cases}$$

#### Проведем совместную декомпозицию системы

$$\varphi_0 = \overline{a_1} \, b_1 \, t$$

$$\begin{cases} \varphi_{0} = \overline{a_{1}} b_{1} t & (S_{Q}^{\varphi_{0}} = 3) \\ e = \varphi_{0} \vee a_{1} a_{2} b_{1} \overline{t} \vee a_{1} a_{2} b_{2} \overline{t} \vee \overline{a_{1}} \overline{a_{2}} b_{2} t \vee \overline{a_{2}} b_{1} b_{2} t & (S_{Q}^{\varphi_{0}} = 21) \\ c_{1} = \varphi_{0} \vee a_{1} \overline{a_{2}} \overline{t} \vee \overline{a_{1}} a_{2} b_{1} \vee a_{1} \overline{b_{1}} \overline{b_{2}} \overline{t} \vee \overline{a_{1}} a_{2} b_{2} \overline{t} \vee \overline{a_{1}} \overline{a_{2}} b_{2} t \vee \overline{a_{2}} b_{1} b_{2} t & (S_{Q}^{e_{1}} = 29) \\ c_{2} = \varphi_{0} \vee \overline{a_{1}} \overline{a_{2}} b_{2} \vee \overline{a_{2}} b_{1} b_{2} \vee \overline{a_{2}} b_{1} \overline{t} \vee \overline{a_{2}} b_{2} \overline{t} \vee a_{2} \overline{b_{1}} \overline{b_{2}} \overline{t} & (S_{Q}^{e_{2}} = 22) \\ c_{3} = \varphi_{0} a_{2} \vee \varphi_{0} \overline{b_{2}} \vee a_{1} \overline{b_{1}} \overline{b_{2}} \vee b_{1} b_{2} \overline{t} \vee \overline{b_{1}} \overline{b_{2}} \overline{t} \vee a_{1} a_{2} \overline{b_{1}} t \vee a_{1} \overline{a_{2}} b_{1} b_{2} \vee a_{2} \\ \vee \overline{a_{1}} \overline{a_{2}} \overline{b_{1}} b_{2} t & (S_{Q}^{e_{3}} = 34) \\ c_{4} = a_{2} \overline{b_{2}} \vee \overline{b_{2}} \overline{t} \vee \overline{a_{2}} b_{2} t & (S_{Q}^{e_{4}} = 10) \end{cases}$$

## Проведем раздельную факторизацию системы

$$\begin{cases} \varphi_0 = \overline{a_1} \, b_1 \, t & (S_Q^{\varphi_0} = 3) \\ e = \varphi_0 \vee a_1 \, a_2 \, \overline{t} \, \left( b_1 \vee b_2 \right) \vee \overline{a_2} \, b_2 \, t \, \left( \overline{a_1} \vee b_1 \right) & (S_Q^e = 15) \\ c_1 = \varphi_0 \vee a_1 \, \overline{t} \, \left( \overline{a_2} \vee \overline{b_1} \, \overline{b_2} \right) \vee \overline{a_1} \, a_2 \, \left( b_1 \vee b_2 \, \overline{t} \right) \vee \overline{a_2} \, b_2 \, t \, \left( \overline{a_1} \vee b_1 \right) & (S_Q^{c_1} = 24) \\ c_2 = \varphi_0 \vee \overline{a_2} \, b_2 \, \left( b_1 \vee \overline{a_1} \vee \overline{t} \right) \vee \overline{a_2} \, b_1 \, \overline{t} \vee a_2 \, \overline{b_1} \, \overline{b_2} \, \overline{t} & (S_Q^{c_2} = 17) \\ c_3 = \varphi_0 \, \left( a_2 \vee \overline{b_2} \right) \vee b_1 \, b_2 \, \left( \overline{t} \vee a_1 \, \overline{a_2} \right) \vee \overline{b_1} \, \overline{b_2} \, \left( a_1 \vee \overline{t} \right) \vee a_1 \, a_2 \, \overline{b_1} \, t \vee \overline{a_1} \, \overline{a_2} \, \overline{b_1} \, b_2 \, t & (S_Q^{c_3} = 30) \\ c_4 = \overline{b_2} \, \left( a_2 \vee \overline{t} \right) \vee \overline{a_2} \, b_2 \, t & (S_Q = 98) \end{cases}$$

#### Проведем совместную декомпозицию системы

$$\varphi_1 = \varphi_0 \vee \overline{a_2} \, b_2 \, t \, \left( \overline{a_1} \vee b_1 \right)$$

$$\begin{cases} \varphi_0 = \overline{a_1} \, b_1 \, t & (S_Q^{\varphi_0} = 3) \\ c_2 = \varphi_0 \vee \overline{a_2} \, b_1 \, \overline{t} \vee \overline{a_2} \, b_2 \, \left( \overline{a_1} \vee b_1 \vee \overline{t} \right) \vee a_2 \, \overline{b_1} \, \overline{b_2} \, \overline{t} & (S_Q^{c_2} = 17) \\ c_3 = \varphi_0 \, \left( a_2 \vee \overline{b_2} \right) \vee b_1 \, b_2 \, \left( \overline{t} \vee a_1 \, \overline{a_2} \right) \vee \overline{b_1} \, \overline{b_2} \, \left( a_1 \vee \overline{t} \right) \vee a_1 \, a_2 \, \overline{b_1} \, t \vee \overline{a_1} \, \overline{a_2} \, \overline{b_1} \, b_2 \, t & (S_Q^{c_3} = 30) \\ c_4 = \overline{b_2} \, \left( a_2 \vee \overline{t} \right) \vee \overline{a_2} \, b_2 \, t & (S_Q^{c_4} = 9) \\ \varphi_1 = \varphi_0 \vee \overline{a_2} \, b_2 \, t \, \left( \overline{a_1} \vee b_1 \right) & (S_Q^{\varphi_1} = 8) \\ e = \varphi_1 \vee a_1 \, a_2 \, \overline{t} \, \left( b_1 \vee b_2 \right) & (S_Q^e = 8) \\ c_1 = \varphi_1 \vee a_1 \, \overline{t} \, \left( \overline{a_2} \vee \overline{b_1} \, \overline{b_2} \right) \vee \overline{a_1} \, a_2 \, \left( b_1 \vee b_2 \, \overline{t} \right) & (S_Q^{c_1} = 17) \\ (S_Q = 92) \end{cases}$$

#### Проведем совместную декомпозицию системы

$$\varphi_2 = \overline{b_1} \, \overline{b_2}, \quad \overline{\varphi_2} = b_1 \vee b_2$$

$$\begin{cases} \varphi_2 = \overline{b_1} \, \overline{b_2} & (S_Q^{\varphi_2} = 2) \\ \varphi_0 = \overline{a_1} \, b_1 \, t & (S_Q^{\varphi_0} = 3) \\ c_2 = \varphi_0 \vee \varphi_2 \, a_2 \, \overline{t} \vee \overline{a_2} \, b_1 \, \overline{t} \vee \overline{a_2} \, b_2 \, \left( \overline{a_1} \vee b_1 \vee \overline{t} \right) & (S_Q^{e_2} = 16) \\ c_3 = \varphi_0 \, \left( a_2 \vee \overline{b_2} \right) \vee \varphi_2 \, \left( a_1 \vee \overline{t} \right) \vee b_1 \, b_2 \, \left( \overline{t} \vee a_1 \, \overline{a_2} \right) \vee a_1 \, a_2 \, \overline{b_1} \, t \vee \overline{a_1} \, \overline{a_2} \, \overline{b_1} \, b_2 \, t & (S_Q^{e_3} = 29) \\ c_4 = \overline{b_2} \, \left( a_2 \vee \overline{t} \right) \vee \overline{a_2} \, b_2 \, t & (S_Q^{e_3} = 9) \\ \varphi_1 = \varphi_0 \vee \overline{a_2} \, b_2 \, t \, \left( \overline{a_1} \vee b_1 \right) & (S_Q^{\varphi_1} = 8) \\ e = \varphi_1 \vee \overline{\varphi_2} \, a_1 \, a_2 \, \overline{t} & (S_Q^e = 6) \\ c_1 = \varphi_1 \vee a_1 \, \overline{t} \, \left( \varphi_2 \vee \overline{a_2} \right) \vee \overline{a_1} \, a_2 \, \left( b_1 \vee b_2 \, \overline{t} \right) & (S_Q^{e_1} = 15) \\ (S_Q = 89) \end{cases}$$

#### Проведем совместную декомпозицию системы

$$\varphi_3 = \overline{a_2} \, b_2, \quad \overline{\varphi_3} = a_2 \vee \overline{b_2}$$

$$\begin{cases} \varphi_3 = \overline{a_2} \, b_2 \\ \varphi_2 = \overline{b_1} \, \overline{b_2} \\ \varphi_0 = \overline{a_1} \, b_1 \, t \\ c_2 = \varphi_0 \vee \varphi_3 \, \left( \overline{a_1} \vee b_1 \vee \overline{t} \right) \vee \varphi_2 \, a_2 \, \overline{t} \vee \overline{a_2} \, b_1 \, \overline{t} \\ c_3 = \varphi_0 \, \overline{\varphi_3} \vee \varphi_2 \, \left( a_1 \vee \overline{t} \right) \vee b_1 \, b_2 \, \left( \overline{t} \vee a_1 \, \overline{a_2} \right) \vee \varphi_3 \, \overline{a_1} \, \overline{b_1} \, t \vee a_1 \, a_2 \, \overline{b_1} \, t \end{cases} \quad (S_Q^{c_2} = 15)$$

$$c_4 = \varphi_3 \, t \vee \overline{b_2} \, \left( a_2 \vee \overline{t} \right) \qquad (S_Q^{c_3} = 26)$$

$$\varphi_1 = \varphi_0 \vee \varphi_3 \, t \, \left( \overline{a_1} \vee b_1 \right) \qquad (S_Q^{c_3} = 7)$$

$$e = \varphi_1 \vee \overline{\varphi_2} \, a_1 \, a_2 \, \overline{t} \qquad (S_Q^{c_2} = 6)$$

$$c_1 = \varphi_1 \vee a_1 \, \overline{t} \, \left( \varphi_2 \vee \overline{a_2} \right) \vee \overline{a_1} \, a_2 \, \left( b_1 \vee b_2 \, \overline{t} \right) \qquad (S_Q^{c_1} = 15)$$

$$(S_Q = 86)$$

#### Проведем совместную декомпозицию системы

$$\varphi_4 = \varphi_3 t$$

$$\begin{cases} \varphi_{3} = \overline{a_{2}} \, b_{2} & (S_{Q}^{\varphi_{3}} = 2) \\ \varphi_{2} = \overline{b_{1}} \, \overline{b_{2}} & (S_{Q}^{\varphi_{2}} = 2) \\ \varphi_{0} = \overline{a_{1}} \, b_{1} \, t & (S_{Q}^{\varphi_{0}} = 3) \\ c_{2} = \varphi_{0} \vee \varphi_{3} \, \left( \overline{a_{1}} \vee b_{1} \vee \overline{t} \right) \vee \varphi_{2} \, a_{2} \, \overline{t} \vee \overline{a_{2}} \, b_{1} \, \overline{t} & (S_{Q}^{\varphi_{2}} = 15) \\ \varphi_{4} = \varphi_{3} \, t & (S_{Q}^{\varphi_{4}} = 2) \\ c_{3} = \varphi_{0} \, \overline{\varphi_{3}} \vee \varphi_{2} \, \left( a_{1} \vee \overline{t} \right) \vee \varphi_{4} \, \overline{a_{1}} \, \overline{b_{1}} \vee b_{1} \, b_{2} \, \left( \overline{t} \vee a_{1} \, \overline{a_{2}} \right) \vee a_{1} \, a_{2} \, \overline{b_{1}} \, t & (S_{Q}^{e_{3}} = 25) \\ c_{4} = \varphi_{4} \vee \overline{b_{2}} \, \left( a_{2} \vee \overline{t} \right) & (S_{Q}^{e_{4}} = 6) \\ \varphi_{1} = \varphi_{0} \vee \varphi_{4} \, \left( \overline{a_{1}} \vee b_{1} \right) & (S_{Q}^{\varphi_{1}} = 6) \\ e = \varphi_{1} \vee \overline{\varphi_{2}} \, a_{1} \, a_{2} \, \overline{t} & (S_{Q}^{e} = 6) \\ c_{1} = \varphi_{1} \vee a_{1} \, \overline{t} \, \left( \varphi_{2} \vee \overline{a_{2}} \right) \vee \overline{a_{1}} \, a_{2} \, \left( b_{1} \vee b_{2} \, \overline{t} \right) & (S_{Q}^{e_{1}} = 15) \\ (S_{Q} = 84) \end{cases}$$

#### Проведем совместную декомпозицию системы

$$\varphi_5 = \varphi_2 \vee \overline{a_2}, \quad \overline{\varphi_5} = \overline{\varphi_2} \, a_2$$

$$\begin{cases} \varphi_3 = \overline{a_2} \, b_2 \\ \varphi_2 = \overline{b_1} \, \overline{b_2} \\ \varphi_0 = \overline{a_1} \, b_1 \, t \\ c_2 = \varphi_0 \vee \varphi_3 \, \left( \overline{a_1} \vee b_1 \vee \overline{t} \right) \vee \varphi_2 \, a_2 \, \overline{t} \vee \overline{a_2} \, b_1 \, \overline{t} \\ \varphi_4 = \varphi_3 \, t \\ c_3 = \varphi_0 \, \overline{\varphi_3} \vee \varphi_2 \, \left( a_1 \vee \overline{t} \right) \vee \varphi_4 \, \overline{a_1} \, \overline{b_1} \vee b_1 \, b_2 \, \left( \overline{t} \vee a_1 \, \overline{a_2} \right) \vee a_1 \, a_2 \, \overline{b_1} \, t \\ \varphi_4 = \varphi_4 \vee \overline{b_2} \, \left( a_2 \vee \overline{t} \right) \\ \varphi_1 = \varphi_0 \vee \varphi_4 \, \left( \overline{a_1} \vee b_1 \right) \\ \varphi_5 = \varphi_2 \vee \overline{a_2} \\ e = \varphi_1 \vee \overline{\varphi_5} \, a_1 \, \overline{t} \\ c_1 = \varphi_1 \vee \varphi_5 \, a_1 \, \overline{t} \vee \overline{a_1} \, a_2 \, \left( b_1 \vee b_2 \, \overline{t} \right) \\ (S_Q = 83) \end{cases}$$

#### Проведем совместную декомпозицию системы

$$\varphi_6 = \overline{a_1} \vee b_1, \quad \overline{\varphi_6} = a_1 \, \overline{b_1}$$

$$\begin{cases} \varphi_{6} = \overline{a_{1}} \vee b_{1} & (S_{Q}^{\varphi_{6}} = 2) \\ \varphi_{3} = \overline{a_{2}} b_{2} & (S_{Q}^{\varphi_{3}} = 2) \\ \varphi_{2} = \overline{b_{1}} \overline{b_{2}} & (S_{Q}^{\varphi_{2}} = 2) \\ \varphi_{0} = \overline{a_{1}} b_{1} t & (S_{Q}^{\varphi_{0}} = 3) \\ c_{2} = \varphi_{0} \vee \varphi_{3} \left(\varphi_{6} \vee \overline{t}\right) \vee \varphi_{2} a_{2} \overline{t} \vee \overline{a_{2}} b_{1} \overline{t} & (S_{Q}^{\varphi_{2}} = 14) \\ \varphi_{4} = \varphi_{3} t & (S_{Q}^{\varphi_{4}} = 2) \\ c_{3} = \varphi_{0} \overline{\varphi_{3}} \vee \varphi_{2} \left(a_{1} \vee \overline{t}\right) \vee \varphi_{4} \overline{a_{1}} \overline{b_{1}} \vee b_{1} b_{2} \left(\overline{t} \vee a_{1} \overline{a_{2}}\right) \vee \overline{\varphi_{6}} a_{2} t & (S_{Q}^{e_{3}} = 24) \\ c_{4} = \varphi_{4} \vee \overline{b_{2}} \left(a_{2} \vee \overline{t}\right) & (S_{Q}^{e_{4}} = 6) \\ \varphi_{1} = \varphi_{0} \vee \varphi_{4} \varphi_{6} & (S_{Q}^{\varphi_{1}} = 4) \\ \varphi_{5} = \varphi_{2} \vee \overline{a_{2}} & (S_{Q}^{\varphi_{5}} = 2) \\ e = \varphi_{1} \vee \overline{\varphi_{5}} a_{1} \overline{t} & (S_{Q}^{e} = 5) \\ c_{1} = \varphi_{1} \vee \varphi_{5} a_{1} \overline{t} \vee \overline{a_{1}} a_{2} \left(b_{1} \vee b_{2} \overline{t}\right) & (S_{Q}^{e_{1}} = 13) \end{cases}$$

#### Проведем совместную декомпозицию системы

$$\varphi_7 = \varphi_6 \vee \overline{t}, \quad \overline{\varphi_7} = \overline{\varphi_6} t$$

$$\begin{cases} \varphi_6 = \overline{a_1} \vee b_1 & (S_Q^{\varphi_6} = 2) \\ \varphi_3 = \overline{a_2} b_2 & (S_Q^{\varphi_3} = 2) \\ \varphi_2 = \overline{b_1} \overline{b_2} & (S_Q^{\varphi_2} = 2) \\ \varphi_0 = \overline{a_1} b_1 t & (S_Q^{\varphi_0} = 3) \\ \varphi_4 = \varphi_3 t & (S_Q^{\varphi_4} = 2) \\ c_4 = \varphi_4 \vee \overline{b_2} \left( a_2 \vee \overline{t} \right) & (S_Q^{\varphi_4} = 2) \\ \varphi_1 = \varphi_0 \vee \varphi_4 \varphi_6 & (S_Q^{\varphi_1} = 4) \\ \varphi_5 = \varphi_2 \vee \overline{a_2} & (S_Q^{\varphi_5} = 2) \\ e = \varphi_1 \vee \overline{\varphi_5} a_1 \overline{t} & (S_Q^e = 5) \\ c_1 = \varphi_1 \vee \varphi_5 a_1 \overline{t} \vee \overline{a_1} a_2 \left( b_1 \vee b_2 \overline{t} \right) & (S_Q^{\varphi_1} = 13) \\ \varphi_7 = \varphi_6 \vee \overline{t} & (S_Q^{\varphi_7} = 2) \\ c_2 = \varphi_0 \vee \varphi_3 \varphi_7 \vee \varphi_2 a_2 \overline{t} \vee \overline{a_2} b_1 \overline{t} & (S_Q^{\varphi_7} = 2) \\ c_3 = \varphi_0 \overline{\varphi_3} \vee \varphi_2 \left( a_1 \vee \overline{t} \right) \vee \overline{\varphi_7} a_2 \vee \varphi_4 \overline{a_1} \overline{b_1} \vee b_1 b_2 \left( \overline{t} \vee a_1 \overline{a_2} \right) & (S_Q^{e_3} = 23) \\ (S_Q = 81) \end{cases}$$

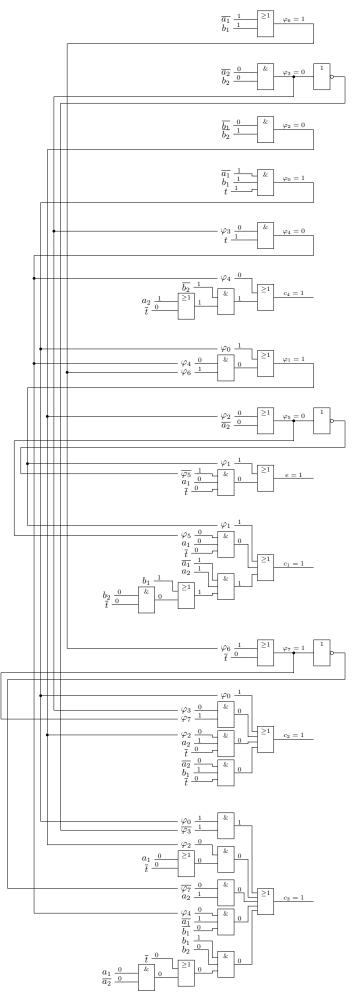
#### Синтез комбинационной схемы в булевом базисе

Будем анализировать схему на следующем наборе аргументов:

$$a_1 = 0$$
,  $a_2 = 1$ ,  $b_1 = 1$ ,  $b_2 = 0$ ,  $t = 1$ 

Выходы схемы из таблицы истинности:

$$e=1, c_1=1, c_2=1, c_3=1, c_4=1$$



Цена схемы: SQ = 81. Задержка схемы: T = 5т.