1.2 Непрограммисткое 1

Построение полинома Жегалкина 15 различными функциями от четырех переменных.

1. $\boldsymbol{f = (X_1 \vee X_2) \wedge (X_3 \vee X_4)}$

X_1	X_2	X_3	X_4	$X_1 \vee X_2$	$X_3 \vee X_4$	f
0	0	0	0	0	0	0
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	1	0
0	1	0	0	1	0	0
0	1	0	1	1	1	1
0	1	1	0	1	1	1
0	1	1	1	1	1	1
1	0	0	0	1	0	0
1	0	0	1	1	1	1
1	0	1	0	1	1	1
1	0	1	1	1	1	1
1	1	0	0	1	0	0
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	1	1	1

$$f(0,0,0,0) = a_0 = 0$$

$$f(0,0,0,1) = a_0 \oplus a_4 = 0$$

$$f(0,0,1,0) = a_0 \oplus a_3 = 0$$

$$f(0,0,1,1) = a_0 \oplus a_3 \oplus a_4 \oplus a_{34} = 0$$

$$f(0,1,0,0) = a_0 \oplus a_2 = 0$$

$$f(0,1,0,1) = a_0 \oplus a_2 \oplus a_4 \oplus a_{24} = 1$$

$$f(0,1,1,0) = a_0 \oplus a_2 \oplus a_3 \oplus a_{23} = 1$$

$$f(0,1,1,1) = a_0 \oplus a_2 \oplus a_3 \oplus a_4 \oplus a_{23} \oplus a_{34} \oplus a_{24} \oplus a_{234} = 1$$

$$f(1,0,0,0) = a_0 \oplus a_1 = 1$$

$$f(1,0,0,1) = a_0 \oplus a_1 \oplus a_4 \oplus a_{14} = 1$$

$$f(1,0,1,0) = a_0 \oplus a_1 \oplus a_3 \oplus a_{13} = 1$$

$$f(1,0,1,1) = a_0 \oplus a_1 \oplus a_3 \oplus a_4 \oplus a_{13} \oplus a_{14} \oplus a_{34} \oplus a_{134} = 1$$

$$f(1,1,0,0) = a_0 \oplus a_1 \oplus a_2 \oplus a_{12} = 0$$

$$f(1,1,0,1) = a_0 \oplus a_1 \oplus a_2 \oplus a_4 \oplus a_{12} \oplus a_{24} \oplus a_{14} \oplus a_{124} = 1$$

$$f(1,1,1,0) = a_0 \oplus a_1 \oplus a_2 \oplus a_3 \oplus a_{12} \oplus a_{13} \oplus a_{23}a_{123} = 1$$

$$f(1,1,1,1) = a_0 \oplus a_1 \oplus a_2 \oplus a_3 \oplus a_4 \oplus a_{12} \oplus a_{13} \oplus a_{14} \oplus a_{24} \oplus a_{23} \oplus$$

$$\oplus a_{34} \oplus a_{123} \oplus a_{124} \oplus a_{134} \oplus a_{234} \oplus a_{1234} = 1$$

$$\boldsymbol{f = X_1X_2X_3 \oplus X_1X_3 \oplus X_1X_4 \oplus X_2X_3 \oplus X_2X_4 \oplus X_1X_3X_4 \oplus X_2X_3X_4 \oplus}$$

$\oplus \boldsymbol{X_1X_2X_4} \oplus \boldsymbol{X_1X_2X_3X_4}$ – полином Жегалкина

2. $\boldsymbol{f = \overline{X_1} \oplus X_2 \oplus X_3 \oplus \overline{X_4}}$

$\boldsymbol{X_1}$	$\boldsymbol{X_2}$	$\boldsymbol{X_3}$	$\boldsymbol{X_4}$	$\boldsymbol{\overline{X_1}}$	$\boldsymbol{\overline{X_1} \oplus X_2}$	$\boldsymbol{\overline{X_1} + X_2 \oplus X_3}$	$\boldsymbol{\overline{X_4}}$	$\boldsymbol{f}$
0	0	0	0	1	1	1	1	0
0	0	0	1	1	1	1	0	1
0	0	1	0	1	1	0	1	1
0	0	1	1	1	1	0	0	0
0	1	0	0	1	0	0	1	1
0	1	0	1	1	0	0	0	0
0	1	1	0	1	0	1	1	0
0	1`	1	1	1	0	1	0	1
1	0	0	0	0	0	0	1	1
1	0	0	1	0	0	0	0	0
1	0	1	0	0	0	1	1	0
1	0	1	1	0	0	1	0	1
1	1	0	0	0	1	1	1	0
1	1	0	1	0	1	1	0	1
1	1	1	0	0	1	0	1	1
1	1	1	1	0	1	0	0	0

Решение методом треугольника:

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$\boldsymbol{f = X_1 \oplus X_2 \oplus X_3 \oplus X_4}$ −полином Жегалкина

3.

Таблица истинности:

X_1	X_2	X_3	X_4	f
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

Решение:

$$f(0,0,0,0) = a_0 = 0$$

$$f(0,0,0,1) = a_0 \oplus a_4 = 0$$

$$f(0,0,1,0) = a_0 \oplus a_3 = 0$$

$$f(0,0,1,1) = a_0 \oplus a_3 \oplus a_4 \oplus a_{34} = 0$$

$$f(0,1,0,0) = a_0 \oplus a_2 = 0$$

$$f(0,1,0,1) = a_0 \oplus a_2 \oplus a_4 \oplus a_{24} = 1$$

$$f(0,1,1,0) = a_0 \oplus a_2 \oplus a_3 \oplus a_{23} = 0$$

$$f(0,1,1,1) = a_0 \oplus a_2 \oplus a_3 \oplus a_4 \oplus a_{23} \oplus a_{24} \oplus a_{34} \oplus a_{234} = 1$$

$$f(1,0,0,0) = a_0 \oplus a_1 = 0$$

$$f(1,0,0,1) = a_0 \oplus a_1 \oplus a_4 \oplus a_{14} = 0$$

$$f(1,0,1,0) = a_0 \oplus a_1 \oplus a_3 \oplus a_{13} = 1$$

$$f(1,0,1,1) = a_0 \oplus a_1 \oplus a_3 \oplus a_4 \oplus a_{13} \oplus a_{14} \oplus a_{134} = 1$$

$$f(1,1,0,0) = a_0 \oplus a_{12} \oplus a_1 \oplus a_2 = 0$$

$$f(1,1,0,1) = a_0 \oplus a_1 \oplus a_2 \oplus a_4 \oplus a_{12} \oplus a_{14} \oplus a_{24} \oplus a_{124} = 1$$

$$f(1,1,1,0) = a_0 \oplus a_1 \oplus a_2 \oplus a_3 \oplus a_{12} \oplus a_{13} \oplus a_{23}a_{123} = 0$$

$$f(1,1,1,1) = a_0 \oplus a_1 \oplus a_2 \oplus a_3 \oplus a_4 \oplus a_{12} \oplus a_{13} \oplus a_{14} \oplus a_{23} \oplus a_{24} \oplus$$

$$\oplus a_{34} \oplus a_{134} \oplus a_{123} \oplus a_{124} \oplus a_{234} \oplus a_{1234} = 1$$

$f = X_1X_2X_3 \oplus X_2X_4 \oplus X_1X_3$ –полином Жегалкина

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4. $\boldsymbol{f = (X_1 \wedge X_3) \wedge (X_2 \vee X_4)}$

$\boldsymbol{X_1}$	$\boldsymbol{X_2}$	$\boldsymbol{X_3}$	$\boldsymbol{X_4}$	$\boldsymbol{X_1 \wedge X_3}$	$\boldsymbol{X_2 \vee X_4}$	$\boldsymbol{f}$
0	0	0	0	0	0	0
0	0	0	1	0	1	1
0	0	1	0	0	0	0
0	0	1	1	0	1	1
0	1	0	0	0	1	1
0	1	0	1	0	1	1
0	1	1	0	0	1	1
0	1	1	1	0	1	1
1	0	0	0	0	0	0
1	0	0	1	0	1	1
1	0	1	0	1	0	1
1	0	1	1	1	1	0
1	1	0	0	0	1	1
1	1	0	1	0	1	1
1	1	1	0	1	1	0
1	1	1	1	1	1	0

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$\boldsymbol{f = X_4 \oplus X_2 \oplus X_2X_4 \oplus X_1X_3}$ −полином Жегалкина

5. $\boldsymbol{f = \left(\left(\overline{X_1} \oplus X_2\right) \vee \left(\overline{X_3} \oplus X_4\right)\right) \mid X_1}$

X_1	X_2	X_3	X_4	$\overline{X_1}$	$\overline{X_3}$	$\overline{X_1} \oplus X_2$	$\overline{X_3} \oplus X_4$	$(\overline{X_1} \oplus X_2) \vee (\overline{X_3} \oplus X_4)$	f
0	0	0	0	1	1	1	1	1	1
0	0	0	1	1	1	1	0	1	1
0	0	1	0	1	0	1	0	1	1
0	0	1	1	1	0	1	1	1	1
0	1	0	0	1	1	0	1	1	1
0	1	0	1	1	1	0	0	0	1
0	1	1	0	1	0	0	0	0	1
0	1	1	1	1	0	0	1	1	1
1	0	0	0	0	1	0	1	1	0
1	0	0	1	0	1	0	0	0	1
1	0	1	0	0	0	0	0	0	1
1	0	1	1	0	0	0	1	1	0
1	1	0	0	0	1	1	1	1	0
1	1	0	1	0	1	1	0	1	0
1	1	1	0	0	0	1	0	1	0
1	1	1	1	0	0	1	1	1	0

$\boldsymbol{f = 1 \oplus X_1 \oplus X_1X_4 \oplus X_1X_3 \oplus X_1X_2X_4 \oplus X_1X_2X_3}$ –полином Жегалкина

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6. $f = \left(\overline{X_1} \vee X_2\right) \wedge (\overline{X_3} \vee X_4)$

X_1	X_2	X_3	X_4	$\overline{x_1}$	$\overline{x_1} \vee x_2$	$\overline{X_3}$	$\overline{X_3} \vee X_4$	f
0	0	0	0	1	1	1	1	1
0	0	0	1	1	1	1	1	1
0	0	1	0	1	1	0	0	0
0	0	1	1	1	1	0	1	1
0	1	0	0	1	1	1	1	1
0	1	0	1	1	1	1	1	1
0	1	1	0	1	1	0	0	0
0	1	1	1	1	1	0	1	1
1	0	0	0	0	0	1	1	0
1	0	0	1	0	0	1	1	0
1	0	1	0	0	0	0	0	0
1	0	1	1	0	0	0	1	0
1	1	0	0	0	1	1	1	1
1	1	0	1	0	1	1	1	1
1	1	1	0	0	1	0	0	0
1	1	1	1	0	1	0	1	1

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$$f = X_3 \oplus X_3X_4 \oplus X_1 \oplus X_1X_3 \oplus X_1X_3X_4 \oplus X_1X_2 \oplus X_1X_2X_3 \oplus$$

$$\oplus X_3X_3X_3X_3 \oplus 1$$ – полином Жегалкина

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7. $\boldsymbol{f = X_1 \wedge (X_2 \vee (X_3 \wedge X_4))}$

$\boldsymbol{X_1}$	$\boldsymbol{X_1}$	$\boldsymbol{X_1}$	$\boldsymbol{X_1}$	$\boldsymbol{X_3 \wedge x_4}$	$\boldsymbol{X_2 \vee (X_3 \wedge X_4)}$	$\boldsymbol{f}$
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	1	0	0	0	0
0	0	1	1	1	1	0
0	1	0	0	0	1	0
0	1	0	1	0	1	0
0	1	1	0	0	1	0
0	1	1	1	1	1	0
1	0	0	0	0	0	0
1	0	0	1	0	0	0
1	0	1	0	0	0	0
1	0	1	1	1	1	1
1	1	0	0	0	1	1
1	1	0	1	0	1	1
1	1	1	0	0	1	1
1	1	1	1	1	1	1

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$\boldsymbol{f = X_1X_3X_4 \oplus X_1X_2 \oplus X_1X_2X_3X_4}$ −полином Жегалкина

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8. $\boldsymbol{X_1 \oplus (X_2 \wedge X_3) \oplus X_4}$

$\boldsymbol{X_1}$	$\boldsymbol{X}$	$\boldsymbol{X_1}$	$\boldsymbol{X_1}$	$\boldsymbol{X_2 \wedge X_3}$	$\boldsymbol{X_1 \oplus (X_2 \wedge X_3)}$	$\boldsymbol{f}$
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	0	0
0	0	1	1	0	0	1
0	1	0	0	0	0	0
0	1	0	1	0	0	1
0	1	1	0	1	1	1
0	1	1	1	1	1	0
1	0	0	0	0	1	1
1	0	0	1	0	1	0
1	0	1	0	0	1	1
1	0	1	1	0	1	0
1	1	0	0	0	1	1
1	1	0	1	0	1	0
1	1	1	0	1	0	0
1	1	1	1	1	0	1

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$\boldsymbol{f = X_1 \oplus X_4 \oplus X_2X_3}$ −полиом Жегалкина

Шишкина Мария Николаевна, 470069

9. $\boldsymbol{f = (X_1/X_2) \wedge (X_3/X_4)}$

$\boldsymbol{X_1}$	$\boldsymbol{X_2}$	$\boldsymbol{X_3}$	$\boldsymbol{X_4}$	$\boldsymbol{X_1/X_2}$	$\boldsymbol{X_3/X_4}$	$\boldsymbol{f}$
0	0	0	0	1	1	1
0	0	0	1	1	1	1
0	0	1	0	1	1	1
0	0	1	1	1	0	0
0	1	0	0	1	1	1
0	1	0	1	1	1	1
0	1	1	0	1	1	1
0	1	1	1	1	0	0
1	0	0	0	1	1	1
1	0	0	1	1	1	1
1	0	1	0	1	1	1
1	0	1	1	1	0	0
1	1	0	0	0	1	0
1	1	0	1	0	1	0
1	1	1	0	0	1	0
1	1	1	1	0	0	0

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$\boldsymbol{f = X_1X_2 \oplus X_3X_4 \oplus X_1X_2X_3X_4 \oplus 1}$ –полином Жегалкина

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10. $\boldsymbol{f = (X_1 \downarrow \overline{X_2}) \vee (\overline{X_3} \mid X_4)}$

X_1	X_2	X_3	X_4	$\overline{X_2}$	$\overline{X_3}$	$X_1 \downarrow \overline{X_2}$	$\overline{X_3} \mid X_4$	f
0	0	0	0	1	1	0	1	1
0	0	0	1	1	1	0	0	0
0	0	1	0	1	0	0	1	1
0	0	1	1	1	0	0	1	1
0	1	0	0	0	1	1	1	1
0	1	0	1	0	1	1	0	1
0	1	1	0	0	0	1	1	1
0	1	1	1	0	0	1	1	1
1	0	0	0	1	1	0	1	1
1	0	0	1	1	1	0	0	0
1	0	1	0	1	0	0	1	1
1	0	1	1	1	0	0	1	1
1	1	0	0	0	1	0	1	1
1	1	0	1	0	1	0	0	0
1	1	1	0	0	0	0	1	1
1	1	1	1	0	0	0	1	1

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$$\boldsymbol{f = 1 \oplus X_4 \oplus X_3X_4 \oplus X_2X_4 \oplus X_2X_3X_4 \oplus X_1X_2X_4 \oplus}$$

$$\boldsymbol{\oplus X_1X_2X_3X_4}$$ –полином Жегалкина

Шишкина Мария Николаевна, 470069

11. $\boldsymbol{f = ((X_1 \wedge X_2)|(X_3 \vee X_4)) \downarrow X_4}$

X_1	X_2	X_3	X_4	$X_1 \wedge X_2$	$X_3 \vee X_4$	$(X_1 \wedge X_2)\|(X_3 \vee X_4)$	f
0	0	0	0	0	0	1	0
0	0	0	1	0	1	1	0
0	0	1	0	0	1	1	0
0	0	1	1	0	1	1	0
0	1	0	0	0	0	1	0
0	1	0	1	0	1	1	0
0	1	1	0	0	1	1	0
0	1	1	1	0	1	1	0
1	0	0	0	0	0	1	0
1	0	0	1	0	1	1	0
1	0	1	0	0	1	1	0
1	0	1	1	0	1	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	1	0	0
1	1	1	0	1	1	0	1
1	1	1	1	1	1	0	0

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$\boldsymbol{f = X_1X_2X_3 \oplus X_1X_2X_3X_4}$ −полином Жегалкина

Шишкина Мария Николаевна, 470069

12. $\boldsymbol{f = \left((X_1 \wedge X_4) \downarrow \left(\overline{X_2} \middle| X_3\right)\right) \vee (\overline{X_1} \wedge X_2)}$

X_1	X_1	X_1	X_1	$X_1 \wedge X_4$	$\overline{X_1} \mid X_1$	$(X_1 \wedge X_4) \downarrow \left(\overline{X_2} \middle| X_3\right)$	$\overline{X_1} \wedge X_2$	f
0	0	0	0	0	1	0	0	0
0	0	0	1	0	1	0	0	0
0	0	1	0	0	0	1	0	1
0	0	1	1	0	0	1	0	1
0	1	0	0	0	1	0	1	1
0	1	0	1	0	1	0	1	1
0	1	1	0	0	1	0	1	1
0	1	1	1	0	1	0	1	1
1	0	0	0	0	1	0	0	0
1	0	0	1	1	1	0	0	0
1	0	1	0	0	0	1	0	1
1	0	1	1	1	0	0	0	0
1	1	0	0	0	1	0	0	0
1	1	0	1	1	1	0	0	0
1	1	1	0	0	1	0	0	0
1	1	1	1	1	1	0	0	0

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$\boldsymbol{f = X_3 \oplus X_2 \oplus X_2X_3 \oplus X_1X_3X_4 \oplus X_1X_2 \oplus X_1X_2X_3X_4}$ –полином Жегалкина

Шишкина Мария Николаевна, 470069

13. $f = \overline{(X_1 \vee X_3)} \vee (\overline{X_4} \wedge X_3)$

X_1	X_2	X_3	X_4	$X_1 \vee X_3$	$\overline{X_1 \vee X_3}$	$\overline{X_2}$	$\overline{X_2} \wedge X_4$	f
0	0	0	0	0	1	1	0	1
0	0	0	1	0	1	1	1	1
0	0	1	0	1	0	1	0	0
0	0	1	1	1	0	1	1	1
0	1	0	0	0	1	0	0	1
0	1	0	1	0	1	0	1	1
0	1	1	0	1	0	0	0	0
0	1	1	1	1	0	0	0	0
1	0	0	0	1	0	1	0	0
1	0	0	1	1	0	1	1	1
1	0	1	0	1	0	1	0	0
1	0	1	1	1	0	1	1	1
1	1	0	0	1	0	0	0	0
1	1	0	1	1	0	0	0	0
1	1	1	0	1	0	0	0	0
1	1	1	1	1	0	0	0	0

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$$\boldsymbol{f = 1 \oplus X_3 \oplus X_3X_4 \oplus X_2X_3X_4 \oplus X_1 \oplus X_1X_4 \oplus X_1X_3 \oplus X_1X_3X_4 \oplus}$$

$$\boldsymbol{\oplus X_1X_2X_4 \oplus X_1X_2X_3X_4}$$ –полином Жегалкина

Шишкина Мария Николаевна, 470069

14. $\boldsymbol{f = (X_1 \oplus X_2) \wedge (\overline{X_3} \oplus X_4)}$

$\boldsymbol{X_1}$	$\boldsymbol{X_2}$	$\boldsymbol{X_3}$	$\boldsymbol{X_4}$	$\boldsymbol{\overline{X_3}}$	$\boldsymbol{\overline{X_3} \oplus X_4}$	$\boldsymbol{X_1 \oplus X_2}$	$\boldsymbol{f}$
0	0	0	0	1	1	0	0
0	0	0	1	1	0	0	0
0	0	1	0	0	0	0	0
0	0	1	1	0	1	0	0
0	1	0	0	1	1	1	1
0	1	0	1	1	0	1	0
0	1	1	0	0	0	1	0
0	1	1	1	0	1	1	1
1	0	0	0	1	1	1	1
1	0	0	1	1	0	1	0
1	0	1	0	0	0	1	0
1	0	1	1	0	1	1	1
1	1	0	0	1	1	0	0
1	1	0	1	1	0	0	0
1	1	1	0	0	0	0	0
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$\boldsymbol{f = X_2 \oplus X_2X_4 \oplus X_2X_3 \oplus X_1 \oplus X_1X_4 \oplus X_1X_3}$ −полином Жегалкина

Шишкина Мария Николаевна, 470069

15. $\boldsymbol{f = \left(\overline{X_1} \wedge (X_2 \downarrow X_3)\right) | (X_4 \oplus X_1)}$

X_1	X_1	X_1	X_1	$X_2 \downarrow X_3$	$\overline{X_3}$	$\overline{X_1} \wedge (X_2 \downarrow X_3)$	$X_4 \oplus X_1$	f
0	0	0	0	1	1	1	0	1
0	0	0	1	1	1	1	1	0
0	0	1	0	0	1	0	0	1
0	0	1	1	0	1	0	1	1
0	1	0	0	0	1	0	0	1
0	1	0	1	0	1	0	1	1
0	1	1	0	0	1	0	0	1
0	1	1	1	0	1	0	1	1
1	0	0	0	1	0	0	1	1
1	0	0	1	1	0	0	0	1
1	0	1	0	0	0	0	1	1
1	0	1	1	0	0	0	0	1
1	1	0	0	0	0	0	1	1
1	1	0	1	0	0	0	0	1
1	1	1	0	0	0	0	1	1
1	1	1	1	0	0	0	0	1

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$$\boldsymbol{f = 1 \oplus X_4 \oplus X_3X_4 \oplus X_2X_4 \oplus X_2X_3X_4 \oplus X_1X_4 \oplus X_1X_3X_4 \oplus}$$

$$\boldsymbol{\oplus X_1X_2X_4 \oplus X_1X_2X_3X_4}$$ –полином Жегалкина