

Formulation:

min=cut;
@bin(x1);
@bin(x2);
@bin(x3);
@bin(x4);
@bin(x5);
@bin(x6);
@bin(x7);
@bin(x8);
@bin(x9);
@bin(x10);
@bin(x11);
@bin(x12);
@bin(x13);
@bin(x14);
@bin(x15);
@bin(x16);
@bin(x17);
@bin(x18);
@bin(x19);
@bin(x20);
@bin(x21);
@bin(x22);
@bin(x23);
@bin(x24);

w12=1;
w117=1;
w124=1;
w23=1;
w213=1;
w221=1;
w222=1;
w34=1;
w316=1;

w320=1;
w45=1;
w415=1;
w418=1;
w56=1;
w511=1;
w515=1;
w610=1;
w614=1;
w78=1;
w717=1;
w89=1;
w813=1;
w910=1;
w1112=1;
w1115=1;
w1314=1;
w1617=1;
w1819=1;
w1824=1;
w1920=1;
w2021=1;
w2223=1;
w2324=1;
@bin(c12);
@bin(c117);
@bin(c124);
@bin(c23);
@bin(c213);
@bin(c221);
@bin(c222);
@bin(c34);
@bin(c316);
@bin(c320);
@bin(c45);
@bin(c415);
@bin(c418);
@bin(c56);

@bin(c511);
@bin(c515);
@bin(c610);
@bin(c614);
@bin(c78);
@bin(c717);
@bin(c89);
@bin(c813);
@bin(c910);
@bin(c1112);
@bin(c1115);
@bin(c1314);
@bin(c1617);
@bin(c1819);
@bin(c1824);
@bin(c1920);
@bin(c2021);
@bin(c2223);
@bin(c2324);
 $c_{12} \geq x_1 - x_2$;
 $c_{12} \geq x_2 - x_1$;
 $c_{12} \leq x_1 + x_2$;
 $c_{12} \leq 2 - x_1 - x_2$;
 $c_{117} \geq x_1 - x_{17}$;
 $c_{117} \geq x_{17} - x_1$;
 $c_{117} \leq x_1 + x_{17}$;
 $c_{117} \leq 2 - x_1 - x_{17}$;
 $c_{124} \geq x_1 - x_{24}$;
 $c_{124} \geq x_{24} - x_1$;
 $c_{124} \leq x_1 + x_{24}$;
 $c_{124} \leq 2 - x_1 - x_{24}$;
 $c_{23} \geq x_2 - x_3$;
 $c_{23} \geq x_3 - x_2$;
 $c_{23} \leq x_2 + x_3$;
 $c_{23} \leq 2 - x_2 - x_3$;
 $c_{213} \geq x_2 - x_{13}$;
 $c_{213} \geq x_{13} - x_2$;
 $c_{213} \leq x_2 + x_{13}$;

$c_{213} \leq 2 - x_2 - x_{13};$
 $c_{221} \geq x_2 - x_{21};$
 $c_{221} \geq x_{21} - x_2;$
 $c_{221} \leq x_2 + x_{21};$
 $c_{221} \leq 2 - x_2 - x_{21};$
 $c_{222} \geq x_2 - x_{22};$
 $c_{222} \geq x_{22} - x_2;$
 $c_{222} \leq x_2 + x_{22};$
 $c_{222} \leq 2 - x_2 - x_{22};$
 $c_{34} \geq x_3 - x_4;$
 $c_{34} \geq x_4 - x_3;$
 $c_{34} \leq x_3 + x_4;$
 $c_{34} \leq 2 - x_3 - x_4;$
 $c_{316} \geq x_3 - x_{16};$
 $c_{316} \geq x_{16} - x_3;$
 $c_{316} \leq x_3 + x_{16};$
 $c_{316} \leq 2 - x_3 - x_{16};$
 $c_{320} \geq x_3 - x_{20};$
 $c_{320} \geq x_{20} - x_3;$
 $c_{320} \leq x_3 + x_{20};$
 $c_{320} \leq 2 - x_3 - x_{20};$
 $c_{45} \geq x_4 - x_5;$
 $c_{45} \geq x_5 - x_4;$
 $c_{45} \leq x_4 + x_5;$
 $c_{45} \leq 2 - x_4 - x_5;$
 $c_{415} \geq x_4 - x_{15};$
 $c_{415} \geq x_{15} - x_4;$
 $c_{415} \leq x_4 + x_{15};$
 $c_{415} \leq 2 - x_4 - x_{15};$
 $c_{418} \geq x_4 - x_{18};$
 $c_{418} \geq x_{18} - x_4;$
 $c_{418} \leq x_4 + x_{18};$
 $c_{418} \leq 2 - x_4 - x_{18};$
 $c_{56} \geq x_5 - x_6;$
 $c_{56} \geq x_6 - x_5;$
 $c_{56} \leq x_5 + x_6;$
 $c_{56} \leq 2 - x_5 - x_6;$
 $c_{511} \geq x_5 - x_{11};$

$c511 > x11 - x5;$
 $c511 \leq x5 + x11;$
 $c511 \leq 2 - x5 - x11;$
 $c515 > x5 - x15;$
 $c515 > x15 - x5;$
 $c515 \leq x5 + x15;$
 $c515 \leq 2 - x5 - x15;$
 $c610 > x6 - x10;$
 $c610 > x10 - x6;$
 $c610 \leq x6 + x10;$
 $c610 \leq 2 - x6 - x10;$
 $c614 > x6 - x14;$
 $c614 > x14 - x6;$
 $c614 \leq x6 + x14;$
 $c614 \leq 2 - x6 - x14;$
 $c78 > x7 - x8;$
 $c78 > x8 - x7;$
 $c78 \leq x7 + x8;$
 $c78 \leq 2 - x7 - x8;$
 $c717 > x7 - x17;$
 $c717 > x17 - x7;$
 $c717 \leq x7 + x17;$
 $c717 \leq 2 - x7 - x17;$
 $c89 > x8 - x9;$
 $c89 > x9 - x8;$
 $c89 \leq x8 + x9;$
 $c89 \leq 2 - x8 - x9;$
 $c813 > x8 - x13;$
 $c813 > x13 - x8;$
 $c813 \leq x8 + x13;$
 $c813 \leq 2 - x8 - x13;$
 $c910 > x9 - x10;$
 $c910 > x10 - x9;$
 $c910 \leq x9 + x10;$
 $c910 \leq 2 - x9 - x10;$
 $c1112 > x11 - x12;$
 $c1112 > x12 - x11;$
 $c1112 \leq x11 + x12;$

$c_{1112} \leq 2 - x_{11} - x_{12};$
 $c_{1115} \geq x_{11} - x_{15};$
 $c_{1115} \geq x_{15} - x_{11};$
 $c_{1115} \leq x_{11} + x_{15};$
 $c_{1115} \leq 2 - x_{11} - x_{15};$
 $c_{1314} \geq x_{13} - x_{14};$
 $c_{1314} \geq x_{14} - x_{13};$
 $c_{1314} \leq x_{13} + x_{14};$
 $c_{1314} \leq 2 - x_{13} - x_{14};$
 $c_{1617} \geq x_{16} - x_{17};$
 $c_{1617} \geq x_{17} - x_{16};$
 $c_{1617} \leq x_{16} + x_{17};$
 $c_{1617} \leq 2 - x_{16} - x_{17};$
 $c_{1819} \geq x_{18} - x_{19};$
 $c_{1819} \geq x_{19} - x_{18};$
 $c_{1819} \leq x_{18} + x_{19};$
 $c_{1819} \leq 2 - x_{18} - x_{19};$
 $c_{1824} \geq x_{18} - x_{24};$
 $c_{1824} \geq x_{24} - x_{18};$
 $c_{1824} \leq x_{18} + x_{24};$
 $c_{1824} \leq 2 - x_{18} - x_{24};$
 $c_{1920} \geq x_{19} - x_{20};$
 $c_{1920} \geq x_{20} - x_{19};$
 $c_{1920} \leq x_{19} + x_{20};$
 $c_{1920} \leq 2 - x_{19} - x_{20};$
 $c_{2021} \geq x_{20} - x_{21};$
 $c_{2021} \geq x_{21} - x_{20};$
 $c_{2021} \leq x_{20} + x_{21};$
 $c_{2021} \leq 2 - x_{20} - x_{21};$
 $c_{2223} \geq x_{22} - x_{23};$
 $c_{2223} \geq x_{23} - x_{22};$
 $c_{2223} \leq x_{22} + x_{23};$
 $c_{2223} \leq 2 - x_{22} - x_{23};$
 $c_{2324} \geq x_{23} - x_{24};$
 $c_{2324} \geq x_{24} - x_{23};$
 $c_{2324} \leq x_{23} + x_{24};$
 $c_{2324} \leq 2 - x_{23} - x_{24};$
 $x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + x_{11} + x_{12} + x_{13} + x_{14} + x_{15} + x_{16} + x_{17} + x_{18} + x_{19} + x_{20} + x_{21} + x_{22}$

$2 + x_{23} + x_{24} = 12;$
 $cut = c_{12} * w_{12} + c_{117} * w_{117} + c_{124} * w_{124} + c_{23} * w_{23} + c_{213} * w_{213} + c_{221} * w_{221} + c_{222} * w_{222} + c_{34} * w_{34} + c_{316} * w_{316} + c_{320} * w_{320} + c_{45} * w_{45} + c_{415} * w_{415} + c_{418} * w_{418} + c_{56} * w_{56} + c_{511} * w_{511} + c_{515} * w_{515} + c_{610} * w_{610} + c_{614} * w_{614} + c_{78} * w_{78} + c_{717} * w_{717} + c_{89} * w_{89} + c_{813} * w_{813} + c_{910} * w_{910} + c_{1112} * w_{1112} + c_{1115} * w_{1115} + c_{1314} * w_{1314} + c_{1617} * w_{1617} + c_{1819} * w_{1819} + c_{1824} * w_{1824} + c_{1920} * w_{1920} + c_{2021} * w_{2021} + c_{2223} * w_{2223}$

結果:

The screenshot shows the LINGO 11.0 Solver Status window for model 1111527. The main window displays a table of variables and their values. The solver status window is open, showing the following details:

Variable	Value	Reduced Cost
CUT	4.000000	0.000000
X1	1.000000	0.000000
X2	1.000000	0.000000
X3	1.000000	0.000000
X4	0.000000	0.000000
X5	0.000000	0.000000
X6	0.000000	0.000000
X7	0.000000	0.000000
X8	0.000000	0.000000
X9	0.000000	0.000000
X10	0.000000	0.000000
X11	0.000000	0.000000
X12	0.000000	0.000000
X13	0.000000	0.000000
X14	0.000000	0.000000
X15	0.000000	0.000000
X16	1.000000	0.000000
X17	1.000000	0.000000
X18	1.000000	0.000000
X19	1.000000	0.000000
X20	1.000000	0.000000
X21	1.000000	0.000000
X22	1.000000	0.000000
X23	1.000000	0.000000
X24	1.000000	0.000000
W12	1.000000	0.000000
W17	1.000000	0.000000
W124	1.000000	0.000000
W23	1.000000	0.000000
W213	1.000000	0.000000
W221	1.000000	0.000000
W222	1.000000	0.000000
W34	1.000000	0.000000
W316	1.000000	0.000000
W320	1.000000	0.000000
W45	1.000000	0.000000
W415	1.000000	0.000000
W418	1.000000	0.000000
W56	1.000000	0.000000
W511	1.000000	0.000000
W515	1.000000	0.000000
W610	1.000000	0.000000

The solver status window shows the following summary:

LINGO 11.0 Solver Status (Model 1111527)	
Solver Status:	Global Opt
Model Class:	ILP
Objective:	4
Infeasibility:	0
Iterations:	4646
Extruded Solver Status:	
Solver Type:	B-and-B
Best Obj:	4
Obj Deviation:	4
Steps:	17
Active:	0
Variables:	
Total:	58
Nonzero:	0
Constraints:	
Total:	135
Nonzero:	0
Nonzeros:	
Total:	455
Nonzero:	0
Optimizer Memory Used (K):	
Total:	48
Elapsed Runtime (hh:mm:ss):	
Total:	00:00:00

產生器程式:

```
#include<iostream>
```

```

using namespace std;

int main() {
    int d = 24;
    int a[200],b[200];
    for (int i = 1;i <= 24;i++) {
        cout << "@bin(x" << i << ");" << endl;//輸出變數
    }
    cout << endl;
    int l=0,c=1;
    for (int i = 1;i < 25;i++) { //逐個輸入兩點間有沒有線
        for (int j = i + 1;j < 25;j++) {
            cout << "w" << i << j << "=" ;
            cin >> l;
            if (l == 1) {
                a[c] = i;
            }
        }
    }
}

```

```

b[c] = j;
c++;
}
}
}
for (int i = 1; i < c; i++) { //輸出有線的式子
cout << "w" << a[i] << b[i] << "=1;" << endl;
}
for (int i = 1; i < c; i++) { //輸出變數
cout << "@bin(c" << a[i] << b[i] << ");" << endl;
}
for (int i = 1; i < c; i++) { //輸出 XOR 式子
cout << "c" << a[i] << b[i] << ">=x" << a[i] << "-x" << b[i] << ";" << endl;
cout << "c" << a[i] << b[i] << ">=x" << b[i] << "-x" << a[i] << ";" << endl;
cout << "c" << a[i] << b[i] << "<=x" << a[i] << "+x" << b[i] << ";" << endl;
cout << "c" << a[i] << b[i] << "<=2-x" << a[i] << "-x" << b[i] << ";" << endl;
}
for (int i = 1; i < 25; i++) { //輸出限制式子
if (i != 24) {
cout << "x" << i << "+";
}
else {
cout << "x" << i << "=12;" << endl;
}
}
cout << "cut=";
for (int i = 1; i < c; i++) { //輸出公式
if (i + 1 != c) {
cout << "c" << a[i] << b[i] << "*w" << a[i] << b[i] << "+";
} else {
cout << "c" << a[i] << b[i] << "*w" << a[i] << b[i] << ";";
}
}
}
}

```