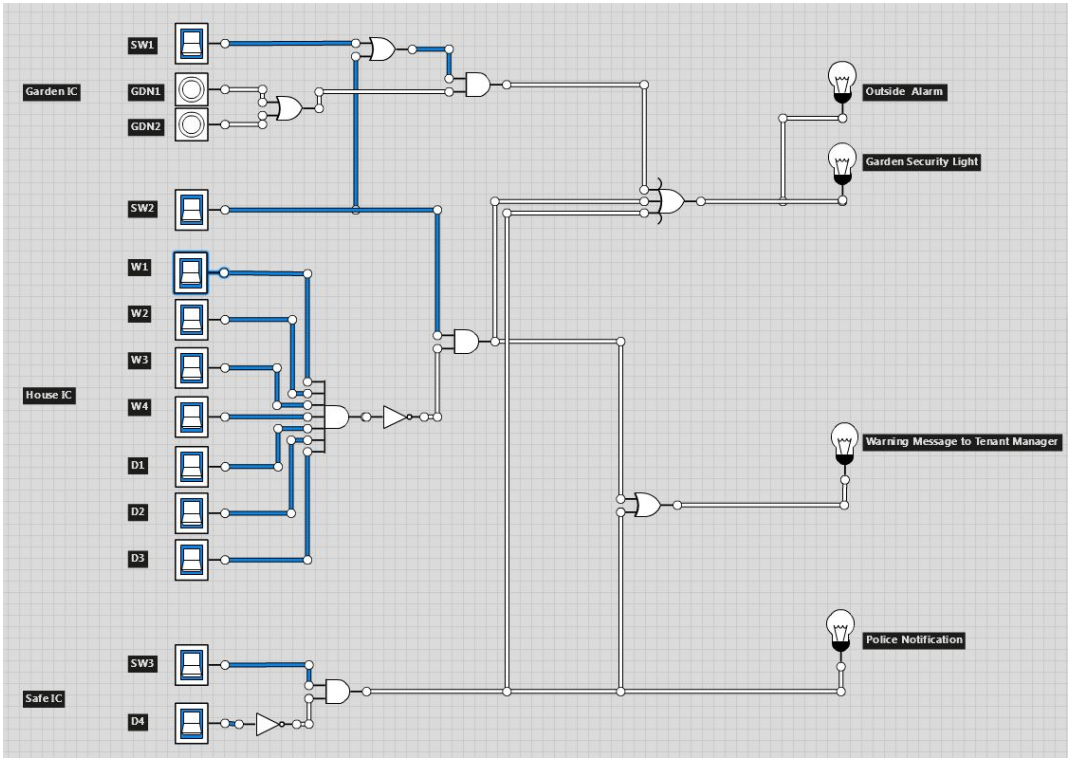
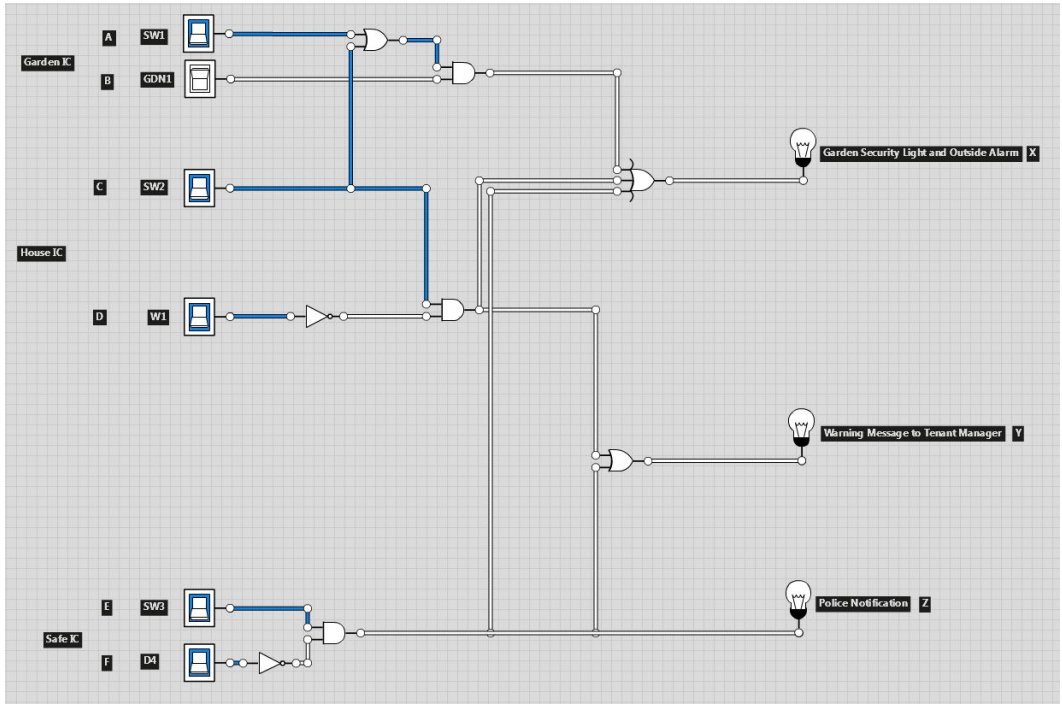
Updating the initial design





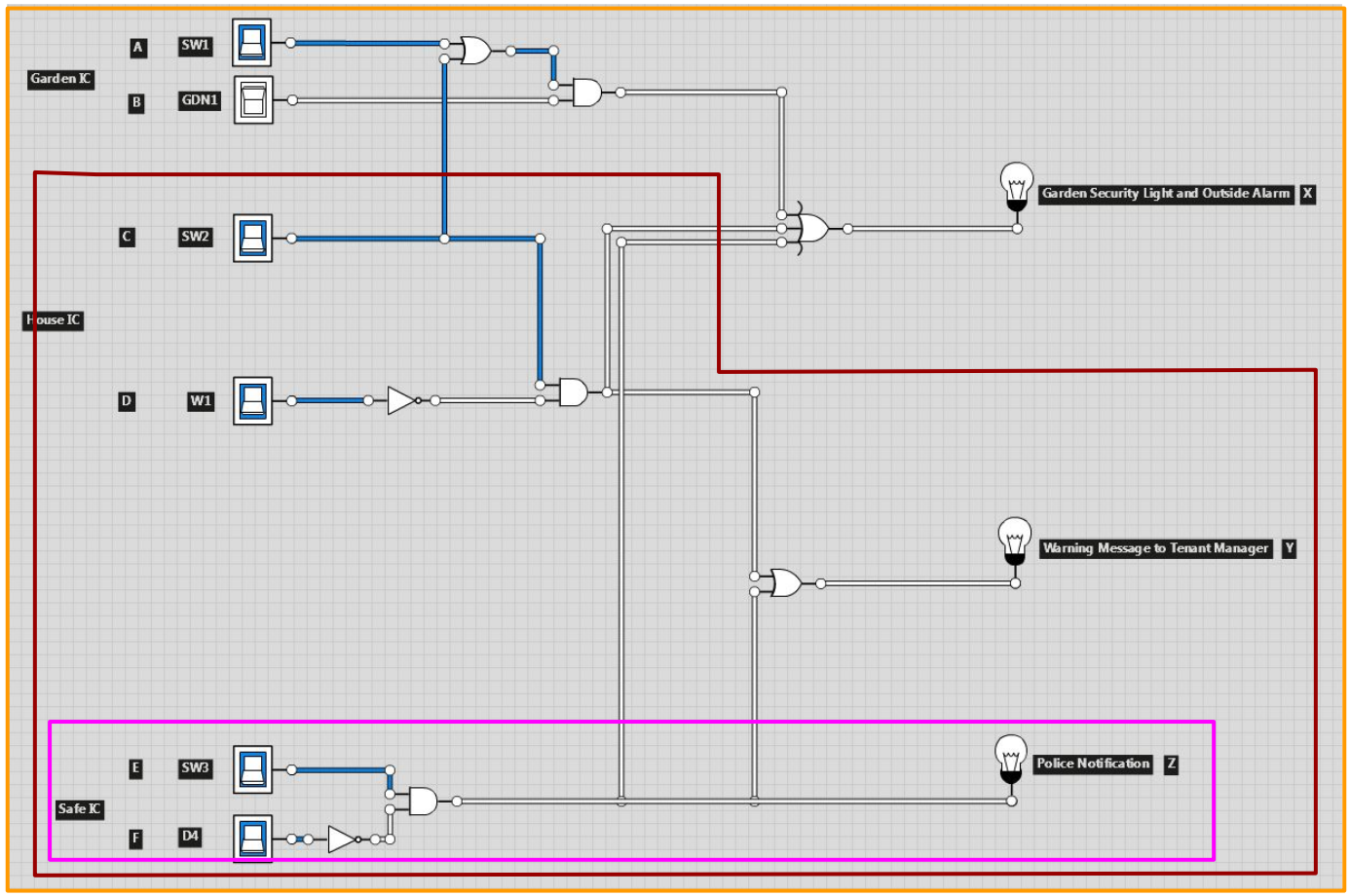
Garden Circuit:
Merged the garden sensor PTMs into one switch, in doing so removing the need for an OR gate.
The two output lights were merged into one as they were identical.

House Circuit:
Merged the window switches into one switch, in doing so removing the need for an AND gate.

Safe Circuit:
No changes were made as the initial design only had one door switch.

Each of the inputs and outputs were assigned letters (A-F and X-Z respectively) to allow for the use of boolean algebra.

Primary Optimisation - Boolean Algebra



X = B(A+C) + CD’ + EF’

Using the distributive law

X = AB + BC + CD’ + EF’

No further simplification

Y = CD’ + EF’

No further simplification

Z = EF’

No further simplification

Secondary Optimisation - Karnaugh Maps

Using the SOP form that we created in the primary optimisation process, we generated Karnaugh maps for each output.

X = B(A+C) + CD' + EF'
X = AB + BC + CD' + EF'

ABC \ DEF	000	001	011	111	101	100	110	010
000							1	1
001	1	1	1				1	1
011	1	1	1	1	1	1	1	1
111	1	1	1	1	1	1	1	1
101	1	1	1				1	1
100							1	1
110	1	1	1	1	1	1	1	1
010							1	1

Y = CD' + EF'

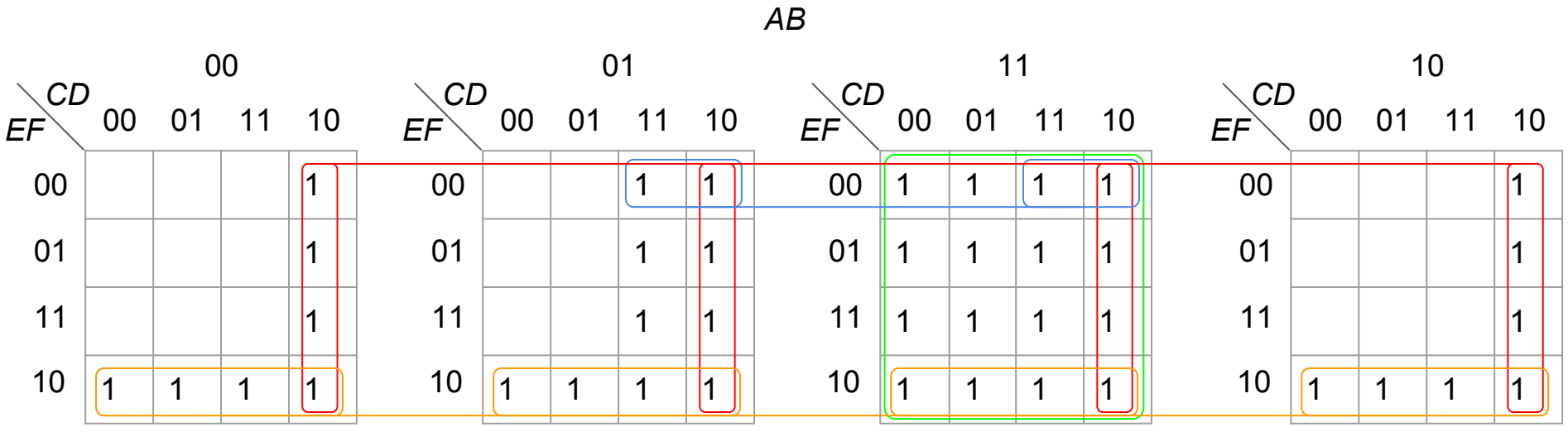
CD \ EF	00	01	11	10
00				1
01				1
11				1
10	1	1	1	1

Z = EF'

E \ F	0	1
0		
1	1	

Testing Optimised Circuit
Against Updated Circuit

https://docs.google.com/spreadsheets/d/1aR111SEPgwN3uULYRzrOjB2mOmJWx8U3RDdO6fz7_Nc/edit#gid=862095346&range=A1



Optimised Circuit LogicLy Truth Tables

A	C	E	F	D	B	X	Y	Z
false	false	false	false	false	false	false	false	false
false	false	false	false	false	true	false	false	false
false	false	false	false	true	false	false	false	false
false	false	false	false	true	true	false	false	false
false	false	false	true	false	false	false	false	false
false	false	false	true	false	true	false	false	false
false	false	false	true	true	false	false	false	false
false	false	false	true	true	true	false	false	false
false	false	true	false	false	false	true	true	true
false	false	true	false	false	true	true	true	true

A	C	E	F	D	B	X	Y	Z
false	true	true	true	true	false	false	false	false
false	true	true	true	true	true	true	false	false
true	false	false	false	false	false	false	false	false
true	false	false	false	false	true	true	false	false
true	false	false	false	true	false	false	false	false
true	false	false	false	true	true	true	false	false
true	false	false	true	false	false	false	false	false
true	false	false	true	false	true	true	false	false
true	false	false	true	true	false	false	false	false
true	false	false	true	true	true	true	false	false

A	C	E	F	D	B	X	Y	Z
false	false	true	false	true	false	true	true	true
false	false	true	false	true	true	true	true	true
false	false	true	true	false	false	false	false	false
false	false	true	true	false	true	false	false	false
false	false	true	true	true	false	false	false	false
false	false	true	true	true	true	false	false	false
false	true	false	false	false	false	true	true	false
false	true	false	false	false	true	true	true	false
false	true	false	false	true	false	false	false	false
false	true	false	false	true	true	true	false	false

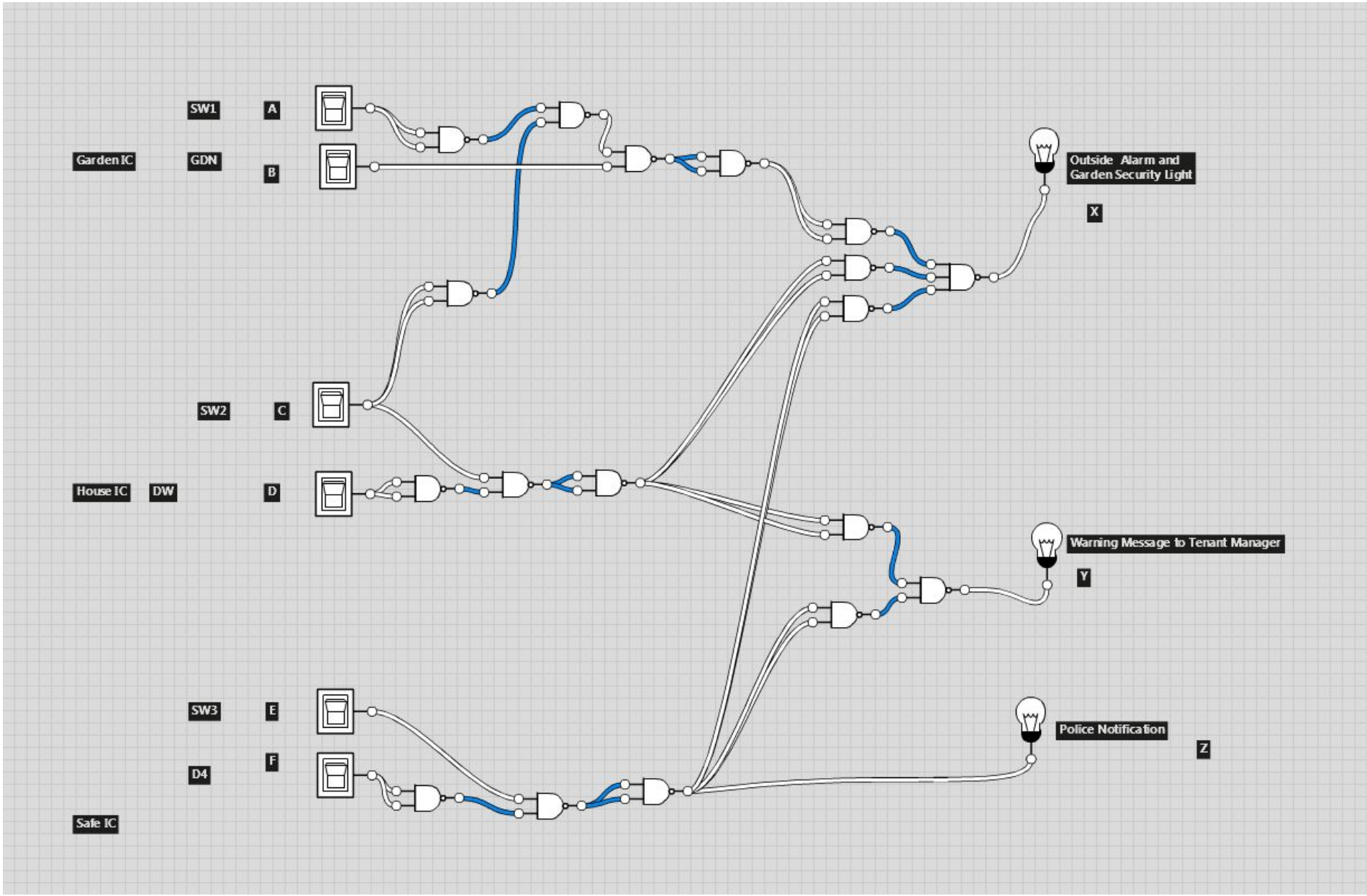
A	C	E	F	D	B	X	Y	Z
true	false	true	false	false	false	true	true	true
true	false	true	false	false	true	true	true	true
true	false	true	false	true	false	true	true	true
true	false	true	false	true	true	true	true	true
true	false	true	true	false	false	false	false	false
true	false	true	true	false	true	true	false	false
true	false	true	true	true	false	false	false	false
true	false	true	true	true	true	false	false	false
true	true	false	false	false	false	true	true	false
true	true	false	false	false	true	true	true	false

A	C	E	F	D	B	X	Y	Z
false	true	false	true	false	false	true	true	false
false	true	false	true	false	true	true	true	false
false	true	false	true	true	false	false	false	false
false	true	false	true	true	true	true	false	false
false	true	true	false	false	false	true	true	true
false	true	true	false	false	true	true	true	true
false	true	true	false	true	false	true	true	true
false	true	true	false	true	true	true	true	true
false	true	true	true	false	false	true	true	false
false	true	true	true	false	true	true	true	false

A	C	E	F	D	B	X	Y	Z
true	true	false	false	true	false	false	false	false
true	true	false	false	true	true	true	false	false
true	true	false	true	false	false	true	true	false
true	true	false	true	false	true	true	true	false
true	true	false	true	true	false	false	false	false
true	true	false	true	true	true	true	false	false
true	true	true	false	false	false	true	true	true
true	true	true	false	false	true	true	true	true
true	true	true	false	true	false	true	true	true
true	true	true	false	true	true	true	true	true

true	true	true	true	false	false	true	true	false
true	true	true	true	false	true	true	true	false
true	true	true	true	true	false	false	false	false
true	true	true	true	true	true	true	false	false

Universal Gate Conversion (NAND)



Universal Gate Truth Table

https://docs.google.com/spreadsheets/d/1aR111SEPgwN3uULYRzrOjB2mOmJWx8U3RDdO6fz7_Nc/edit#gid=0&range=A1

Universal Gate LogicLy Truth Tables

A	C	E	F	D	B	X	Y	Z
false	false	false	false	false	false	false	false	false
false	false	false	false	false	true	false	false	false
false	false	false	false	true	false	false	false	false
false	false	false	false	true	true	false	false	false
false	false	false	true	false	false	false	false	false
false	false	false	true	false	true	false	false	false
false	false	false	true	true	false	false	false	false
false	false	false	true	true	true	false	false	false
false	false	true	false	false	false	true	true	true
false	false	true	false	false	true	true	true	true

A	C	E	F	D	B	X	Y	Z
false	true	true	true	true	false	false	false	false
false	true	true	true	true	true	true	false	false
true	false	false	false	false	false	false	false	false
true	false	false	false	false	true	true	false	false
true	false	false	false	true	false	false	false	false
true	false	false	false	true	true	true	false	false
true	false	false	true	false	false	false	false	false
true	false	false	true	false	true	true	false	false
true	false	false	true	true	false	false	false	false
true	false	false	true	true	true	true	false	false

A	C	E	F	D	B	X	Y	Z
false	false	true	false	true	false	true	true	true
false	false	true	false	true	true	true	true	true
false	false	true	true	false	false	false	false	false
false	false	true	true	false	true	false	false	false
false	false	true	true	true	false	false	false	false
false	false	true	true	true	true	false	false	false
false	true	false	false	false	false	true	true	false
false	true	false	false	false	true	true	true	false
false	true	false	false	true	false	false	false	false
false	true	false	false	true	true	true	false	false

A	C	E	F	D	B	X	Y	Z
true	false	true	false	false	false	true	true	true
true	false	true	false	false	true	true	true	true
true	false	true	false	true	false	true	true	true
true	false	true	false	true	true	true	true	true
true	false	true	true	false	false	false	false	false
true	false	true	true	false	true	false	false	false
true	false	true	true	true	false	false	false	false
true	false	true	true	true	true	false	false	false
true	true	false	false	false	false	true	true	false
true	true	false	false	false	true	true	true	false

A	C	E	F	D	B	X	Y	Z
true	true	true	true	false	false	true	true	false
true	true	true	true	false	true	true	true	false
true	true	true	true	true	false	false	false	false
true	true	true	true	true	true	true	false	false

A	C	E	F	D	B	X	Y	Z
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false	true	false	true	false	true	true	true	false
false	true	false	true	true	false	false	false	false
false	true	false	true	true	true	true	false	false
false	true	true	false	false	false	true	true	true
false	true	true	false	false	true	true	true	true
false	true	true	false	true	false	true	true	true
false	true	true	false	true	true	true	true	true
false	true	true	true	false	false	true	true	false
false	true	true	true	false	true	true	true	false

A	C	E	F	D	B	X	Y	Z
true	true	false	false	true	false	false	false	false
true	true	false	false	true	true	true	false	false
true	true	false	true	false	false	true	true	false
true	true	false	true	false	true	true	true	false
true	true	false	true	true	false	false	false	false
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