Truth table for 4 inputs and 7 outputs. The output values in the bottom 6 rows (decimal input values 10 – 15) are marked ‘d’ because it does not matter what the output is for these inputs.

z	y	x	w	a	b	c	d	e	f	g
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	0	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	0	1	1
0	1	1	0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1
1	0	1	0	d	d	d	d	d	d	d
1	0	1	1	d	d	d	d	d	d	d
1	1	0	0	d	d	d	d	d	d	d
1	1	0	1	d	d	d	d	d	d	d
1	1	1	0	d	d	d	d	d	d	d
1	1	1	1	d	d	d	d	d	d	d

Karnaugh maps for each of the outputs:

a	xw				
z y		00	01	11	10
	00	1		1	1
	01		1	1	1
	11	d	d	d	d
	10	1	1	d	d

$a = x + z + y \, . \, w + \overline{w} \, . \, \overline{y}$

b	xw				
z y		00	01	11	10
	00	1	1	1	1
	01	1		1	
	11	d	d	d	d
	10	1	1	d	d

$b = \overline{z} \, . \, \overline{y} + \overline{x} \, . \, \overline{w} + z + x \, . \, w$

c		xw			
zy		00	01	11	10
	00	1	1	1	
	01	1	1	1	1
	11	d	d	d	d
	10	1	1	d	d

$c=\overline{x}+w+y$

d		xw			
zy		00	01	11	10
	00	1		1	1
	01		1		1
	11	d	d	d	d
	10	1	1	d	d

$d=z+x.\overline{w}+\overline{z}.\overline{y}.x+\overline{y}.\overline{w}+\overline{x}.w.y$

e		xw			
zy		00	01	11	10
	00	1			1
	01				1
	11	d	d	d	d
	10	1		d	d

$e=\overline{y}.\overline{w}+z.\overline{x}.\overline{w}+x.\overline{w}$

f		xw			
zy		00	01	11	10
	00	1			
	01	1	1		1
	11	d	d	d	d
	10	1	1	d	d

$f=z+\overline{x}.\overline{w}+y.\overline{w}+\overline{x}.y$

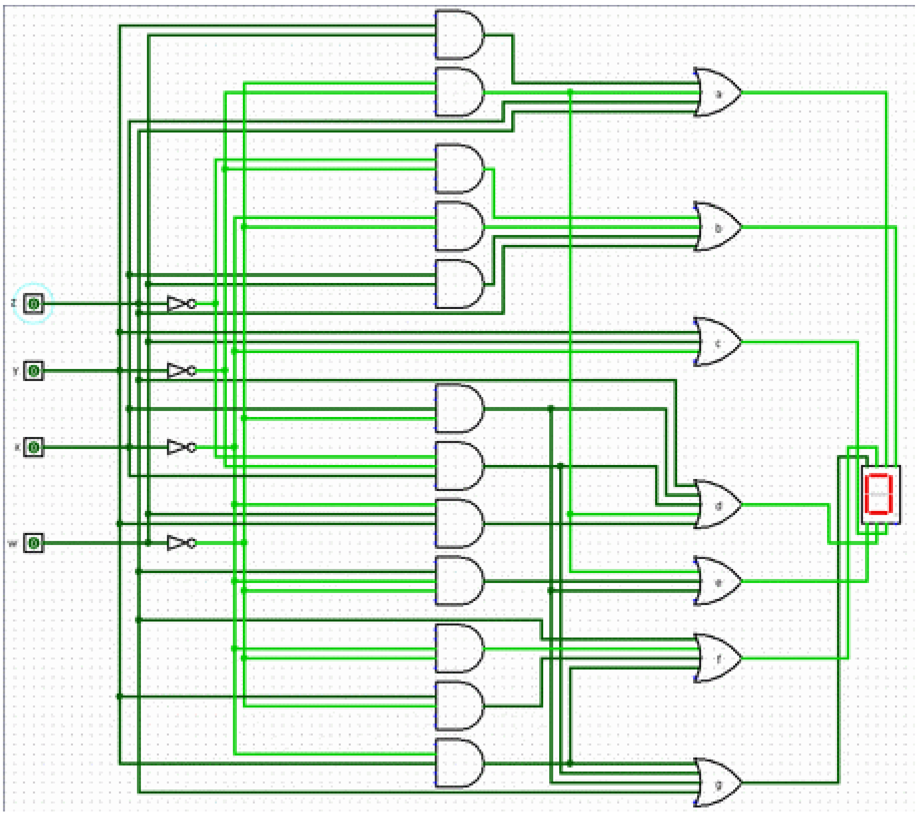
g	xw				
zy		00	01	11	10
	00			1	1
	01	1	1		1
	11	d	d	d	d
	10	1	1	d	d

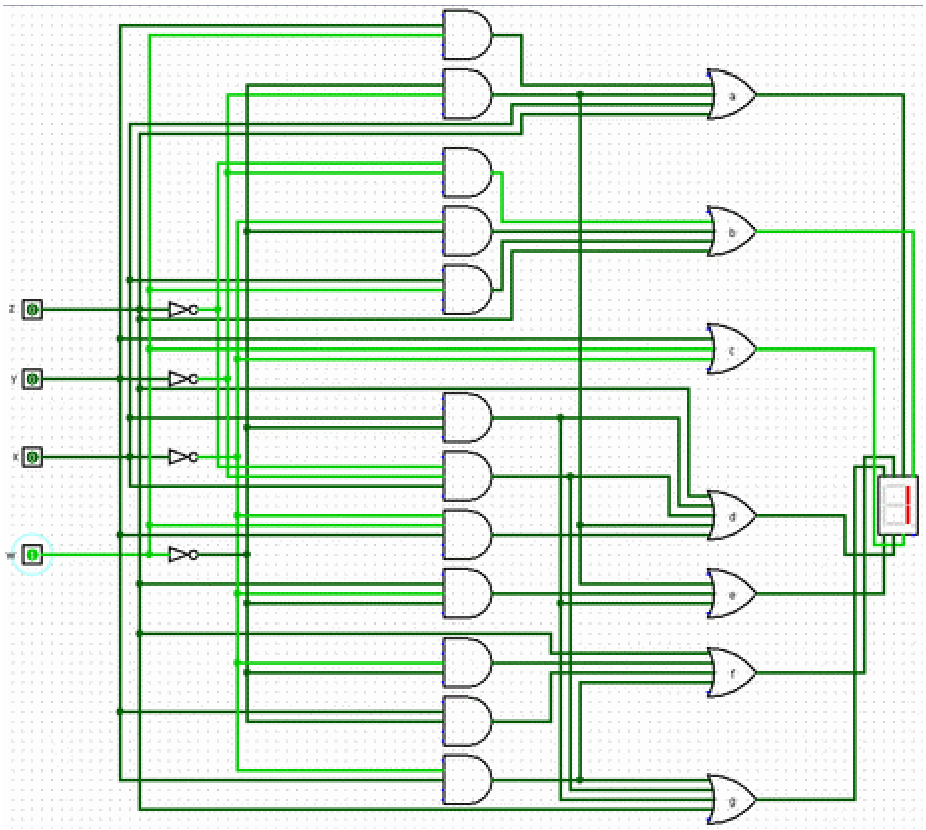
$$g = z + \overline{x}.y + \overline{z}.\overline{y}.x + x.\overline{w}$$

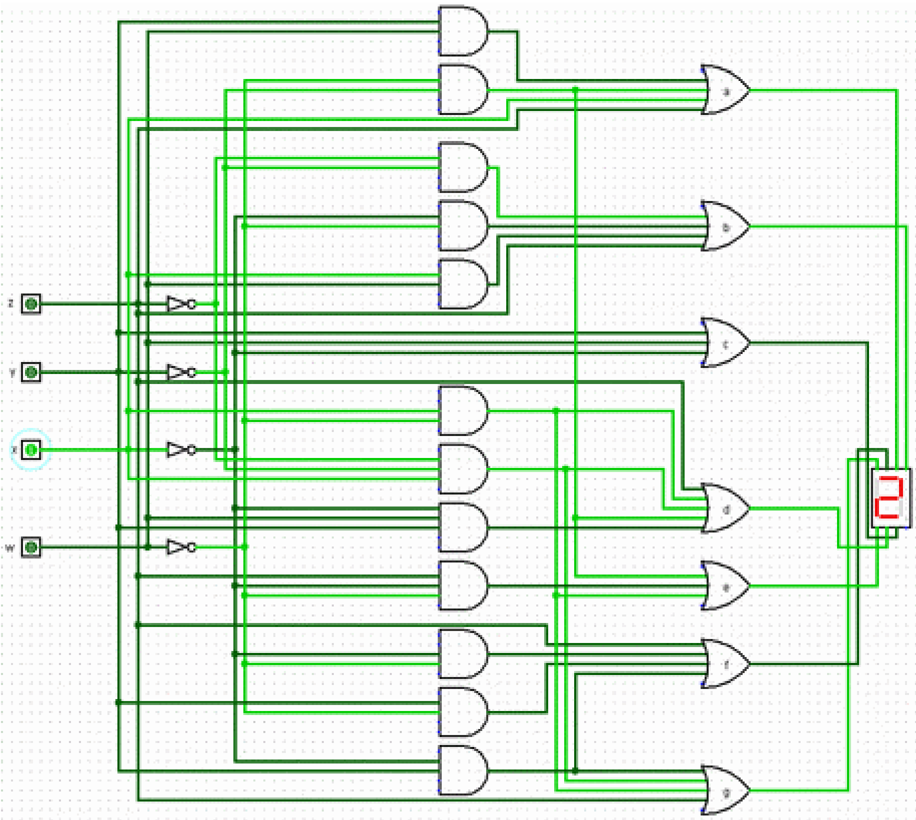
AND gates which are repeated and can therefore be reused in the circuit:

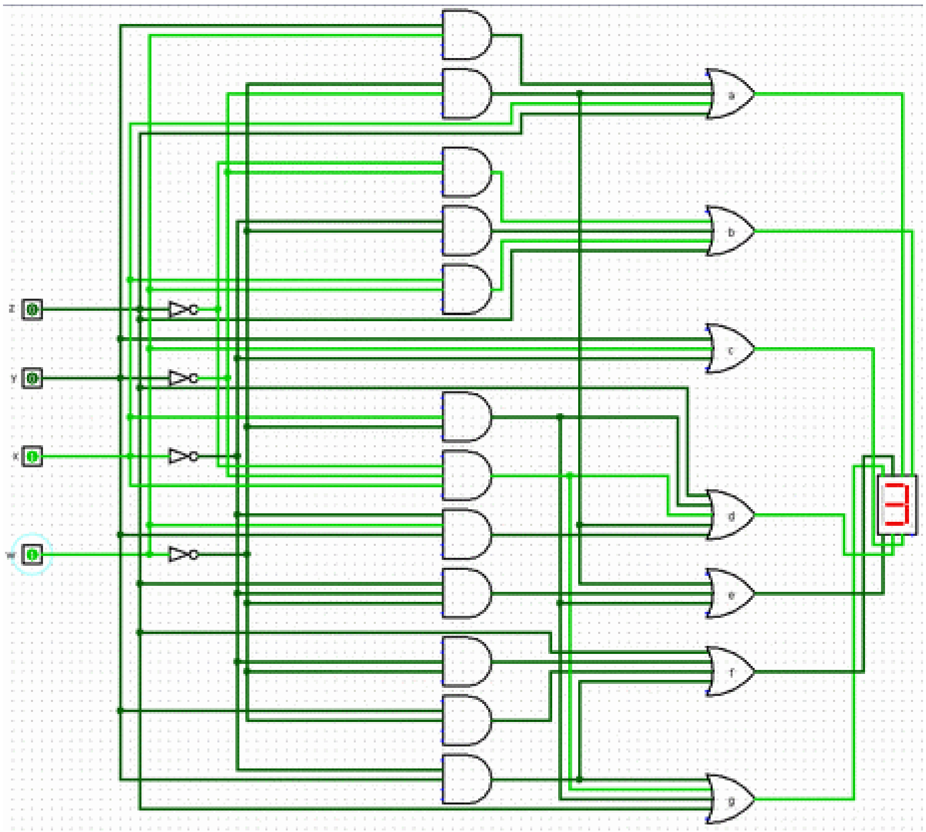
$\overline{w}.\overline{y}$	$x.\overline{w}$	$\overline{z}.\overline{y}.x$	$\overline{x}.y$
a, d, e	d, e, g	d, g	f, g

Screen-prints of the circuit showing each of the 10 decimal digits on the 7-segment display for the relevant binary input.








z
y
x
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c
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e
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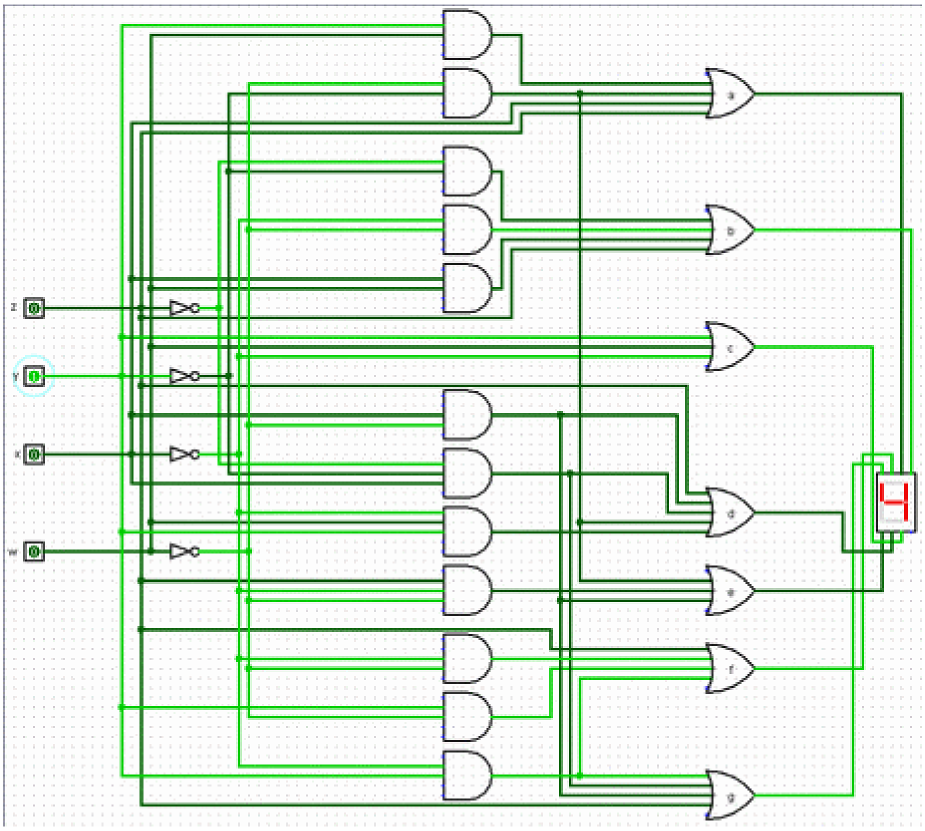
z
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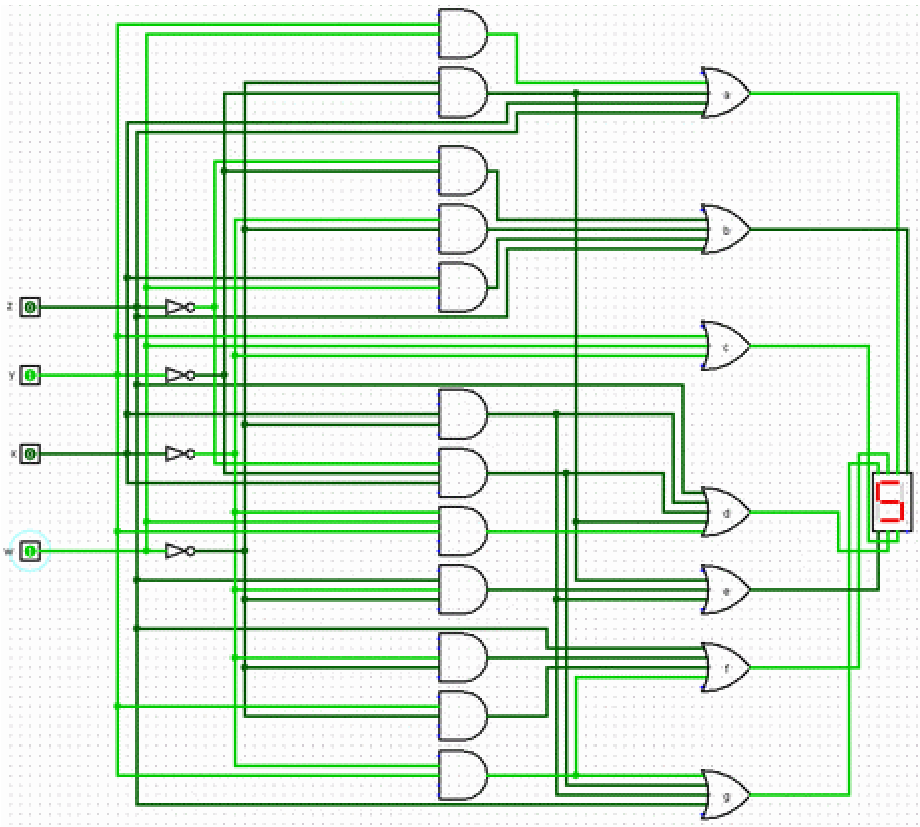
z
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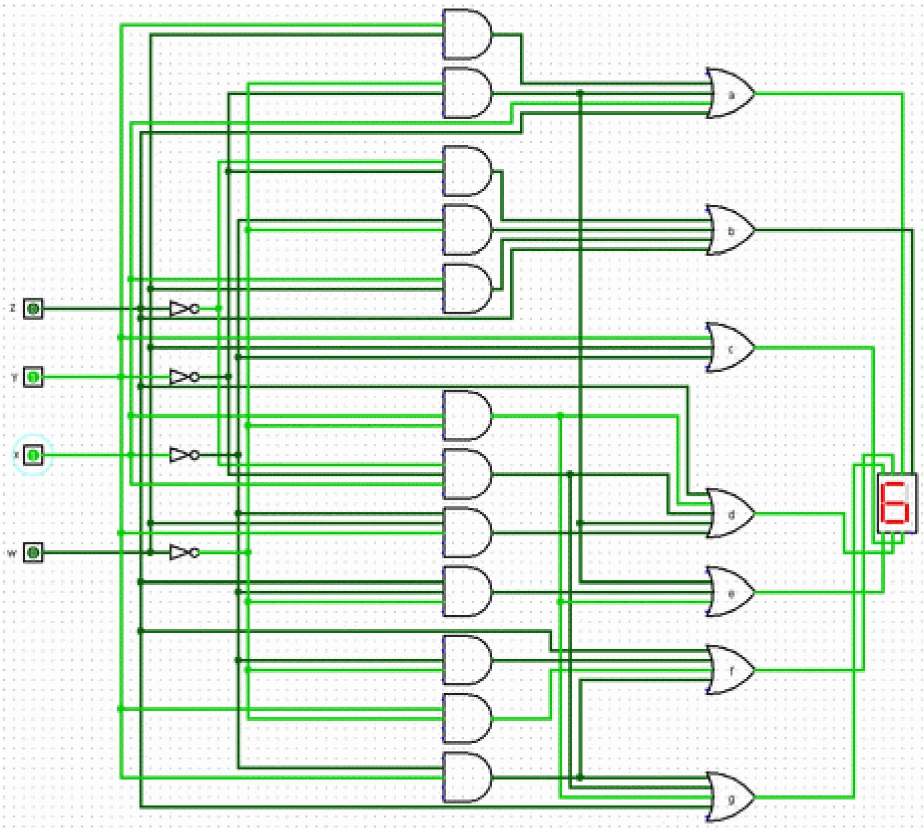
z
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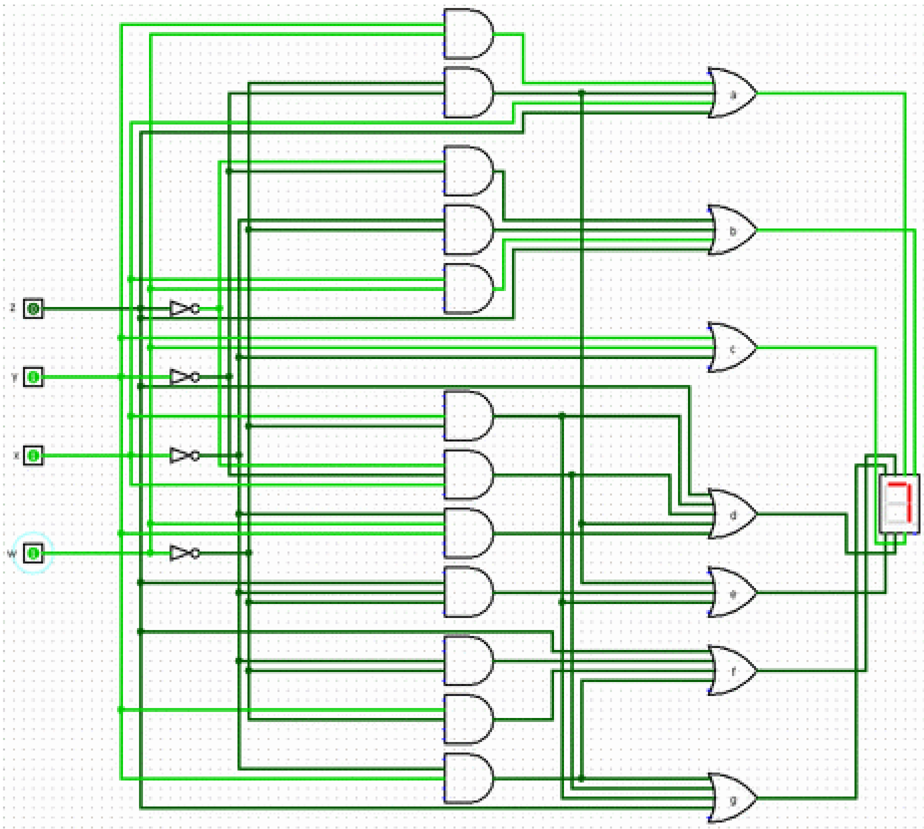
z
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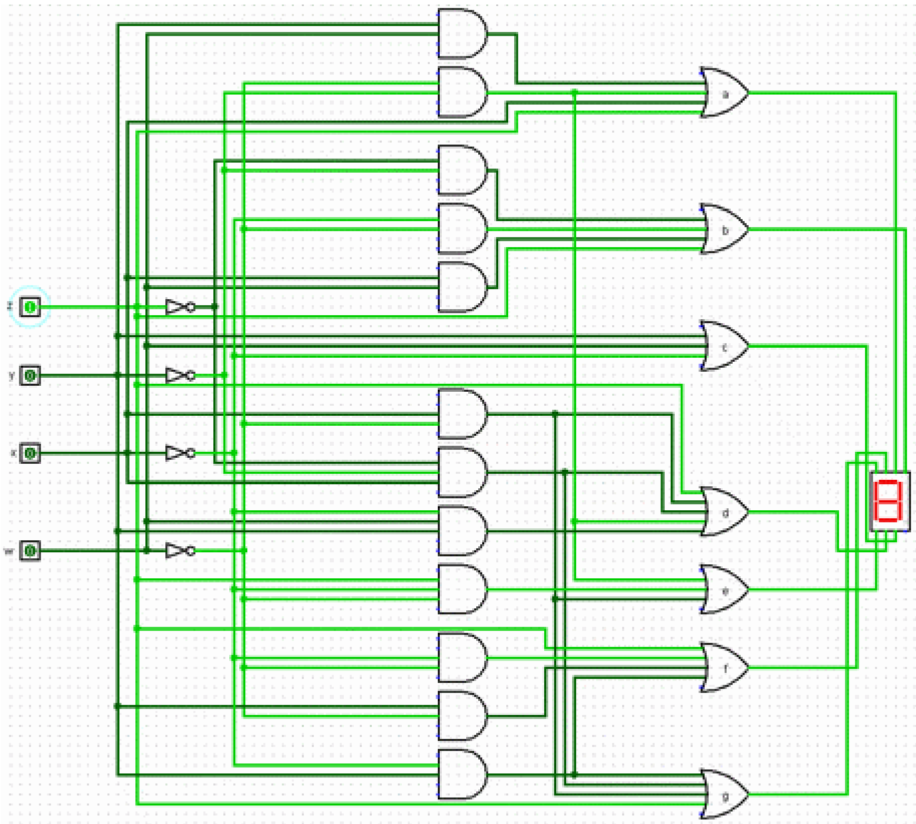
z
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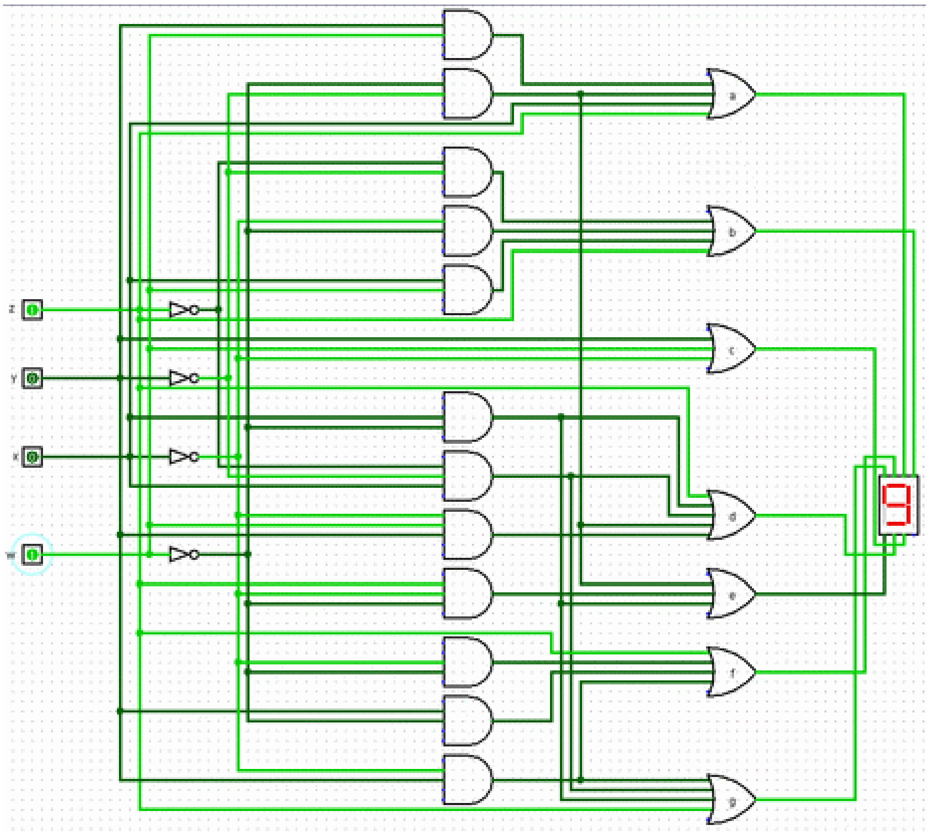
z
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e
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