

## 11.15 Multiple outputs

**i** This section has been set as optional by your instructor.

### Multiple output circuits

Many combinational circuits have multiple outputs for the same inputs. Each output can be treated as a unique function. For a truth table, each output becomes a new column. For equations, each output is a unique equation.

**PARTICIPATION ACTIVITY** 11.15.1: Multiple outputs: This circuit has three inputs and two outputs.

Start ☐ 2x speed

a	b	c	y	z
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	1	0	1	0
1	0	1	1	0
1	1	1	1	1

$y = a'bc + ab'c + abc' + abc$   
 $z = a'b'c + a'bc' + ab'c' + abc$

**PARTICIPATION ACTIVITY** 11.15.2: Multiple output circuits.

Consider the example above.

- 1) The truth table has 3 inputs, 8 rows, and \_\_\_\_ outputs.  
☐ 1  
☐ 2  
☐ 3
- 2) Output y is 1 for how many input combinations?  
☐ 1  
☐ 2  
☐ 4
- 3) When filling in 1's in the columns for y, z, a designer likely considers y, z \_\_\_\_  
☐ together  
☐ separately
- 4) When creating the equations, a designer considers y, z \_\_\_\_.  
☐ together  
☐ separately
- 5) When creating the circuit, the designer kept the circuits \_\_\_\_.  
☐ intermingled  
☐ separate
- 6) For a different truth table with two outputs w, x, if three 1's exist in w's column, then \_\_\_\_ 1's exist in x's column.  
☐ one  
☐ three  
☐ an unknown number of

### Example: 7-segment display

A **7-segment display** is a common display device having 7 light segments that can be lit in different patterns to represent numbers 0-9 and some letters too.

Start ☐ 2x speed

		1	a
		1	b
		1	c
		1	d
		0	e
		0	f
		1	g

i	j	a	b	c	d	e	f	g
0	0	1	1	1	1	1	1	0
0	1	0	1	1	0	0	0	0
1	0	1	1	0	1	1	0	1
1	1	1	1	1	1	0	0	1

$$a = i'j' + ij' + ij$$

$$b = i'j' + i'j + ij' + ij$$

$$c = i'j' + i'j + ij$$

...

**PARTICIPATION  
ACTIVITY**

11.15.4: 7-segment display.

- 1) What is abcdefg to display a 2? Type as:  
0000000

Check [Show answer](#)

- 2) What is abcdefg to display an 8? Type  
as: 0000000

Check [Show answer](#)

- 3) If inputs ij are 00, what are outputs  
abcdefg?

Check [Show answer](#)

- 4) Is b an input or output of the circuit  
being designed? Type input or output.

Check [Show answer](#)

- 5) The designer created equation  $c = i'j' + i'j + ij$ . That equation can be simplified to  $c = i'j' + \underline{\hspace{1cm}}$ ? Type one literal. Hint:  $i'j' + ij = ?$

Check [Show answer](#)

- 6) The designer created equation  $b = i'j' + i'j + ij' + ij$ . That equation can be simplified to  $b = ?$

Check [Show answer](#)

- 7) A designer decides to display a 3-bit  
binary number (0-7). The circuit will  
have three inputs ijk. How many outputs  
will the circuit have?

Check [Show answer](#)