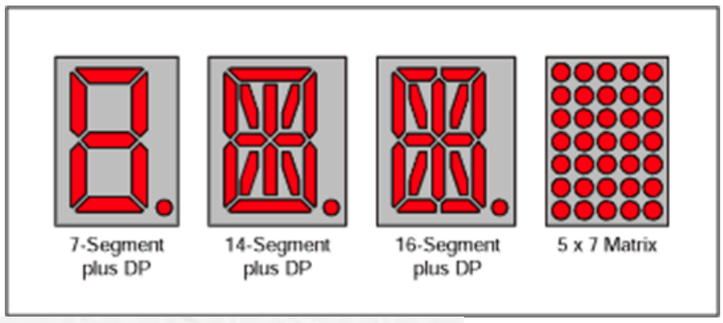
Online Test (ver D) - Boolean Logic

Name: Student #:

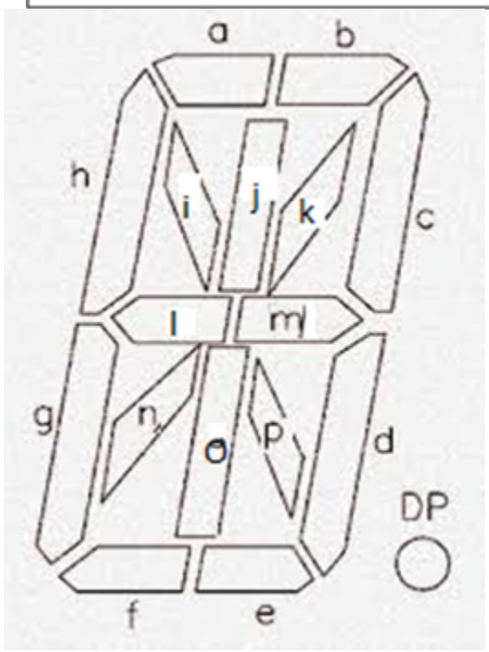
APP [/ 23]

1. We have experience working with a seven segment display but there are many other displays that can be used. The one we will be focusing on is the 16 - Segment Display.



Your task is to display the capital letter 'E'. Note: 16 segments map perfectly in the Hexadecimal grid as follows:

Correctly populating the K-Map chart: / 1
Optimal groupings: /3
Final Answer: / 1



D	C	B	A	Seg
0	0	0	0	a =1
0	0	0	1	b =1
0	0	1	0	c =0
0	0	1	1	d=0
0	1	0	0	e=1
0	1	0	1	f=1
0	1	1	0	g=1
0	1	1	1	h=1
1	0	0	0	i=0
1	0	0	1	j=0
1	0	1	0	k=0
1	0	1	1	L=1
1	1	0	0	m=1
1	1	0	1	n=0
1	1	1	0	o=0
1	1	1	1	p=0

Use the K-Map chart below to map out the capital letter 'E'. Think of the SEG column as the output column. Only turn on the segments that spell out that letter on the display. Example if you were to spell out the letter P, segment d would not be turned on so the row with segment d (D=0, C=0, B=1, A=0) would have an output of 0 (meaning off). This should help you plan out your map!

CD / AB	00	01	11	10
00	1	1	0	0
01	1	1	1	1
11	1	0	0	0
10	0	0	1	0

TO USE THE MAP Double-click on the K-Map chart to the left. It is inserted as a picture so you will need to edit it. Click on each cell to enter in a '1' or a '0. Then to show the mappings you will need to use the ***scribble tool.*** To change the tool click this icon and select ***scribble.*** Now you can show all of your groupings. Show every possible grouping.

FINAL ANSWER:

$E = A'C' + A'B + BC'D' + AB'CD$

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2. Three sensors are attached to a printing device, with three alarms attached to the sensors.
   - The first sensor, "A," detects if the device needs ink.
   - The second sensor, "B," detects if the device needs repair.
   - The third sensor, "C," detects if the device should jam.

If the device jams or needs repair, alarm 1 sounds.
If the device jams or is short on ink, alarm 2 sounds.
If two or more problems occur at once, alarm 3 sounds.
Note: More than one alarm can sound at the same time.
[**3 marks** : 1 for each alarm column]

Sensor A	***Sensor B***	***Sensor C***	***Alarm 1***	***Alarm 2***	***Alarm 3***
0	*0*	*0*	**0**	**0**	**0**
0	*0*	*1*	**1**	**1**	**0**
0	*1*	*0*	**1**	**0**	**0**
0	*1*	*1*	**1**	**1**	**1**
1	*0*	*0*	**0**	**1**	**0**
1	*0*	*1*	**1**	**1**	**1**
1	*1*	*0*	**1**	**1**	**1**
1	*1*	*1*	**1**	**1**	**1**

[2 marks] Convert the truth table into an expression for the Alarm 3 output.
Place your answer in the box below

$F = \overline{A}\,BC + A\overline{B}C + AB\overline{C} + ABC$

[3 marks] Simplify the expression using known theorems and identities learned in class.

$F = \overline{A}\,BC + A\overline{B}C + AB\overline{C} + ABC$
$F = BC(\overline{A} + A) + A\overline{B}C + AB\overline{C}$
$F = BC(1) + A\overline{B}C + AB\overline{C}$
$F = BC + A\overline{B}C + AB\overline{C}$
$F = C(B + A\overline{B}) + AB\overline{C}$
$F = C(A + B) + AB\overline{C}$
$F = CA + CB + AB\overline{C}$
$F = BC + A(B\overline{C} + C)$
$F = BC + A(B + C)$
$F = BC + AB + AC$

[2 marks] Solve using a k-map for alarm1. Remember that Sensor A, B, and C are inputs and alarm1 is the output.

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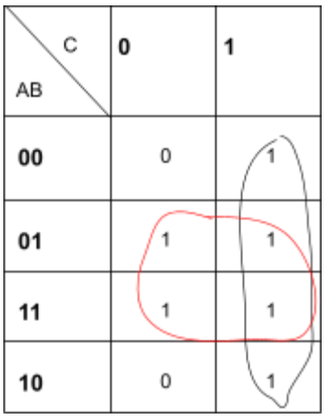
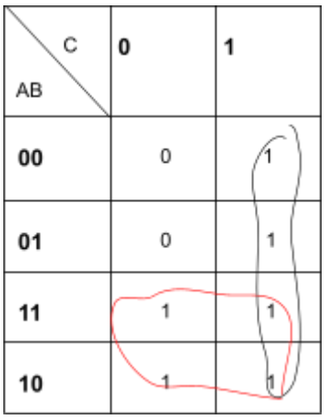


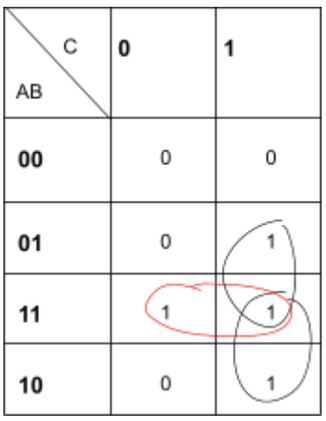
Expression: C+B

[2 marks] Solve using a k-map for alarm2. Remember that Sensors A, B, and C are inputs and alarm2 is the output.



Expression: C+A

[2 marks] Solve using a k-map for alarm3. Remember that Sensor A, B, and C are inputs and alarm3 is the output.



Expression: AB+AC+BC

[4 marks] Using Logisim, create the schematic for the whole circuit involving all three inputs (A, B, C) and the three outputs (alarm1, alarm2, and alarm 3). Use pins for the inputs and use LED's for the outputs. Provide labels for the inputs and outputs to make your schematic more clear. Upload your .circ file to this assignment post.

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