Combinational Logic II

Boolean Equations

Order of Operations

1) ______ 3) _____

Circuit Examples

Bubble

A bubble denotes inversion as shown below

Logic Circuits

Draw the circuit for: A' + (A' B) + C

Draw the circuit for: $(A' + (A' \cdot B)) \oplus (C+A) = D$

Draw the logic circuit for: D = ABC + A'(B+C) + A(B') + C

Draw the logic circuit for: D = (A' + B + C) + A(B + C) + B(C') + AC
What boolean equation does this logic circuit represent?
What boolean equation does this logic circuit represent?
What boolean equation does this logic circuit represent?
What boolean equation does this logic circuit represent?
Logical Completeness
You can create a circuit for ANY truth table with only
In addition, you can complete any truth table with only
You can also complete any truth table with only

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V	\cap			_	1	_
A	U	ĸ	u	а	П	е

Complete the	ruth table:	
A	В	Out =
0	0	
0	1	
1	0	
1	1	

There are 2 ways for the output of a 2-input xor gate to be 1:

If:

1 - A is _____ AND B is ____ OR 2 - A is ____ AND B is ____

Schematics

Draw a logic circuit that corresponds with the truth table of an ${\sf xor}$ gate

Sum of Products (SOP)

How do we get from a truth table to a logic expression?

Procedure

- 1) Identify rows with an output equal to ______
- 2) Write product terms AND the inputs together where the ____ inputs are _____
- 3) _____ the product terms together to form a _____

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Exa	m	pl	es

Write '	the SOP	for Ou	t	
s	A	В	Out	Product terms (aka):
0	0	0	0	
0	0	1	0	
0	1	0	1	
0	1	1	1	Sum of products:
1	0	0	0	
1	0	1	1	
1	1	0	0	
1	1	1	1	This is the truth table of a:
				•
Wnita:	the SOP	for Ou	+	
S	A A	В	Out	Product terms:
0	0	0	1	
0	0	1	0	
0	1	0	0	
0	1	1	1	
1	0	0	1	Sum of products:
1	0	1	0	
1	1	0	0	
1	1	1	1	
•	•	•	=	

Product of Sums (POS)

How do we get from a truth table to a logic expression?

Procedure

 Identify rows with an output equal to 	1)	Identify	rows	with	an	output	equal	to	
---	----	----------	------	------	----	--------	-------	----	--

~ `	· .		~ -						
2)	Write sum	terms -	- OR	the	inputs	together	where	the	inputs are

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_		
Exam	nl	P
	\sim	

١.	Write t	he POS	for Ou	t	
	S	A	В	Out	Sum terms (aka):
	0	0	0	0	
	0	0	1	0	
	0	1	0	1	
	0	1	1	1	
	1	0	0	0	Product of some
	1	0	1	1	Product of sums:
	1	1	0	0	
	1	1	1	1	
	Write t	he POS	for Ou	t	Sum terms:
	S	A	В	Out	
	0	0	0	1	
	0	0	1	0	
	0	1	0	0	
	0	1	1	1	Product of sums:
	1	0	0	1	Product of Sums:
	1	0	1	0	
	1	1	0	0	
	1	1	1	1	

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PLA: P	_ L	A	
A structured logic element th	nat takes a set of _		
and of]	logic.		
Draw the basic form of a PLA	1		
Example			
Implement the logic for an XC	OR gate as a PLA		

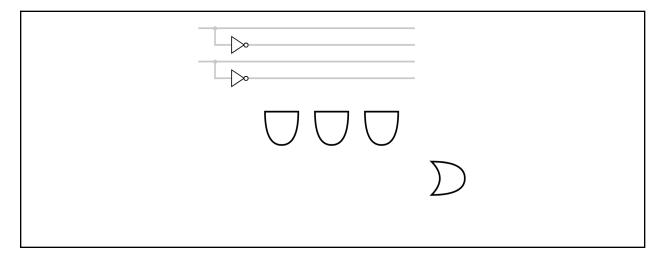
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Example

Implement this truth table as a PLA

A	В	S	С
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1



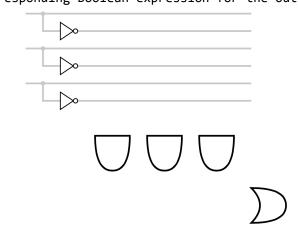
This PLA implements logic as a ______

Examples

Given: Truth table

(fill in values for D in the truth table)

Solve: 1) Draw the circuit 2) Write the corresponding Boolean expression for the output



A	В	С	D
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

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Given: Truth table

(fill in values for D and E in the truth table)

Solve: 1) Draw the circuit 2) Write the corresponding Boolean expressions for the outputs



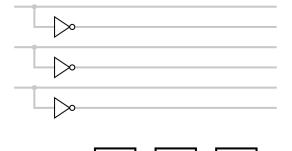
Α	В	С	D	E
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

 $\sum_{i=1}^{n}$

Given: Circuit

(finish drawing this circuit)

Solve: 1) Complete the truth table 2) Write the corresponding Boolean expression for the output





A	В	С	D
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

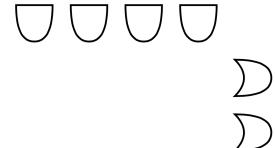
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Given: Circuit

(finish drawing this circuit)

Solve: 1) Complete the truth table 2) Write the corresponding Boolean expression for the outputs



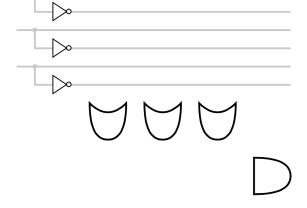


Α	В	С	D	Е
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Given: Truth table

(fill in values for D in the truth table)

Solve: 1) Draw the circuit 2) Write the corresponding Boolean expression for the output



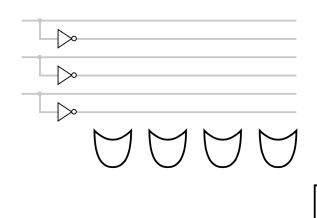
A	В	С	D
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

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Given: Truth table
(fill in values for D and E in the truth table)

Solve: 1) Draw the circuit 2) Write the

corresponding Boolean expressions for the outputs

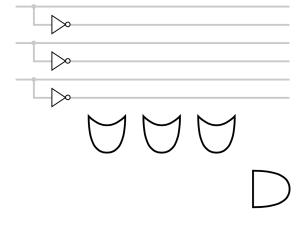


Α	В	С	D	Е
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Given: Circuit

(finish drawing this circuit)

Solve: 1) Complete the truth table 2) Write the corresponding Boolean expression for the output



A	В	С	D
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

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Given: Circuit					
(finish drawing this circuit)	A	В	С	D	E
Solve: 1) Complete the truth table 2) Write the corresponding Boolean expressions for the outputs	0	0	0		
Corresponding Boolean expressions for the outputs	0	0	1		
	0	1	0		
	0	1	1		
	1	0	0		
	1	0	1		
	1	1	0		
	1	1	1		
					-