Weekly Quiz 30

Discussion

Digital Logic:

Boolean Algebra, Minimization, Number System

Instructor:

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MTech, IISc Bangalore

GATE CSE AIR 53; AIR 67;
AIR 107; AIR 206; AIR 256

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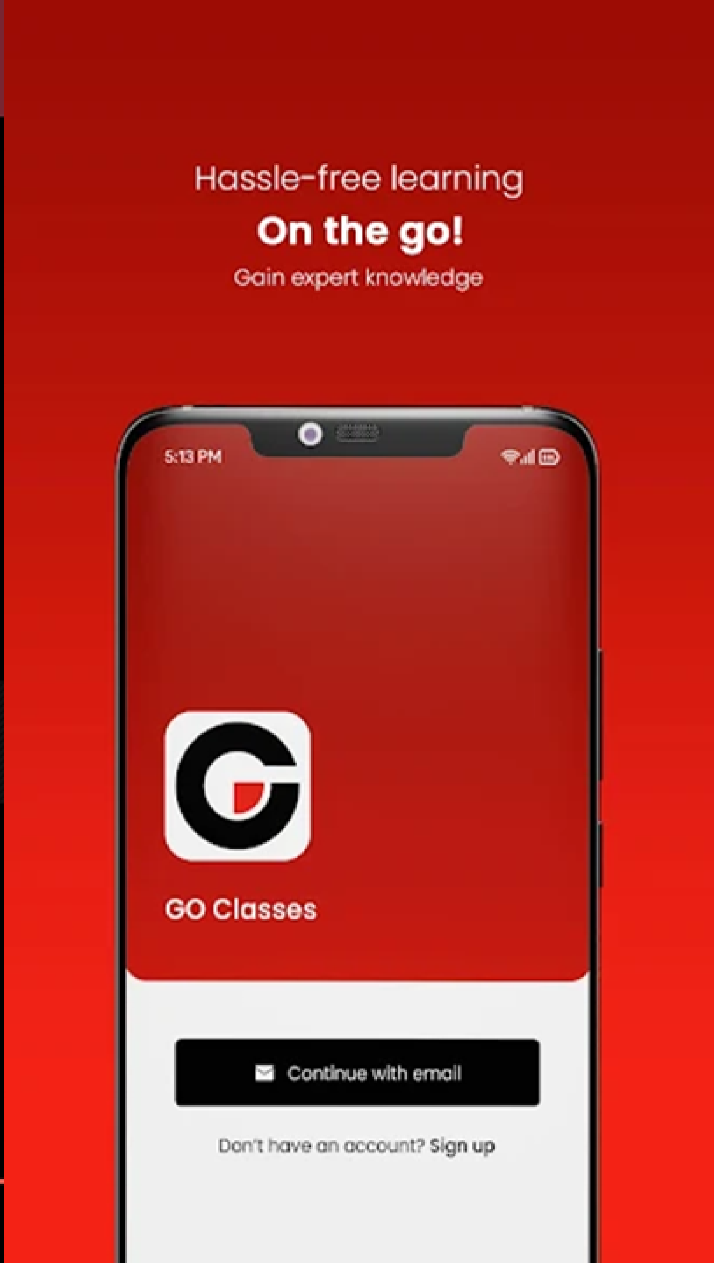

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Weekly Quiz 30

Discussion

Digital Logic:

Boolean Algebra, Minimization, Number System

Weekly Quiz 30: Digital Logic

In this Quiz, ALL the questions are from GATE EC PYQs.

GATE ECE 2022 | Question: 17

asked in Others Feb 15, 2022 • retagged Mar 21, 2022 by Lakshman Bhaiya

128 views

2

Select the Boolean function(s) equivalent to $x + yz$, where x, y, and z are Boolean variables, and $+$ denotes logical OR operation.

A. $x + z + xy$
B. $(x + y)(x + z)$
C. $x + xy + yz$
D. $x + xz + xy$

gateece-2022 multiple-selects

GATE ECE 2022 | Question: 17

asked in Others Feb 15, 2022 • retagged Mar 21, 2022 by Lakshman Bhaiya

2

Select the Boolean function(s) equivalent to $x + yz$, where x, y, and z are Boolean variables, and $+$ denotes logical OR operation.

A. $x + z + xy$ ✗

B. $(x + y)(x + z)$ ✓

C. $x + xy + yz$ ✓

D. $x + xz + xy$ ✗

B, C Ans.

gateece-2022 multiple-selects

(A) $x + z + xy = \underbrace{x + xy} + z$

$= x + z \neq x + yz$

$\underbrace{A + AB = A}$

Absorption Law

(B)

$$(x+y)(x+z) = xx + xz + yx + yz$$

$$= \underbrace{x + xz + xy}_{x} + yz$$

$$\underline{\underline{x + yz}} \checkmark$$

$$\boxed{x + yz = (x+y)(x+z)}$$

Distributive Law

$$x + xy = x$$

$$\alpha + \alpha\beta = \alpha$$

(c) $x + xy + yz$

$\underbrace{x + xy}$

$x + yz$ ✓

$$\boxed{A + AB = A}$$

Absorption Law

D

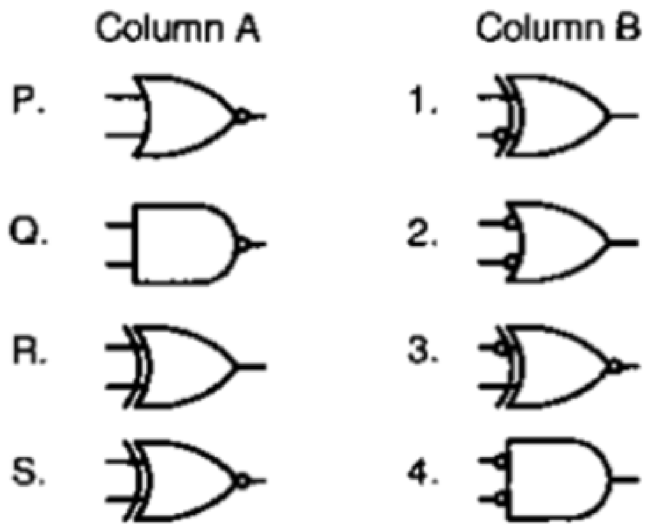
$x + xz + xy$

$x + xy = x \neq x + yz$

GATE ECE 2010 | Question: 11

asked in Combinational Circuits Sep 15, 2022 • recategorized Jan 27 by Lakshman Bhaiya

Match the logic gates in **Column A** with their equivalents in **Column B.**



A. P-2, Q-4, R-1, S-3
B. P-4, Q-2, R-1, S-3
C. P-2, Q-4, R-3, S-1
D. P-4, Q-2, R-3, S-1

GATE ECE 2010 | Question: 11

P − 4 Q − 2
R − 3 S − 1

asked in Combinational Circuits Sep 15, 2022 • recategorized Jan 27 by Lakshman Bhaiya

$\bar{a} + \bar{b}$

2

Match the logic gates in **Column A** with their equivalents in **Column B**.

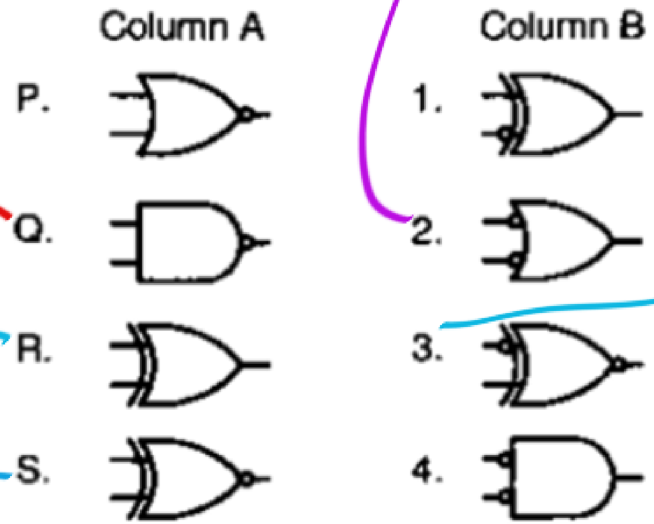
$\bar{a} \odot b = a \oplus b$

$\overline{ab} = \bar{a} + \bar{b}$

NAND

$a \oplus b$ ExOR

$a \odot b$ XNOR



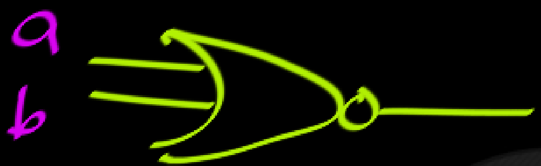
A. P-2, Q-4, R-1, S-3

B. P-4, Q-2, R-1, S-3

C. P-2, Q-4, R-3, S-1

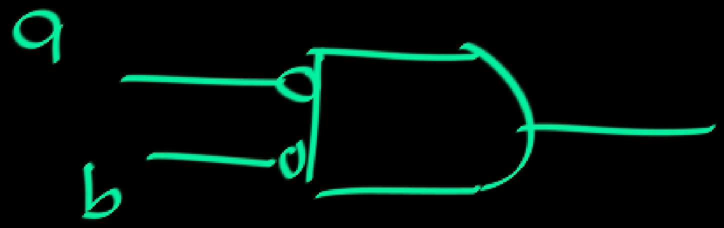
D. P-4, Q-2, R-3, S-1

P : NOR gate



$\overline{a+b}$

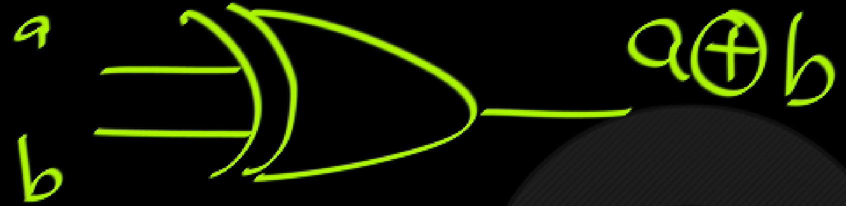
$= \bar{a}\,\bar{b} \longrightarrow$ Y



$\bar{a}\,\bar{b}$

P – Y ✓

R: EXOR gate

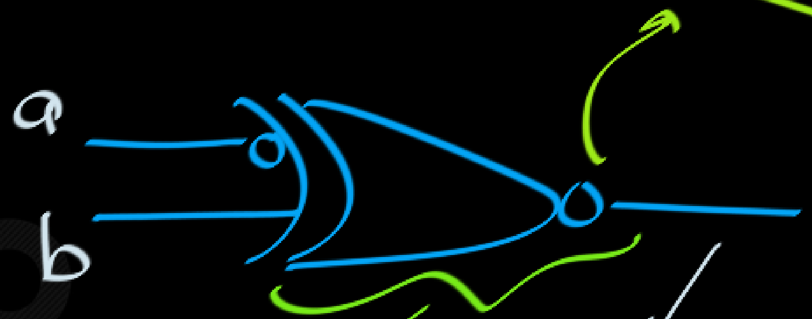


$\bar{a} \odot b = a \oplus b$

prove it

3

Complement



$\overline{\bar{a} \oplus b}$

XNOR gate $\equiv \bar{a} \odot b$

$$a \oplus b = \bar{a} \oplus \bar{b}$$

$$\bar{a} \oplus b = a \odot b$$

$$a \oplus \bar{b} = a \odot b$$

$$\overline{a \oplus b} = a \odot b$$

$$\bar{a} \odot b = a \oplus b$$

Proof: by Case method

Case 1:

$a = 0$

$\left.\begin{array}{l} LHS = b \\ RHS = b \end{array}\right\}$ Same

Case 2:

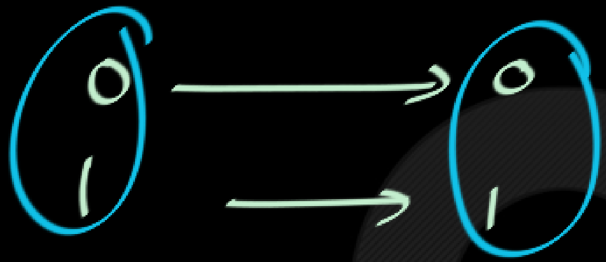
$a = 1$

$\left.\begin{array}{l} LHS = \bar{b} \\ RHS = \bar{b} \end{array}\right\}$

Same

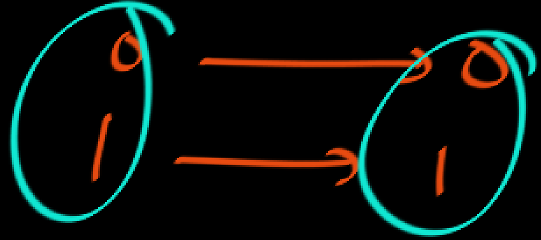
$1 \odot b = \boxed{b}$

$1 \odot b = b$ ✓



$0 \oplus b = \boxed{b}$

$0 \oplus b = b$



$0 \odot b = \boxed{\quad} \rightarrow \bar{b}$

$0 \rightarrow 1$

$1 \rightarrow 0$

$1 \oplus b = \boxed{\quad} \rightarrow \bar{b}$

$0 \rightarrow 1$

$1 \rightarrow 0$

x $\underbrace{\bar{a} \odot b}$ = $\underbrace{a \oplus b}$

$\bar{a}b + a\bar{b} = \bar{a}b + a\bar{b}$

$$\boxed{x \oplus y = \bar{x}y + x\bar{y}}$$

$$\boxed{x \odot y = \bar{x}\bar{y} + xy}$$

$$\boxed{\underbrace{a \odot b} = \bar{a} \oplus b}$$

①

$\bar{a} \oplus b$

ec.gateoverflow.in/459/gate-ece-2014-set-2-question-15

GO Electronics

GATE ECE 2014 Set 2 | Question: 15

asked in Digital Circuits Mar 26, 2018 • recategorized Feb 26, 2021 by Lakshman Bhaiya

129 views

1

The number of bytes required to represent the decimal number 1856357 in packed BCD (Binary Coded Decimal) form is __________.

gate2014-ec-2 digital-circuits number-system number-representation

GATE ECE 2014 Set 2 | Question: 15

1

The number of bytes required to represent the decimal number 1856357 in packed BCD (Binary Coded Decimal) form is __________.

4

gate2014-ec-2 digital-circuits number-system number-representation

$$\underbrace{1856357}_{\text{Decimal Number}}$$

7 Digits

with 3 Bytes
= only 24 bits
can be Represented

Packed BCD:

$7 \times 4 = \boxed{28 \text{ Bits}}$

$\left\lceil \frac{28}{8} \right\rceil = 4$ Bytes ✓

Packed BCD

1 8 5 6 3 5 7

0001 1000 0101 0110 0011 0101 0111

In Bytes

4 bytes

BCD : Binary Coded Decimal

Decimal	BCD form
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

BCD : Binary Coded Decimal

BCD

Packed BCD

Use 4 bits to encode a Decimal Digit.

Unpacked BCD

Use 8 bits to encode a Decimal Digit.

By Default;

BCD ≡ Packed BCD

we use 4-bits to encode a Decimal Digit.

Decimal	(Packed) BCD	Unpacked BCD
0	0000	0000 0000
1	0001	0000 0001
2	0010	0000 0010
3	0011	0000 0011
4	0100	0000 0100
⋮		
8	1000	0000 1000
9	1001	0000 1001

Decimal	(Packed) BCD	Unpacked BCD
0	0000	0000 0000
1	0001	0000 0001
2	0010	0000 0010
3	0011	0000 0011
4	0100	0000 0100
⋮		
8	1000	0000 1000
9	1001	0000 1001

BCD : Binary Coded Decimal

BCD

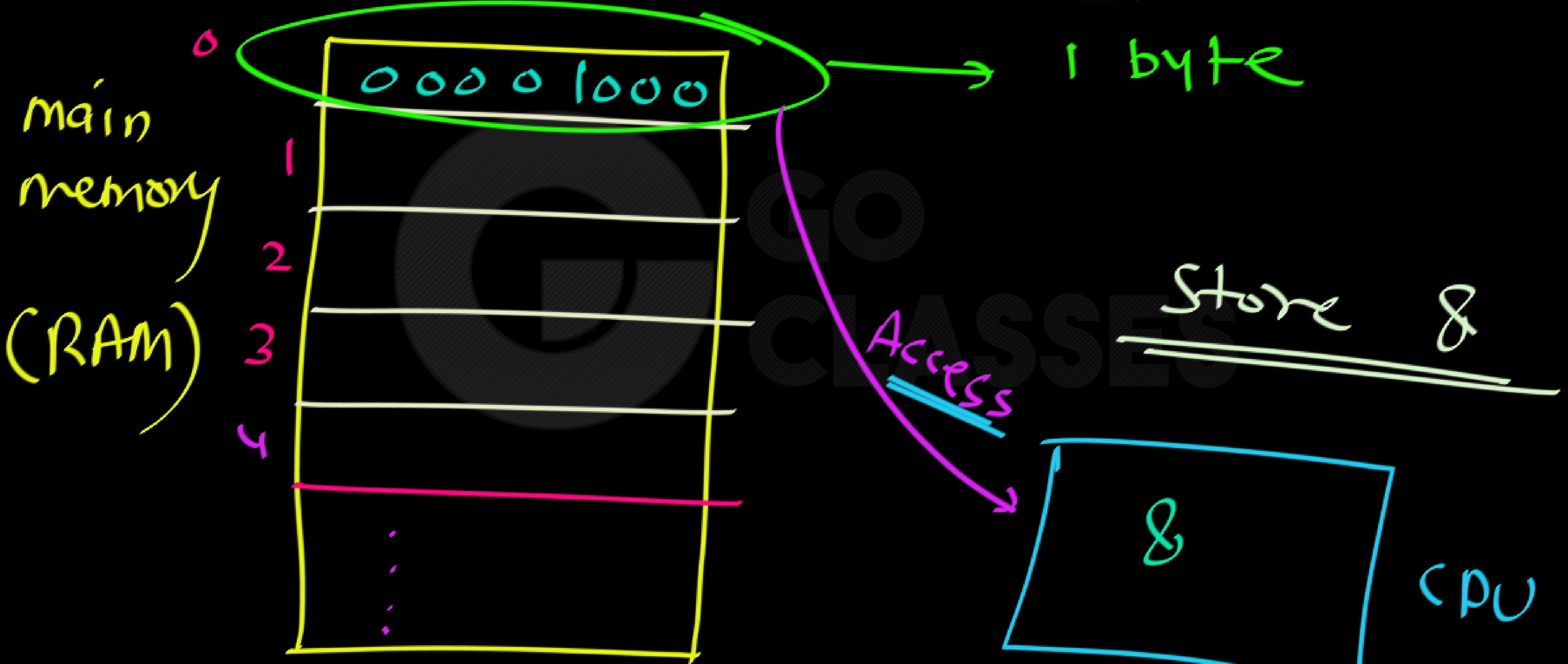
Packed BCD

4 bits per Decimal Digit

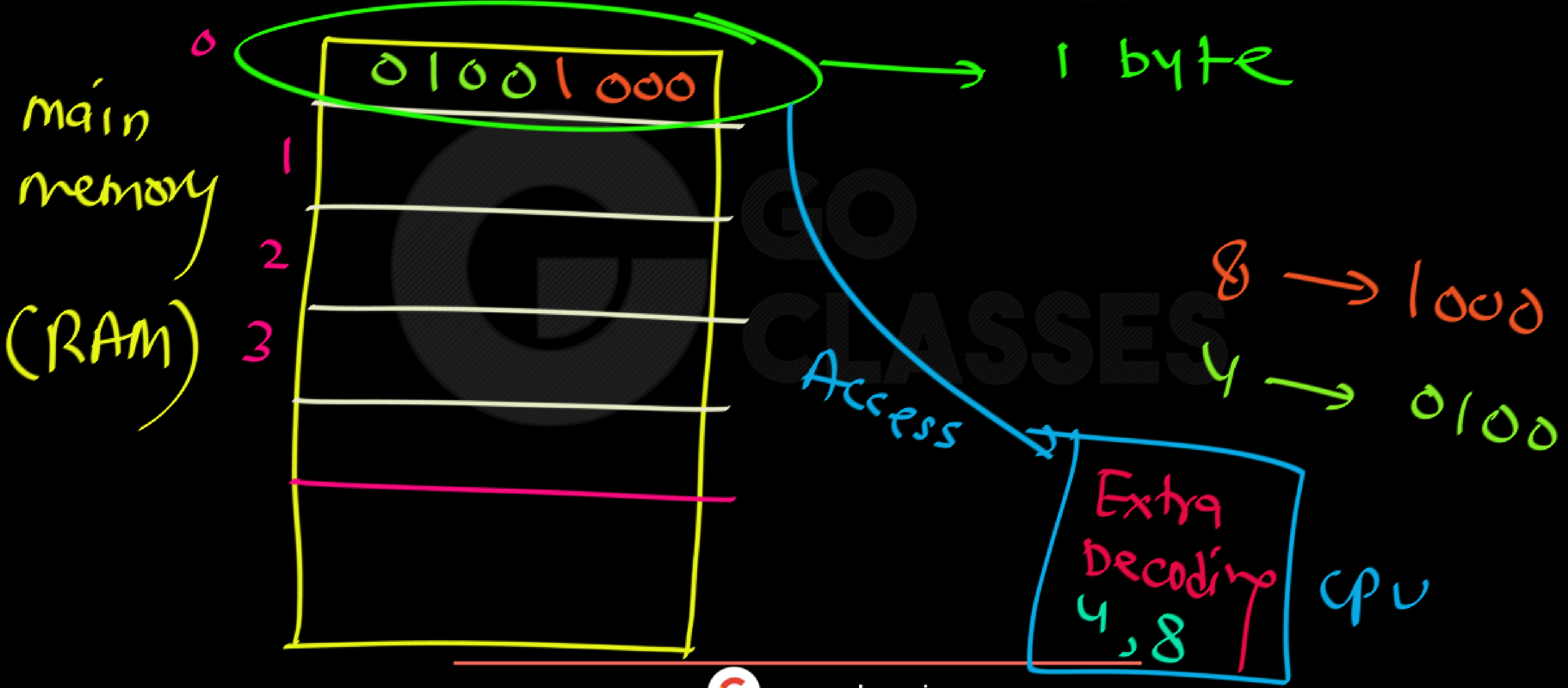
Unpacked BCD

8 bits per Decimal Digit

Benefit of Unpacked BCD:



In packed BCD:



GATE ECE 2014 Set 1 | Question: 15

asked in Digital Circuits Mar 26, 2018 • edited Nov 17, 2020 by soujanyareddy13 161 views

1

The Boolean expression $(X+Y)(X+\overline{Y})+\overline{(X\,\overline{Y})+\overline{X}}$ simplifies to

A. X
B. Y
C. XY
D. $X+Y$

gate2014-ec-1 digital-circuits boolean-algebra

GATE ECE 2014 Set 1 | Question: 15

1

The Boolean expression $(X+Y)(X+\overline{Y})+\overline{(X\,\overline{Y})+\overline{X}}$ simplifies to

A. X
B. Y
C. XY
D. $X+Y$

gate2014-ec-1 digital-circuits boolean-algebra

$$(x+y)(x+\bar{y}) + \overline{x\bar{y}+\bar{x}}$$

$$\overline{\bar{x}+x\bar{y}} = \overline{\bar{x}+\bar{y}} = xy$$

$$\bar{x} + \cancel{x}\bar{y} = \bar{x} + \bar{y}$$

$$A + \bar{A}B = A + \cancel{\bar{A}}B = A + B$$

$$A + \bar{A}B = \underbrace{(A + \bar{A})}_{1}(A + B) = A + B$$

$$\alpha + \bar{\alpha}\beta = \alpha + \beta$$

$$\bar{A} + \cancel{A}B = \bar{A} + B$$

$$\underbrace{(x+y)(x+\bar{y})} + \overline{x\bar{y}+\bar{x}} = xy$$

$$(x+y)(x+\bar{y}) = xx + x\bar{y} + xy + y\bar{y}$$

x $\qquad$ 0

$$= x + x\bar{y} + xy$$

$$= x + xy = x$$

$$\boxed{A + AB = A}$$

Absorption law

$$(x+y)(x+\bar{y}) + \overline{x\bar{y}+\bar{x}}$$

x $\quad$ xy

$$= x + xy = x$$

GATE ECE 2015 Set 1 | Question: 38

1

A 3-input majority gate is defined by the logic function $M(a, b, c) = ab + bc + ca$. Which one of the following gates is represented by the function $M(\overline{M(a, b, c)}, M(a, b, \bar{c}), c)$?

A. 3-input NAND gate
B. 3-input XOR gate
C. 3-input NOR gate
D. 3-input XNOR gate

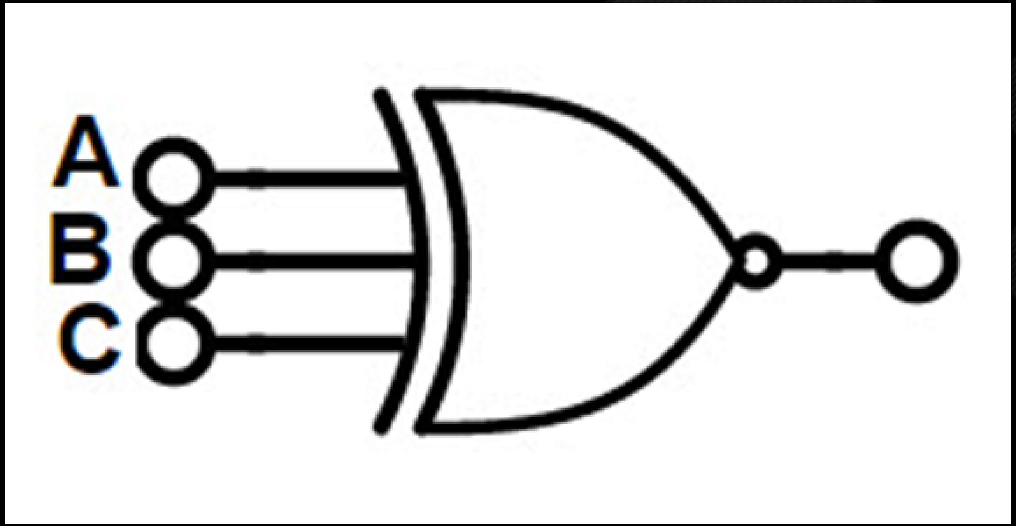
gate2015-ec-1 digital-circuits logic-gates

An Important NOTE:

Difference between

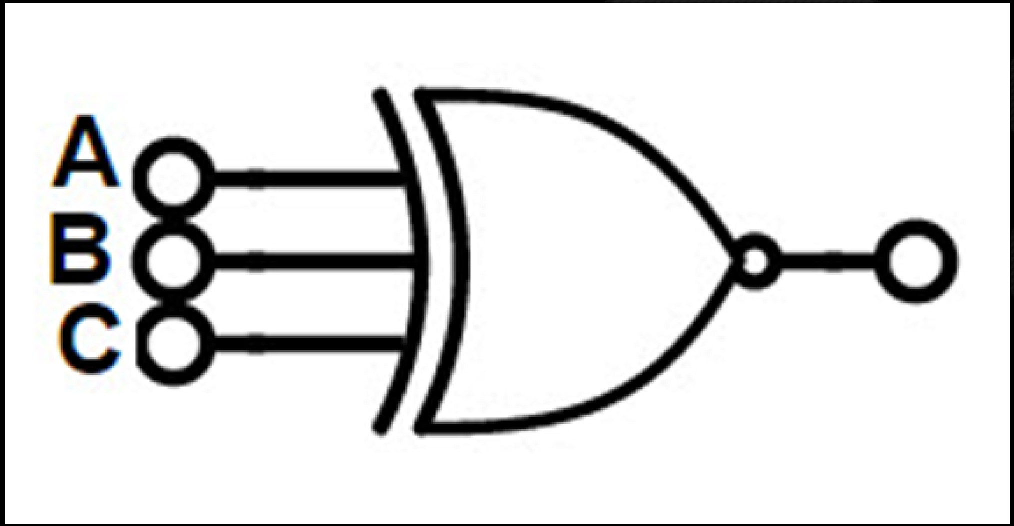
XNOR GATE & XNOR Function

Are these SAME???



$$A \odot B \odot C$$

Are these SAME???



$$\neq \quad A \odot B \odot C$$

Quick Recap of

XOR, XNOR functions:

XOR, XNOR functions over 2 input variables:

a	b	$a \oplus b$	$a \odot b$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	0	1

$$a \oplus b = \overline{a \odot b}$$

$$\left.\begin{aligned} a \oplus b &= \overline{a \odot b} \\ a \odot b &= \overline{a \oplus b} \end{aligned}\right\} \text{for 2 input Variables}$$

XNOR function is Associative:

$\odot$ is Associative.

$$(a \odot b) \odot c = a \odot (b \odot c)$$

Can prove using Truth Table.

x	y	z	$(x \odot y) \odot z$	$x \odot (y \odot z)$
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	0
1	0	0	1	1
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

XNOR is Associative.

$$(a \odot b) \odot c = a \odot (b \odot c)$$

We can write it

$$\underbrace{a \odot b \odot c}$$

XOR, XNOR function

are Associative & Commutative:

$a \oplus b = b \oplus a$

$a \odot b = b \odot a$

Commutative Property

$(a \odot b) \odot c = a \odot (b \odot c)$

$(a \oplus b) \oplus c = a \oplus (b \oplus c)$

Associative Prop.

XOR, XNOR functions over 3 input variables:

x	y	z	$x \odot y \odot z$	$x \oplus y \oplus z$
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	0
1	0	0	1	1
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

XOR, XNOR functions over 3 input variables:

$$\boxed{a \oplus b \oplus c = a \odot b \odot c}$$

XOR, XNOR:

2 Variables

$a \oplus b = \overline{a \odot b}$

3 Variables

$a \oplus b \oplus c =$

$a \odot b \odot c$

XOR, XNOR:

Even variables

$a \oplus b = \overline{a \odot b}$

Odd variables

$a \oplus b \oplus c = a \odot b \odot c$

EXOR = 1 iff Odd number of 1's.

ExNOR = 1 iff Even number of 0's

XOR is Odd 1's Detector.
XNOR is Even 0's Detector.

$$1 \oplus 0 \oplus 1 \oplus 0 \oplus 0 \oplus 0 = 0$$

$$1 \odot 0 \odot 1 \odot 0 \odot 0 \odot 0 = 1$$

for odd number of input variables:

$$\oplus(a_1, a_2, ---, a_{odd}) = \odot(a_1, a_2, ---, a_{odd})$$

for even number of input variables:

$$\oplus(a_1, ---, a_{even}) = \overline{\odot(a_1, a_2, --, a_{even})}$$

1

Let $\mathrm{A}, \mathrm{B}, \mathrm{C}$ be three boolean variables. $\oplus$ and $\odot$ are exclusive-or(ExOr) and exclusive-nor(ExNor) operations respectively.

Consider the following statements:

1. $(\mathrm{A} \oplus \mathrm{B}) \oplus \mathrm{C} = \mathrm{A} \oplus (\mathrm{B} \oplus \mathrm{C})$
2. $(\mathrm{A} \odot \mathrm{B}) \odot \mathrm{C} = \mathrm{A} \odot (\mathrm{B} \odot \mathrm{C})$
3. $\mathrm{A} \oplus \mathrm{B} \oplus \mathrm{C} = \mathrm{A} \odot \mathrm{B} \odot \mathrm{C}$
4. $\mathrm{A} \oplus \mathrm{B} \oplus \mathrm{C} = \overline{(\mathrm{A} \odot \mathrm{B} \odot \mathrm{C})}$

Which of the above statements is/are correct?

A. 1 and 3 only
B. 2 and 4 only
C. $1, 2$ and 3 only
D. $1, 2$ and 4 only

Odd

1

Let A, B, C be three boolean variables. $\oplus$ and $\odot$ are exclusive-or(ExOr) and exclusive-nor(ExNor) operations respectively.

Consider the following statements:

1. $(A \oplus B) \oplus C = A \oplus (B \oplus C)$
2. $(A \odot B) \odot C = A \odot (B \odot C)$
3. $A \oplus B \oplus C = A \odot B \odot C$
4. $A \oplus B \oplus C = \overline{(A \odot B \odot C)}$

Which of the above statements is/are correct?

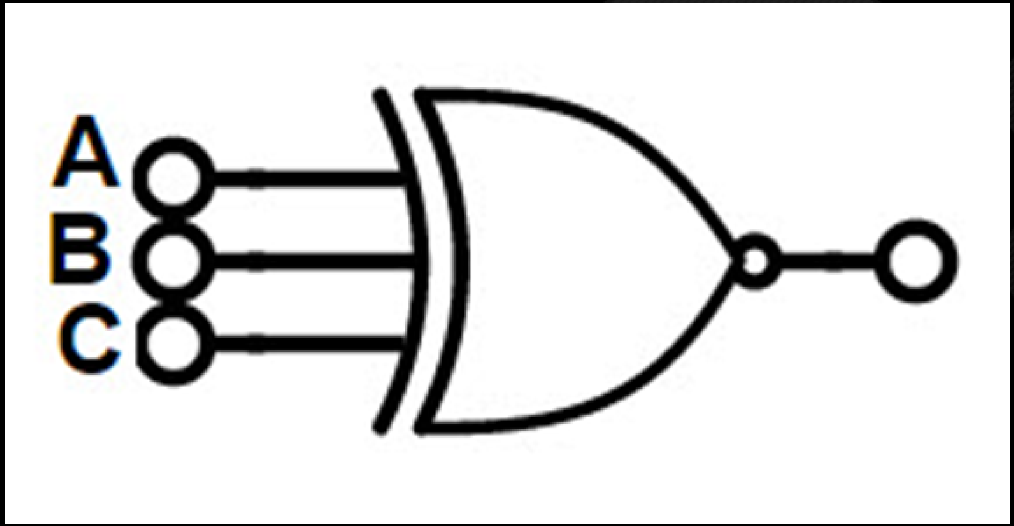
A. 1 and 3 only
B. 2 and 4 only
C. 1, 2 and 3 only
D. 1, 2 and 4 only

$\oplus$ is Associative.
$\odot$ is "

$\boxed{A \oplus B \oplus C = A \odot B \odot C}$

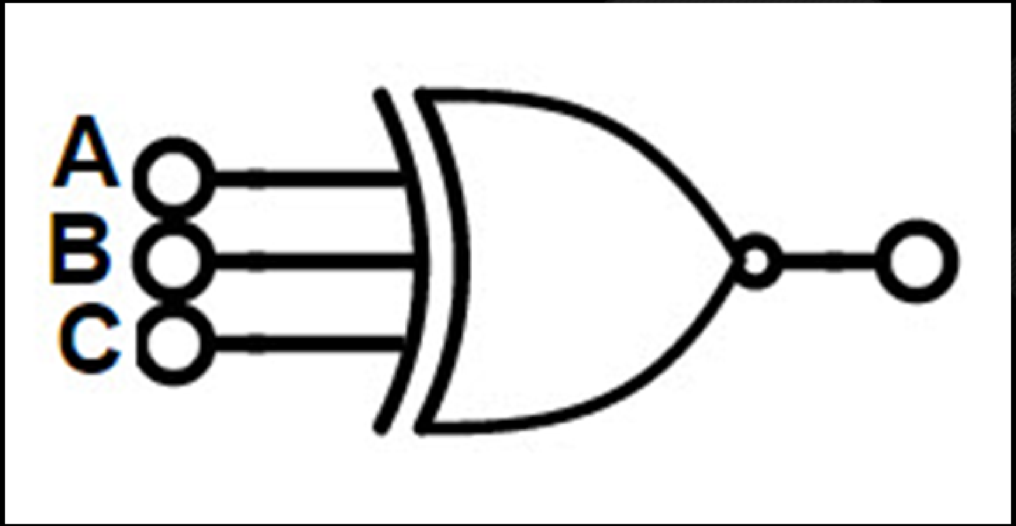
$A \oplus B = \overline{A \odot B}$

Are these SAME???



$$A \odot B \odot C$$

Are these SAME???



$\neq$

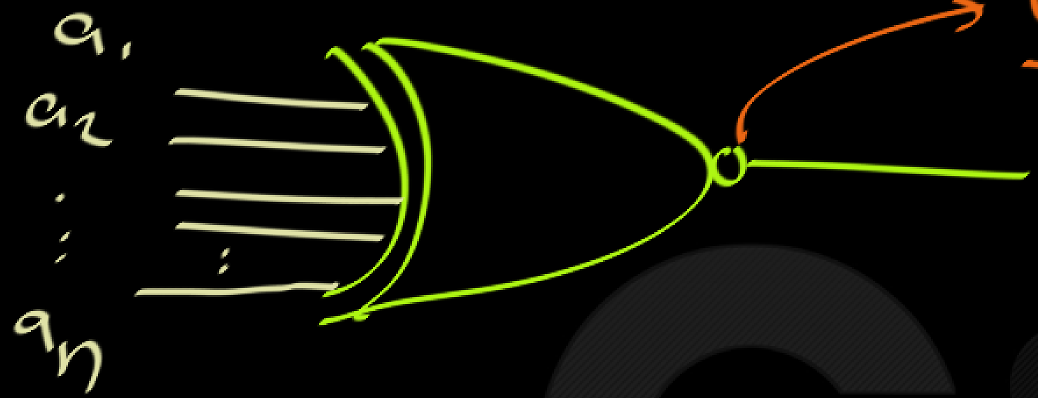
$$A \odot B \odot C$$

NOTE:

XNOR Gate is Defined as NOT of XOR Gate.

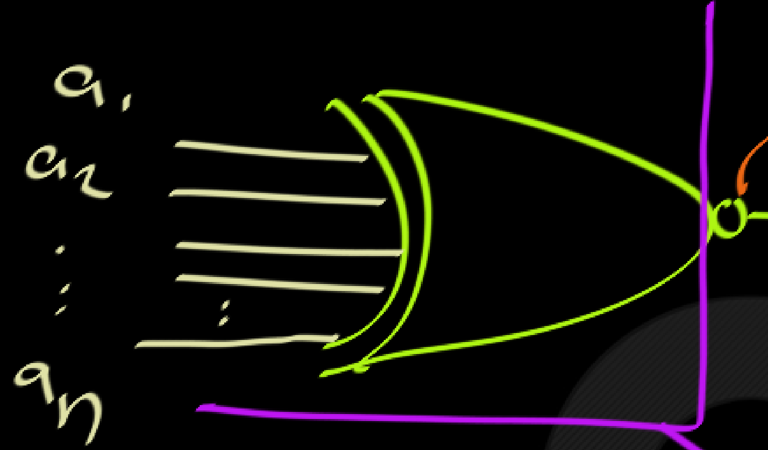
Always

Complement



$Y = \overline{a_1 \oplus a_2 \oplus \cdots \oplus a_n}$

XNOR Gate



Complement

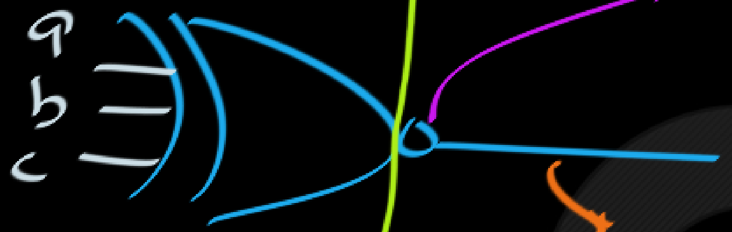
$Y = \overline{a_1 \oplus a_2 \oplus \cdots \oplus a_n}$

XNOR Gate

ExOR gate

GATE

Complement



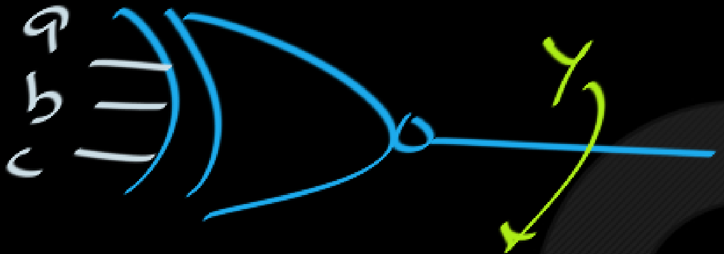
$Y = \overline{a \oplus b \oplus c}$

$\bar{E}xor = a \oplus b \oplus c$

function

$$a \oplus b \oplus c = a \odot b \odot c$$

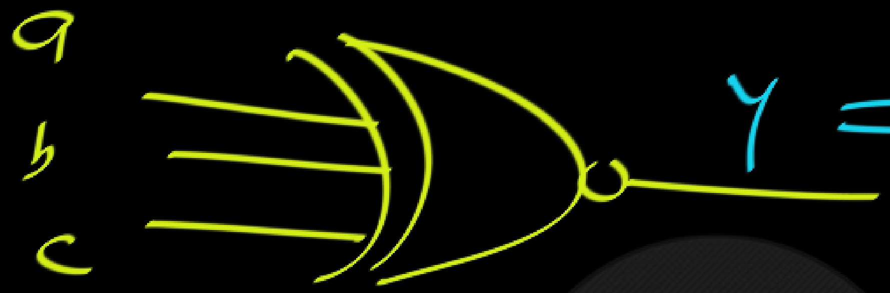
GATE



$\overline{a \oplus b \oplus c}$

function

$a \oplus b \oplus c = a \odot b \odot c$



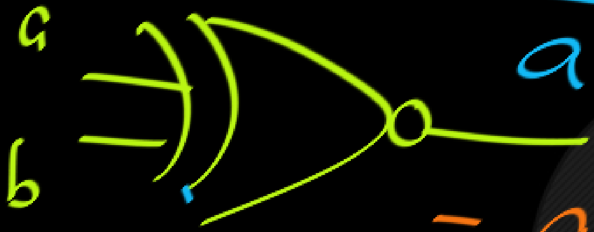
$$Y = \overline{a \oplus b \oplus c}$$

$$= \overline{a \odot b \odot c}$$

<u>We know</u>:

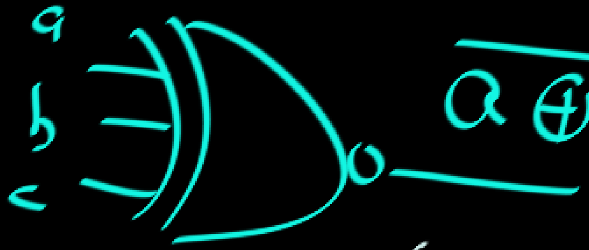
$$a \oplus b \oplus c = a \odot b \odot c$$

Gate Vs function



$\overline{a \oplus b}$

$= a \odot b$



$\overline{a \oplus b \oplus c}$

$\neq a \odot b \odot c$

$a \oplus b \oplus c = a \odot b \odot c$

$a \oplus b = \overline{a \odot b}$

$\neq \quad a \odot b \odot c$

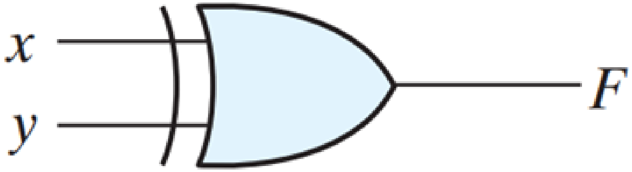
EXNOR gate is $\boxed{\text{NOT of XOR gate}}$

Note:

XNOR Gate for any number of input variables is Always Defines as

NOT of ExOR gate

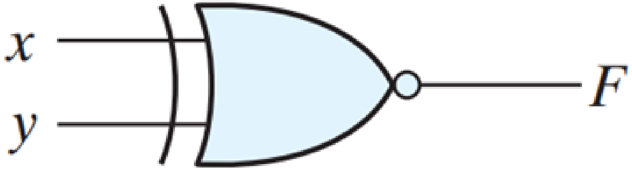
Exclusive-OR (XOR)



$$F = xy' + x'y$$
$$= x \oplus y$$

x	y	F
0	0	0
0	1	1
1	0	1
1	1	0

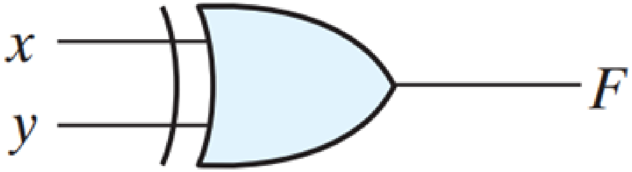
Exclusive-NOR or equivalence



$$F = xy + x'y'$$
$$= (x \oplus y)'$$

x	y	F
0	0	1
0	1	0
1	0	0
1	1	1

Exclusive-OR (XOR)

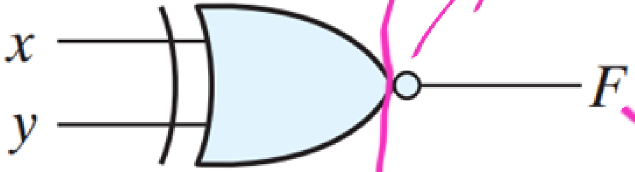


$$F = xy' + x'y = x \oplus y$$

x	y	F
0	0	0
0	1	1
1	0	1
1	1	0

Exclusive-NOR or equivalence

Complement



$$F = xy + x'y' = (x \oplus y)'$$

x	y	F
0	0	1
0	1	0
1	0	0
1	1	1

$x \oplus y$

$\overline{x \oplus y} =$

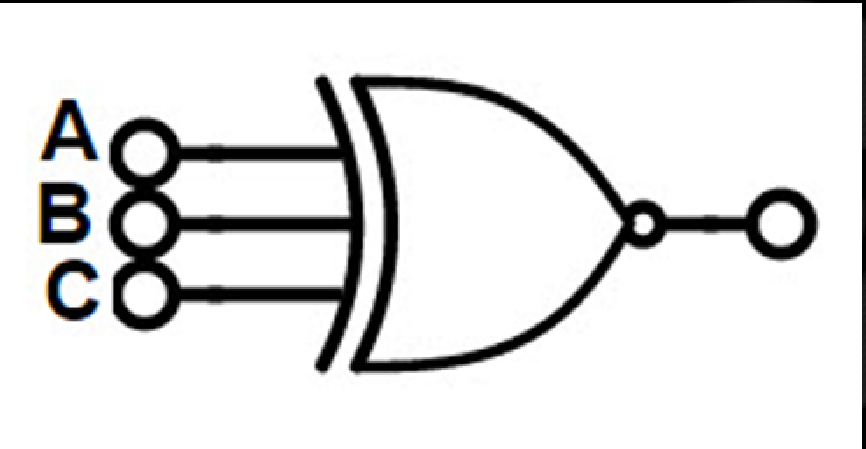
$x \odot y$

NOTE:

XNOR Gate is Defined as NOT of XOR Gate.

Always

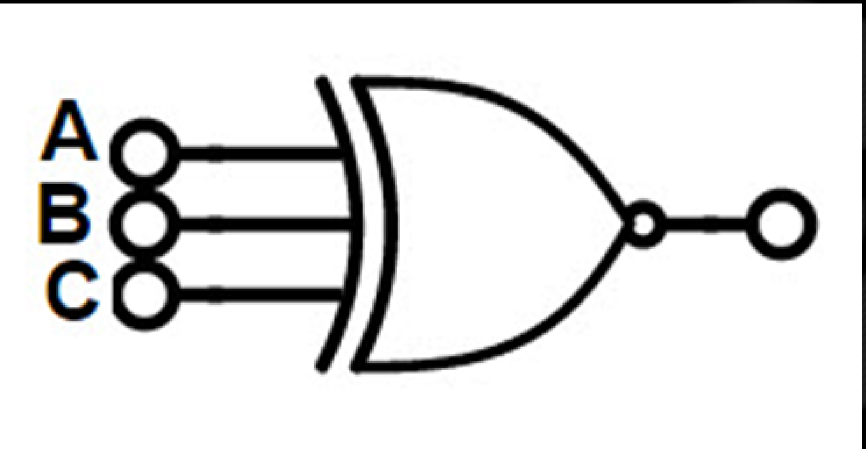
XNOR gate is defined as NOT of XOR gate:



$$= \overline{A \oplus B \oplus C}$$

$$\neq A \odot B \odot C$$

XNOR gate is defined as NOT of XOR gate:



$$= \overline{\boxed{A \oplus B \oplus C}}$$

$$= \overline{A \odot B \odot C}$$

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The exclusive-OR gate has a graphic symbol similar to that of the OR gate, except for the additional curved line on the input side. The equivalence, or exclusive-NOR, gate is the complement of the exclusive-OR, as indicated by the small circle on the output side of the graphic symbol.

Source: Morris Mano

electronics.stackexchange.com/questions/285392/3-input-xnor-gate-operation

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The misunderstanding is that, given XOR as a logic gate, XNOR is *defined* as being always its negation.

Having defined your XOR-3 as an *odd parity checker* (by accepting the minterm xyz - otherwise it would be a *one hot checker*), the correct interpretation of a XNOR-3 would then be an *even parity checker* (as pointed by Bradman175). This simply means that the expression for your algebraic XNOR-3 is not correct in this context.

In other words, $\boxed{x \odot y \odot z \neq \text{XNOR-3}}$.

The **XNOR** "**Gate**" is logically equivalent to an inverted XOR *i.e.*, XOR gate followed by a NOT gate (inventor). Thus XNOR produces 1 (high) output when the input combination has even number of 1's.

Table 4.20 *3-input XNOR gate*

Conclusion:

A Very Important NOTE is:

$ExNOR-3$ gate with inputs a, b, c **is NOT same as** $a \odot b \odot c$**.**

$ExNOR-n$ gate is defined as Complement of $ExOR-n$ gate.

NOTE that:

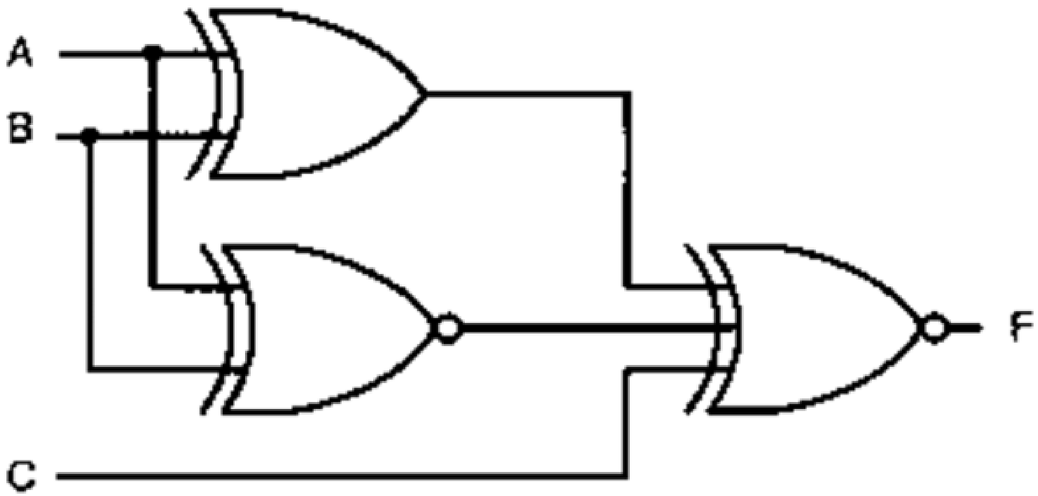
$$a \odot b \odot c = a \oplus b \oplus c$$

BUT $ExNOR-3 \neq ExOR-3$

The exclusive-NOR gate is the complement of the exclusive-OR gate, as indicated by the small circle on the output side of the graphic symbol.

GATE EC 2010 Question:

Q.12 For the output F to be 1 in the logic circuit shown, the input combination should be

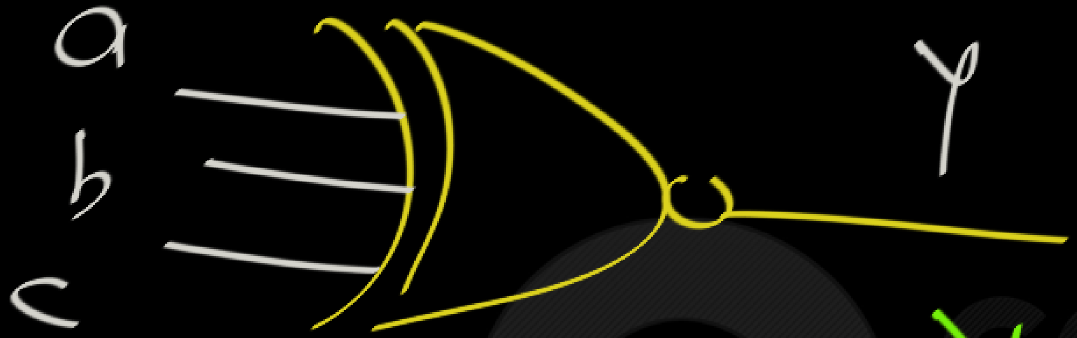


(A) A = 1, B = 1, C = 0 (B) A = 1, B = 0, C = 0

(C) A = 0, B = 1, C = 0 (D) A = 0, B = 0, C = 1

$$f = x \odot \bar{x} \odot c$$

$$= \overline{x \oplus \bar{x} \oplus c}$$



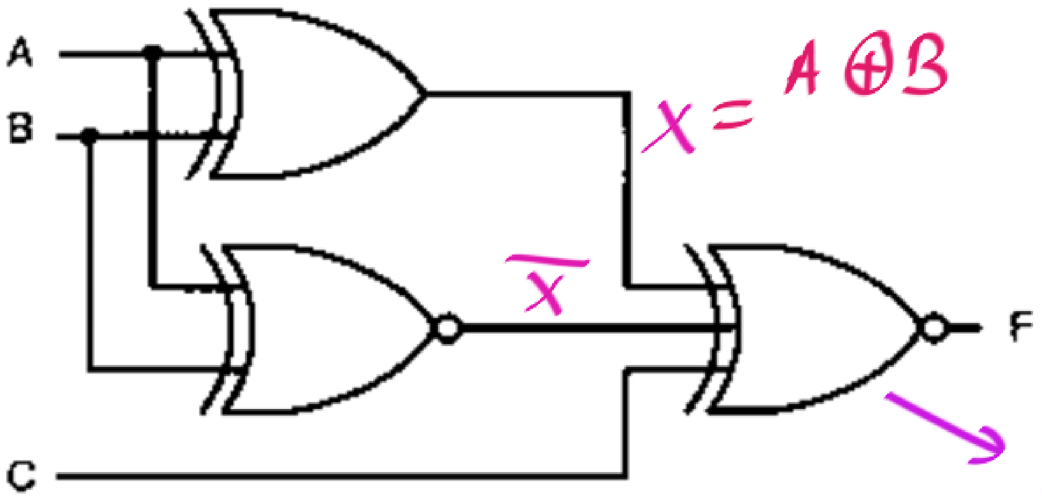
$Y \neq a \odot b \odot c$

$Y = \overline{a \oplus b \oplus c}$

GATE EC 2010 Question:

Q.12 For the output F to be 1 in the logic circuit shown, the input combination should be

$\boxed{F = C}$



XNOR-3 GATE

(A) A = 1, B = 1, C = 0 (B) A = 1, B = 0, C = 0

(C) A = 0, B = 1, C = 0 (D) A = 0, B = 0, C = 1

$$f = \overline{x \oplus \overline{x} \oplus c}$$

$$= \overline{1 \oplus c} = \overline{\overline{c}} = c$$

$$\boxed{f = c} \Rightarrow \boxed{f = 1 \text{ iff } c = 1}$$

$x \oplus \overline{x} = 1$

$a \oplus b = 1$ iff $a \neq b$.

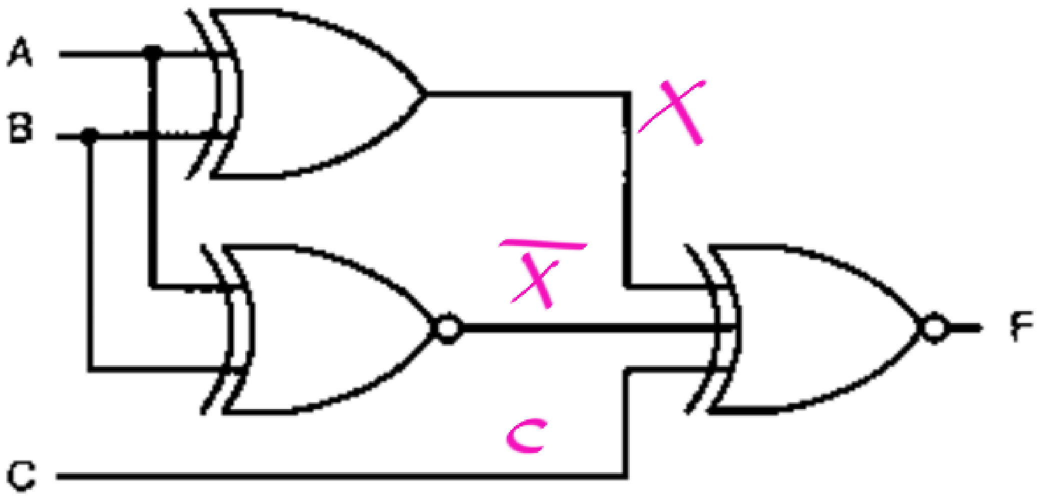
$$1 \oplus c = \boxed{?} \longrightarrow \bar{c}$$

$$\begin{array}{ccc} 0 & \longrightarrow & 1 \\ 1 & \longrightarrow & 0 \end{array}$$

GATE EC 2010 Question:

EC2010.pdf 4 / 24 157%

Q.12 For the output F to be 1 in the logic circuit shown, the input combination should be



(A) A = 1, B = 1, C = 0

(B) A = 1, B = 0, C = 0

(C) A = 0, B = 1, C = 0

(D) A = 0, B = 0, C = 1

$f = x \odot \bar{x} \odot c \rightarrow$ WRONG

$= 0 \odot c$

$= \bar{c}$

$x \odot \bar{x} = 0$

$f = \bar{c}$ → options A, B, C

$\boxed{a \odot b = 1 \text{ iff } a = b}$

$f = 1$ iff $c = 0$

$$0 \odot c = \boxed{?} \rightarrow \bar{c}$$

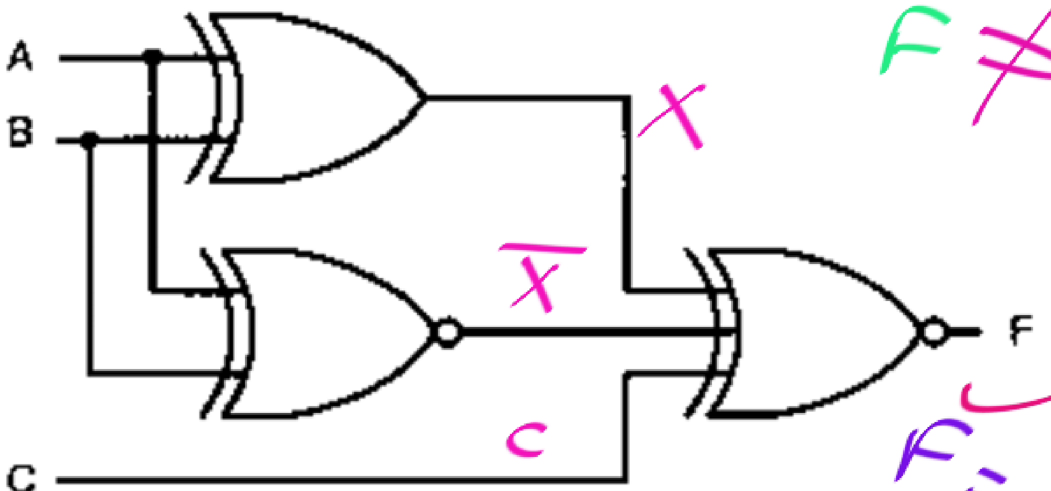
$$0 \rightarrow 1$$

$$1 \rightarrow 0$$

GATE EC 2010 Question:

MSQ

Q.12 For the output F to be 1 in the logic circuit shown, the input combination should be



$F \neq x \odot \overline{x} \odot c$

$F = \overline{x \oplus \overline{x} \oplus c}$

(A) A = 1, B = 1, C = 0

(B) A = 1, B = 0, C = 0

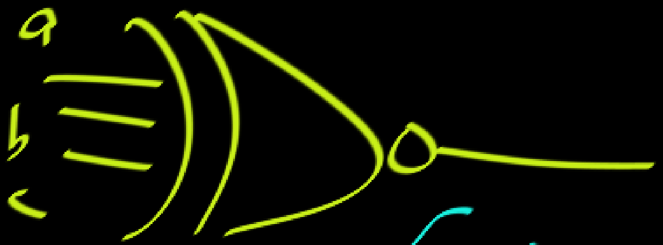
(C) A = 0, B = 1, C = 0

(D) A = 0, B = 0, C = 1

$Y \neq a \odot b \odot c$

$Y = \overline{a \oplus b \oplus c}$

ExNOR gate is NOT of ExOR gate

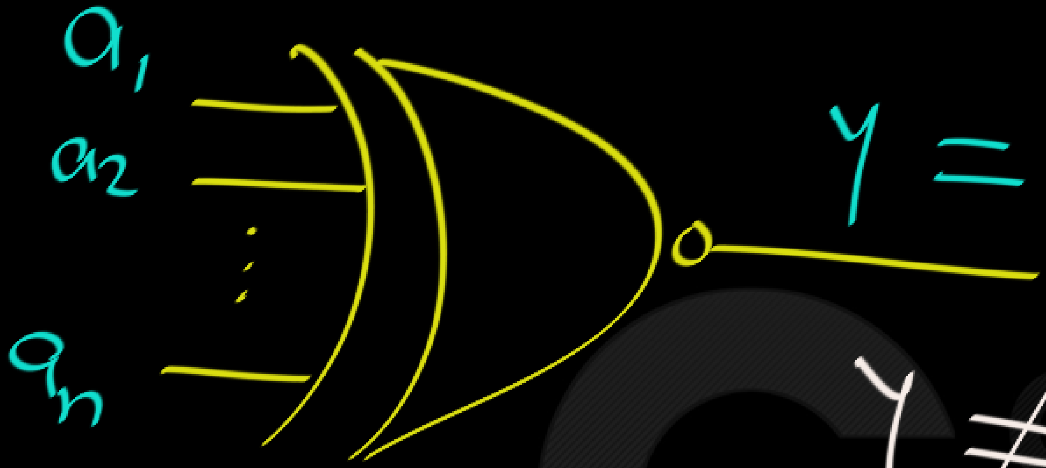


XNOR gate

$Y = \overline{a \oplus b \oplus c}$

$a \oplus b \oplus c$

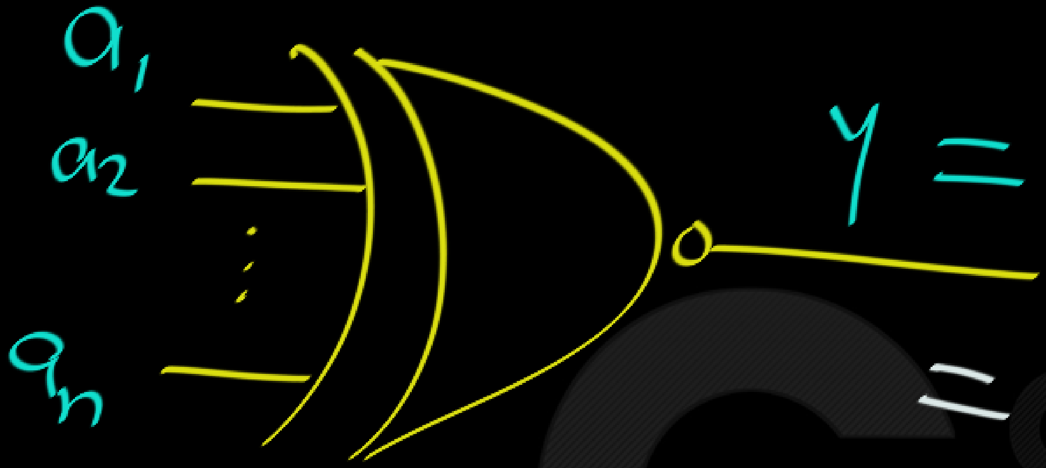
$= a \odot b \odot c$



$$Y = \overline{a_1 \oplus a_2 \oplus \cdots \oplus a_n}$$

$$Y \neq a_1 \odot a_2 \odot a_3 \cdots \odot a_n.$$

n : <u>even</u> OR <u>odd</u>

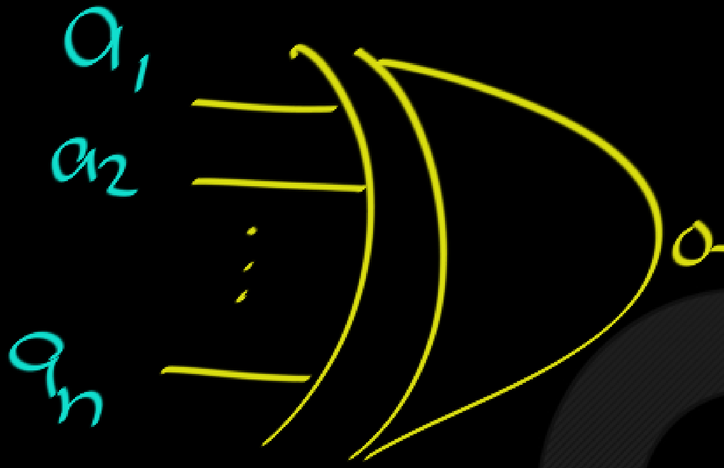


$$y = \overline{a_1 \oplus a_2 \oplus \cdots \oplus a_n}$$

$$= a_1 \odot a_2 \odot \cdots \odot a_n$$

n : even

$$\overline{a_1 \oplus a_2 \oplus \cdots \oplus a_n} = a_1 \odot a_2 \odot \cdots \odot a_n$$



$$Y = \overline{a_1 \oplus a_2 \oplus \cdots \oplus a_n}$$

$$\neq a_1 \odot a_2 \odot \cdots \odot a_n$$

n : Odd

$$\boxed{a_1 \oplus a_2 \oplus \cdots \oplus a_n = a_1 \odot a_2 \odot \cdots \odot a_n}$$

GATE ECE 2015 Set 1 | Question: 38

asked in **Digital Circuits** Mar 28, 2018 • recategorized Nov 15, 2020 by **soujanyareddy13** 81 views

1

A 3-input majority gate is defined by the logic function $M(a,b,c) = ab + bc + ca$. Which one of the following gates is represented by the function $M(\overline{M(a,b,c)}, M(a,b,\bar{c}), c)$?

A. 3-input NAND gate
B. 3-input XOR gate
C. 3-input NOR gate
D. 3-input XNOR gate

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81 views

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A. 3-input NAND gate
B. 3-input XOR gate
C. 3-input NOR gate
D. 3-input XNOR gate

Complement of each other.

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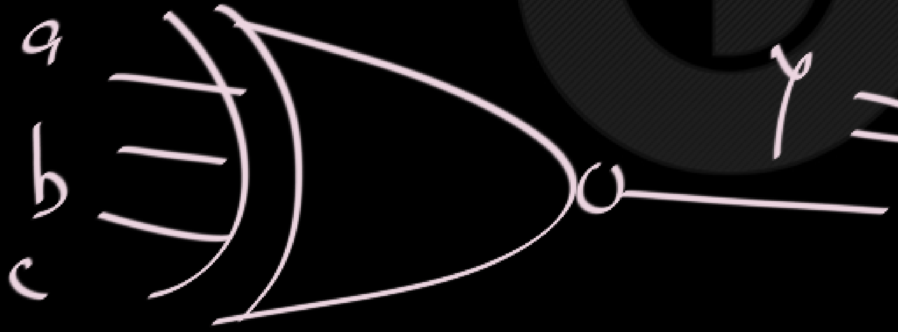
XNOR gate is Always Complement of ExOR gate.



$Y = \overline{a \oplus b \oplus c}$ ✓

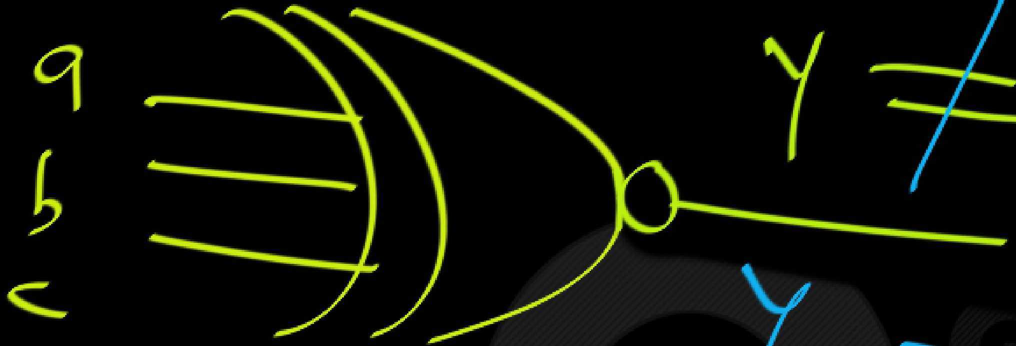
3-input XNOR gate

$\neq$

3 input XOR gate

$a \oplus b \oplus c$

$= a \odot b \odot c$



$$y \neq a \odot b \odot c$$

$$y = \overline{a \oplus b \oplus c}$$

$M(a,b,c) = ab + bc + ca$

$$M\left(\underbrace{\overline{M(a,b,c)}}_{X}, \underbrace{M(a,b,\bar{c})}_{Y}, c\right) = ?$$

$M(X,Y,c) = XY + Xc + Yc$

$$M(a,b,c) = ab + bc + ca$$

$$X = \overline{M_{(a,b,c)}} = \overline{ab + bc + ca}$$

$$= \left[(\bar{a}+\bar{b})(\bar{b}+\bar{c})\right](\bar{c}+\bar{a})$$

$$= \left[\bar{a}\bar{b} + \bar{a}\bar{c} + \bar{b} + \bar{b}\bar{c}\right](\bar{c}+\bar{a})$$

$$= (\bar{b} + \bar{a}\bar{c})(\bar{c}+\bar{a}) = \longrightarrow$$

$$X = (\bar{b} + \bar{a}\bar{c})(\bar{c} + \bar{a})$$

$$= \bar{b}\bar{c} + \bar{b}\bar{a} + \underbrace{\bar{a}\bar{c}\bar{c} + \bar{a}\bar{c}\bar{a}}_{\bar{a}\bar{c}}$$

$$\boxed{X = \bar{a}\bar{b} + \bar{a}\bar{c} + \bar{b}\bar{c}}$$

$$\alpha + \alpha\beta = \alpha$$

$$\bar{b} + \bar{b}\,\bar{c} + \bar{a}\,\bar{b}$$

$$\underbrace{\bar{b} + \bar{b}\,\bar{a}} = \bar{b} \checkmark$$

$$M(a,b,c) = ab + bc + ca$$

$$Y = M(a,b,\bar{c}) = ab + b\bar{c} + a\bar{c}$$

$$X = \overline{M(a,b,c)} = \bar{a}\bar{b} + \bar{a}\bar{c} + \bar{b}\bar{c}$$

$M(a,b,c) = ab + bc + ca$

$M(x,y,c) = xy + xc + yc$

$$xy = (\bar{a}\bar{b} + \bar{a}\bar{c} + \bar{b}\bar{c})(ab + b\bar{c} + a\bar{c})$$

$$= 0 + 0 + 0 + 0 + \bar{a}\bar{c}b + 0 + 0 + 0 + 0 + a\bar{b}\bar{c}$$

$$xy = \bar{a}\bar{c}b + a\bar{b}\bar{c}$$

$$Xc = \left(\bar{a}\bar{b} + \bar{a}\bar{c} + \bar{b}\bar{c}\right)c$$

$$= \bar{a}\bar{b}c + 0 + 0 = \bar{a}\bar{b}c$$

$$Yc = \left(ab + a\bar{c} + b\bar{c}\right)(c)$$

$$= abc$$

$M(a,b,c) = ab + bc + ca$

$\bar{a}\bar{b}c$

$M(x,y,c) = xy + xc + yc$

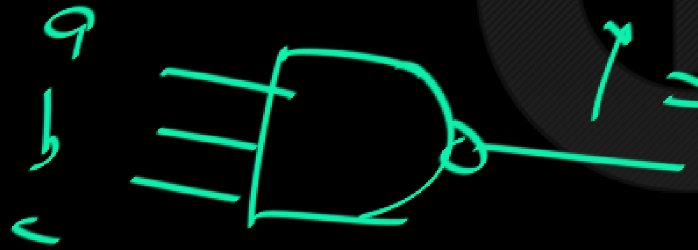
abc

$\bar{a}\bar{c}b + a\bar{b}\bar{c}$

$M(x,y,c) = \bar{a}\bar{b}c + abc + \bar{a}b\bar{c} + a\bar{b}\bar{c}$

$$M(x,y,c) = \boxed{abc + \bar{a}\bar{b}c + \bar{a}b\bar{c} + a\bar{b}\bar{c}}$$

Option A:

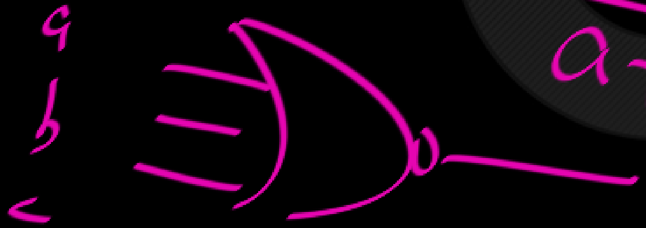


$$Y = \overline{abc} = \boxed{\bar{a} + \bar{b} + \bar{c}} \neq$$

Consider $(a, b, c) = (0, 0, 0)$

$$M(x,y,c) = \boxed{abc + \bar{a}\bar{b}c + \bar{a}b\bar{c} + a\bar{b}\bar{c}}$$

option c:



$$\overline{a+b+c} = \bar{a}\bar{b}\bar{c} \neq$$

Consider $(a,b,c) = (0,0,0);(1,1,1)$

$M(x, y, c) = abc + \bar{a}\bar{b}c + \bar{a}b\bar{c} +$

$a\bar{b}\bar{c}$

$$M(x, y, c) = \boxed{abc + \bar{a}\bar{b}c + \bar{a}b\bar{c} + a\bar{b}\bar{c}}$$

$$= a \oplus b \oplus c$$

$$= a \oplus b \oplus c$$

$a \oplus b \oplus c = 1$ iff odd number of variables are 1.

$$a \oplus b \oplus c = abc + a\bar{b}\bar{c} + \bar{a}b\bar{c} + \bar{a}\bar{b}c$$

$$M(a,b,c) = ab + bc + ca$$

$$M\left(\overline{M(a,b,c)},\ M(a,b,\bar{c}),\ c\right) =$$

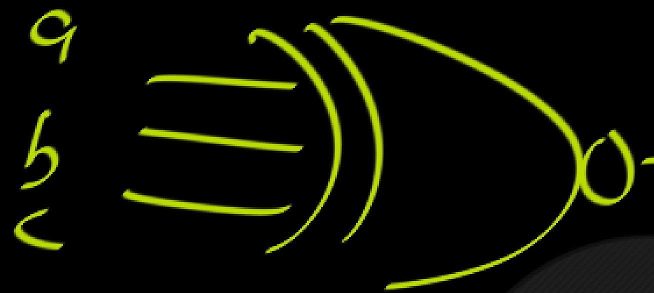
$$= a \oplus b \oplus c$$

$$= a \odot b \odot c$$

Ans : $a \oplus b \oplus c$

$||$

$a \odot b \odot c$



$$Y \neq a \odot b \odot c$$

$$Y = \overline{a \oplus b \oplus c}$$

ec.gateoverflow.in/631/gate-ece-2015-set-1-question-38

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GATE ECE 2015 Set 1 | Question: 38

asked in **Digital Circuits** Mar 28, 2018 • recategorized Nov 15, 2020 by **soujanyareddy13**

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B. 3-input XOR gate

C. 3-input NOR gate

D. 3-input XNOR gate

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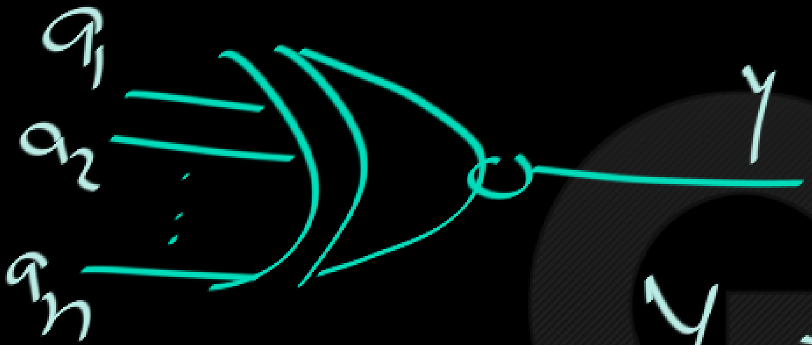
$= abc + \bar{a}\bar{b}c + \bar{a}b\bar{c} + ab\bar{c}$

$= a \oplus b \oplus c$

Very Important:



$$y \neq a_1 \odot a_2 \odot \cdots \odot a_n$$

$$y = \overline{a_1 \oplus a_2 \oplus \cdots \oplus a_n}$$

XNOR gate is Always Complement of XOR gate.