## GATE CS 2019

## Questions \& Solutions

POWERED BY:
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## GA Section

## 1 Marks:

Q. The expenditure of project $\qquad$ as follows:
Equipments - 20 lakh.
Salary - 12 lakhs.
A. Breaks
B. Break
C. Break down
D. Breaks down
(Memory Based)
Ans. D.
Q. What court is to Judge $\qquad$ is to Teacher.
A. a School
B. a Syllabus
C. a Punishment
D. a Student
(Memory Based)
Ans. A.
Q. Ten friends decided to give a gift to teacher by dividing the total amount. If two of them decided not to give, then each of them has to give Rs. 150 more. What was the total amount?
A. 6000
B. 12000
C. 666
D. 3000
(Memory Based)
Ans. A.
Let total amount be x
If all ten given the gift, then share of each $=\frac{x}{10}$
If 8 gives the gift, then share of each $=x / 8$
According to given condition
$\frac{x}{8}=\frac{x}{10}+150$
$\frac{x}{8}-\frac{x}{10}=150$
$\frac{5 x-4 x}{40}=150$
$\frac{x}{40}=150$
$\Rightarrow x=40 \times 150$
$X=6000$
Q. Two cars started moving in same direction from same point with speeds $50 \mathrm{~km} / \mathrm{h}$ and $60 \mathrm{~km} / \mathrm{h}$ respectively. Then after how many hours from starting, the distance between then will be 20 km ?
A. 1 hr
B. 3 hrs
C. 2 hrs
D. 6 hrs
(Memory Based)
Ans. C.
Let two cars be $A$ and $B$ moving with speeds $50 \mathrm{~km} / \mathrm{h}$ and $60 \mathrm{~km} / \mathrm{h}$ respectively and let the time taken be ' t ' hours after which the distance between them will be 20 kms .
So, distance travelled by A in ' $t$ ' hours
$=50 \mathrm{tkms}$
And distance travelled by $B$ in ' $t$ ' hours
$=60 \mathrm{tkms}$
So, $60 \mathrm{t}-50 \mathrm{t}=20$
$\Rightarrow 10 \mathrm{t}=20 \quad$ or $\mathrm{t}=2 \mathrm{hrs}$
Q. The search Engine model $\qquad$ around the fulcrum of trust.
A. Revolves
B. Plays
C. Burst
D. Sinks
(Memory Based)
Sol. C.
Suppose statement IV is true. All other is false
What S rays is true
$P$ says $\rightarrow Q$ committed crime $\rightarrow$ false.
Hence Q not committed.
$Q$ says $\rightarrow$ S committed crime false $\rightarrow$ Hence $S$ not committed only crime
$R$ says $\rightarrow I$ dinn't do that $\rightarrow$ false.
Hence, $R$ is criminal
S says $\rightarrow$ What Q says about me is false
Hence validated
$\Rightarrow R$ is criminal

## 2 Marks:

Q. Triangle is Teacher, Rectangle is Administrator and circle is Researcher. Then the percentage of Administrator is in range of

A. $0-15$
B. $16-30$
C. $31-46$
D. 47-60
(Memory Based)
Ans. C.
Total people $=$ Teachers + Administrators + Researchers
$80+20+60=160$
Administrators $=20+20+10=50$
Percentage $=50 / 160 \times 100=31.25 \%$
Q. Police arrested $P, Q, R, S \rightarrow 4$ criminals. All of them know each other.
I. $P$ says " $Q$ committed crime"
II. Q says " S committed crime"
III. R says " I didn't do that"
IV. S says what Q says about me is false"

If only one statement is correct, then who is the criminal?
A. P
B. Q
C. R
D. S
(Memory Based)
Ans. A.

## CS Section

## 1 Marks:

Q. Given Grammar

$$
S^{\prime} \rightarrow S
$$

$\mathrm{S} \rightarrow<\mathrm{L}>/$ id
$L \rightarrow L, S / S$
Let $\mathrm{I}_{0}=$ closure $\left(\left\{\left[\mathrm{S}^{\prime} \rightarrow \bullet \mathrm{S}\right]\right\}\right)$
The number of items in Goto ( $\mathrm{I} 0,<$ ) in
(Memory Based)
Ans. 5
Sol.

$$
\text { Io } \begin{array}{|l|l|}
\hline \mathrm{S}^{\prime} \rightarrow \cdot \mathrm{S} \\
\mathrm{~S} \rightarrow \cdot<\mathrm{L}> \\
\mathrm{S} \rightarrow \cdot \text { id }
\end{array} \quad \text { Goto }(\mathrm{Io},<) \begin{aligned}
& \mathrm{S} \rightarrow<\cdot \mathrm{L}> \\
& \mathrm{S} \rightarrow \cdot \mathrm{~L}, \mathrm{~S} \\
& \mathrm{~L} \rightarrow \cdot \mathrm{~S} \\
& \mathrm{~S} \rightarrow \cdot<\mathrm{L}> \\
& \mathrm{S} \rightarrow \cdot \mathrm{id} \\
& \hline
\end{aligned}
$$

Q. Derivation used in LR parser
A. Leftmost in reverse
B. Leftmost
C. Rightmost
D. Rightmost in reverse
(Memory Based)
Ans. A
Sol. Leftmost derivation in reverse is done Hence A is correct
Q. If 15 computers are to be connected using 8 port ethernet switches, then the minimum number of switches required are $\qquad$
(Memory Based)
Ans.
Sol. one port for network connection, remaining part $=7$
$\frac{15}{7}=2.14$
3
Q. Given IP $=100.10 .5 .2,100.10 .5 .4,100.10 .5 .6$ and subnet mask 255.255.255.252 which of the IPs are in same network?
(Memory Based)
Ans.
Sol. $100.10 .5 .2 \Rightarrow$ Net is $\Rightarrow 100.10 .5 .0$
100.10.5.4 $\Rightarrow$ Net id $\Rightarrow 100.10 .5 .4$
$100.10 .5 .6 \Rightarrow$ Net id $\Rightarrow 100.10 .5 .4$
Hence 100.10.5.4 2 100.10.5.6 will be on same network
Q. Pair of protocols used to send \& retrieve email (in that order)
A. IMAP, POP3
B. IMAP, SMTP
C. SMTP, POP3
D. SMTP, MIME
(Memory Based)
Ans. C
Sol. IMAP $\rightarrow$ Internet Message Access protocol
(store and view)
POP3 $\rightarrow$ Post Office Protocol
(retrieve email)
SMTP $\rightarrow$ Simple Mail Transfer Protocol
(send Email)
MIME $\rightarrow$ Multi purpose Internet Mail Extensions
(For media)
Q. Given Statement.
I. Strict 2 - Phase lock protocol generate Conflict Serializable schedule that are also recoverable
II. Time stamp - ordering concurrency control protocol with Thomas write rule can generate view serialized schedule that are not conflict serializable which are True?
A. Only I
B. Only II
C. Both True
D. Both are false
(Memory Based)
Q. $\quad \mathrm{G}$ is undirected graph n -vertices where $\mathrm{n} \geq 2$, then find the number of different Hamiltonian cycle in G.
(Memory Based)
Ans. $\frac{(n-1)!}{2}$ Option D.
Q. The value of $3^{51} \bmod 5$ is $\qquad$
(Memory Based)
Ans. 2
Sol. $3^{51} \bmod 5$
$=\left(3^{3}\right)^{17} \bmod 5$
$=\left(2^{7}\right)^{17} \bmod 5$
$=(2)^{17} \bmod 5$
$=(2)^{16} \cdot 2 \bmod 5$
$=\left(2^{4}\right)^{4} \cdot 2 \bmod 5$
$=(16)^{4} \cdot \bmod 5 \cdot 2 \bmod 5$
$=1 \bmod 5 \cdot 2 \bmod 5$
$=2$
Q. Given : A set $S$ with elements $\{1,2,3,4, \ldots .13\} .2$ number are chosen randomly from this set what will be the probability that 2 numbers chosen will have the same MSB in binary representation?
(Memory Based)
Ans. 0.4615
Sol. $1 \rightarrow 0001$
$2 \rightarrow 0010$
$3 \rightarrow 0011$
$4 \rightarrow 0100$
$5 \rightarrow 0101$
$6 \rightarrow 0110$
$7 \rightarrow 0111$
$8 \rightarrow 1000$
$9 \rightarrow 1001$
$10 \rightarrow 1010$
$11 \rightarrow 1011$
$12 \rightarrow 1100$
$13 \rightarrow 1101$
$\frac{(\mathrm{MSB} \rightarrow 0)+(\mathrm{MSB} \rightarrow 1)}{{ }^{13} \mathrm{C}_{2}}$
$\frac{{ }^{7} C_{2}+{ }^{6} C_{2}}{{ }^{13} C_{2}}=0.4615$
Q. include < studio h>

Int r( )
\{
static int num $=7$;
return num - - ;
\}
int main ( )
\{
for (r(); r( ) ; r ( ) )
Print f("\%d", r());
return 0;
\}
(Memory Based)
Sol. Static variable value will be initialized only at the time of compilation.
$\underset{\text { num }}{7} \rightarrow$ Hence execute it.
Expected Answer 52
Q. int jumble (int $x$, int $y$ )
\{ $x=2 . x+y$; return x ;
\}
main ()
$\{$ int $x=2, y=5$;
$y=$ jumble $(y, x)$
$x=$ jumble $(y, x)$
Pf (" \%d ", x)
return
\}
(Memory Based)
Sol. It is call by value, $y=5, x=2$
$y=$ jumble $(5,2)=12$
Now, $x=2 \quad y=12$
$x=$ jumble $(12,2)=26$
Hence, 26 will be printed
Expected Answer 26
Q. Given $Z=X-Y$. What $X, Y, Z$ are all sign-magnitude from $X$ and $Y$ are represented in $n$-bits. To avoid overflow $Z$ would be required?
A. $n+1$
B. $n+2$
C. $n-1$
D. n
(Memory Based)
Ans. A.
With $n+1$ number of bits, there will not be overflow for either addition or
subtraction of two $n$-bits number.
Q. Three process sharing the given variable

D = 100,

| P1 | P2 | P3 |
| :--- | :--- | :--- |
| $D=D+20$ | $D=$ <br> $D-50$ | $D=D+10$ |

Process exited on uniprocessor system running in time - shared operating system. If the min \& max possible value of $D$ after these process have Completed execution are $x y$. then $y-x$ is
(Memory Based)

Sol. Each statements is executed in 3 step

1. Read D
2. Increment D
3. Write D

Hence, the maximum value will be 130 \&d min value will be 50
$\therefore \mathrm{y}-\mathrm{x}=80$
Q. The given program
include <stdio.h>
main ()
\{
int i;
For ( $\mathrm{i}=0 ; \mathrm{i}<10 ; \mathrm{i}++$ )
If $(\mathrm{i} \% 2==0)$ fork ( )
return 0;
\}
Find the total child Process?
(Memory Based)
Sol. $I=0$
Fork ( )
Fork will be called 5 times $\Rightarrow \mathrm{n}=5$
No of child process $=2 n-1$

$$
=31
$$

Q. An array of 25 elements is sorted using quicksort. Pivot element is chosen randomly. What is the Probability of pivot element gets placed in worst possible condition in first round?
(Memory Based)
Sol. In worst case
Element may be placed at I or cost position caring a biased - array situation.
Hence $1 / 25+1 / 25=2 / 25$

## 2 Marks:

Q. In an RSA system $n=3007$ and $f(n)=2880$ where $f$ is the Euler's totient function of $n$. What is the prime factor of $n$ which is greater than 50 ?
(Memory Based)
Ans. 96
Sol. $n=3007$
$F(n)=2880$
$\rightarrow f(n)=(p-1)(q-1) \ldots .$.
Where $p, q$ are prime factor of $n$
$\mathrm{n}=3007 * 31 * 97$
$\Rightarrow$ prime factor greater than 50 is 96
Q. Given the functional dependencies
$\mathrm{QR} \rightarrow \mathrm{S}$
$R \rightarrow P$
$\mathrm{S} \rightarrow \mathrm{Q}$
They are decomposed into 2 functional dependencies $Y$ (PR) and $Z$ (QRS).
Which of the following statements is/are true
$S_{1}$ : $Y$ and $Z$ are in BCNF
$\mathrm{S}_{2}$ : Y and Z are both dependency preserving and lossless decompositions
A. $S_{1}$ only
B. $\mathrm{S}_{2}$ only
C. Both are true
D. Neither are true
(Memory Based)

Sol.

$\mathrm{R} \rightarrow \mathrm{P} \quad \mathrm{QR} \rightarrow \mathrm{S}\{\mathrm{QR}, \mathrm{SR}\}$
$S \rightarrow Q$
$\mathrm{R}(\mathrm{P}, \mathrm{Q}, \mathrm{R}, \mathrm{S})$
$\Downarrow$
Decomposed (Y(PR) Z(QRS)

$$
\begin{array}{ll}
\mathrm{R} \rightarrow \mathrm{P} & \mathrm{QR} \rightarrow \mathrm{~S} \\
& \mathrm{~S} \rightarrow \mathrm{Q}
\end{array}
$$

| Primary | $\{\mathrm{R}\}$ | Primary $-\{\mathrm{QR}\}$ |
| :---: | :---: | :---: |
| Key | $\Downarrow$ |  |
|  | BCNF | HR |
|  |  | Hence it is not <br> in BCNF |

Hence $S_{1}$ is false but $\{R\}$ which is Common in both table act as primary key in $Y$ Hence it is lossless \& DP. $S_{2}$ is true
Q. Which of the following is not correct for $B+$ Tree Creation used for creating and index of RDBMS table
A. Each leaf made has pointer to next leaf
B. B+ Tree in height balance Tree
C. Key Volume in Each node Kept in Sorted
D. Non leaf have pointer data record
(Memory Based)
Ans. D
Sol. B+ Tree $\rightarrow$
A) Correct
B) Yes, height balanced
C) Yes Key Values are sorted
D) Non leaf stores only pointer to leaf nodes

Leaf node stores data pointer
Hence D is right option
Q. Which of the following is not CFL ?
A. $L=\left\{W W^{R}, W \in\{0,1\}^{*}, n \geq 0\right\}$
B. $L=\left\{W^{n} b^{n} W^{R} ; W \in(0,1)^{*} n \geq 0\right\}$
C. $L=\left\{W a^{n} W^{R} b^{n} ; W \in(0,1)^{*}, n \geq 0\right\}$
D. $L=\left\{a^{n} b^{i} ; i=<n, 3 n, 5 n, 7 n>, n \geq 0\right\}$
(Memory Based)
Ans. C
Sol. (A) WWR $\rightarrow$ can be done using stack hence CFL
(B) WanbnWR $\rightarrow$

Push W
Push $a^{n}$
Pop ${ }^{n}$ for $b^{n}$
Can be done using stack Hence CFL
Pop $W$ for $W^{R}$
(C) Cannot be done using stack, hence not CFL
(D) Can be done using stack, hence CFL
Q. $\quad L$ is regular grammar over $\Sigma=(a, b)$. Find which one is not regular.
A. $L \cdot L^{R}=\left(x y \mid x \in L, y^{R} \in L\right)$
B. Suffix $(L)=\left(y \in \Sigma^{x} \mid \exists x E^{x} x y \in L\right)$
C. Prefix $(\mathrm{L})=\left(y \in \Sigma^{x} \mid \exists x E^{x} x y \in L\right)$
D. $W W^{R} \mid W \in L$
(Memory Based)
Ans. D
Sol. (A) $L \rightarrow$ Regular grammar
(B) Regular $\mathrm{LR} \rightarrow$ Also regular grammar
(C) Regular $\rightarrow L \cdot L^{R} \rightarrow$ Regular
(D) $W^{R}$ is not regular

Hence D is correct.
Q. Consider the following snapshot of a system running $n$ processes. Process $i$ is holding $X_{i}$ instances of a resource $R, 1<=1<=n$. Currently, all instances of $R$ are occupied. Further, for all $i$, process $i$ has placed a request for an additional $Y_{i}$ instances while holding the $X_{i}$ instance it already has. There are exactly two processes p and q such that $Y_{p}=Y_{q}=0$. What condition will make sure only $X_{p}$ and $X_{q}$ are executed.
(Memory Based)
Ans. $X_{p}+X_{q}<\min$
Sol.

| $P_{1}$ | $P_{2}$ | $\ldots .$. | $P_{n}$ |
| :--- | :--- | :--- | :--- |
| $\downarrow$ |  |  |  |
| $X_{1}$ | $X_{2}$ | $\ldots .$. | $X_{n}$ |
| $X_{1}$ | $Y_{2}$ | $\ldots .$. | $Y_{n}$ |

Only $X_{p}$ and $X_{q}$
$X_{p}+X_{q}<\min \left(Y_{k}\right)$
$1 \leq \mathrm{k} \leq \mathrm{n} \& \mathrm{k}!=\mathrm{p} \& \mathrm{k}!\mathrm{n}$
$\left(Y_{k}: 1<=k<=n, k!=p, k!=q\right)$
Q. There are 3-process given. Each value for arrival time and burst time is given in milisecond. Find the $Z$ value if waiting time in 1 milisecond.

| Process | A.T | B. $T$ |
| :---: | :---: | :---: |
| $P_{1}$ | 0 | 3 |
| $P_{2}$ | 1 | 1 |
| $P_{3}$ | 3 | 3 |
| $P_{4}$ | 4 | 2 |

(Memory Based)
Ans. $Z=3$
Sol. Three cases
If $Z>3$

| $\mathrm{P}_{1}$ | $\mathrm{P}_{2}$ | $\mathrm{P}_{1}$ | $\mathrm{P}_{3}$ | $\mathrm{P}_{4}$ |
| :--- | :--- | :--- | :--- | :--- |
| 0 | L | 2 | 4 | 7 |
| $\mathrm{Z}+7$ |  |  |  |  |

W.T.

| $\mathrm{P}_{1}$ | $\mathrm{P}_{2}$ | $\mathrm{P}_{3}$ | $\mathrm{P}_{4}$ |
| :--- | :--- | :--- | :--- |
| L | 0 | 1 | 3 |

W.T. $=\frac{5}{4}=1$ Hence not possible.

If $2 \leq 3$

| $\mathrm{P}_{1}$ | $\mathrm{P}_{2}$ | $\mathrm{P}_{1}$ | $\mathrm{P}_{4}$ | $\mathrm{P}_{3}$ |
| :--- | :--- | :--- | :--- | :--- |
| 0 | L | 2 | 4 | $4+2$ |$\quad 4+2+3$

= W.T.

| P1 | P2 | P3 | P4 |
| :--- | :--- | :--- | :--- |
| 1 | 0 | $Z$ | 0 |

$=\frac{1+z}{4}=1$
$Z=3$
Q. $\quad R=\left[\begin{array}{cccc}1 & 2 & 4 & 8 \\ 1 & 3 & 9 & 27 \\ 1 & 4 & 16 & 64 \\ 1 & 5 & 25 & 125\end{array}\right]$

The absolute value of product of eigen value of $R$ is

Ans. 12
Sol. $R=\left[\begin{array}{cccc}1 & 2 & 4 & 8 \\ 1 & 3 & 9 & 27 \\ 1 & 4 & 16 & 64 \\ 1 & 5 & 25 & 125\end{array}\right]$
$R_{2} \Rightarrow R_{2}-R_{1}$
$R_{3} \Rightarrow R_{3}-R_{1}$
$R_{4} \Rightarrow R_{4}-R_{1}$
$R=\left[\begin{array}{cccc}1 & 2 & 4 & 8 \\ 0 & 1 & 5 & 19 \\ 0 & 2 & 12 & 56 \\ 0 & 3 & 21 & 117\end{array}\right]$
$R_{3} \Rightarrow R_{3}-2 R_{2}$
$R_{4} \Rightarrow R_{4}-3 R_{2}$
$R=\left[\begin{array}{cccc}1 & 2 & 4 & 8 \\ 0 & 1 & 5 & 19 \\ 0 & 0 & 2 & 18 \\ 0 & 0 & 6 & 60\end{array}\right]$
Now calculate determinant
$=1 \times 1(2 \times 60-18 \times 6)$
$=120-108=12$
Q. $\quad \lim _{x \rightarrow 3} \frac{x^{4}-81}{2 x^{2}-5 x-3}$
A. $\frac{108}{7}$
B. Limit not exist
C. $\frac{53}{12}$
D. 1
(Memory Based)
Sol. $\lim _{x \rightarrow 3} \frac{x^{4}-81}{2 x^{2}-5 x-3}$

$$
\begin{aligned}
& \Rightarrow \lim _{x \rightarrow 3} \frac{\left(x^{2}\right)^{2}-(9)^{2}}{2 x^{2}-6 x+x-3} \\
& \Rightarrow \lim _{x \rightarrow 3} \frac{\left(x^{2}-9\right)-\left(x^{2}+9\right)}{(2 x+1)(x-3)} \\
& \Rightarrow \lim _{x \rightarrow 3} \frac{(x+3)(x-3)\left(x^{2}+9\right)}{(2 x+1)(x-3)} \\
& =\frac{(3+3)(18)}{7}=\frac{18 \times 6}{7}=\frac{108}{7}
\end{aligned}
$$

Q. \# include < stdio h >
int main ()
\{
int arr []$=\{2,4,6,8,10\}$
int sum $=0, i, * b=a r r+4$;
for ( $i=0, i<5, i++$ )
\{
sum $=$ sum $+(* b-i)-*(b-i) ;$
\}
print of (" \%d\n", sum);
return 0;
\}
(Memory Based)
Sol. Ans. 10

| 1 1 2 3 4 <br> 2 4 6 8 10 |  |
| :--- | :--- | :--- | :--- | :--- |

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Sum $=0+9-8=1$
Sum $=1+8-6=3$
Sum $=3+7-4=6$
Sum $=6+6-2=10$
Q. How many times sum will be printed?
int main ()
\{
float sum $=0.0, j=1.0, i=2.0$
while ( $\mathrm{i} / \mathrm{j}>0.0625$ )
\{
j = j + j;
sum $=$ sum $+i / j$
print f("\% f \n", sum)
return 0;
\}
(Memory Based)
Sol. Loop will run till $\mathrm{i} / \mathrm{j}>0.0625$
in each iteration
$j+j+j=2 j$ and $i$ remain fix.
$\mathrm{i} / \mathrm{j}>0.0625 \Rightarrow \frac{i}{0.0625}>i \Rightarrow j<32$
initially $\mathrm{j}=2$
$\Rightarrow$ it will take 5 iteration to become $\mathrm{j}=32$.
Hence sum will be printed five times.
Q. \# include < stdio h>
void convert [int n]
\{
If $(\mathrm{n}<0)$
$\{$
else
\{
convert (n/2) ;
print t ("\%d \n", n);
\}
\}
What will be the output when convert is called by passing a positive integer ( $n>0$ )
(Memory Based)
Sol. $\operatorname{con}(n) \rightarrow \operatorname{con}(n / 2) \rightarrow \operatorname{con}\left(n 2^{2}\right)$
Go to infinite loop with no output
Q. $\quad 16$ bit 2 's compliment representation in sign magnitude form of -28 is
A. $1111 \quad 1111 \quad 1110 \quad 0100$
B. $1101 \quad 1100 \quad 11010000$
C. $1111 \quad 1111 \quad 1111 \quad 1100$
D. $1111 \quad 1111 \quad 1110 \quad 0100$
(Memory Based)
Ans. D.
$+28 \longrightarrow 011100$
1's compliment $\longrightarrow 100011$

2's compliment $\longrightarrow 100100$
To represent it as a 16 bit number we copy MSB bit and paste it to the left side.
$\therefore 16$ bit representation will be
$1111 \quad 1111 \quad 11100100$
Q. Which of the following logic is invalid
A. $\mathbf{X} \oplus \mathbf{Y}=\left(\mathbf{X Y}+\mathbf{X}^{\prime} \mathbf{Y}^{\prime}\right)^{\prime}$
B. $\mathbf{X} \oplus \mathbf{Y}=\mathbf{X}+\mathbf{Y}$ if $\mathbf{X Y}=\mathbf{O}$
C. $\mathbf{X}+(\mathbf{Y} \oplus \mathbf{Z})=(\mathbf{X} \oplus \mathbf{Y})+\mathbf{Z}$
D. $(\mathbf{X} \oplus \mathbf{Y}) \oplus \mathbf{Z}=\mathbf{X} \oplus(\mathbf{Y} \oplus \mathbf{Z})$
(Memory Based)
Ans. C.
$X \oplus Y=X Y^{\prime}+X^{\prime} y$
a) $\left(X Y+X^{\prime} Y^{\prime}\right)^{\prime}=\left(X_{\text {NOR }}\right)^{\prime}=X O R$
b) If $X Y=0$, that implies $X=0, Y=1 ; X \oplus Y=1=X+Y$
$X=1, Y=0, X \oplus Y=1=X+Y$
$X=0, Y=0 ; X \oplus Y=0=X+Y$
c) $X+(Y \oplus Z)=X+Y^{\prime} Z+Y Z^{\prime}$
LHS Not same
$(X \oplus Y)+Z=X Y^{\prime}+X^{\prime} Y+Z$ RHS
d) XOR is associative

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