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SUBJECTWISE WEIGHTAGE

S.No.	Name of the Subject	One Mark Questions	Two Marks Questions	Total No. of Questions
1	Discrete Mathematics	1	2	3
2	Engineering Mathematics	3	3	6
3	Theory of Computation	3	2	5
4	Compiler Design	2	2	4
5	Database Management Systems	1	4	5
6	Computer Networks	4	1	5
7	Operating Systems	1	3	4
8	Algorithms	2	2	4
9	Data Structures	2	2	4
10	Programming Languages	2	2	4
11	Digital Logic	2	2	4
12	Computer Organization & Architecture	2	5	7
13	General Aptitude	5	5	10
Total No. Of Questions		**30**	**35**	**65**

Q.1 – Q.5 Carry ONE mark Each

01. Despite his initial hesitation, Rehman's____ to contribute to the success of the project never wavered.
Select the most appropriate option to complete the above sentence.
(a) ambivalence (b) satisfaction
(c) resolve (d) revolve

01. Ans: (c)

Sol:

- The sentence describes Rehman's determination despite his initial hesitation.
- The missing word must mean determination, commitment, or firm decision since his intention "never wavered."

Option Analysis:

(a) Ambivalence – means being uncertain or having mixed feelings. This contradicts "never wavered."
(b) Satisfaction – means feeling content, which doesn't fit the idea of determination.
(c) Resolve – means firm determination, which perfectly matches the sentence.
(d) Revolve – means to turn around, which is unrelated to the meaning.

Correct Answer: (c) resolve

02 Bird : Nest :: Bee :
Select the correct option to complete the analogy.
(a)Kennel (b) Hammock
(c)Hive (d) Lair

02. Ans: (c)

Sol: This is an analogy question based on habitats or homes of animals/insects.

- A bird lives in a nest.
- A bee lives in a hive.

Option Analysis:

(a) Kennel – A shelter for dogs, incorrect.
(b) Hammock – A hanging bed, unrelated.
(c) Hive – The correct answer, as bees live in hives.
(d) Lair – A den for wild animals (e.g., lions, tigers), incorrect.

Correct Answer: (c) Hive

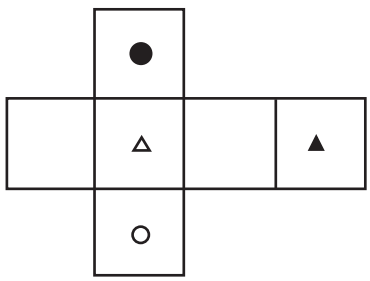
03. If $Pe^{x} = Qe^{-x}$ for all real values of x, which one of the following statements is true?
(a) P = Q = 0 (b) P = Q = 1
(c) P = 1; Q = – 1 (d) $\frac{P}{Q} = 0$

03. Ans: (a)

Sol: If P = Q = 0

then possible

04. The paper as shown in the figure is folded to make a cube where each square corresponds to a particular face of the cube. Which one of the following options correctly represents the cube?
Note: The figures shown are representative.



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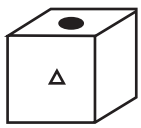
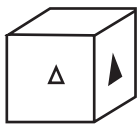
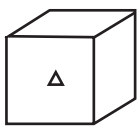
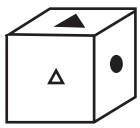
(a) 
(b) 
(c) 
(d) 

04. Ans: (a)

Sol: Opposite faces } ⇒ empty → empty

▲→ Δ

●→○

we have to use elimination method.

then option "A" is correct.

05. Let p_1 and p_2 denote two arbitrary prime numbers. Which one of the following statements is correct for all values of p_1 and p_2?

(a) $p_1 + p_2$ is not a prime number.

(b) $p_1 p_2$ is not a prime number.

(c) $p_1 + p_2 + 1$ is a prime number.

(d) $p_1 p_2 + 1$ is a prime number.

05. Ans: (b)

Sol:

Option (a) → $p_1 + p_{2\_is}$ not a prime number 2 + 7 = 9 (not prime) this answer is wrong

Option (c) → $p_1 + p_2 + 1$ is a prime number 3 + 5 + 1 this answer is wrong

Option (d) → $p_1 + p_2 + 1$ is a prime number 5(7) + 1 = 36 not prime this answer is wrong

Option (b) → $p_1 p_2$ is not a prime number 2 + 3 = 5 (prime) this is a right answer.

Q.6 – Q.10 Carry TWO marks Each

06. Based only on the conversation below, identify the logically correct inference:

"Even if I had known that you were in the hospital, I would not have gone there to see you", Ramya told Josephine.

(a) Ramya knew that Josephine was in the hospital.

(b) Ramya did not know that Josephine was in the hospital.

(c) Ramya and Josephine were once close friends; but now, they are not.

(d) Josephine was in the hospital due to an injury to her leg.

06. Ans: (b)

Sol: This is a conditional statement Ramya did not visit Josephine in the hospital.

- Whether she knew or not, she still would not have gone.
- This implies she did NOT know Josephine was hospitalized but does NOT indicate any other facts.

Option Analysis:

(a) Ramya knew that Josephine was in the hospital.

- Incorrect because the statement suggests she did not know.

(b) Ramya did not know that Josephine was in the hospital.

- This is the only valid inference.

(c) Ramya and Josephine were once close friends, but now they are not.

- There is no information about their past relationship.

(d) Josephine was in the hospital due to an injury to her leg.

- The reason for hospitalization is not mentioned in the statement.

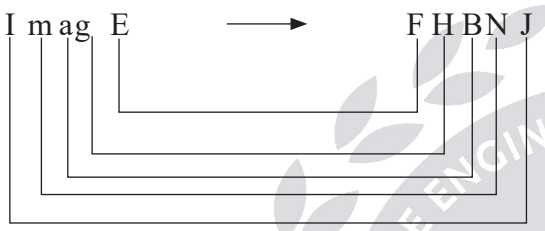
Correct Answer: (b) Ramya did not know that Josephine was in the hospital.

07. If IMAGE and FIELD are coded as FHBNJ and EMFJG respectively then, which one among the given options is the most appropriate code for BEACH ?

(a) CEADP (b) IDBFC
(c) JGIBC (d) IBCEC

07. Ans: (b)

Sol:



logic: +1, +1, +1 ---- but reverse order

08. Which one of the following options is correct for the given data in the table?

Iteration (i)	0	1	2	3
Input (I)	20	− 4	10	15
Output (X)	20	16	26	41
Output (Y)	20	− 80	− 800	− 12000

(a) $X(i) = X(i-1) + I(i)$; $Y(i) = Y(i-1)\, I(i)$; $i > 0$

(b) $X(i) = X(i-1) I(i)$; $Y(i) = Y(i-1) + I(i)$; $i > 0$

(c) $X(i) = X(i-1) I(i)$; $Y(i) = Y(i-1) I(i)$; $i > 0$

(d) $X(i) = X(i-1) + I(i)$; $Y(i) = Y(i-1)\, I(i-1)$; $i > 0$

08. Ans: (a)

Sol: at check option (a)

$i = 1$

$x(1) = x(1-1) + I(1)$

$= x(0) + I(1)$

$= 20 - 4$

$= 16$

$x(1) = 16$

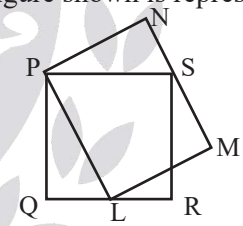
so option (a) is correct

remaining not possible

09. In the given figure, PQRS is a square of side 2 cm and PLMN is a rectangle. The corner L of the rectangle is on the side QR. Side MN of the rectangle passes through the corner S of the square.

What is the area (in cm^2) of the rectangle PLMN?

Note: The figure shown is representative.

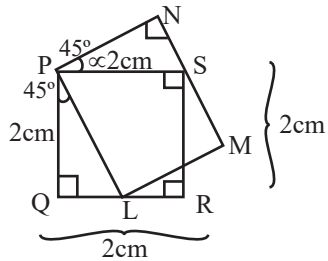


(a) $2\sqrt{2}$ (b) 2 (c) 8 (d) 4

09. Ans: (d)

Sol: Given

PQRS is a square of side Q cm



Let us consider.

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$\angle NPS = \alpha$

$\angle QPL = \beta$

we know that, $\angle P = 90°$ for both PQRS sqaure and PLMN rectangle

$\therefore \angle NPS + \angle LPS = 90°, \angle QPL + \angle LPS = 90°$

Let $\angle LPS = r^1$

$\therefore \alpha + r^1 = 90°, \ \beta + r^1 = 90°$

$\alpha = 90° - r^1 \ldots (1), \ \beta = 90° - r^1 \ldots (2)$

From (1) & (2) $\alpha = \beta$ we will get.

Consider Δ^{le} PQL,

$$\cos\beta = \frac{PQ}{PL} \ldots\ldots (3)$$

Consider Δ^{le} PNS,

$$\cos\alpha = \frac{PN}{PS} \ldots\ldots (4)$$

Since $\alpha = \beta$, we can write (3) & (4) as

$\cos\alpha = \cos\beta$

$$\frac{PQ}{PL} = \frac{PN}{PS}$$

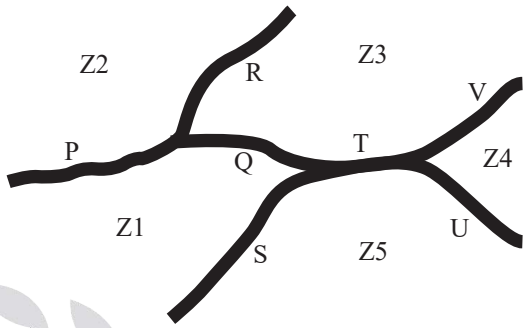
$$\frac{2}{PL} = \frac{PN}{2} \ (\because \text{ sides of square are 2 cm})$$

$PL \cdot PN = 2 \times 2 = 4.$

Question asked is area of rectangle PLMN = PL.PN = 4.

10. The diagram below shows a river system consisting of 7 segments, marked P, Q, R, S, T, U, and V. It splits the land into 5 zones, marked Z1, Z2, Z3, Z4, and Z5. We need to connect these zones using the least number of bridges. Out of the following options, which one is correct?

Note: The figure shown is representative.



(a) Bridges on P, Q, and T

(b) Bridges on P, Q, S, and T

(c) Bridges on Q, R, T, and V

(d) Bridges on P, Q, S, U, and V

10. Ans: (c)

Q.11 – Q.35 Carry ONE mark Each

11. If $A = \begin{pmatrix} 1 & 2 \\ 2 & -1 \end{pmatrix}$, then which ONE of the following is A^8?

(a) $\begin{pmatrix} 25 & 0 \\ 0 & 25 \end{pmatrix}$ (b) $\begin{pmatrix} 125 & 0 \\ 0 & 125 \end{pmatrix}$

(c) $\begin{pmatrix} 625 & 0 \\ 0 & 625 \end{pmatrix}$ (d) $\begin{pmatrix} 3125 & 0 \\ 0 & 3125 \end{pmatrix}$

11. Ans: (c)

Sol: Let us find the characteristic equation

$|A - \lambda I| = 0$

$$\begin{vmatrix} 1-\lambda & 2 \\ 2 & -1-\lambda \end{vmatrix} = 0$$

$(1-\lambda)(-1-\lambda) - 4 = 0$

$(\lambda - 1)(\lambda + 1) - 4 = 0$

$\lambda^2 - 1 - 4 = 0$

$\lambda^2 - 5 = 0$

$\Rightarrow \quad A^2 - 5I = 0$

$A^2 = 5I$

$A^8 = (A^2)^4$

$= (5I)^4$

$= 625\ I$

12. The value of x such $x > 1$, satisfying the equation $\int_1^x t \ln t \, dt = \frac{1}{4}$ is

(a) $\sqrt{e}$ (b) e (c) e^2 (d) $e - 1$

12. Ans: (a)

Sol: $\int_1^x t \ln t \, dt = \frac{1}{4}$

$$\left((\ln t)\left(\frac{t^2}{2}\right) - \int \frac{1}{t} \cdot \frac{t^2}{2} dt\right)_1^x = \frac{1}{4}$$

$$(\ln t)\left(\frac{t^2}{2}\right) - \frac{t^2}{4}\Big)_1^x = \frac{1}{4}$$

$$\left(\frac{x^2}{2}\ln x - \frac{x^2}{4}\right) - \left(0 - \frac{1}{4}\right) = \frac{1}{4}$$

$$\frac{x^2}{2}\left(\ln x - \frac{1}{2}\right) = 0$$

x cannot be 0 as $x > 1$

$$\ln x - \frac{1}{2} = 0$$

$$\ln x = \frac{1}{2}$$

$$\Rightarrow x = e^{\frac{1}{2}}$$

13. Consider a binary tree T in which every node has either zero or two children. Let $n > 0$ be the number of nodes in T.
Which ONE of the following is the number of nodes in T that have exactly two children?

(a) $\frac{n-2}{2}$ (b) $\frac{n-1}{2}$ (c) $\frac{n}{2}$ (d) $\frac{n+1}{2}$

13. Ans: (b)

Sol: If 'n' denotes total no. of nodes, 'I' denotes total no. of internal nodes, 'L' denotes total no. of leaf nodes of a K-ary tree then

$L = I(K - 1) + 1$

$n - I = I(K-1) + 1$ [$\because n = I + L$]

$n - I = I(2 - 1) + 1$ [$\because$ Given $K = 2$]

$\therefore n - 1 = 2I$

$\therefore I = \frac{n-1}{2}$

$\therefore$ No. of nodes having exactly two children

$= \frac{n-1}{2}$

14. Let L, M, and N be non-singular matrices of order 3 satisfying the equations
$L^2 = L^{-1}$, $M = L^8$ and $N = L^2$.
Which ONE of the following is the value of the determinant of (M−N)?

(a) 0 (b) 1 (c) 2 (d) 3

14. Ans: (a)

Sol: $M = L^8 = L^2 L^6 = L^{-1} L^6 = L^5 = L^2 L^3 = L^{-1} L^3 = L^2$

$\Rightarrow M = L^2$

$\Rightarrow M - N = L^2 - L^2 = 0$

$|M - N| = 0$

15. Let P(x) be an arbitrary predicate over the domain of natural numbers.
Which ONE of the following statements is TRUE?

(a) $(P(0) \wedge (\forall x[P(x) \Rightarrow P(x+1)])) \Rightarrow (\forall x P(x))$

(b) $(P(0) \wedge (\forall x[P(x) \Rightarrow P(x-1)])) \Rightarrow (\forall x P(x))$

(c) $(P(1000) \wedge (\forall x[P(x) \Rightarrow P(x-1)])) \Rightarrow (\forall x P(x))$

(d) $(P(1000) \wedge (\forall x[P(x) \Rightarrow P(x+1)])) \Rightarrow (\forall x P(x))$

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15. Ans: (a)

Sol: Given that P(x) is an arbitrary predicate over the domain of natural numbers

N = {1, 2, 3, 4,_ _ _ _ _ _ _ _}

Consider P(x): x is a whole number option (A) is true for any value of x ∈N,

where options (B), (C), and (D) are FALSE

16. Consider the following statements:

(i) Address Resolution Protocol (ARP) provides a mapping from an IP address to the corresponding hardware (link-layer) address.

(ii) A single TCP segment from a sender S to a receiver R cannot carry both data from S to R and acknowledgement for a segment from R to S.

Which ONE of the following is CORRECT?

(a) Both (i) and (ii) are TRUE

(b) (i) is TRUE and (ii) is FALSE

(c) (i) is FALSE and (ii) is TRUE

(d) Both (i) and (ii) are FALSE

16. Ans: (b)

Sol: Statement-1 is TRUE

ARP is a network protocol used to find the MAC (Media Access Control) address corresponding to a given IP address.

Statement-2 is FALSE

TCP uses piggybacking to send an acknowledgement (ACK) along with data in the same segment.

17. Consider the routing protocols given in **List I** and the names given in **List II**:

List I:

(i) Distance vector routing

(ii) Link state routing

List II:

(A) Bellman-Ford

(B) Dijkstra

For matching of items in List I with those in List II, which ONE of the following options is CORRECT?

(a) (i) – (A) and (ii) – (B)

(b) (i) – (A) and (ii) – (A)

(c) (i) – (B) and (ii) – (A)

(d) (i) – (B) and (ii) – (B)

17. Ans: (a)

Sol: (i) → (a)

DVR algorithm uses Bellman - Ford Algorithm to find out the optimal Path.

(ii) → (b)

Link state Routing algorithm uses Dijkstra's Algorithm to construct the SPT.

18. A machine receives an IPv4 datagram. The protocol field of the IPv4 header has the protocol number of a protocol X.

Which ONE of the following is NOT a possible candidate for X?

(a) Internet Control Message Protocol (ICMP)

(b) Internet Group Management Protocol (IGMP)

(c) Open Shortest Path First (OSPF)

(d) Routing Information Protocol (RIP)

18. Ans: (d)

Sol: RIP (Routing Information Protocol) - Uses UDP (Port 520)

- RIP is a routing protocol but does NOT have a direct protocol number in the IPv4 header.
- Instead, RIP uses UDP as its transport layer protocol (UDP port 520).
- Since RIP is encapsulated inside UDP, it does NOT appear directly in the Protocol field of an IPv4 header.

- IPv4 Protocol field value = 1 → ICMP
- IPv4 Protocol field value = 2 → IGMP
- IPv4 Protocol field value = 89 → OSPF

19. Consider the following C program:

```
# include <stdio.h>
void stringcopy(char *, char *);
int main(){
    char a[30] = "@#Hello World!";
    stringcopy(a, a + 2);
    printf("%s\n", a);
    return 0;
}
void stringcopy(char *s, char *t) {
    while(*t)
        *s++ = *t++;
}
```

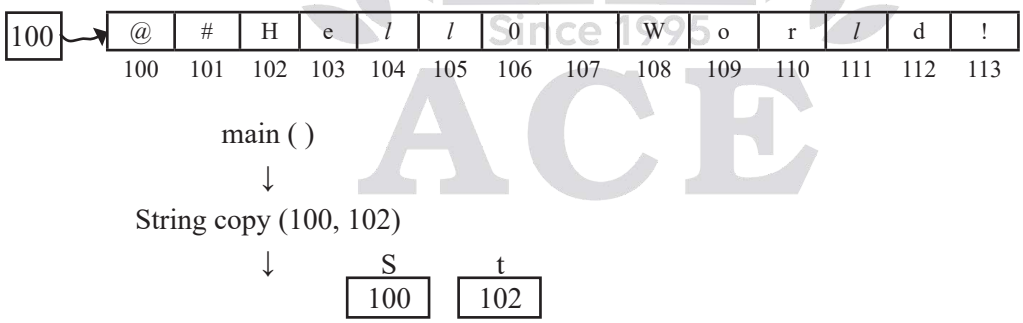
Which ONE of the following will be the output of the program?

(a) @#Hello World! (b) Hello World!

(c) ello World! (d) Hello World!d!

19. Ans: (d)

Sol:



Since *t is ASC11 value of 'H' which is non-zero, so condition in while loop is true and *s + + = * t + + will replace content of address 100 with content of address 200 in the above diagram. By continuing we get finally Hello worl!d!

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20. Consider an unordered list of N distinct integers. What is the minimum number of element comparisons required to find an integer in the list that is NOT the largest in the list?
(a) 1 (b) N −1 (c) N (d) 2N −1

20. Ans: (a)

Sol: Let us consider 'L' is a list of 'N' distinct integers. By comparing L[0] with L[1] we get an element which is not largest. So it takes only one comparision.

21. Consider the following statements about the use of backpatching in a compiler for intermediate code generation:
(I): Backpatching can be used to generate code for Boolean expression in one pass.
(II): Backpatching can be used to generate code for flow-of-control statements in one pass.
Which ONE of the following options is CORRECT?
(a) Only (I) is correct.
(b) Only (II) is correct.
(c) Both (I) and (II) are correct.
(d) Neither (I) nor (II) is correct.

21. Ans: (c)

Sol: Back patching cam be used to generate code of both boolean expressions and flow-of-control statements in one pass.

22. Given the following syntax directed translation rules:
Rule1: R→ AB {B.i=R.i−1;A.i=B.i;R.i=A.i+1;}
Rule2: P → CD {P.i=C.i+D.i;D.i=C.i+2;}
Rule 3:Q → EF {Q.i=E.i+F.i;}
Which ONE is the CORRECT option among the following?
(a) Rule 1 is S-attributed and L-attributed; Rule 2 is S-attributed and not L-attributed; Rule 3 is neither S-attributed nor L-attributed.
(b) Rule 1 is neither S-attributed nor L-attributed; Rule 2 is S-attributed and L-attributed; Rule 3 is S-attributed and L-attributed.
(c) Rule 1 is neither S-attributed nor L-attributed; Rule 2 is not S-attributed and is L-attributed; Rule 3 is S-attributed and L-attributed.
(d) Rule 1 is S-attributed and not L-attributed; Rule 2 is not S-attributed and is L-attributed; Rule 3 is S-attributed and L-attributed.

22. Ans: (c)

Sol: **Rule 1:** 'i' is inherited attribute and is evaluating from right subtree for the rule A. i = B.i, therefore it is not 'L' attributed
Rule 2: In D.i = c.i+2; i is inherited attributed, so it is not 'S' attributed, but it is evaluating from left subtree therefore it is 'L' attributed
Rule 3: In Q.i = E. i + F.i, 'i' is synthesized attribute, therefore it is both 'S' and 'L' attributed.

23. Consider a network that uses Ethernet and IPv4. Assume that IPv4 headers do not use any options field. Each Ethernet frame can carry a maximum of 1500 bytes in its data field. A UDP segment is transmitted. The payload (data) in the UDP segment is 7488 bytes.
Which ONE of the following choices has the CORRECT total number of fragments transmitted and the size of the last fragment including IPv4 header?
(a) 5 fragments, 1488 bytes
(b) 6 fragments, 88 bytes
(c) 6 fragments, 108 bytes
(d) 6 fragments, 116 bytes

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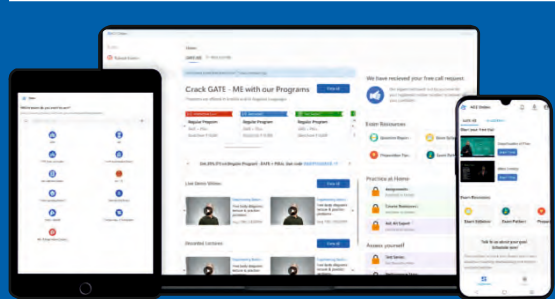

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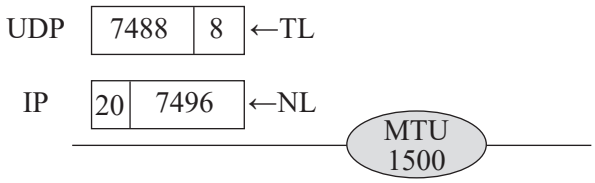
23. Ans: (d)

Sol:



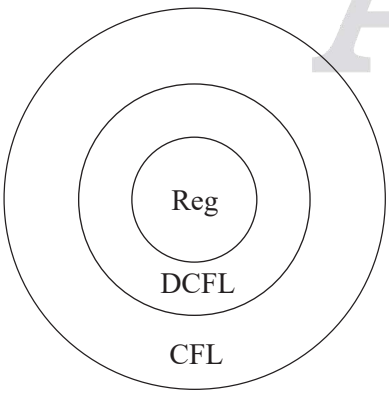
$$\text{No. of fragments} = \frac{7496}{1480} = 5.06 \approx 6$$

	(1)	(2)	(3)	(4)	(5)	(6)
DL	1480	1480	1480	1480	1480	96
HL	20	20	20	20	20	20
						116 bytes

24. Which ONE of the following languages is accepted by a deterministic pushdown automaton?
(a) Any regular language.
(b) Any context-free language.
(c) Any language accepted by a non-deterministic pushdown automaton.
(d) Any decidable language.

24. Ans: (a)

Sol: All regular languages are accepted by DPDA (deterministic pushdown automaton).



25. Let G_1, G_2 be Context Free Grammars (CFGs) and R be a regular expression. For a grammar G, let L(G) denote the language generated by G.
Which ONE among the following questions is decidable?
(a) Is $L(G_1) = L(G_2)$?
(b) Is $L(G_1) \cap L(G_2) = \phi$?
(c) Is $L(G_1) = L(R)$?
(d) Is $L(G_1) = \phi$?

25. Ans: (d)

Sol: Let G be CFG is L(G) empty ?
Above is decidable statement remaining all are undecidable.

26. Processes P_1, P_2, P_3, P_4 arrive in that order at times 0, 1, 2, and 8 milliseconds respectively, and have execution times of 10, 13, 6, and 9 milliseconds respectively. Shortest Remaining Time First (SRTF) algorithm is used as the CPU scheduling policy. Ignore context switching times.
Which ONE of the following correctly gives the average turnaround time of the four processes in milliseconds?
(a) 22 (b) 15 (c) 37 (d) 19

26. Ans: (d)

Sol:

P/D	AT	ET	CT	TAT
P_1	0	10	16	16
P_2	1	13	38	37
P_3	2	6	8	6
P_4	8	9	25	17

$$\therefore \text{Avg TAT} = \frac{16+37+6+17}{4} = \frac{76}{4}$$

$$= 19$$

Gantt chart:

P_1	P_1	P_3	P_1	P_4	P_2

0 1 2 8 16 25 38

P_1–10 → P_2–13 → P_3–6

P_1–9 → P_2–13

P_1–8 → P_2–13 → P_4–9

P_1–8 → P_2–13 → P_4–9

P_2–13

27. An audit of a banking transactions system has found that on an earlier occasion, two joint holders of account A attempted simultaneous transfers of Rs. 10000 each from account A to account B. Both transactions read the same value, Rs. 11000, as the initial balance in A and were allowed to go through. B was credited Rs. 10000 twice. A was debited only once and ended up with a balance of Rs. 1000.
Which of the following properties is/are certain to have been violated by the system?
(a) Atomicity (b) Consistency
(c) Isolation (d) Durability

27. Ans: (b, c)

Sol: As both joint holders transaction carried without any control resulting violation of isolation and final result is inconsistency.

28. Which of the following is/are part of an Instruction Set Architecture of a processor?
(a) The size of the cache memory
(b) The clock frequency of the processor
(c) The number of cache memory levels
(d) The total number of registers

28. Ans: (d)

Sol: The size of cache memory, number of cache levels and clock frequency of the processor are not related to the processor Architecture number of CPU registers fabricated in the processor belongs to the processor Architecture.

29. Which of the following statements regarding Breadth First Search (BFS) and Depth First Search (DFS) on an undirected simple graph G is/are TRUE?
(a) A DFS tree of G is a Shortest Path tree of G.
(b) Every non-tree edge of G with respect to a DFS tree is a forward/back edge.
(c) If (u,v) is a non-tree edge of G with respect to a BFS tree, then the distances from the source vertex s to u and v in the BFS tree are within ± 1 of each other.
(d) Both BFS and DFS can be used to find the connected components of G.

29. Ans: (b, c, d)

Sol: A DFS tree of G is not providing shortest path of G so only (A) is FALSE and remaining options (b), (c), (d) are True.

30. Consider the two lists List I and List II given below:
List I:
(i) Context free languages
(ii) Recursive languages
(iii) Regular languages
List II:
(A) Closed under union
(B) Not closed under complementation
(C) Closed under intersection
For matching of items in **List I** with those in **List II**, which of the following option(s) is/are CORRECT?
(a) (i) – (A), (ii) – (B), and (iii) – (C)
(b) (i) – (B), (ii) – (A), and (iii) – (C)
(c) (i) – (B), (ii) – (C), and (iii) – (A)
(d) (i) – (A), (ii) – (C), and (iii) – (B)

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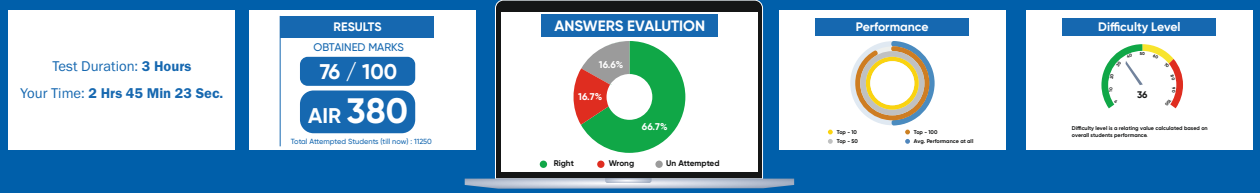
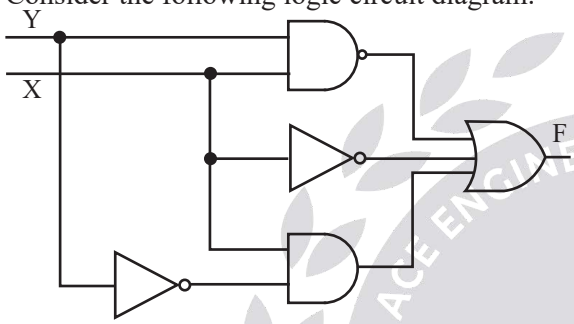


30. Ans: (b, c)

Sol: → Context free languages not closed under the intersection, complementation

→ Recursive, regular language closed under union, intersection complementation.

31. Consider the following logic circuit diagram.



Which is/are the CORRECT option(s) for the output function F?

(a) $\overline{XY}$ (b) $\overline{X}+\overline{Y}+X\overline{Y}$

(c) $\overline{XY}+\overline{X}+X\overline{Y}$ (d) $X+\overline{Y}$

31. Ans: (a, b & c)

Sol: From the given logic circuit diagram

$F = \overline{XY}+\overline{X}+X\overline{Y}$ → option : (c)

$F = \overline{X}+\overline{Y}+\overline{X}+X\,\overline{Y}[\because \overline{X}+\overline{X}=\overline{X}]$

$F = \overline{X}+\overline{Y}+X\overline{Y}$ ⟶ option: (B)

$F = \overline{X}+\overline{Y}\,[1+x]\ [\because 1+x=1]$

$F = \overline{X}+\overline{Y} = \overline{X.Y}$ ⟶ option: (A)

32. The following two signed 2's complement numbers (multiplicand M and multiplier Q) are being multiplied using Booth's algorithm:

M : 1100 1101 1110 1101 and

Q : 1010 0100 1010 1010

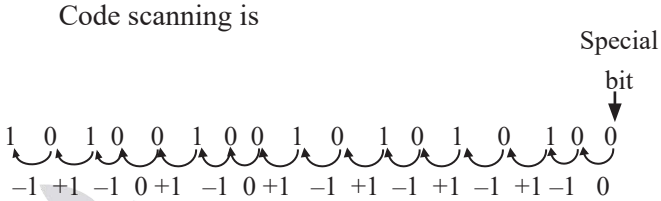
The total number of addition and subtraction operations to be performed is _____. (Answer in integer)

32. Ans: 13 (Range : 13 to 13)

Sol: Given multiplier (Q)

= 1010 0100 1010 1010

Code scanning is



Total additions = 6

Total subtractions = 7

13

33. int x = 126, y = 105;
do {
if(x>y) x=x-y;
else y=y-x;
} while(x!=y);
printf("%d",x);

The output of the given C code segment is _____. (Answer in integer)

33. Ans: 21 (Range : 21 to 21)

Sol: Initially x = 126, y = 105

After interation no	Value of x	Value of y	Checking x! = y
1	x = 21	y = 105	TRUE
2	x = 21	y = 84	TRUE
3	x = 21	y =63	TRUE
4	x = 21	y = 42	TRUE
5	x = 21	y = 21	FALSE

The value of x printed is 21.

34. In a 4-bit ripple counter, if the period of the waveform at the last flip-flop is 64 microseconds, then the frequency of the ripple counter in kHz is _____. (Answer in integer)

34. Ans: 250 (Range : 250 to 250)

Sol: In a 4 bit ripple counter, the frequency at the last flip-flop (f) = $\frac{f_i}{2^4} = \frac{f_i}{16} \rightarrow (1)$

[Here f_i = Input frequency]

Given time period [T] of the last flip-flop = 64μs

frequency (f) = $\frac{1}{T} = \frac{1}{64 \times 10^{-6}} \rightarrow (2)$

from (1) & (2)

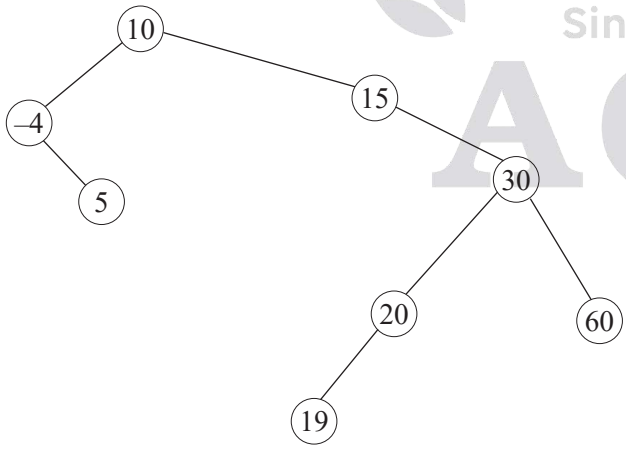
$\frac{f_i}{16} = \frac{1}{64 \times 10^{-6}} \Rightarrow f_i = 250 \times 10^3$ Hz

f_i = 250 KHz

35. Suppose the values 10,–4,15,30,20,5,60,19 are inserted in that order into an initially empty binary search tree. Let T be the resulting binary search tree. The number of edges in the path from the node containing 19 to the root node of T is _____. (Answer in integer)

35. Ans: 4 (Range: 4 to 4)

Sol: After inserting 10, –4, 15, 30, 20, 5, 60, 19 values into initially empty binary search true. We get final binary search tree is as follows.



The no. of edges in the path from the node containing 19 to the root node is 4.

36. Suppose we are transmitting frames between two nodes using Stop-and-Wait protocol. The frame size is 3000 bits. The transmission rate of the channel is 2000 bps (bits/second) and the propagation delay between the two nodes is 100 milliseconds. Assume that the processing times at the source and destination are negligible. Also, assume that the size of the acknowledgement packet is negligible. Which ONE of the following most accurately gives the channel utilization for the above scenario in percentage?

(a) 88.23 (b) 93.75

(c) 85.44 (d) 66.67

36. Ans: (a)

Sol: B = 2 kbps

L = 3000 bits

T_p = 100ms

η = ?

$T_x = \frac{L}{B} = \frac{3 \times 10^3}{2 \times 10^3} = 1500\text{ms}$

$a = \frac{T_p}{T_x} = \frac{100\text{ms}}{1500\text{ms}} = 0.066$

$\therefore \quad \eta = \frac{1}{1+2a}$

$= \frac{1}{1+2(0.066)} = \frac{1}{1.132}$

$= 88.33\%$

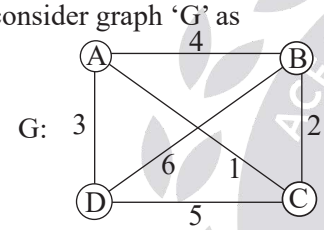
37. Let G be an edge-weighted undirected graph with positive edge weights. Suppose a positive constant α is added to the weight of every edge.
Which ONE of the following statements is TRUE about the minimum spanning trees (MSTs) and shortest paths (SPs) in G before and after the edge weight update?

(a) Every MST remains an MST, and every SP remains an SP.
(b) MSTs need not remain MSTs, and every SP remains an SP.
(c) Every MST remains an MST, and SPs need not remain SPs.
(d) MSTs need not remain MSTs, and SPs need not remain SPs.

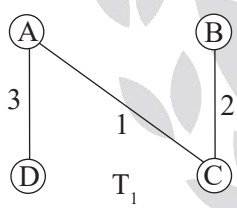
37. Ans: (c)

Sol: Given graph G is edge-weighted undirected graph with positive edge weights

Let us consider graph 'G' as

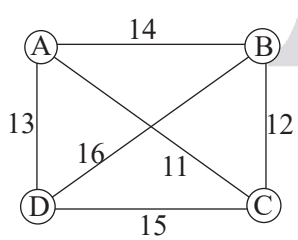


The minimum spanning tree of above graph is



Cost (MST) = 1 + 2 + 3 = 6 units

Let us suppose $\alpha = 10$ The graph 'G' becomes



In the graph 'G'. The shortest path b/w the nodes A,B is 3 units which consists the edges

(A)—(C)—(B), but

In the graph 'G', their shortest path is 14 units with edge (A)—(B)

Hence MST remains same, where shortest 'SP' need not be remains same.

38. A meld operation on two instances of a data structure combines them into one single instance of the same data structure. Consider the following data structures:

P: Unsorted doubly linked list with pointers to the head node and tail node of the list.
Q: Min-heap implemented using an array.
R: Binary Search Tree.

Which ONE of the following options gives the worst-case time complexities for meld operation on instances of size n of these data structures?

(a) P: $\Theta(1)$, Q: $\Theta(n)$, R: $\Theta(n)$
(b) P: $\Theta(1)$, Q: $\Theta(n \log n)$, R: $\Theta(n)$
(c) P: $\Theta(n)$, Q: $\Theta(n \log n)$, R: $\Theta(n^2)$
(d) P: $\Theta(1)$, Q: $\Theta(n)$, R: $\Theta(n \log n)$

38. Ans: (a)

Sol: (P) We can perform meld operation on two doubly linked lists by just updating tail node pointer of first doubly linked list so it takes Q(1).

(Q) By converting two min heap instances into a single array and then apply BUILD-Min heap algorithm which internally uses heapify procedure. In general heapify procedure takes logn time and total time nlogn but by using sum of heights of all nodes approach it takes $\theta(n)$ time.

(R) By applying in order traversal on two BST, we get elements in increasing order and then merge them into signle sorted risk takes $\theta(n)$ and construct BST with $\theta(n)$ time.

39. For a direct-mapped cache, 4 bits are used for the tag field and 12 bits are used to index into a cache block. The size of each cache block is one byte. Assume that there is no other information stored for each cache block.
Which ONE of the following is the CORRECT option for the sizes of the main memory and the cache memory in this system (byte addressable), respectively?
(a) 64 KB and 4 KB (b) 128 KB and 16 KB
(c) 64 KB and 8 KB (d) 128 KB and 6 KB

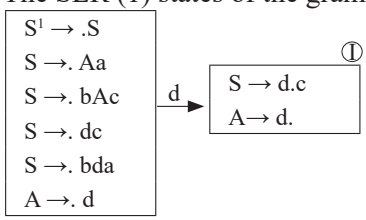
39. Ans: (a)

Sol: Type of mapping is Direct
Number of bits in the tag field = 4
Number of bits incache index = 12
One block size = one byte
Hence cache memory size = 2^{12} B
= 4 KB
and size of main memory = 2^{16} Bytes
= 64 KB

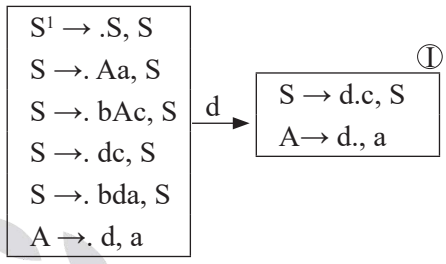
40. Given a Context-Free Grammar G as follows:
S → Aa | bAc | dc | bda
A → d
Which ONE of the following statements is TRUE?
(a) G is neither LALR(1) nor SLR(1)
(b) G is CLR(1), not LALR(1)
(c) G is LALR(1), not SLR(1)
(d) G is LALR(1), also SLR(1)

40. Ans: (c)

Sol: The SLR (1) states of the grammar is



state I is having shift-reduce conflict in SLR (1)
the LALR (1) states of the grammar is



state 'I' is not S-R conflict in LALR (1)
∴ Grammar is LALR (1) but not SLR (1).

41. An array A of length n with distinct elements is said to be bitonic if there is an index $1 \le i \le n$ such that A[1..i] is sorted in the non-decreasing order and A[i+1 ..n] is sorted in the non-increasing order.
Which ONE of the following represents the best possible asymptotic bound for the worst-case number of comparisons by an algorithm that searches for an element in a bitonic array A?
(a) Θ(n) (b) Θ(1)
(c) $\Theta(\log^2 n)$ (d) Θ(log n)

41. Ans: (d)

Sol: The peak (or maximum element) can be found using binary search.
If A[mid] > A[mid + 1] then peak towards the left otherwise peak towards the right.
1. Finding peak element: θ(logn)
2. Searching left half: θ(logn)
3. Searching right half : θ(logn)
The overal time complexity
= θ(logn + logn + logn)
= θ(logn)

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42. Let F be the set of all functions from {1,…,n} to {0,1}. Define the binary relation $\preccurlyeq$ on F as follows: $\forall f, g \in F$, $f \preccurlyeq g$ if and only if $\forall\ x \in \{1,...,n\}$, $f(x) \le g(x)$, where $0 \le 1$.

Which of the following statement(s) is/are TRUE?

(a) $\preccurlyeq$ is a symmetric relation

(b) $(F, \preccurlyeq)$ is a partial order

(c) $(F, \preccurlyeq)$ is a lattice

(d) $\preccurlyeq$ is an equivalence relation

42. Ans: (b & c)

Sol: Given 'F' be the set of all functions from {0, 1, 2,.... n) to {0, 1}

Hence total 2^n functions possible.

$\forall, f, g \in F$, $f \preccurlyeq g$ if and only if $\forall\ x$ {1, 2,....n}

$f(x) \le g(x)$, where $0 \le 1$

Reflexive:

$\forall\ f \in F$, we have $f(x) \le f(x)$

$\Rightarrow f \preccurlyeq f\ \forall\ f$

$\therefore$ $(F, \preccurlyeq)$ is Reflexive

Symmetric: Consider $f, g \in F$

Let $f \preccurlyeq g \Rightarrow f(x) \le g(x)$

But $g(x) \le f(x)$ Not possible

Means $g \not\preccurlyeq f$

$\therefore$ $(F, \preccurlyeq)$ is NOT symmetric.

Anti-symmetric: Consider $f, g, h \in F$

Let $f \preccurlyeq g$ and $g \preccurlyeq f$

$\Rightarrow f(x) \le g(x)$ and $g(x) \le f(x)$

$\Rightarrow f = g$

Hence $(f, \preccurlyeq)$ is Anti-symmetric

Transitive: Let $f, g, h \in F$.

consider $f \preccurlyeq g$ and $g \preccurlyeq h$

$\Rightarrow f(x) \le g(x)$ and $g(x) \le h(x)$

$\Rightarrow f(x) \le h(x)$

$\Rightarrow f \le h$

Hence $(F, \preccurlyeq)$ is Transitive.

Therefore $(F, \preccurlyeq)$ is Reflexive, Anti-symmetric and transitive.

Hence $(F, \preccurlyeq)$ is a POSET

In $(F, \preccurlyeq)$ Join and meet exists for every pair of elements.

Hence $(F, \preccurlyeq)$ is a Lattice.

43. Given the following Karnaugh Map for a Boolean function F(w, x, y, z):

wx \ yz				
	1	0	0	1
	0	1	1	0
	0	1	1	0
	1	0	0	1

Which one or more of the following Boolean expression(s) represent(s) F?

(a) $\bar{w}\,\bar{x}\,\bar{y}\,\bar{z} + w\,\bar{x}\,\bar{y}\,\bar{z} + \bar{w}\,\bar{x}yz + xz$

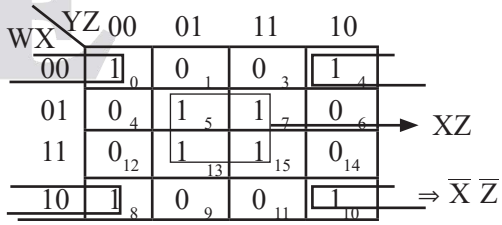
(b) $\bar{w}\,\bar{x}\,\bar{y}\,\bar{z} + \bar{w}\,\bar{x}\,y\,\bar{z} + w\,\bar{x}yz + xz$

(c) $\bar{w}\,\bar{x}\,\bar{y}\,\bar{z} + w\,\bar{x}\,\bar{y}\,\bar{z} + w\,\bar{x}\,\bar{y}z + xz$

(d) $\bar{x}\,\bar{z} + xz$

43. Ans: (a & d)

Sol: Given K-map



$F = \bar{X}\,\bar{Z} + X\,Z \rightarrow$ option (d)

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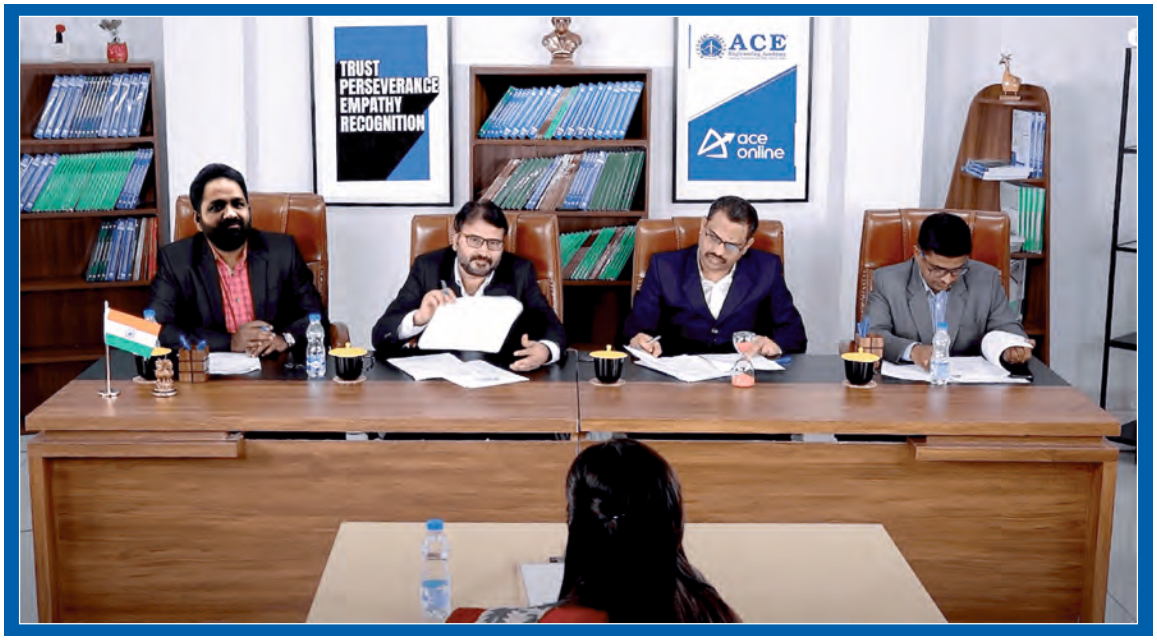

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Now convert $\overline{X}\,\overline{Z}$ into standard form

$F = (1)\,\overline{X}(1)\,\overline{Z} + X\,Z$

$(\overline{W} + W)\overline{X}(\overline{Y} + Y)\,\overline{Z} + XZ$

$F = \overline{W}\,\overline{X}\,\overline{Y}\,\overline{Z} + W\,\overline{X}\,\overline{Y}\,\overline{Z} + \overline{W}\,\overline{X}\,Y\,\overline{Z} + W\overline{X}\,Y\overline{Z} + XZ \rightarrow$ option(A)

44. Consider a system of linear equations PX = Q where $P \in \mathbb{R}^{3\times3}$ and $Q \in \mathbb{R}^{3\times1}$. Suppose P has an LU decomposition, P = LU, where

$$L = \begin{bmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{bmatrix} \text{ and } U = \begin{bmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{bmatrix}$$

Which of the following statement(s) is/are TRUE?

(a) The system PX = Q can be solved by first solving LY = Q and then UX = Y.

(b) If P is invertible, then both L and U are invertible.

(c) If P is singular, then at least one of the diagonal elements of U is zero.

(d) If P is symmetric, then both L and U are symmetric.

44. Ans: (a, b, c)

Sol: If P is symmetric then both L and U need not be symmetric.

45. Consider a stack data structure into which we can PUSH and POP records. Assume that each record pushed in the stack has a positive integer key and that all keys are distinct.

We wish to augment the stack data structure with an O (1) time MIN operation that returns a pointer to the record with smallest key present in the stack

1. without deleting the corresponding record, and
2. without increasing the complexities of the standard stack operations.

Which one or more of the following approach(es) can achieve it?

(a) Keep with every record in the stack, a pointer to the record with the smallest key below it.

(b) Keep a pointer to the record with the smallest key in the stack.

(c) Keep an auxiliary array in which the key values of the records in the stack are maintained in sorted order.

(d) Keep a Min-Heap in which the key values of the records in the stack are maintained.

45. Ans: (a)

Sol:

(a) Let's push elements into the stack and track the minimum value at each step. We keep an extra value (a pointer) with each element in the stack that tracks the minimum element seen sofar.

Data Structure Design:

Each element in the stack stores

1. The actual value pushed
2. The minimum value-seen upto that point (i.e., minimum value of all elements below it in the stack)

This ensures that we always have access to the minimum element at top of stack.

(b) It works only if smallest element never popped, when smallest element popped we need to recalculate minimum by scanning takes θ(n). Push takes 0(1) but pop takes 0(n).

(c) Maintaining a sorted requires insertion in 0(n) during push to maintain order pop also require searching the auxilary array to remove the element. But we need 0(1) time push and pop operation.

(d) A min heap supporting 0(1) Min operation but insertion and deletion takes 0(logn). But we need push, pop in 0(1) so this approach not an optimal.

46. Consider the following relational schema along with all the functional dependencies that hold on them.
R1(A, B, C, D, E): { D →E,EA→B,EB→C}
R2(A, B, C, D): { A→D,A→B,C→A}
Which of the following statement(s) is/are TRUE?
(a) R1 is in 3NF (b) R2 is in 3NF
(c) R1 is NOT in 3NF (d) R2 is NOT in 3NF

46. Ans: (c, d)

Sol: In R1 key is AD and D→E is partial FD therefore R_1 is in 1N. In R_2 key is C and A →D, A → B are transitive FD therefore R_2 is in 2NF but not in 3NF.

47. Consider a demand paging system with three frames, and the following page reference string: 1 2 3 4 5 4 1 6 4 5 1 3 2. The contents of the frames are as follows initially and after each reference (from left to right):

initially	after												
-	1*	2*	3*	4*	5*	4	1	6*	4	5	1*	3*	2*
-	1	1	1	1	1	1	1	6	6	6	6	6	2
-	-	2	2	4	4	4	4	4	4	4	1	1	1
-	-	-	3	3	5	5	5	5	5	5	5	3	3

The *-marked references cause page replacements. Which one or more of the following could be the page replacement policy/policies in use?
(a) Least Recently Used page replacement policy
(b) Least Frequently Used page replacement policy
(c) Most Frequently Used page replacement policy
(d) Optimal page replacement policy

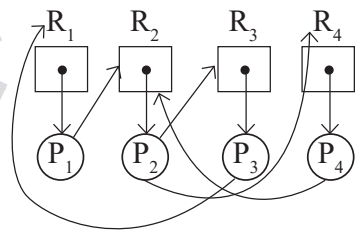
47. Ans: (d)

Sol: With Optimal Page Replacement algorithm only, the given access of Page reference string is possible. So, option (d) is correct.

48. $P = \{P_1, P_2, P_3, P_4\}$ consists of all active processes in an operating system.
$R = \{R_1, R_2, R_3, R_4\}$ consists of single instances of distinct types of resources in the system.
The resource allocation graph has the following assignment and claim edges.
Assignment edges: $R_1 \rightarrow P_1$, $R_2 \rightarrow P_2$, $R_3 \rightarrow P_3$, $R_4 \rightarrow P_4$ (the assignment edge $R_1 \rightarrow P_1$ means resource R_1 is assigned to process P_1, and so on for others)
Claim edges: $P_1 \rightarrow R_2$, $P_2 \rightarrow R_3$, $P_3 \rightarrow R_1$, $P_2 \rightarrow R_4$, $P_4 \rightarrow R_2$ (the claim edge $P_1 \rightarrow R_2$ means process P_1 is waiting for resource R_2, and so on for others)
Which of the following statement(s) is/are CORRECT?
(a) Aborting P_1 makes the system deadlock free.
(b) Aborting P_3 makes the system deadlock free.
(c) Aborting P_2 makes the system deadlock free.
(d) Aborting P_1 and P_4 makes the system deadlock free.

48. Ans: (c)

Sol:



If P1 and P4 got aborted, then, P3 gets finished. After that, P2 also gets finished. So that, System can be deadlock free. Hence, Option (d) is Correct.
If P2 got aborted, then, P1 gets finished. After that, P4 also gets finished. Atlast P3 too.
So, Option (c) is Correct.

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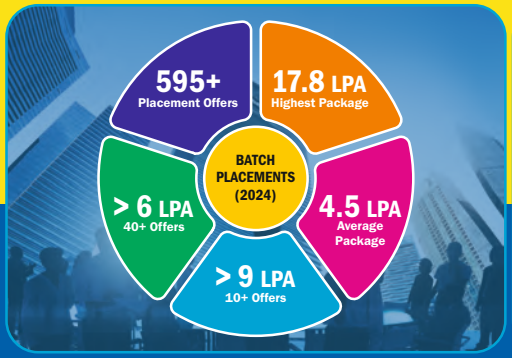

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49. Three floating point numbers X,Y, and Z are stored in three registers R_X, R_Y, and R_Z, respectively in IEEE 754 single precision format as given below in hexadecimal:

R_X = 0xC1100000, R_Y = 0x40C00000, and R_Z = 0x41400000

Which of the following option(s) is/are CORRECT?

(a) 4(X+Y) + Z = 0 (b) 2Y – Z = 0

(c) 4X + 3Z = 0 (d) X+Y+Z = 0

49. Ans: (a, b, c)

Sol: $R_X = C\ 1100000_{16}$

1	1 0 0 0 0 0 1 0	0 0 1 0 0 0 0 0....0
S	E	M

130–127

Value $= (-1)^1 * 1.0010000...0*2$

$= (-)\ 1001.00 * 2^0 = -9$

$R_Y = 40C00000_{16}$

0	1 0 0 0 0 0 0	1 0 0 0 0 0....0
S	E	M

129–127

Value $= (-1)^0 * 1.1000..0 * 2$

$= 110.0 \times 2^0 = 6$

$R_Z = 41400000_{16}$

0	1 0 0 0 0 0 0 1 0	1 0 0 0 0 0....0
S	E	M

130–127

Value $= (-1^0) * 1.10..0 \times 2$

$= 1100.0 \times 2^0 = 12$

Hence X = –9, Y = 6, Z = 12

(a) 4(X+Y) + Z = 0 TRUE

(b) 2Y – Z = 0 TRUE

(c) 4X + 3Z = 0 TRUE

(d) X+Y+Z = 0 False

Ans: a, b, c

50. Which of the following Boolean algebraic equation(s) is/are CORRECT?

(a) $\overline{A}\,B\,C + A\overline{B}\,\overline{C} + \overline{A}\,\overline{B}\,\overline{C} + A\overline{B}C + ABC = BC + \overline{B}\,\overline{C} + \overline{A}\,\overline{B}$

(b) $AB + \overline{A}C + BC = AB + \overline{A}\,C$

(c) $(A + C)(\overline{A} + B) = AB + \overline{A}C$

(d) $\overline{(A + \overline{B} + \overline{D})(C + D)(\overline{A} + C + D)(A + B + \overline{D})} = \overline{A}D + \overline{C}\,\overline{D}$

50. Ans: (b, c, d)

Sol: Option (A) L.H.S

$\overline{A}\,B\,C + A\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}\,\overline{C} + A\overline{B}\,C + AB\,C$

$BC[\overline{A} + A] + \overline{B}\,\overline{C}[A + \overline{A}] + A\overline{B}C$

$BC + \overline{B}\,\overline{C} + A\,\overline{B}\,C$

$BC + \overline{B}[\overline{C} + C\,A]\ [\because x + \overline{x}\,y = x + y]$

$BC + \overline{B}\,[\overline{C} + A]$

$BC + A\,\overline{B} + \overline{B}\,\overline{C}$ which is not equal to R.H.S hence option (A) is wrong

Option (b): L.H.S

$AB + \overline{A}\,C + BC$ [$\because$ using consensus theorem $xy + \overline{x}\,z + yz = xy + \overline{x}z$]

$= AB + \overline{A}C$ = R.H.S

2nd method.

$AB + \overline{A}C + (1)\,BC$

$AB + \overline{A}\,C + (\overline{A} + A)\,BC$

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

$AB[1 + C] + \overline{A}\,C[1 + B]$

$= AB + \overline{A}\,C$ = R.H.S hence option (b) is correct

Option (c) : L.H.S

$[A + C]\,[\overline{A} + B]$

$= A\overline{A} + AB + \overline{A}C + BC$

$= AB + \overline{A}C + BC$ $\left\{\because \text{using consensus theorem } xy + \overline{x}z + yz = xy + \overline{x}z\right\}$

$= AB + \overline{A}C \longrightarrow$ Option (c) is correct.

Option (d) L.H.S

$\overline{[A+\overline{B}+\overline{D}][C+D].[\overline{A}+C+D][A+B+\overline{D}]}$

$= \overline{[A+\overline{B}+D]} + \overline{[C+D]} + \overline{[\overline{A}+C+D]} + \overline{[A+B+\overline{D}]}$

$= \overline{A}.B.D + \overline{C}\,\overline{D} + A\overline{C}\,\overline{D} + \overline{A}\,\overline{B}\,D$

$= \overline{A}D[B+\overline{B}] + \overline{C}\,\overline{D}[1+A]$

$= \overline{A}D + \overline{C}\,\overline{D} \longrightarrow$ option(D) is correct

51. Consider two grammars G_1 and G_2 with the production rules given below:

G_1 : S → if E then S | if E then S else S| a

E → b

G_2 : S → if E then S | M

M → if E then M else S | c

E → b

where if , then, else, a, b, c are the terminals.

Which of the following option(s) is/are CORRECT?

(a) G_1 is not LL(1) and G_2 is LL(1).

(b) G_1 is LL(1) and G2 is not LL(1).

(c) G_1 and G_2 are not LL(1).

(d) G_1 and G_2 are ambiguous.

51. Ans: (c,d)

Sol: In S → if E then S | if E then S else S|a

First (if E then S) n first (if E then S else S) = {if}

therefore G_1 is not LL (1).

If G_2: S → if E then S|M

First (if E then S) n first (m) = {if}

therefore G_2 is not LL (1)

Both G_1 and G_2 are ambiguous grammar

52. Let Σ={a, b, c}. For x ∈Σ^*, and α∈Σ, let $\#_\alpha(x)$ denote the number of occurrences of α in x.

Which one or more of the following option(s) define(s) regular language(s)?

(a) $\{a^m b^n \mid m, n \geq 0\}$

(b) $\{a,b\}^* \cap \{a^m b^n c^{m-n} \mid m \geq n \geq 0\}$

(c) $\{w \mid w \in \{a,b\}^*, \#_a(w) \equiv 2 \pmod 7$, and $\#_b(w) \equiv 3 \pmod 9\}$

(d) $\{w \mid w \in \{a,b\}^*, \#_a(w) \equiv 2 \pmod 7$, and $\#_a(w) = \#_b(w)\}$

52. Ans: (a, c)

Sol: Option (a): $\{a^m b^n \mid m, n \geq 0\}$

it can be expressed as a^*b^* hence it is regular.

(c) $\{w \mid w \in \{a,b\}^*, \#_a(w) \equiv 2 \pmod 7$, and $\#_b(w) \equiv 3 \pmod 9\}$

We can design FA this language, it takes total of 7×9 states.

53. Consider the database transactions T1 and T2, and data items X and Y. Which of the schedule(s) is/are conflict serializable?

Transaction T1
R1(X)
W1(Y)
R1(X)
W1(X)
COMMIT(T1)

Transaction T2
W2(X)
W2(Y)
COMMIT(T2)

(a) R1(X), W2(X), W1(Y), W2(Y), R1(X), W1(X), COMMIT(T2), COMMIT(T1)

(b) W2(X), R1(X), W2(Y), W1(Y), R1(X), COMMIT(T2), W1(X), COMMIT(T1)

(c) R1(X), W1(Y), W2(X), W2(Y), R1(X), W1(X), COMMIT(T1), COMMIT(T2)

(d) W2(X), R1(X), W1(Y), W2(Y), R1(X), COMMIT(T2), W1(X), COMMIT(T1)

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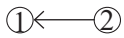
53. Ans: (b)

Sol: Precedence graph of option A 

Precedence graph of option B 

Precedence graph of option C 

Precedence graph of option D 

54. Consider the following relational schema:
Students (rollno: integer, name: string, age: integer, cgpa: real)
Courses (courseno: integer, cname: string, credits: integer)
Enrolled (rollno: integer, courseno: integer, grade: string)
Which of the following options is/are correct SQL query/queries to retrieve the names of the students enrolled in course number (i.e., courseno) 1470?

(a)
```
SELECT S.name
FROM Students S
WHERE EXISTS (SELECT * FROM Enrolled E
                WHERE E.courseno = 1470
                    AND E.rollno = S.rollno);
```

(b)
```
SELECT S.name
FROM Students S
WHERE SIZEOF (SELECT * FROM Enrolled E
                WHERE E.courseno = 1470
                    AND E.rollno = S.rollno) > 0;
```

(c)
```
SELECT S.name
FROM Students S
WHERE 0 < (SELECT COUNT(*)
            FROM Enrolled E
                WHERE E.courseno = 1470
                    AND E.rollno = S.rollno);
```

(d)
```
SELECT S.name
FROM Students S NATURAL JOIN Enrolled E
WHERE E.courseno = 1470;
```

54. Ans: (a, c, d)

Sol: Option A,C are correlated sub query and option D is join query and all A, C, D returns the name of the students enrolled in course number 1470.

55. Given a computing system with two levels of cache (L1 and L2) and a main memory. The first level (L1) cache access time is 1 nanosecond (ns) and the "hit rate" for L1 cache is 90% while the processor is accessing the data from L1 cache. Whereas, for the second level (L2) cache, the "hit rate" is 80% and the "miss penalty" for transferring data from L2 cache to L1 cache is 10 ns. The "miss penalty" for the data to be transferred from main memory to L2 cache is 100 ns.

Then the average memory access time in this system in nanoseconds is _____ . (rounded off to one decimal place)

55. Ans: 4.0 (Range : 4.0 to 4.0)

Sol: $T_{L_1} = 1ns, H_{L_1} = 90\%$

$H_{L_2} = 80\%, T_{L_2} = 10$ ns

$H_{mm} = 100\%, T_{mm} = 100$ ns

AmAT = Connection is serial

$(H_{L_1} * T_{L_1}) + (1-H_{L_1}) * H_{L_2} * (T_{L_2} + T_{L_1})$

$+ (1-H_{L_1}) * (1-H_{L_2}) * (T_{mm} + T_{L_2} + T_{L_3})$

CPU ⟷ L_1 ⟷ L_2 ⟷ MM

$= (0.9)^{ns} + (0.1 * 0.8 * 11 ns) + (0.1) * (0.2) * 111$ ns

$= 0.9$ ns $+ 0.88$ ns $+ 2.22$ ns

$= 4$ ns Ans: 4.0

56. A 5-stage instruction pipeline has stage delays of 180, 250, 150, 170, and 250, respectively, in nanoseconds. The delay of an inter-stage latch is 10 nanoseconds. Assume that there are no pipeline stalls due to branches and other hazards. The time taken to process 1000 instructions in microseconds is _____ . (rounded off to two decimal places)

56. Ans: 261.04 (Range: 260.20 to 261.20)

Sol: K = 5, n = 1000

Tseg = (250 + 10)ns = 260 ns

t_p/program = (K + n –1) * Tseg

= 261040 ns = 261.04 ns

57. In a B+- tree where each node can hold at most four key values, a root to leaf path consists of the following nodes:

A = (49, 77, 83, –), B = (7, 19, 33, 44), C = (20*, 22*, 25*, 26*)

The *-marked keys signify that these are data entries in a leaf.

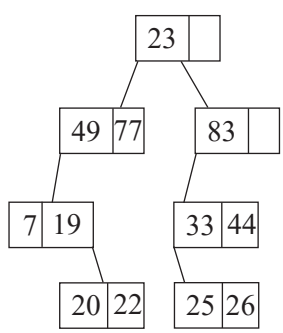
Assume that a pointer between keys K_1 and K_2 points to a subtree containing keys in $[K_1,K_2)$, and that when a leaf is created, the smallest key in it is copied up into its parent.

A record with key value 23 is inserted into the B+-tree.

The smallest key value in the parent of the leaf that contains 25* is _____. (Answer in integer)

57. Ans: 33 (Range: (33 to 33)

Sol:



In the resultant tree after inserting key 23 is the smallest parent of the leaf that contains 25 is 33.

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Bharath S. R. A
AIR-10 (IN)

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& MANY MORE...

TOTAL 206 SELECTIONS IN TOP 100

EC: 37 | EE: 49 | CE: 18 | ES: 4 | ME: 35 | XE: 8
PI: 24 | CS:8 | DA:3 | BM:1 | NM:1 | IN: 18

58. A computer system supports a logical address space of 2^{32} bytes. It uses two-level hierarchical paging with a page size of 4096 bytes. A logical address is divided into a b-bit index to the outer page table, an offset within the page of the inner page table, and an offset within the desired page. Each entry of the inner page table uses eight bytes. All the pages in the system have the same size.
The value of b is _____. (Answer in integer)

58. Ans: 9 (Range: 11 to 11)

Sol: LA = 32 bits
PS = 4096 Bytes = 2^{12} B
e = 8 Bytes
$\therefore$ LAS = 2^{32} B = $2^{11} \times 2^9 \times 2^{12}$ B
As per question, 2-level paging is used.

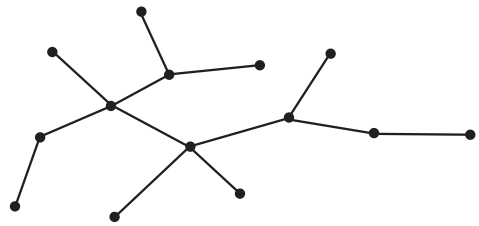
$\Rightarrow$ LA = 32 $\left[\frac{P(20)}{d(12)}\right]$ $\left[\frac{P_1(11)}{P_2(9)}\right]$ $\rightarrow$ index to the OPT.

No. of entries in one page of IPT

$= \frac{PS}{e} = \frac{2^{12}}{2^3} = 2^9 \Rightarrow P_2 = 9$

59. Consider the following algorithm someAlgo that takes an undirected graph G as input.
someAlgo(G)
1. Let v be any vertex in G. Run BFS on G starting at v. Let u be a vertex in G at maximum distance from v as given by the BFS.
2. Run BFS on G again with u as the starting vertex. Let z be the vertex at maximum distance from u as given by the BFS.
3. Output the distance between u and z in G.

The output of someAlgo(T) for the tree shown in the given figure is _____. (Answer in integer)



59. Ans: 6 (Range: 6 to 6)

Sol: Step-1: If u be a vertex in G at maximum distance from 'v' as given by BFS then 'u' must be a mode whose adjacent nodes have already been visited and 'u' will have degree is 1.
Step-2: If we again start BFS on 'u' and reaching farthest node 'z' then the distance between u and z is called diameter of the graph. Hence diagnometer of this graph = 6.

60. Let $\Sigma=\{1,2,3,4\}$. For $x \in \Sigma^*$, let prod(x) be the product of symbols in x modulo 7. We take prod(ϵ)=1, where ϵ is the null string.
For example, prod(124)=(1×2×4) mod 7=1.
Define $L=\{x \in \Sigma^* \mid prod(x)=2\}$.
The number of states in a minimum state DFA for L is _____. (Answer in integer)

60. Ans: 6 (Range: 6 to 6)

Sol: As per the data
Prod (ε) = 1 where is null string
Prod (124) = (1×2×4) mod 7 = 1
prod(x) be the product of the symbols in
x modulo 7 & x ε $\sum^*$ = {1,2,3,4}*
i.e x is obtained by product of 1,2,3,4 value
Using only multiplication, it's not possible to get a product of 7. i.e., we cannot get x module 7 = 0
Possible modulo 7 values {1,2,3,4,5,6}
therefore minimum state DFA required only 6 states.

61. An application executes 6.4×10^8 number of instructions in 6.3 seconds. There are four types of instructions, the details of which are given in the table. The duration of a clock cycle in nanoseconds is _____. (rounded off to one decimal place)

Instruction type	Clock cycles required per instruction (CPI)	Number of instructions executed
Branch	2	2.25×10^8
load	5	1.20×10^8
Store	4	1.65×10^8
Arithmetic	3	1.30×10^8

61. Ans: 3.0 (Range: 3.0 to 3.0)

Sol: Number of instructions = $6.4 * 10^8$
time taken = 6.3 second
Total number of clocks needed for
Branch Instructions = 4.5×10^8
Load instructions = 6×10^8
Store instructions = 6.6×10^8
Arith metic Instructions = 3.9×10^8
Hence program execution requires $21 * 10^8$ clocks
Total time needed is 6.3 seconds = 6.3×10^9 ns
$= 63 \times 10^8$ ns
Hence each clock cycle time

$$= \frac{63\times10^8 \text{ns}}{21 * 10^8} = 3 \text{ ns}$$

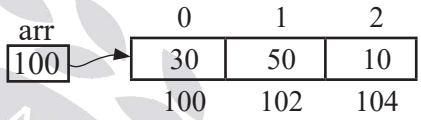
62. Consider the following C program:

```
#include <stdio.h>
int main(){
    int a;
    int arr[5] = {30,50,10};
    int *ptr;
    ptr = &arr[0] + 1;
    a = *ptr;
    (*ptr)++;
    ptr++;
    printf("%d", a + (*ptr) + arr[1]);
    return 0;
}
```

The output of the above program is _____. (Answer in integer)

62. Ans: 111 (Range: 111 to 111)

Sol: **Step-1:**



Step-2:
ptr = &arr[0] + 1
ptr = 100 + (1×2)
ptr = 102 // ptr is pointing to 102

Step-3:
a = *ptr // content at 102 address copied into 'a' hence a becomes 50

Step-4:
(*ptr)++ // Since ptr pointing to 102 so (*ptr)++ will update 50 as 51 hence content at 102 becomes 51

Step-5:
ptr++ // ptr is pointing to 104

Step-6:

Printf ("%d", a + (*ptr) + arr [1])
50 + 10 + 51 = 111

Finally output = 111

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TOTAL 36 SELECTIONS IN TOP 10

CE: 09 | ME: 10 | EE: 08 | E&T: 09

63. Consider the following C program:

```
#include <stdio.h>
int g(int n) {
    return (n+10);
}
int f(int n) {
     return g(n*2);
}
int main() {
    int sum, n;
    sum=0;
    for (n=1; n<3; n++)
        sum += g(f(n));
   printf ("%d", sum);
   return 0;
}
```

The output of the given C program is _____. (Answer in integer)

63. Ans: 46 (Range: 46 to 46)

Sol: $\text{Sum} = \text{Sum} + \sum_{n=1}^{2} g(f(n))$

$\text{Sum} = \text{Sum} + g(f(1)) + g(f(2))$

$= \text{Sum} + g(g(2)) + g(g(4))$

$= \text{Sum} + g(12) + g(14)$

$\text{Sum} = 0 + 22 + 24 \quad (\because \text{Sum} = 0)$

$\text{Sum} = 46$

$\therefore$ Output = 46

64. A quadratic polynomial $(x-\alpha)(x-\beta)$ over complex numbers is said to be square invariant if $(x-\alpha)(x-\beta)=(x-\alpha^2)(x-\beta^2)$. Suppose from the set of all square invariant quadratic polynomials we choose one at random.

The probability that the roots of the chosen polynomial are equal is _____. (rounded off to one decimal place)

64. Ans: 0.5 (Range: 0.5 to 0.5)

Sol: The values of α, β which satisfy the square invariance are $\{(0,0), (1,1), (0,1), (1,0), (w,w^2), (w^2,w)\}$

where w is cube root of unity.

when $\alpha = 0$, $\beta = 0$ the square invariant quadratic polynomial is $x^2 = x^2$

When $\alpha = 0$, $\beta = 1$ the square invariant quadratic polynomial is

$x(x-1) = x(x-1^2)$

$x^2 - x = x^2 - x$

when $\alpha = 1$, $\beta = 0$ the square invariant quadratic polynomial is

$(x-1)x = (x-1^2)(x)$

$x^2 - x = x^2 - x$

when $\alpha = 1$, $\beta = 1$ the square invariant quadratic polynomial is

$(x-1)(x-1) = (x-1^2)(x-1^2)$

$x^2 - 2x + 1 = x^2 - 2x + 1$

when $\alpha = w$, $\beta = w^2$ the square invariant quadratic polynomial is

$(x-w)(x-w^2) = (x-w^2)(x-w^4)$

$w^4 = w$

$\Rightarrow$ $(x-w)(x-w^2) = (x-w^2)(x-w)$

When $\alpha = w^2$, $\beta = w$ the square invariant quadratic polynomial is

$(x-w^2)(x-w) = (x-w^4)(x-w^2)$

$(x-w^2)(x-w) = (x-w)(x-w^2)$

We got 4 distinct square invariance polynomial

There are two favourable cases in which we have equal roots $\{(0, 0), (1, 1)\}$

The probability that the roots of the chosen polynomial are equal is $= \frac{2}{4} = 0.5$

65. The unit interval (0,1) is divided at a point chosen uniformly distributed over (0,1) in $\mathbb{R}$ into two disjoint subintervals.
The expected length of the subinterval that contains 0.4 is _____. (rounded off to two decimal places)

65. Ans: 0.74 (Range: 0.70 to 0.80)

Sol: Let x be the point which is uniformly chosen over (0, 1).

For $x > 0.4$, the sub interval is (0, x) which contains 0.4 and the sub interval length is x

For $x < 0.4$, the sub interval which contains 0.4 is (x, 1) and the sub interval length is (1 – x)

$p(x > 0.4) = 0.6$ and $p(x < 0.4) = 0.4$

the expected length of the subinterval that contains 0.4 is $= E[x|\, x > 0.4]\, p(x > 0.4| + E\,[1–x|\, x < 0.4]\, p(x < 0.4)$

$$E[x \mid x > 0.4] = \frac{0.4+1}{2} = 0.7$$

$$E[1-x \mid x < 0.4] = \frac{0.6+1}{2} = 0.8$$

the expected length of the subinterval that contains 0.4 is $(0.7)(0.6) + (0.8)(0.4) = 0.74$

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