

Entrance Test for

00814

Ph.D. (Computer Science) Programme - 2016

Time : 3 hours

Maximum Marks : 100

Note :

- (i) Question paper is comprised of two sections, namely A and B.
- (ii) Both section A and B are compulsory.
- (iii) Each section is of 50 marks.
- (iv) All questions in both sections are compulsory.
- (v) Use of scientific calculator/any calculator is allowed.
- (vi) Section A : Comprised of Research Methodology based subjective questions.
- (vii) Section B : Comprised of subject specific (computer science) objective type question.
 - For each correct answer 1 mark will be awarded.
 - For each wrong answer 0.25 mark will be deducted
 - Only one correct answer amongst the options should be marked.

SECTION - A

1. Write the Matrix Multiplication algorithm using Dynamic Programming. Given a chain of four matrices A_1, A_2, A_3 and A_4 with $p_0=5, p_1=4, p_2=6, p_3=2$ and $p_4=7$. Find $m [1, 4]$; using matrix multiplication algorithm through dynamic programming. **4+6=10**

OR

Let us assume that a Read - Write (R/W) head of a CD (Compact Disk) player is at a distance 'r' from the axis of rotation. It rotates in anticlockwise direction, with angular velocity ' ω ', to read the data on disk. Say at any time 'T' it subtends an angle ' θ ', to the horizontal axis and positioned at point $P(x_1, y_1)$. After time ΔT its new position is $Q(x_2, y_2)$, where it subtends angle $(\theta + \Delta\theta)$ to the horizontal axis. Draw a Diagram for the situation mentioned above, use it to determine the system of equations. Use the system of equations to derive the transformation matrix. Use homogeneous system of coordinates and extend your derivation of transformation matrix to 3 - D system of coordinates and write transformation matrix when rotations are applied w.r.t x, y and z axis.

2. What are sparse matrices ? Discuss the techniques to manage the data in sparse matrix, with suitable example. How the identified technique contributes to efficiency ? **5**
3. Two hundred randomly selected adults were asked whether the use of "Whatsapp" is primarily entertaining, educational or waste of time (only one answer could be chosen). The respondents were categorized by gender. Responses are given below (Given critical value of $\lambda^2=5.99$ at $\alpha=0.05$ and $df=2$) **10**

Opinion → Gender ↓	Entertaining	Educational	Waste of Time	Total
FEMALE	52	28	30	110
MALE	28	12	50	90
TOTAL	80	40	80	200

Is this evidence convincing that there is a relationship between gender and opinion in the population interest ?

OR

Performance of ten software applications are tested and ranked by using three testing tools the ranking data is as follows :

Software App Tool ↙	1	2	3	4	5	6	7	8	9	10
1	1	6	5	10	3	2	4	9	7	8
2	3	5	8	4	7	10	2	1	6	9
3	6	4	9	8	1	2	3	10	5	7

Determine which pair of testing tools has the nearest approach in command to rank the performance of software application.

4. Descriptive statistics of the data of the profits of 100 call centers from two different regions is given below : 5

Region I: \bar{X} = 16.62, Mode = 18.47, σ = 3.04
(mean) (standard deviation)

Region II: \bar{X} = 45.56, Mode = 36.94, σ = 17.71
(mean) (standard deviation)

Calculate coefficient of skewness and analyse the results. Based on the above analysis answer the following :

- (a) What is the polarity of skewness for region I and II respectively ?
- (b) In which region, greater concentration is towards higher profits ?
- (c) In which region, greater concentration is towards lower profits ?
- (d) Earning of profit in which region is more skewed ?
5. (a) An opaque pot contains 5 red and 4 blue balls. Two balls are withdrawn from the pot (without replacement). What is the probability that : 3+2=5
- (i) the two balls that are drawn are of the same colour
- (ii) both the balls are of different colours
- (b) Two fair dices are rolled simultaneously. Find the conditional probability that sum of the scores of the dices will be exactly 7 given that the sum of the throw is odd number.
6. (a) Differentiate between discrete random variable and continuous random variables in the context of probability distribution. 2+3=5
- (b) A fair coin is tossed 4 times. Draw the probability distribution of getting heads in the tosses.
7. Explain the term "stratified sampling". A car company wants to conduct a survey on popular localities about colour of cars owned by people. How will they create stratified sample ? Explain. 5
8. Explain the following with the help of an example of each in the context of statistical testing : 5
- (a) NULL hypothesis (b) Level of significance
- (c) Degrees of freedom (d) One - tailed test
- (e) Type - z errors

SECTION - B

1. Well known database system that use the network database model is :
 - (1) IBM information management system.
 - (2) Interbase
 - (3) Integrated Database Management system
 - (4) Mimer SQL

2. _____ protocol impose restrictions on the order in which items are accessed, and can thereby ensure serializability without requiring the use of two - phase locking and can additionally ensure dead lock freedom.
 - (1) Locking
 - (2) Strict two - phase
 - (3) Time stamp - ordering
 - (4) Graph - based

3. Transactions are required to have the ACID properties. The property that ensures all the effects of a transactions are reflected in the database, or none are reflected is :
 - (1) Atomicity
 - (2) Consistency
 - (3) Isolation
 - (4) Durability

4. We use heuristics to reduce the number of plans considered and thereby to reduce the cost of query evaluation. Heuristic rule(s) for transforming relational algebra queries include.
 - (1) Perform selection operations as early as possible
 - (2) Perform projections early
 - (3) Avoid cartesian products
 - (4) All of the above

5. _____ is an abstraction in which relationship sets are treated as higher level entity sets, and can participate in relationships.
 - (1) Specialization
 - (2) Generalization
 - (3) Association
 - (4) Aggregation

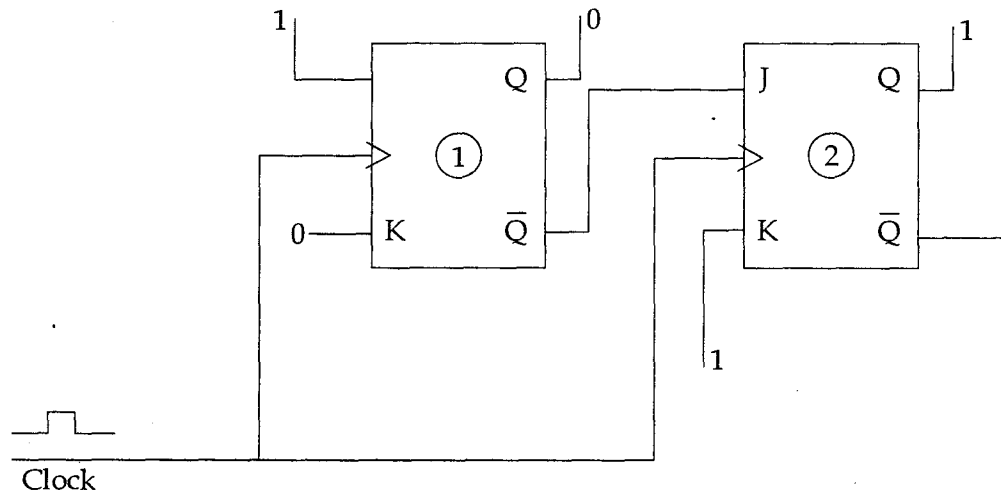
6. Banker's Algorithm implements a _____ policy.
 - (1) Deadlock characterization
 - (2) Deadlock Avoidance
 - (3) Deadlock Prevention
 - (4) Deadlock Detection

7. _____ is the coincidence of high page traffic and low CPU utilization in operating systems.
 - (1) Page fault
 - (2) Disk striping
 - (3) Thrashing
 - (4) Race condition

8. In scheduling, the average no. of jobs or processes completed by a server in one unit of time is called :
 - (1) Weighted turn around time
 - (2) Turn around time
 - (3) Response time
 - (4) Throughput

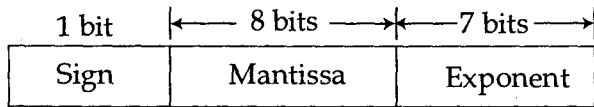
9. A separate _____ is provided on the client side for each remote procedure in RPC.
- (1) Process identifier (2) Controller
(3) Stub (4) Name convention
10. In the Bakery algorithm to solve the critical section problem.
- (1) Each process receives a number (may or may not be unique) and the one with the lowest number is served next.
(2) Each process is put into a queue and picked up in an ordered manner.
(3) Each process gets a unique number and the one with the highest value is served next.
(4) Each process gets a unique number and the one with the lowest value is served next.
11. Using the extended Euclidean Algorithm, find out the multiplicative inverse of 1234 mod 4321.
- (1) 3239 (2) 3237
(3) 3217 (4) There is no multiplicative inverse in this case
12. Which of the following reason is correct to support the statement that AES "f function" is better than DES "f function" ?
- (1) It has mix column step where the different bytes interact with each other.
(2) It has wholesale swapping of row or columns.
(3) It has Byte sub step to contribute non-linearity.
(4) It has shift row step to permute the bytes.
13. Select the primitive operations given below which are used in RC4 algorithm.
- (i) XOR operation (ii) Data - dependent rotations
(iii) Round function (iv) Modulo operation
(v) Byte swapping
- (1) Only (i) and (ii) (2) Only (ii), (iii) and (iv)
(3) Only (i), (iv) and (v) (4) Only (i), (ii) and (v)
14. Determine the Euler's Tatient Function $\phi(37)$ and $\phi(35)$.
- (1) 36 and 24 (2) 0 and 2 (3) 36 and 2 (4) 36 and 34
15. If a bit error occurs in the transmission of cipher - text character in 8 bit CFB (Cipher Feedback) mode, how far does the error propogate ?
- (1) 4 characters (2) 8 characters
(3) 9 characters (4) 10 characters
16. Assume the peak voltage value of a signal is 20 times the peak voltage of the noise. Calculate the SNR_{dB} .
- (1) 21.29 (2) 400 (3) 20 (4) 26.02

17. Find out the number of invalid (unused) code sequences '5B/6B encoding' can have ?
 (1) 24 (2) 32 (3) 48 (4) 64
18. An IPv4 datagram is carrying 1024 bytes of data. If there is no option information, what should be the value of the 'Header Length Field' and the value of 'Total Length Field'.
- (1) Header length field = 20 and Total length field = 1048.
 (2) Header length field = 10 and Total length field = 1048.
 (3) Header length field = 20 and Total length field = 1044.
 (4) Header length field = 05 and Total length field = 1048.
19. What is baud rate of the standard 10 - mbps Ethernet ?
 (1) 1 megabaud (2) 2 megabaud (3) 10 megabaud (4) 20 megabaud
20. In context of TCP, to make the initial sequence number (a random number); most systems start the counter at 1 during bootstrap and increment the counter by 64,000 every 0.5 second. How long does it take for the counter to wrap around ?
 (1) 128000 seconds (2) 232533 seconds
 (3) 1000000 seconds (4) 33554 seconds
21. What will be the expression of optimised function represented by :
 $F(A, B, C, D) = \Sigma(1, 2, 8, 9, 10, 11)$
- (1) $\bar{A}B + AD$ (2) $A\bar{B} + \bar{A}B\bar{D}$ (3) $A\bar{B} + \bar{A}D$ (4) $A\bar{B} + \bar{B}D$
22. What would be the next state of following circuit. Assume that flip-flop 1 is in Reset/clear (0) state and flip-flop 2 is in set state (1). The J-K flip-flops are used, and state is represented as the state bits flip flop 1 and then of flip - flop2.



- (1) 00 (2) 01 (3) 10 (4) 11

23. Assume the following binary floating point number representation.

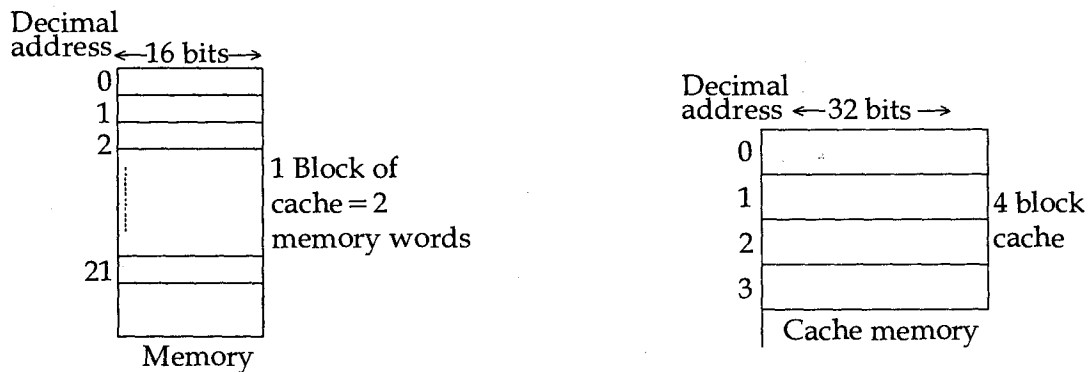


- Sign bit is for mantissa
- Exponent is biased exponent having a bias of 64
- Mantissa is a fractional normalised mantissa
- Zero is not represented a in this system.

Represent (-0.11×2^{-12}) using this representation.

- | | |
|--------------------------|--------------------------|
| (1) 1 1110 0000 011 0000 | (2) 1 1100 0000 011 0110 |
| (3) 1 1100 0000 011 0100 | (4) 1 1000 0000 011 0010 |

24. Assume the following memory and cache organisation.



Assume that the content of memory word 21 is also in the cache, what would be the cache block number in which memory word 21 is located, if direct main - memory to cache mapping scheme is used.

- | | | | |
|-------------|-------------|-------------|-------------|
| (1) Block 0 | (2) Block 1 | (3) Block 2 | (4) Block 3 |
|-------------|-------------|-------------|-------------|

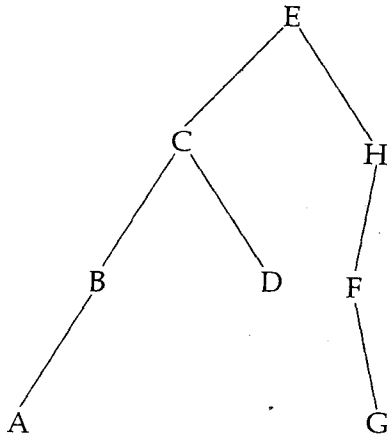
25. A machine uses stack for subroutine call as well as for passing parameters. It uses 16 bit registers and byte addressible RAM. Assume that stack is to be made in memory only and only one parameter of 8 bits is to be passed. Also assume that the return address is 32 bit long and no other register is saved. What would be the position of parameter from the stack top, if control has moved to the subroutine : (SP represents stack pointer and points to top of stack)

- | | | | |
|--------|------------|------------|------------|
| (1) SP | (2) SP - 2 | (3) SP - 4 | (4) SP - 6 |
|--------|------------|------------|------------|

26. The maximum number of nodes on level i of a Binary Tree is _____. The level of a Binary Tree is ≥ 1 .

- (1) 2^{i-1} (2) $2^i - 1$ (3) 2^i (4) i^2

27. What are the expected number of comparisons required to find a node chosen at random in the following Binary Search Tree.



- (1) 6 (2) 2 (3) 4.35 (4) 2.75

28. In a lower Triangular Matrix, the maximum number of non-zero terms in row i ($i \geq 1$) is _____.

- (1) i^2 (2) $i - 1$ (3) i (4) $i + 1$

29. Any algorithm which sorts by comparisons only must have a worst case computing time of atleast _____ where n is number of elements.

- (1) $O(n^2)$ (2) $O(n \log n)$ (3) $O(n)$ (4) $O(\log n)$

30. All connected undirected Graphs with _____ edges are trees where ' n ' is the number of vertices.

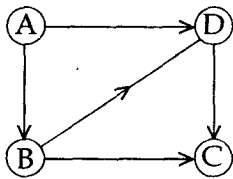
- (1) n (2) $n - 1$ (3) n^2 (4) $n + 1$

31. Grammar of odd palindromes over $\Sigma = \{a, b\}$ is :
- (1) $S \rightarrow asa|bsb|\wedge$ (2) $S \rightarrow asa|bsb|a|b|\wedge$
(3) $S \rightarrow aas|bbs|\wedge$ (4) $S \rightarrow aas|bbs|a|b|\wedge$
32. As per chomsky classification of grammar, Type-2 grammar addresses :
- (1) Context Sensitive Grammar (2) Regular Grammar
(3) Context Free Grammar (4) Irregular Grammar
33. Regular expression to describe the language $L = \{\wedge a, a, bb, abbbb, \dots\}$
- (1) $\wedge + a(bb)^*$ (2) $a(bb)^*$ (3) $\wedge + a^*(bb)^*$ (4) $\wedge + a^*bb^*$
34. Every context sensitive language is Turing decidable :
- (1) always true (2) always false
(3) sometimes true (4) sometimes false
35. Each regular language is context-free language but converse need not be true.
- (1) always true (2) always false
(3) sometimes true (4) sometimes false
36. Conjunctive Normal form (CNF) expression for $D \rightarrow (A \rightarrow (B \wedge C))$ is :
- (1) $((\sim D \vee \sim A \vee B) \wedge (\sim D \vee \sim A \vee C))$
(2) $((\sim D \wedge \sim A \vee B) \vee (\sim D \wedge \sim A \wedge C))$
(3) $((D \vee A \vee \sim B) \wedge (\sim D \vee A \vee \sim C))$
(4) $((D \wedge A \wedge \sim B) \vee (D \wedge A \wedge \sim C))$
37. Demorgan's laws for Predicate logic involves :
- (1) Operators (2) Quantifier
(3) Both (1) and (2) (4) Sometimes (1) and sometimes (2)
38. $\frac{P \rightarrow Q, P}{Q}$ refers to which inference rule ?
- (1) Modus Ponens (2) Modus Tollens
(3) Syllogism (4) Disjunctive syllogism
39. Semantic Networks are also known as :
- (1) Associative Network (2) Neural Network
(3) Recursive Transition Network (4) Augmented Networks

40. Unification is a process in which there is :

- (1) Any substitution that makes two or more expression equal
- (2) Any substitution that makes exactly two expression equal
- (3) Any substitution that makes unequal expressions
- (4) either (1) or (2)

41. Which of the following is a valid topological sorting of the given graph ?



- (1) ABCD
- (2) BACD
- (3) BADC
- (4) ABDC

42. Apply the Greedy Algorithm to solve Knapsack problem to find the optimal solution for the following problem : There are five objects. For every object weight and value are given as shown in the table below : The maximum capacity of Knapsack is 60 kg.

Objects	Wi (weight)	Vi (Value)
Object 1	5 kg	₹ 30
Object 2	10 kg	₹ 20
Object 3	20 kg	₹ 100
Object 4	30 kg	₹ 90
Object 5	40 kg	₹ 160

- (1) ₹ 250
- (2) ₹ 260
- (3) ₹ 270
- (4) ₹ 290

43. Total number of comparisons made in Quicksort for sorting a file of size n is :

- (1) $O(n \log n)$
- (2) $O(n^2)$
- (3) $O(n)$
- (4) None of the above

44. What is the chromatic number of the complete bipartite graph $K_{0,3,4}$?
- (1) 2 (2) 3 (3) 4 (4) 5
45. The problems 3 - SAT and 2 - SAT are :
- (1) both are in P
(2) both are NP complete
(3) NP complete and in P respectively
(4) Undecidable and NP-complete respectively
46. Which of the following sentence is **not** true ?
- (1) A class serves as a blueprint or a plan.
(2) By defining a class objects are created.
(3) Using inheritance new class can be built on top of the old class.
(4) Object oriented applications are built from reusable software components.
47. What is **not** true about inline function ?
- (1) Function must be declared inline before calling.
(2) It is a function whose body is substituted at place of its call.
(3) It saves the execution time.
(4) It does not effect the code size of the program.
48. While using array in Java which exception should be handled to avoid error in access the array elements ?
- (1) Array Index Out of Bound Exception
(2) Array Out of Bound Exception
(3) Array Access Out of Bound Exception
(4) Array Read Out of Bound Exception

49. Which statement is **not** true about multithreaded programming in Java ?
- (1) A synchronized method can be run for a particular object or class by only one thread at a time.
 - (2) Deadlock can occur when all threads are in blocked state.
 - (3) A thread can be created by implementing Runnable Interface, which is having only one method run.
 - (4) There is no method available to set the priority of a thread.
50. What is true about XML ?
- (1) XML enables the programmer to create any tag they want to have.
 - (2) Very specific document processor is used to create and maintain XML.
 - (3) XML does not allow a programmer to define any attribute for any opening tag.
 - (4) SAX (Simple API for XML) parser process the contents of an XML file parallaly.

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