Masters of Computer Applications

MCAC303: Automata Theory

Marks=10 **SET-1** **Duration: 30 Minutes**

Consider $\Sigma = \{a, b\}$. Construct regular expressions and corresponding finite automata (FAs) for the languages described below:

- all the strings of non-zero length where each '*b*' is immediately preceded by '*a*'
- all the even length strings having *a* at second position and ending with '*a*'

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Subject:- MCAC304: Operating Systems

Time: One Hour **Max. Marks: 15**

Note: All questions are compulsory. Question no. 6 carries 5 marks, each question from 1 to 5 carries 2 marks.

Q1. Explain different ways to identify that particular statements are in the parent process or in the child process.

Q2. Discuss process groups related to system calls which do not handle errors.

Q3. Explain race condition with the help of `count` variable used in producer and consumer problem.

Q4. Discuss `signal()` system call for signal handling.

Q 5. What will be the output of the following code segment? Justify your answer.

```
int main() {
        printf("University of Delhi.\n");
        fork();
        fork();
        printf("MCA 3rd sem.\n");
        fork();
        printf("Operating Systems.\n");
        return 0; }
```

Q 6. What is process suspension. Discuss system calls with signature for process suspension.

Department of Computer Science
University of Delhi
MCAO 302: Data Mining (CIA-I)

Time: 1 hour | 20 October 2022 | Maximum Marks: 15

1. Which of the following statement(s) is/are correct?

   (a) The information gain of an attribute can be any positive number.

   (b) The information gain of an attribute can be less than 0.

   (c) The information gain of an attribute is at most 1.

   (d) The information gain of an attribute can be greater than the entropy of the target. [1]

2. Which of the following are true about decision trees?

   (a) They can be used only for classification.

   (b) All the leaves must be pure

   (c) The tree depth never exceeds $O(logn)$ for n sample points.

   (d) Pruning usually achieves better test accuracy than stopping early. [1]

3. List a situation in which identification numbers (unique ID associated with each instance) can be used for training a classifier. [1]

4. What is the confidence for the rules $A \rightarrow \phi$ and $\phi \rightarrow A$? [1]

5. Assume we are trying to learn a decision tree. Our input data consists of N samples, each with k attributes ($N \gg k$). If all attributes are continuous, what is the maximum number of leaf nodes that we can have in a decision tree for this data? [3]

6. Consider the following set of frequent 3-itemsets:
   $\{1,2,3\}, \{1,2,4\}, \{1,2,5\}, \{1,3,4\}, \{1,3,5\}, \{2,3,4\}, \{2,3,5\}, \{3,4,5\}$.
   List all candidate 4-itemsets generated in Apriori. Assume that there are only five items in the data set. [3]

7. For the transactional database given in Table below where $1, 2, 3, 4, 5, 6$ and 7 are items, the Apriori algorithm requires five database scans to find all the maximal frequent itemsets. TRUE or FALSE? Justify your answer. [5]

threshold = 50%.

ID	Items
t_1	$1, 2, 3, 5$
t_2	$1, 2, 3, 4, 5$
t_3	$1, 2, 3, 7$
t_4	$1, 3, 6$
t_5	$1, 2, 4, 5, 6$

Master of Computer Application

MCAC302: Information Security

Semester III
Year of Admission: 2021

Time: 1 Hour **Max. Marks: 15**

Note:
1. Attempt all parts of a question together.
2. Use of calculators is not allowed.

1. (a) If all messages are of the same length and a message is never repeated, then is it secure to re-use the same one-time pad for encryption? Justify your answer. (3)

   (b) Encipher the following message using the Hill Cipher with key = "*FILM*". (2)
   "*INCEPTION*"

2. Rank the following substitution ciphers in the order of the magnitude of confusion they create. Justify your answer. (3)
   (a) Vernam Cipher
   (b) Monoalphabetic Cipher
   (c) Ceaser Cipher

3 (a) Alice and Bob agree to use *Playfair* cipher for the secret communication with Key = *SECRET*, *x* as the special character used for padding and i and j are treated as the same character. For a particular message, Bob receives the cipher text C= *ITCSITEUOHAMCZ*. Provide a detailed description of the decryption process followed by Bob. (3)

   (b) Find the multiplicative inverse of 26187 modulo 1533 using the Extended Euclidean algorithm. (1)

4 Why is the worst-case time complexity of executing a "*Known Plaintext*" attack on a 112-bit key *Double DES* is $O(2^{56})$ and not $O(2^{112})$? Explain. (3)

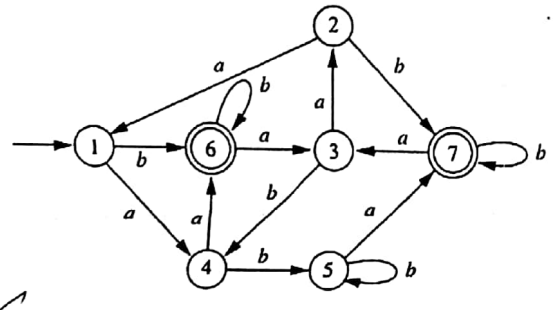
Minor Exam
Master of Computer Applications
MCAC 303: Automata Theory
Unique Paper Code: 223401303
Year of admission: 2021

Time: One Hour **Max. Marks: 30**

Instructions:

1. All questions carry equal marks.
2. Notations have their usual meaning.
3. Assume $\Sigma = \{a, b\}$ as the underlying alphabet unless mentioned otherwise.

1. Construct a minimum state finite automaton equivalent to the following finite automaton:



2. Construct regular expression and the corresponding finite automaton (FA) for the language: $L = \{w \in \Sigma^* \text{ and } |w| > 0$: w ends with $\boldsymbol{b}$ and does not contain the substring **aa**$\}$.

3. Using pumping lemma, show that the language $\boldsymbol{L}$: $\{\boldsymbol{a^{n+m}b^mc^n}$; **m, n >= 1**$\}$, is not regular over the alphabet $\Sigma = \{a, b, c\}$.

4. Show the step-wise construction of Non-deterministic Finite Automaton (NFA) for the regular expression $\boldsymbol{ba + (a + bb)a^*b}$. Also, convert the above NFA to corresponding Deterministic Finite Automaton (DFA).

5. For languages $\mathbf{L_1}$ and $\mathbf{L_2}$ described by the corresponding regular expressions $\mathbf{(ab^*)^*}$ and $\mathbf{b(a + b)^*}$, construct the following a) DFA for $\mathbf{L_1}$ and $\mathbf{L_2}$ and b) DFA that defines $\mathbf{L_1 \cap L_2}$.

6. *Design a deterministic pushdown automaton* (DPDA) for the language $\boldsymbol{L}$: $\{\mathbf{b^n c\, a^n}: \boldsymbol{n \geq 1}\}$. *Show the trace of the constructed* DPDA on a string $\boldsymbol{bbbcaaa}$.

Minor exam

Master of Computer Application (MCA)

MCAC-301 (223401301): Design and Analysis of Algorithms

Semester: III

Time: 1 Hours **Max. Marks: 20**

Instructions for the Students: Attempt all questions.

1. (a) Which sorting algorithm has execution time that is least dependent on initial ordering of the input. 1

   (b) How many minimum numbers of comparisons required to find the minimum and maximum of 100 numbers. 1

   (c) How many maximum numbers of comparisons needed to sort 9 items using Radix sort (Assume each item is octal number)? 1

   (d) When a sorting technique is called stable? Make a comment on Selection, Merge, insertion and quick sort. 1

   (e) Consider a recurrence relation F(n)=F(n-1) +F(n-2), find nth term and suggest a good searching algorithm. Justify your answer. 1

   (f) If one uses straight two-way merge sort algorithm to sort the following elements in ascending order 20, 47, 15, 8, 9, 4, 40, 30, 12, 17. What will be the order of these elements after the second pass of the algorithm? 1

   (g) A stable sort preserves the order of values that are equal with respect to the comparison function. We have three dimensional points [(7, 1, 8), (3, 5, 7), (6, 1, 4), (6, 5, 9), (0, 2, 5), (9, 0, 9)]. We sort these in ascending order by the second coordinate. What will be the resultant array? 1

2. Arrange the following functions in increasing order of asymptotic growth. 2

$$10, \quad \sqrt{n}, \quad \log n, \quad n, \quad \frac{100}{n}, \quad n^{\lg n}, \quad n^{\sqrt{n}}$$

3. *Consider the recurrence relation* 2.5

$$T(n) = \begin{cases} 2\,T(\sqrt{n}) + 1 & n > 2 \\ 2 & 0 < n \le 2 \end{cases}$$

Find the time complexity for above recurrence relation?

4. What is the time complexity for the following module? Assume that n>0. 2.5

Int module (int n)

```
{
  If (n == 1)
     return 1;
  else
     return ( n + module (n-1))
}
```

$T(n) = T(n-1) + n$

$T(n-1) = T(n-2) + n-1$

$T(n-k) = T(n-(k+1)) + n-k$

5. Identify and correct the error in given algorithms for integer multiplication using divide and conquer approach. 3.

$Assume\ n = length(a) = length(b)$

$if \quad length(a) \ge 1 \quad then\ return \quad a * b$

$Partition\ a, b\ into\ a = a_1 * 10^{\frac{n}{2}} + a_2 \quad and \quad b = b_1 * 10^{\frac{n}{2}} + b_2$

$A = Multiply\ (a_1, a_1)$

$B = Multiply\ (b_2, b_2)$

$C = Multiply\ (a_1 + ?\ , b_1 + ?\ )$

$Return\ A * 10n + (3 - A - ?) * 10^{\frac{n}{2}} + ?$

6. Consider the following recurrence function

$$f(1) = 1;$$

$$f(2n) = 2f(n) - 1 \qquad for\ n \ge 1;$$

$$f(2n+1) = 2f(n) + 1 \qquad for\ n \ge 1$$

Then, which of the following statements is/are TRUE?

- statement1. $f(2^n - 1) = 2^n - 1$
- statement2. $f(2^n) = 1$
- statement3. $f(5.2^n) = 2^{n+1} + 1$
- statement4. $f(2^n + 1) = 2^n + 1$