SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

18CSC301T FORMAL LANGUAGE AND AUTOMATA

Question Bank

UNIT V

PART A

1. Define Diagonlization (L_d) Language (Dec '14)

Ans:

The diagonlization language is the set of string w_i, such that w_i is not in $L(M_i)$. L_d consists of all string w such that the TM M whose code is w does not accept when given w as input.

$L_d = \{w_i \mid w_i$ is not accept by $M_i\}$

2. Give examples for NP complete problems (Dec '14)

Ans:

Traveling Salesman problem, 0/1 knapsack problem, Hamiltonian circuit problem and graph coloring problem.

3. Define - RE (Recursive Enumerable language) (May 15)

Ans:

A recursively enumerable language is a formal language for which there exists a Turing machine (or other computable function) which will enumerate all valid strings of the language. Recursively enumerable languages are known as type-0 languages in the Chomsky hierarchy of formal languages. All regular, context-free, context-sensitive and recursive languages are recursively enumerable

4. Define recursive and non-recursive language (May '15)

Ans: A formal language is recursive if there exists a total Turing machine that, when given a finite sequence of symbols as input, accepts it if belongs to the language and rejects it otherwise. Recursive languages are also called decidable. The Undecidable language is called as non-recursive language.

5. State Rice theorem

Ans:

Rice's theorem states that, for any non-trivial property of the recursive enumerable languages is undecidable.

6. **Distinguish between time and space complexities**
   Ans:

Time Complexities	Space Complexities
Time complexity deals with finding out how the computational time of an algorithm changes with the change in size of the input.	Space complexity deals with finding out how much (extra)space would be required by the algorithm with change in the input size.
To calculate time complexity of the algorithm the best way is to check if we increase in the size of the input, will the number of comparison(or computational steps) also increase	To calculate space complexity the best bet is to see additional memory requirement of the algorithm also changes with the change in the size of the input.

7. What are tractable problem
Ans:
Tractable problems can be solved by computer algorithms that run in polynomial time; i.e., for a problem of size n, the time or number of steps needed to find the solution is a polynomial function of n
Ex: Searching in ordered or unordered list, sorting ect.,
8. What is an intractable problem ? Give examples

Ans:
Algorithms for solving hard, or intractable, problems, requires time that are exponential functions of the problem size.
Ex: Tower of Hanoi, List all permutation of n number, ect.
9. Define NP complete problem

Ans:
In computational complexity theory, a decision problem is NP-complete when it is both in NP and NP-hard. NP may be equivalently defined as the set of decision problems that can be solved in polynomial time on a non-deterministic Turing machine.
10. What are recursive sets (DEC '13)

Ans: In computability theory, a set of natural numbers is called recursive, computable or decidable if there is an algorithm which terminates after a finite amount of time and correctly decides whether or not a given number belongs to the set.
11. What is universal turning machine (Dec '13)

A universal Turing machine ,is a Turing machine that can simulate an arbitrary Turing machine on arbitrary input. The universal machine essentially achieves this by reading both the description of the machine to be simulated as well as the input thereof from its own tape.
12. List the Basic Primitive function

Ans:
Zero function : C_n : N_n □ N, C_n (x1,----x2) = 0
Projection function: P_{ni} = N_n □ N, P_{ni} (xi,----xn) = xi

Successor function: S: N □ N, S(x) = x+1

13. Define Universal Language

Ans:

The Universal language L_u consists of strings that are interpreted as a TM followed by an input for that TM. The string is in L_u if the TM accepts that input.

14. Define Gödel numbering

Ans:

A Gödel numbering is a function that assigns to each symbol of some formal language a unique natural number, called its Gödel number. A Gödel numbering can be interpreted as an encoding in which a number is assigned to each symbol of a mathematical notation, after which a sequence of natural numbers can then represent a sequence of symbols. Gödel used a system based on prime factorization. Given sequence (x1,x2,x3,----xn)

enc(x1,x2,x3,....xn) = $2_{x1}.3_{x2}.5_{x3}$.------P_{xn}

15. Give two property of RE sets which are undecidable

Ans:

The language accepted by a TM is called Recusively enumerable (RE) language. Every non-Trivial property of RE is undecidable. Here are two such properties

(a) Whether the language accepted by a TM is regular language

(b) Whether the language accepted by a TM is context free language

These are the two properties that are undecidable

16. Is travelling salesman problem a NP or P Problem ? Justify

Ans: Travelling salesman problem (TSP) is NP complete. It can be proved by reducing travelling salesman problem to Hamiltonian circuit. As Hamiltonian circuit is NP complete we can easily prove that TSP is not NP Complete.

PART B

1. (a) Show that the union of two recursive language is recursive and union of two recursively enumerable language is recursive 12 (DEC 14)

(b) Define the language L_u and show that L_u is RE language (4 mark Dec'14)

2. State and prove post correspondence problem and Give example (16 Mk. Dec'14)

(or)

Explain PCP and deicdable and Undecidable problem with example

3. (a) Explain the class P and NP problems (May '15)

(b) Write short notes on Universal Turing machine (8 Mark)

4. Prove that a problem P2 cannot be solved in polynomial time can be proved by the reduction of a problem P1 which is under class P1 to P2

5. (a) Prove that if a language is recursive if and only if it and its complement are both recursively enumerable (8 Mark Dec '13)

(b) Prove L_{ne} is recursively enumerable (8 Mark June '13)

6. Define diagonalization language. Show that the language Ld is not a recursively enumerable language (June '14)

7. Define PCP. Let sigma = {0,1}. Let A and B be the lists of three strings each defined as :

	List A	List B
i	w_i	x_i
1	1	111
2	10111	10
3	10	0

Dose this PCP have a solution

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