Branch : CS

Batch : Hinglish

Theory of Computation

Undecidability

DPP 02

[MSQ]

1. Let L = {(X) | is a DFA and L (X) is a infinite language }; where (X) represents the illustration of the deterministic finite automata (DFA).

Then which of the statement is/are correct?

(a) It is recognizable by Turing.

(b) Its complement is recognizable by Turing.

(c) It is Turing decidable (recursive).

(d) It is context-free but not regular.

[MSQ]

2. Which of the following statement is/are incorrect?

(a) If L is CFL and A is DCFL then L–A is CFL.

(b) The subset of a decidable language is always decidable.

(c) If L and A are DCFL then $\left(\overline{L} \cap \overline{A}\right)$ is CFL.

(d) None of the above are incorrect.

[MCQ]

3. Consider some language $P \in \{0,1\}^*$ reduces to another language $Q \in \{0,1\}^*$. Which of the following statement is true?

(a) P is decidable.

(b) A Turing machine that recognizes P can be used to construct a truing that recognizes Q.

(c) If Q is decidable then P is decidable.

(d) If P is decidable then Q is decidable.

[MCQ]

4. Consider the following statement:

S_1: In phase structured language, membership problem is semi decidable.

S_2: In context-free languages, membership problem can be solved in ploynomial time.

(a) Only S_1 is true

(b) Only S_2 is true

(c) Both S_1 and S_2 is true

(d) Neither S_1 nor S_2 is true

[MCQ]

5. Consider the following statements:

S_1: For a decidable language X, X^R may or may not be decidable. (X^R represents the reverse of language X).

S_2: If X is not recursively enumerable then $\overline{X}$ must be recursively enumerable.

(a) Only S_1 is true

(b) Only S_2 is true

(c) Both S_1 & S_2 are false

(d) Both S_1 & S_2 are true

[MCQ]

6. Consider the following statements about Turing machine.

S_1: If there is some Turing machine that accepts every string in L and rejects every string not in L then L is decidable.

S_2: If there is some Turing machine that accepts every string in L and either rejects or loops on every string not in L, then L is semi-decidable or computably enumerable (CE).

(a) Only S_1 is true

(b) Only S_2 is true

(c) Both S_1 & S_2 are true

(d) Neither S_1 nor S_2 is true

[MSQ]

7. Which of the following is/are decidable properties of context-free?

(a) for context-free grammar X, find if string $w \in X$.

(b) for context-free grammar X, find if $L(X) = \phi$.

(c) for context-free grammar X, find if L(X) is infinite.

(d) none of the above are decidable properties of context free.

[MCQ]

8. Consider the following statements:

S_1: There is language for which no TM available. Then surely language will be Not RE.

S_2: Language is undecidable if and only there is no HTM available for language.

Which of the following is incorrect?

(a) S_1 only.

(b) S_2 only.

(c) Both S_1 and S_2.

(d) Neither S_1 Nor S_2.

Answer Key

1. **(a, b, c)**
2. **(a, b, c)**
3. **(c)**
4. **(c)**
5. **(c)**
6. **(c)**
7. **(a, b, c)**
8. **(d)**

Hint & Solutions

1. (a, b, c)

L → regular

(a) True: Regular ⊂ recursively enumerable.

(b) True: $\overline{\text{regular}}$ = regular and regular ⊂ RE.

(c) True: regular ⊂ recursive.

2. (a, b, c)

(a) False: CFL is not closed under intersection.

(b) False: Σ* is decidable but it has undecidable subsets (a^p → P is not prime)

(c) False: same as option a

Hence, a, b, c are false

3. (c)

If P is reduced to Q then properties of Q are possessed by P hence, answer is 'C'.

4. (c)

S_1: True → membership problem in unrestrited (∴ Phrase is unerstricted) is semi- decidable

S_2: True → using CYK algorithm, membership problem in context-free language can be solved in ploynomial time.

5. (c)

S_1: False → On input 'P', the algorithm for X^R, will reverse 'P' and then run the algorithm for X.

S_2: False → There are langauge like REGULAR which are not R.E. and their complement is also not RE.

6. (c)

- If there is some Turing machine that accepts every string in L and rejects every string not in 'L' then 'L' is decidable.
- If there is some Turing machine that accepts every string in L and either rejects or loops on every string not in L then L is semi decidable or computably enumerable(CE).

7. (a, b, c)

- There exists a membership algorithm for CFG so, it is decidable.
- Context-free emptiness problem is decidable.
- The context-free finiteness problem is decidable.

8. (d)

Both statements are correct.

So, Correct option is (d).