

Formal Languages and Automata Theory (CS303)

End-Semester Examination

Indian Institute of Technology, Patna

November, 2020

Full marks- 100 (10 X 10), Duration- 24 Hours

Submission Deadline: 09:00 AM, 26/11/2020

1. Let $\Sigma = \{ \text{double}, +, *, /, (,) \}$ and consider the language

$\text{Comp} = \{w \in \Sigma^* \mid w \text{ is a legal arithmetic expression}\}.$

Examples:

- $\text{double} + \text{double} * \text{double}$
- $((\text{double} / \text{double}) * (\text{double} + \text{double})) + (\text{double})$

Can we build a PDA for Comp? Justify your answer in short.

2. Write a context free grammar that generates the following language. Use the alphabet $\Sigma = \{0, 1\}$

$Cg = \{x \# y \mid |x| \neq |y|\}$

3. Convert a context-free grammar G to PDA M such that $L(G)=L(M)$?

Grammar

$S \rightarrow 1SV0$

$S \rightarrow 1$

$V \rightarrow V0$

$V \rightarrow \lambda$

4. Using pumping lemma prove whether the following languages are regular/not regular.

a. $L = \{0^{2L}w \mid w \in \{0, 1\}^*, |w| = L\}$

b. $L = \{0^n 1^m 2^k \mid k \neq n + m\}$

5. Prove that the set of deterministic context-free languages is a proper subset of the class of context-free languages?

6. Design a TM for the given language $L = \{0^n 1^{cn} : n, c \in \mathbb{N}\}$?

7. "Does the given turning machine accept a regular language" Prove the stated problem is undecidable??
8. Convert the grammar with productions into Chomsky normal form

$$S \rightarrow Aba,$$

$$A \rightarrow aab,$$

$$B \rightarrow Ac$$
9. Show that $L = \{0^n 1^j : n=j^2\}$ is not context free
10. Prove that a non-deterministic turning machine M takes k step to solve a problem. Then a standard tuning machine takes $O(\alpha^{kn})$ steps. Where n and α are independent of k .