

Formal Language and Automata Theory (CS21004)

Tutorial - VIII

Class: CSE 2nd Year

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Exercise 1. Let $L_1 = \{a^i b^j : i \neq j \text{ and } 2i \neq j\}$. Show that L_1 is context-free.

Exercise 2. Prove that $L_2 = \{x \in \{a, b, c\}^* : |x|_a = |x|_b = |x|_c\}$ is not a CFL.

Exercise 3. Prove that $L_3 = \{x \in \{0, 1\}^* : x = ww\}$ is not a CFL.

Exercise 4. Let $\Sigma = \{1, 2, 3, 4\}$ and $L_4 = \{w \in \Sigma^* : \text{in } w \text{ the number of 1s equals the number of 2s, and the number of 3s equals the number of 4s}\}$. Show that L_4 is not a CFL. (Sipser-India (2nd ed.) pp-133, 2.32)

Exercise 5. Let L be the language of all palindromes over $\{a, b\}$ with equal number of a 's and b 's. Show that L is not a CFL.

Exercise 6. Prove that $L_6 = \{a^p : p \text{ is a prime}\}$ is not a context-free language.

Exercise 7. Prove that $L_7 = \{a^{n^2}\}$ is not a context-free language.

Exercise 8. Let $G = (V, \Sigma, R, S)$ be a CFG in CNF. The number of non-terminals is $|V| = v$. Show that the language is infinite if grammar generates a string with at least 2^v derivation steps.