School of Mathematical and Computational Sciences

Indian Association for the Cultivation of Science

Master's/Integrated Master's-PhD Program/ Integrated Bachelor's-Master's Program/PhD Course

Theory of Computation II: COM 5108

Tutorial III (20 August 2025)

Instructor: Goutam Biswas *Autumn Semester 2025*

1. Is the following language decidable?

$$L_{CFG} = \{< G, x >:\ G \text{ is a CFG and } w \in L(G)\}.$$

2. Is the following language decidable?

$$E_{CFG} = \{< G >: L(G) = \emptyset\}.$$

3. Is the following language decidable?

$$E_{TM} = \{< M >:\ M \text{ is a Turing machine and } L(M) = \emptyset\}.$$

4. Is the following language decidable?

$$A_{TM} = \{< M >:\ M \text{ is a Turing machine and } L(M) = \{0,1\}^*\}.$$

5. Is the following language decidable?

$$L_w = \{< M >:\ M \text{ is a Turing machine and } w \in L(M)\}.$$

6. Prove that none of $L_{reg} = \{< M >:\ L(M) \text{ is a regular language}\}$ or $\overline{L_{reg}} = \{< M >:\ L(M) \text{ is not a regular language}\}$ are *recursively enumerable (Turing recognizable)* languages.