

Languages and Automata

Course Code: BMETE915023

The language of the course is English. We will compress the classic (pre-1975) material outlined below so as to make room for more recent developments, in particular weighted automata and transformers.

Course Topics

1. **Algebra of Languages:** Operations on languages.
2. **Generative Grammars:** Chomsky language classes. Standard grammars. Closure properties. Context-free grammars.
3. **Context-Free Languages:** Chomsky normal form. Bar-Hillel lemma. Reduced grammars. Leftmost derivations. Recursive variables. Greibach normal form. Regular context-free languages. Homomorphic characterization. Context-free expressions. Parikh functions.
4. **Context-Sensitive Languages:** Non-length-reducing grammars. Recursive languages. Kuroda normal form.
5. **Sentential Languages:** Révész normal form. Left-aligned derivations. Algorithmically undecidable problems.
6. **Automata:** The concept of an automaton. Finite automata. Sequential behavior of automata. Nondeterministic automata. Homomorphism, isomorphism. Congruences of automata. Characteristic semigroup. Automaton mappings.
7. **Language Recognition in Automata:** Languages recognizable by automata without output symbols. Semigroup-theoretic characterization. Syntactic semigroup. Equivalence of recognizer automata. Languages recognizable by nondeterministic automata. Closure properties.
8. **Regular Languages:** Kleene's theorem. $L_3 = R$. Pumping lemma. Decision algorithms. Fundamental theorem of finite automata.
11. **Pushdown Automata.**
12. **Turing Machines.**