Formal Languages and Automata Theory - Video course

COURSE OUTLINE

Unit 1: (D. Goswami)
Introduction to the course. Texts and References are given.

Unit 2: (D. Goswami)
Alphabet, Strings, Languages, Finite Representation of languages, Regular Expressions.

Unit 3: (K. V. Krishna)
Context-free Grammars (CFGs) - Formal definition, sentential forms, leftmost and rightmost derivations., the language of a CFG. Derivation tree or Parse tree - Definition, Relationship between parse trees and derivations. Parsing and ambiguity, Ambiguity in grammars and Languages. Regular grammars.

Unit 4: (D. Goswami)
Finite automata (FA) - its behavior; DFA - Formally definition, simplified notations (state transition diagram, transition table), Language of a DFA. NFA - Formal definition, Language of an NFA, Removing, epsilon-transitions. Equivalence of DFAs and NFAs.

Unit 5: (K. V. Krishna)
Myhill-Nerode Theorem and minimization of finite automata.

Unit 6: (D. Goswami)
Establishing the equivalence between regular languages, regular grammars and finite automata.

Unit 7: (K. V. Krishna)
2DFA, Moore and Mealy automata.

Unit 8: (K. V. Krishna)
Some closure properties of Regular languages - Closure under Boolean operations, reversal, homomorphism, inverse homomorphism, etc. Pumping lemma, proving languages to be non regular.

Unit 9: (D. Goswami)
Simplification of CFGs - Removing useless symbols, epsilon-Productions, and unit productions, Normal forms - CNF and GNF.

Unit 10: (K. V. Krishna)
Some closure properties of CFLs - Closure under union, concatenation, Kleene closure, substitution, homomorphism, reversal, intersection with regular set, etc. Pumping lemma.

Unit 11: (K. V. Krishna)
Pushdown automata and showing the equivalence between PDA and CFG.

Unit 12: (K. V. Krishna)
Turing Machines TM - Formal definition and behavior, Transition diagrams, Language of a TM, TM as accepters and deciders. TM as a computer of integer functions. Variants of Turing machines.

Unit 13: (K. V. Krishna)
Grammars and grammatically computable functions.

Unit 14: (D. Goswami)
Recursive languages, Some properties of recursive and recursively enumerable languages, Codes for TMs. A language that is not recursively enumerable (the diagonalization language). The universal language, Undecidability of the universal
language, The Halting problem, Undecidable problems about TMs.

Unit 15: (K. V. Krishna)
The universal language, Undecidability of the universal language, The Halting problem, Undecidable problems about TMs.

Unit 16: (D. Goswami)
Context-sensitive languages, linear bounded automata and Chomsky Hierarchy.

COURSE DETAIL

<table>
<thead>
<tr>
<th>Module No. &amp; Module Name</th>
<th>Topic</th>
<th>No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. Introduction</td>
<td>Lecture 1: Introduction</td>
<td>01</td>
</tr>
<tr>
<td>1. Languages and finite representation</td>
<td>Lecture 1: Alphabet, Strings, Languages Lecture 2: Finite Representation</td>
<td>02</td>
</tr>
<tr>
<td>2. Grammars</td>
<td>Lecture 1: Grammars (CFG) Lecture 2: Derivation Trees Lecture 3: Regular Grammars</td>
<td>03</td>
</tr>
<tr>
<td>4. Minimization of finite automata</td>
<td>Lecture 1: Myhill-Nerode Theorem Lecture 2: Minimization</td>
<td>02</td>
</tr>
<tr>
<td>5. RL ↔ RG ↔ FA</td>
<td>Lecture 1: RE =&gt; FA Lecture 2: FA =&gt; RE Lecture 3: FA &lt;=&gt; RG</td>
<td>03</td>
</tr>
<tr>
<td>6. Variants of finite automata</td>
<td>Lecture 1: Variants of FA</td>
<td>01</td>
</tr>
<tr>
<td>8. Simplification of CFGs</td>
<td>Lecture 1: Simplification of CFG Lecture 2: Normal Forms of CFG</td>
<td>02</td>
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<td>Lecture</td>
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<td><strong>9. Properties of CFLs</strong></td>
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<td><strong>Lecture 1:</strong> Properties of CFLs</td>
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<td><strong>10. Pushdown automata</strong></td>
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| **Lecture 1:** Pushdown Automata  
**Lecture 2:** PDA <=> CFG |
| **11. Turing machines** |
| **Lecture 1:** Turing Machines  
**Lecture 2:** Turing Computable Functions  
**Lecture 3:** Combining Turing Machines  
**Lecture 4:** Multi Input  
**Lecture 5:** Turing Decidable Languages  
**Lecture 6:** Variants of Turing Machines |
| **12. Structured grammars** |
| **Lecture 1:** Structured Grammars |
| **13. Decidability and undecidability** |
| **Lecture 1:** Decidability  
**Lecture 2:** Undecidability  
**Lecture 3:** Undecidability  
**Lecture 4:** Undecidability |
| **14. Introduction to complexity theory** |
| **Lecture 1:** Time Bounded Turing Machines  
**Lecture 2:** P and NP  
**Lecture 3:** NP-Completeness  
**Lecture 4:** NP-Complete Problems  
**Lecture 5:** NP-Complete Problems  
**Lecture 6:** NP-Complete Problems |
| **15. Chomsky Hierarchy** |
| **Lecture 1:** Chomsky Hierarchy |

**Total** 41

**References:**