Nirma University

Institute of Technology

Computer Science and Engineering Department

Course Policy

B.Tech. Computer Science and Engineering

Semester: VI , Academic Year: 2021-22, Term: Even

Course Code & Name	:	2CS601 Theory of Computation
Credit Details	:	4
Course Co-ordinator	:	Jigna Patel
Contact No. & Email	:	Ext: 9565, jignas.patel@nirmauni.ac.in
Office	:	Besides N506
Visiting Hours	:	11 am to 4 pm
Course Blog	:	https://ce501tu.wordpress.com
Course Faculty	:	Tejal Upadhyay, Prof Usha Patel, Prof Deepti Saraswat
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Office	:	N Block 5th Floor
Visiting Hours	:	11 am to 4 pm
Course Blog		https://ce501tu.wordpress.com

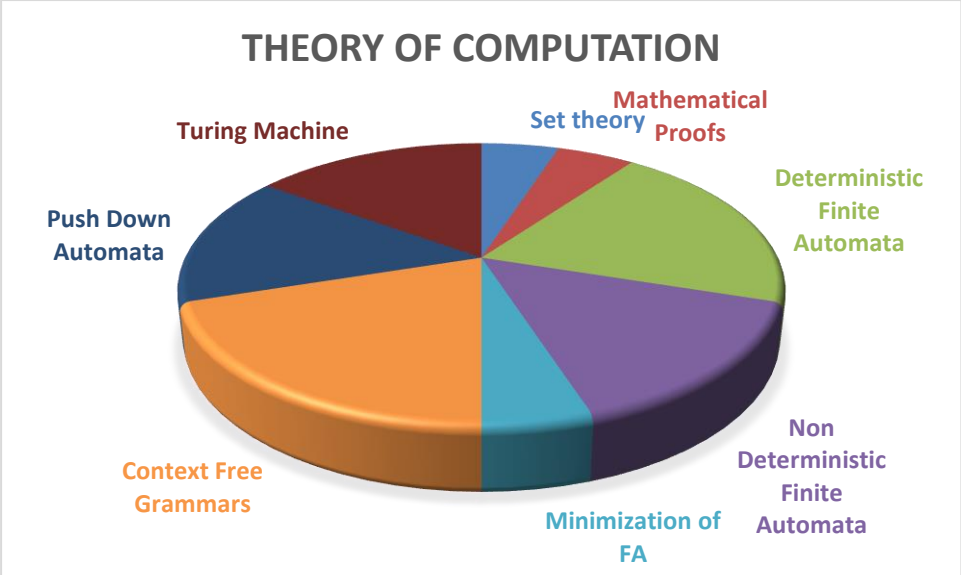
Introduction to Course:

Theory of computation plays a strong foundation for a lot of abstract areas of computer science. It is a very close cousin of Artificial Intelligence than say Probability or Computer vision.

TOC teaches you about the elementary ways in which a computer can be made to think. There is a great deal of work that was made possible in the area of Natural Language Processing that involved building Finite State machines also known as Finite State Automata. State machines are also used in certain areas of mathematics like Number theory.

Regular expressions can be beautifully represented using Non-deterministic Finite Automata.

Any algorithm can be expressed in the form of a finite state machine and can serve as a really helpful visual representation of the same. Sometimes, the finite state machines are easier to understand thus helping the cause furthermore.



Course Learning Outcomes:

After successful completion of this course, student will be able to:

- understand formal language theory and its application to computer science
- apply mathematical preliminaries to develop the basic components of language design
- design simple computational machines using the concepts of language theory
- correlate computability with formal computational machines

Syllabus

Topic	Teaching Hours
Unit I **Review of Mathematical Terms and Theory:** Basic Mathematical Notations and Set Theory, Logic Functions and Relations, Language Definitions, Mathematical Inductions and Recursive definitions	5
Unit II **Finite Automata**: Deterministic and Non Deterministic Finite Automata, Ù-Transitions, Conversion from NFA to DFA, Kleene's Theorem, Regular and Non Regular Languages	8

Unit III **CFG (Context Free Grammar):** Introduction To CFG, CFG and Known Languages, Unions Concatenations and *'S Notations and CFL, Derivations of Trees and Ambiguity, Unambiguous CFG and Algebraic Expressions, Normal Forms and Simplified Forms	**10**
Unit IV **Pushdown Automata, CFL and NFL**: Introduction To PDA, Definition, DPDA, PDA corresponding to CFG, CFG Corresponding To PDA, Introduction To CFL, Intersections and Complements of CFL, Decisions Problems and CFL	**12**
Unit V **Turing Machines, Recursive Language:** Model of Computation and Church Turing Thesis, Definition of Turing Machine, TM and Language Acceptors, Variations of TM, Non Deterministic TM, Universal TM, Enumerable and Language, Recursive and Non Recursive Enumerable Computation Functions, Measuring, Classifications and Complexity, Primitive Recursive Functions, Halting Problem, Recursive Predicates and Some Bounded Operations	**10**

Self-study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Tutorial details: (problem sheet, schedule, assessment policy)

References:

1. John C. Martin, Introduction To Languages and Theory of Computation, TMH
2. A.V. Aho, Ravi Sethi, J. D. Ullman, Compiler tools Techniques, Addison Wesley publication

Component wise Continuous Evaluation & Semester End Examination weightage:

Lesson Plan

Lecture No.	Topic	Mapped CLO
1	Introduction to Course and Formal Languages	1
	REGULAR LANGUAGES AND FINITE AUTOMATA	2 & 3
2	Regular Languages and Regular Expressions	
3	Memory requirement of language recognition	

4	Introduction to Finite Automata	
5	More Examples on Finite Automata	
6	Distinguishing one string from other	
7	Union, Intersection and complement of languages, FA for Union, Intersection and complement	
8	**Non Deterministic Finite Automata** Introduction-Need of Non Deterministic	2 & 3
9	Conversion from NFA to DFA	
10	More Examples on NFA to DFA conversion	
11	NFA with Λ Transitions	
12	Conversion from NFA-Λ to NFA	
13	More Examples on NFA-Λ to NFA	
14	Introduction to Kleene's theorem Examples on Kleene's Theorem	
15	Criteria for Regularity	
16	**Minimal Finite Automata and Pumping Lemma.** Examples on Minimal Finite Automata	2 &3
17	More examples on Minimization	
18	Pumping Lemma for Regular languages	
19	Examples on Pumping Lemma	
21	**CFG (CONTEXT FREE GRAMMAR)** Introduction to CGF	
22	Grammar rules to define languages and CFG	
23	Examples on CFG	
24	Unions ,concatenations and * notations and CFL	
25	CFG and Regular expressions and Regular Grammar	
26	Derivations of trees and ambiguity	
27	Identifying nullable variable and elimination null productions	
28	Identifying and removing unit productions	
29	Chomsky Normal Form and conversion of CFG to CNF	
30	More Examples on CNF.	
31	**PUSHDOWN AUTOMATA, CFL AND NON-CFL** Introduction and definition of PDA	2 & 3
32	PDA for languages	
33	Deterministic PDA	
34	PDA corresponding to CFG	
35	Intersections and complements of CFL	
36	Pumping Lemma for CFL	
37	More Examples on Pumping Lemma for CFL	

38	Top – down and bottom – up PDA	
39	Examples on Bottom up PDA	
40	**TURING MACHINES & RECURSIVE LANGUAGE** Definition of Turing machine, TM and language acceptors	4
41	Examples on Turing machines	
42	Computing function with Turing Machine	
43	Model of computation and Church turing thesis	
44	Recursive and Enumerable Language	
45	**COMPUTATION FUNCTIONS, TRACTABLE & INTRACTABLE PROBLEMS:** Introduction , recursive functions, Time and Space complexity	4

Tutorial Plan

Tutorial No	Topic	Mapped CLO
1	Basics of Set Theory & PMI, Strong PMI	1
2	Finite Automata	2 & 3
3	Non Deterministic Finite Automata	2 & 3
4	Minimization of DFA & Pumping Lemma	2 & 3
5	Context Free Grammars	2 & 3
6	More Examples on CFG and CNF	2 & 3
7	Push Down Automata	2 & 3
8	More Examples on Push Down Automata	2 & 3
9	Turing Machines	2 & 3
10	More Examples on Turing Machines	2 & 3

Course Assessment Schemes

(Course without Laboratory & Tutorial components)

Assessment scheme	CE			SEE
Component weightage	0.6			0.4
	Class Test (Quiz 1 and Quiz 2) 35%	Sessional Exam 35%	Innovative assignment(DES) 30%	

Teaching-learning methodology: (Mention the proposed)

- Lectures: Use of Black board, PPT, Discussion, Case Studies etc.
- Tutorial: Innovative ways of Numerical solving, derivations, Problem Solving, Application of Mathematical Models to real Systems etc.

Active learning techniques (Mention the proposed)

- Flipped Class-room (Topics to be mentioned) , Muddiest Points
- Others (Specify)

Types of Special/Innovative Assignments, Term Papers, mini Projects etc.

- Tutorial Evaluation

Course Material:

- Course Policy
- PPTs, Notes, other Material: https://sites.google.com/a/nirmauni.ac.in/ce501_theory-of-computation/home/academics/ay-2010-11/course-material

- Assignments, Tutorials, Lab Manuals : https://sites.google.com/a/nirmauni.ac.in/ce501_theory-of-computation/assignments

- Question bank: https://sites.google.com/a/nirmauni.ac.in/ce501_theory-of-computation/home/academics/ay-2010-11/v-question-bank

- Web-links, Blogs, Video Lectures, Journals :
- https://sites.google.com/a/nirmauni.ac.in/ce501_theory-of-computation/home/academics/ay-2010-11/m-course-related-important-web-links

- Animations /Simulations, Softwares
- Advanced topics
- Industries/Organizations

Course Outcome Attainment:

- Use of formal evaluation components of continuous evaluation, tutorials, laboratory work, semester end examination
- Informal feedback during course conduction
- Surveys & Peer observation

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