National University of Sciences & Technology (NUST)
School of Electrical Engineering and Computer Science (SEECS)
Department of Computer Science

Theory of Automata and Formal Languages

Course Code:	CS-352	**Semester:**	Spring 2019
Credit Hours:	3+0	**Prerequisite Codes:**	Math-161 (Discrete Mathematics)
Instructor:	Dr. Safdar Abbas Khan	**Class:**	BSCS 6AB
Office:	A-308, SEECS Faculty Block		
Lecture Days:	Tuesdays and Wednesdays	**E-mail:**	safdar.abbas@seecs.edu.pk
Class Room:	IAEC Lecture Hall	**Consulting Hours:**	Mon & Tue 9-10 am (by prior email)
Knowledge Group:	KG-CCS	**Updates on LMS:**	Before every lecture

Course Description:

This is a foundational course in computer science. The purpose of this course is to ask very fundamental questions about the very nature of computation:

1. What is a computation?
2. What is the exact definition of an algorithm?
3. Are there any problems that cannot be computationally solved?
4. How much resources are needed to solve a problem?
5. Can we identify problems that can be solved in principle (given a lot of resources) but cannot be solved in practice?

Course Learning Outcomes (CLOs):

		Upon completion of the course, students should demonstrate the ability to:	PLO Mapping**	BT Level*
	CLO 1	Understand and analyze the computing devices as finite state machines.	PLO A	C4
	CLO 2	Understand the salient features and limitations of computational models.	PLO B	C2
	CLO 3	Design finite state machines for a large class of problems.	PLO C	C3

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain
  - *Knowledge(C-1), Comprehension(C-2), Application(C-3), Analysis(C-4), Synthesis(C-5), Evaluation(C-6)*
  - *Perception(P-1), Set(P-2), Guided Response(P-3), Mechanism(P-4), Complete Overt Response(P-5), Adaption(P-6), Organization(P-7)*
  - *Receiving(A-1), Responding(A-2), Valuing(A-3), Organization(A-4), Internalizing(A-5)*

** Description of Program Learning Outcomes (PLOs) is available on website and in a separate document.

Topics to be Covered:

1. Deterministic finite automata	2. Nondeterministic finite automata
3. Regular languages and regular expressions	4. Pumping lemma for regular languages
5. MyHill-Nerode's theorem	6. Context free grammars and languages
7. Pushdown automata	8. Pumping lemma for CFLs
9. Designing PDAs and CFGs	10. Limitations of PDAs and DFAs
11. Turing machines	12. Understanding features of Turing machines

Lecture Breakdown:

Week No.	Topics	Assessment	Remarks
1	• Deterministic finite automata • Designing a DFA		
2	• Regular languages • Regular expressions		
3	• Nondeterministic finite automata • Equivalence of NFAs and DFAs		
4	• Generalized nondeterministic finite automata		
5	• Pumping lemma for regular languages		
6	**OHT-1**		
7	• Myhill-Nerode theorem		
8	• Pushdown automata • Context free grammars		
9	• Equivalence of PDAs and CFGs		
10	• Designing CFGs according to the language demanded by scenario		
11	• Pumping lemma for CFLs • Limitations of PDAs		
12	**OHT-2**		
13	• Turing machines		
14	• Designing Turing machines for complex problems • Decidability and infinite search space		
15	• Turing non-recognizable languages		
16	• P vs NP problems. Searching problems in large but finite search space.		
17	• Comprehensive seminar/ some advanced topic/ Semester project presentations of selected groups		
18	**ESE**		

Books:

Text Book:	1. Michael Sipser, “Introduction to the Theory of Computation”, 3rd Ed., Cengage Learning, 2013
Reference Books:	1. John C. Martin, “Introduction to Languages and the Theory of Computation”, 4th Ed., McGraw Hill, 2011. 2. J.E. Hopcroft, R. Motwani and J.D. Ullman, “Introduction to Automata Theory, Languages and Computation”, 2nd Ed., Addison-Wesley 2001. 3. Elaine A. Rich “Automata, Computability and Complexity: Theory and Applications”, Prentice Hall, 2013

Course Assessment	
Exam:	2 One Hour Tests (OHT) and 1 End Semester Exam (ESE)
Graded Assignments:	4 – 5 graded assignments
Semester Course Project:	One project. Possibility of forming a group
Quizzes:	4 - 5 Quizzes

Grading Policy:	
Quiz/graded assignment Policy:	The quizzes will be unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures.
Assignment Policy:	In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams.
Plagiarism:	SEECS maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.