Future Academy
Higher Future Institute for Specialized Technological Studies

Course Specification

1- Course information:	
Course Code:	CSC362
Course Title:	Automata Theory
Year/level	3ed
Academic Programs	Computer Science Program (B.Sc.)
Contact hours/ week	(Theoretical=3hrs)

2- Course aims:

This course aims to provide students with introduction to basic properties of automata (deterministic DFA, non-deterministic NFA) and formal languages models and their applications in computer science. The fundamental topics to be covered in this course include regular expressions, finite automata, (non-)regular languages, context-free grammars, regular grammars, Chomsky normal forms, pushdown automata, context-free languages, parsing and Turing machines.

These fundamentals are essential prerequisite for those who may pursue more advanced topics and applications of Computer Science. Since the ultimate goal of automata theory is the construction of efficient program languages, no study of automata is complete without some experience designing grammars. For this purpose, a medium-scale program language design project will be assigned as a class project. The design project is an essential part of the successful course completion.

This subject will introduce students to the algorithms, formal languages and grammars, automata theory, decidability, complexity, and computability. It helps students to understand and conduct mathematical proofs for computation and algorithms.

3- Intended learning outcomes of the course (ILOs):

a- Knowledge and understanding:

On successful completion of this course, the student should be able to:

al- Acquire concepts relating to the theory of computation and computational models including decidability and intractability.

a2- Understand the concept of formal languages through such mechanism as regular expression, recursive definitions, finite automata, transition graph.

a3- Gain the knowledge of basic kinds of finite automata (DFA & NFA) and their capabilities.

a4- Understand of regular and context-free languages and Non-regular Language, the Chomsky Hierarchy, Pushdown automata, Turing Machines.
a5- Recognize the rules and limitations of regular languages and context-free languages.

b- Intellectual skills:

On completing this course, the student should be able to:
b1- Design regular expression, DFA, NFA, a pushdown automata and a Turing machine for a computer language
b2- Convert between NFA to DFA.
b3-Construct context free, regular, Chomsky normal form grammars to design computer languages
b4- Implement a parser for a computer language.
b5- Design solution to simple automata problems.
b6- Evaluate a range of options to solve and interpret a range of an identified problem.
b7-Transform TG to Regular Expression -Regular Expression to FA .

c- Professional and practical skills:

At the end of this course, the student will be able to:
c1- Apply the understanding of key notions of computing theory through complex problem solving
c2- Transform between equivalent deterministic and non-deterministic finite automata, and regular expressions
c3- Model Push Down Automata for CFLs and constructs a PDA for different CFLs
c4- Minimize finite automata and grammars of context free languages.
c5- Model Turing machine Automata
c6- Apply knowledge of computing and methodologies within technical domains.

d- General and transferable skills:

On successful completion of this course, the student should be able to:
d1- Search for the importance of computational theory.
d2- Work in teams on complicated projects that require applications of mathematics, and communicate the results verbally and in written form
d3- Manage tasks and resources

4- Course contents

Week No.	Topics/units	Number of hours		ILO's
		Lecture hours	Practical/ Tutorial hours	
1	Chapters 1 (Introduction to Automata Theory) -Automata Theory -Terminology	3	0	a1, c1, d1
2	Chapters 2 & 3 (Languages and Recursive Definitions)	3	0	a2, a3, b1,

	-Languages -Kleene Closure -Terminology -Recursive Definition -Arithmetic Expression			b2, b6, c2, c4
3	Chapters 4 (Regular Expressions) - Regular Expressions -Regular Languages -EVEN-EVEN	3	0	
4	Chapter 5 (Finite Automata) - Definitions of Finite Automata - Examples of Finite Automata DFA, NFA -EVEN-EVEN revisited + Quiz 1	3	0	
5	Chapter 6 & 8 (TG and FA with Output) -Transition Graph (Definition) -Transition Graph vs. Finite Automata -Moore Machine and Mealy Machine -Moore Machine = Mealy Machine	3	0	a2, a5, b3, b7, c2, c4
6	Chapter 7 (Kleene's Theorem) -Kleen's Theorem -TG to Regular Expression -Regular Expression to FA -Nondeterministic FA -NFA and Kleene's Theorem	3	0	
7	Midterm Exam	3	0	
8	Chapter 9 & 10 (Regular and Non-regular Languages) -Closure Properties (Union, Intersection. Kleene Star) -Complements and Intersections (Closure Properties) -Pumping Lemma -Quotient Languages	3	0	a4, a5, b1, b4, b5, c1, c6
9	Chapter 12 (Context Free Grammars) -Grammars, Context Free Grammars -Ambiguity -Total Language Trees -Syntax Trees, Generation Trees, Parse Trees, Production Trees, Derivation Trees	3	0	
10	Chapters 13 & 16 (Non-context Free Languages) -Chomksy Normal Form -Regular Grammars -Pumping Lemma for CFLs Chapter 17 (Context Free Languages) -Closure Properties	3		a4, a5, b1, b5, c5

	-Intersection and Complement -Context Free Languages vs. Regular Languages			
11	Chapter 14 (Pushdown Automata) -Pushdown Automata (PDA) -Applications of PDA + Quiz 2	3		a4, b1, c3
12	Chapters 19 & 20 (Turing and Post Machines) -Turing Machine	3		a3, a4, b5, b6, c5, c6, d2, d3
13	Course Project discussion	3		b5, b6, c6, d2, d3
14	Course Review	3		

5- Teaching and learning methods

Methods	**a1**	**a2**	**a3**	**a4**	**a5**	**b1**	**b2**	**b3**	**b4**	**b5**	**c1**	**c2**	**c3**	**c4**	**c5**	**c6**	**d1**	**d2**	**d3**
Lectures & seminars	√	√	√	√	√	√	√	√	√	√									
Tutorial Exercise																			
Practical sections																			
Self-learning																	√		
Problem solving											√	√	√	√	√	√			
Assays and reviews																			
Discussion groups																		√	
Brainstorming																			
Blended-learning																			
E-learning		√	√														√	√	

6- Teaching and learning methods for Low-achieving students

- Assign a portion of the office hours for those students.
- Repeat the explanation of some of the material and tutorials.
- More quizzes to assess their ability for understanding the course
- Encourage the team work for those students with other advanced ones to increase their participation and understanding

7- Student assessment

Assessment method	Time	Grade weight (%)	Week	ILOs
Course Work (Tutorial Exercise and Assignments)		15	Every week	a1, a2, a3, a4, a5, b1, b2, b3, b4, b5, c1, c2, c3, c4, c5
Quiz 1	30 min	5	Week#4	-
Mid-term exam	1 hr	15	Week#7	a1, a2, a3, b1, b2, b4, c1, c2
Quiz 2	30 min	5	Week#11	a1, a2, a3, b1, c1, c2
Practical exam	-	-		a4, b2, b3, c4
Final Written exam	2 hrs	60	Week#15 & 16	a2, a3, a4, a4, a5, b1, b2, b3, b4, b5, b6, b7

8-List of references

8.1. Student notebooks:

Comprehensive instructor notes ("slides") will be made available on the course web page classroom.

8.2. Essential textbooks:

1- S.P. Eugene Xavier “Theory of Automata, Formal Languages and Computation”, , NEW AGE INTERNATIONAL (P) LIMITED, ISBN (10) : 81-224-2334-5, 2005.

2- John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman –" Introduction to automata theory, languages, and computation" (3rd Edition). Addison-Wesley. ISBN-13:978-0321455369

8.3. Recommended textbooks:

1- Harry Lewis, Christos H. Papadimitriou - Elements of the Theory of Computation (2ndEdition). Prentice Hall. ISBN-13: 978-0132624787

8.4. Journals, Periodical and Reports ……..etc.

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8.5. Websites

https://online.stanford.edu/courses/soe-ycsautomata-automata-theory

https://www.classcentral.com/subject/automata

https://cstheory.stackexchange.com/questions/1955/books-on-automata-theory-for-self-study

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