University of Macau
Computer and Information Science Department
SFTW223 – Formal Languages and Automata
Syllabus
2nd Semester 2010/2011
Part A – Course Outline

Compulsory course in Computer Science

Catalog description:

(3-2) 4 credits. This course introduces the fundamental concepts of formal languages and automata. It emphasizes the general principles of formal languages, grammars and automata theory. Topics include finite automata, regular expressions, regular languages and their properties, context-free grammars, languages and their properties, pushdown automata, Turing machines and undecidability.

Course type:

Theoretical with substantial laboratory/practice content

Prerequisites:

- SFTW110

Textbook(s) and other required material:

- John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, *Introduction to Automata Theory, Languages and Computation*, 3rd edition, Addison Wesley, 2007.

Major prerequisites by topic:

1. Basic knowledge in Mathematical Reasoning.
2. Basic knowledge in Set Theory.
3. Basic knowledge in Relations.
4. Basic knowledge in Graphs.
5. Basic knowledge in Trees.

Course objectives:

1. Learn the fundamental concepts of formal languages and automata.[a, e, k]
2. Be able to construct regular expressions, grammars, and automata for different levels of formal languages. [a, e]
3. Understand the relationship between Turing machines and modern computers. [a, j]
4. Understand the limitations and undecidable problems of modern computers and. [a, j]

Topics Covered:

1. **Finite Automata (10 hours)** - Study the deterministic finite automata, non-deterministic finite automata, Finite Automata with ε-transitions, and their relationship.
2. **Regular Expressions (10 hours)** - Study the definitions and manipulations of regular expression, and its equivalence to finite automata; Define regular languages.
3. **Regular Languages and Their Properties (5 hours)** - Study the limitations of finite automata and pumping lemma; Study closure properties of regular languages; Study minimization of finite automata.

4. **Context-Free Grammars (10 hours)** - Define context-free grammars and context-free languages; Study derivations, parse trees and ambiguity of context-free grammars; Study simplification and normal forms of context-free grammars.
5. **Pushdown Automata (10 hours)** - Define pushdown automata and study its relationship to context-free grammars; Study acceptance by empty stack and final states; Study prefix properties and ambiguity of context-free languages.
6. **Context-Free Languages and Their Properties (10 hours)** - Study the limitations of context-free grammars and pumping lemma; Study closure properties of context-free languages;
7. **Turing Machines (5 hours)** - Define Turing machines and universal Turing machines; Study extensions and restrictions of Turing machines.
8. **Undecidability (10 hours)** - Define recursively enumerable, recursive, and non recursively enumerable languages and their relationships with Turing machines; Define decidable and undecidable problems; Study universal language problems and modified post correspondence problems.

Class/laboratory schedule:

Timetabled work in hours per week			No of teaching weeks	Total hours	Total credits	No/Duration of exam papers
Lecture	**Tutorial**	**Practice**				
3	2	Nil	14	70	4	1 / 3 hours

Student study effort required:

Class contact:	
Lecture	42 hours
Tutorial	28 hours
Other study effort	
Self-study	42 hours
Homework assignment	9 hours
Exams	15 hours
Total student study effort	136 hours

Student assessment:

Final assessment will be determined on the basis of:

- Homework 20%
- Mid-term exam 30%
- Final Exam 50%

Course assessment:

The assessment of course objectives will be determined on the basis of:

1. Homework and exams
2. Course evaluation

Course Outline:

Weeks	Topics	Course work

1,2	**Finite Automata** - Study the deterministic finite automata, non-deterministic finite automata, Finite Automata with ε-transitions, and their relationship.	Assignment#1
3,4	**Regular Expressions** - Study the definitions and manipulations of regular expression, and its equivalence to finite automata; - Define regular languages.	Assignment#2
5	**Regular Languages and Their Properties** - Study the limitations of finite automata and pumping lemma; - Study closure properties of regular languages; - Study minimization of finite automata.	
6,7	**Context-Free Grammars** - Define context-free grammars and context-free languages - Study derivations, parse trees and ambiguity of context-free grammars - Study simplification and normal forms of context-free grammars	Assignment#3
8,9	**Pushdown Automata** - Define pushdown automata and study its relationship to context-free grammars; - Study acceptance by empty stack and final states; -Study prefix properties and ambiguity of context-free languages.	Assignment#4
10,11	**Context-Free Languages and Their Properties** - Study the limitations of context-free grammars and pumping lemma; - Study closure properties of context-free languages;	Assignment#5
12	**Turing Machines** - Define Turing machines and universal Turing machines; - Study extensions and restrictions of Turing machines.	Assignment#6
13,14	**Undecidability** - Define recursively enumerable, recursive, and non recursively enumerable languages and their relationships with Turing machines; - Define decidable and undecidable problems; -Study universal language problems and modified post correspondence problems.	

Contribution of course to meet the professional component:

This course prepares students to work professionally in the area of formal languages and automata.

Relationship to CS program objectives and outcomes:

This course primarily contributes to Computer Science program outcomes that develop student abilities to:
(a) an ability to apply knowledge of mathematics, science, and engineering.
(e) an ability to identify, formulate, and solve engineering problems.

The course secondarily contributes to Computer Science program outcomes that develop student abilities to:
(j) a knowledge of contemporary issues.
(k) an ability to use the techniques, skills, and modern engineering tools necessary for computer engineering practice.

Relationship to CS program criteria:

Criterion	DS	PF	AL	AR	OS	NC	PL	HC	GV	IS	IM	SP	SE	CN
Scale: 1 (highest) to 4 (lowest)	3		4				2							

Discrete Structures (DS), Programming Fundamentals (PF), Algorithms and Complexity (AL), Architecture and Organization (AR), Operating Systems (OS), Net-Centric Computing (NC), Programming Languages (PL), Human-Computer Interaction (HC), Graphics

and Visual Computing (GV), Intelligent Systems (IS), Information Management (IM), Social and Professional Issues (SP), Software Engineering (SE), Computational Science (CN).

Course content distribution:

Percentage content for			
Mathematics	Science and engineering subjects	Complementary electives	**Total**
50%	50%	0%	100%

Coordinator:

Chi Man Pun, Associate Professor of Computer Science and Engineering

Persons who prepared this description:

Chi Man Pun, Sept 12, 2011.

Part B General Course Information and Policies

2nd Semester 2011/2012

Instructor: Prof. Chi Man Pun Office: N319
Office Hour: Monday 2:30-4:00pm, Thursday 3:00-5:00pm, or by appointment
Phone: 8397-4369
Email: cmpun@umac.mo

Time/Venue:

Theory	Monday	4:00 - 7:00pm	WLG304
Practice	Tuesday	8:30 - 10:30am	U106
	Wednesday	4:30 - 6:30pm	U106

Grading Distribution:

Percentage Grade	Final Grade	Percentage Grade	Final Grade	Percentage Grade	Final Grade
100 – 93	A	77 – 73	B-	57 – 53	D+
92 – 88	A-	72 – 68	C+	52 – 50	D
87 – 83	B+	67 – 63	C	below 50	F
82 – 78	B	62 – 58	C-		

Comment:
The objectives of the lectures are to explain and to supplement the textbook. Students who wish to succeed in this course should read the correspondence chapters of the textbook prior to the lecture and should work all homework assignments by themselves. You are encouraged to look at other sources (other references, etc.) to complement the lectures and textbook.

Homework Policy:
The completion and correction of homework is a powerful learning experience; therefore:

- There will be approximately 6 homework assignments.
- Homework is due two weeks after assignment unless otherwise noted, no late homework is accepted.
- Possible revision of homework grades may be discussed with the grader within one week from the return of the marked homework
- The course grade will be based on the average of the HW grades.

Mid-term Exam:
One mid-term exam will be held at about the middle of the semester.

Note

- Attendance is strongly recommended.
- Check course web pages for announcement, homework and lectures. Report any mistake on your grades within one week after posting.
- No make-up exam is given except for medical proof.
- Cheating is absolutely prohibited by the university.

Appendix:

Rubric for Program Outcomes

Rubric for (a)	5 (Excellent)	3 (Average)	1 (Poor)
Understand the theoretic background	Students understand theoretic background and the limitations of the respective applications.	Students have some confusion on some background or do not understand theoretic background completely.	Students do not understand the background or do not study at all.
Use a correct model and formulation correctly	Students choose a model correctly and properly apply correct techniques.	Students choose a wrong model sometime, use a wrong formula, or a different technique.	Students use a wrong model and wrong formula, or do not know how to model.
Compute the problem correctly	Students use correct techniques, analyze the problems, and compute them correctly.	Students sometime solve problem mistakenly using wrong techniques.	Students do not know how to solve problems or use wrong techniques completely.

Rubric for (e)	5 (Excellent)	3 (Average)	1 (Poor)
Identify applications in engineering systems	Students understand problem and can identify fundamental formulation.	Students understand problem but cannot apply formulation, or cannot understand problem.	Students cannot identify correct terms for engineering applications.
Modeling, problem formulation and problem solving	Students choose and properly apply the correct techniques.	Students model correctly but cannot select proper technique or model incorrectly but solve correctly accordingly.	Students at loss as to how to solve a problem.

Rubric for (j)	5 (Excellent)	3 (Average)	1 (Poor)
Relevance to the present time	Student displays an understanding of the theoretical or practical impact and an ability to correlate a subject, perception, communication,	Student is able to display an understanding of current topics and issues with some knowledge regarding their impact in a bigger global and societal sense.	Student has difficulty demonstrating an awareness or familiarity with current topics and issues relevant to most current global and societal affairs.

	association and reasoning from a global and societal perspective.		
Rubric for (k)	5 (Excellent)	3 (Average)	1 (Poor)
Use modern principles, skills, and tools in engineering practice	Student applies the principles, skills and tools to correctly model and analyze engineering problems, and understands the limitations.	Student applies the principles, skills and tools to analyze and implement engineering problems.	Student does not apply principles and tools correctly and/or does not correctly interpret the results.