University of Computer Studies
B.C.Sc. (Fourth Year)

CS-504 (Advanced Artificial Intelligence) (Elective)

Course Description

Course code number	**CS-504(AI)**	**Course Title**	**Artificial Intelligence + Natural Language Processing**
Semester hours	3 hours	**No. of Credit Units**	3
Prerequisite	computer science background	**Course Coordinator**	Dr. Thinn Lei Soe Lecturer

Course Aims

The main purpose of this course is

- To understand natural language processing and to learn how to apply basic algorithms in this field.
- To get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics, as well as the resources of natural language data - corpora.
- To conceive basics of knowledge representation, inference, and relations to the artificial intelligence.

Learning Outcomes

By the end of the course, the student must be able to:

- Compose key NLP elements to develop higher level processing chains
- Understand the concept of regular expression
- Learn commonly used operations involving regular expression/pattern matching
- Choose appropriate solutions for solving typical NLP subproblems (tokenizing, tagging, parsing)
- Measure of how alike two strings are to each other

Course Contents

The goal of natural language processing (NLP) is to design and build computer systems that are able to analyze natural languages like German or English, and that generate their outputs in a natural language, too. In this course students will learn

1. Knowledge in Speech and Language Processing, ambiguity of Language
2. Regular expression and Finite-State Automata with examples

3. Survey of English Morphology and Finite-State Morphological Parsing
4. How to build a Finite-State Lexicon and Finite-State Transducers
5. Tokenization of word and sentence and detecting, correcting of spelling errors
6. Examples of string edit distance

Course Organization

The expected learning outcomes for the course will be assessed through six forms of activity:

1. Attending the lectures
2. Preparing for and participating in the recitations.
3. Assignments
4. Reading the text
5. Quiz
6. Exams

Reference Materials:

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition , Prentice Hall; 2nd edition (May 16, 2008) , ISBN-13: 978-131873216, ISBN-10: 0131873210

2. Christopher D. Manning, Hinrich Schütze, Foundations of Statistical Natural Language Processing, The MIT Press; 1st Edition (June 18, 1999), ISBN-10:0262133601, ISBN-13: 978-0262133609

3. Artificial Intelligence, A Modern Approach (Second Edition) by by Stuart Russell & Peter Norving

Exam Assessment (AI 70%+NLP 30%)

Paper Exam	60%
Tutorial	10%
Assignment	10%
Presentation	10%
Class participation + Quiz	10%

Tentative Schedule

Natural Language Processing
15 periods for 15 weeks (50 minutes for 1 period)

No.	Chapter	Pages	Periods	Detail Lectures

1	**Chapter 1 Introduction**	**1-15**	**3**	
	1.1 Knowledge in Speech and Language Processing 1.2 Ambiguity of Language: why NLP is difficult? 1.3 Models and Algorithms 1.5 state of the art 1.6 Some brief history		3	Overview
2	**Chapter 2 Regular Expressions and Automata**	**2-27**	**4**	
	2.1 Regular Expressions 2.2 Finite State Automata 2.3 Regular Languages and FSAs		4	Detail Detail Detail
3	**Chapter3 Words and Transducers**	**1-36**	**7**	
	3.1 Survey of English Morphology 3.2 Finite-State Morphological Parsing 3.3 Building a Finite-State Lexicon 3.4 Finite-State Transducers 3.5 FSTs for Morphological Parsing 3.6 Transducers and Orthographic Rules 3.7 Combing FST Lexicon and Rules 3.8 Lexicon-Free FSTs: The Porter Stemmer 3.9 Word and Sentence Tokenization 3.10 Detecting and Correcting Spelling Errors 3.11 Minimum Edit Distance 3.12 Human Morphological Processing			Overview Overview Detail Detail Detail Overview Detail Detail Overview Overview Detail Detail
	Tutorial		**1**	All Chapters

Artificial Intelligence
30 periods for 15 weeks (50 minutes for 1 period)

No.	Chapter	Page	Period	Detail Lecture
	Chapter 4 **Informed Search and Exploration**		**8**	
1	4.1 Informed (Heuristic) Search Strategies Greedy best-first search	94-97	1	Explain detail
2	A* search : Minimizing the total estimated solution cost	97-101	1	Explain detail
3	Memory-bounded heuristic search Ex 4.1, 4.3 and 4.4	101-104	1	
4	4.2 Heuristic Functions	105-110	1	Explain detail
5	4.3 Local search algorithms & Optimization Problems	110-111	1	Explain detail
6	Hill-climbing search	111-114	1	Explain detail
7	Simulated annealing search Local beam search	115-116	1	

8	Genetic Algorithms	116-119	1	
	Chapter 5 Constraint Satisfaction Problems		**6**	
9	5.1 Constraints Satisfaction Problems	137-141	1	Explain detail
10	5.2 Backtracking Search for CSPS	141-143	2	Overview, Figure 5.4
11	Variable and value ordering Forward Checking Constraint Propagation	143-147	1	Explain detail Figure 5.6
12	5.3 Local search for constraint satisfaction problems Ex- 5.5 and Old Question	150-151	2	
	Chapter 7 Logical Agents		**12**	
13	7-1 Knowledge-Based Agents 7-2 The Wumpus World	195 -197 197 -200	2	Detail Explain
14	7-3 Logic	200 -204	1	Detail Explain
15	7- 4 Propositional Logic A Very Simple Logic Syntax Semantics A Simple Knowledge Base Inference Equivalence, Validity and Satisfiability	204 - 211	2	Detail Explain
16	7- 5 Reasoning Patterns in Propositional Logic Resolution CNF A resolution algorithm Forward and Backward Chaining	211 -220	3	Detail Explain
17	7- 6 Effective Propositional Inference A complete Backtracking Algorithm 7- 7 Agents Based on Propositional Logic A Comparison	220 – 222 231	2	
18	Exercises 1, 2, 4, 5, 6, 7, 8, 9	236 - 238	1	
19	Revision & Assignment Tutorial(Chapter 7)	232 - 233	1	
	Chapter 8 First-Order Logic		**9**	
20	8-1 Representation Revisited	240 - 245	1	Explain detail
21	8-2 Syntax and Semantics of First-Order Logic Models for First-Order Logic Symbols and interpretations Terms Atomic Sentences Complex Sentences Quantifiers Equality	245 - 253	2	Explain detail

22	8-3 Using First-Order Logic Assertions and Queries in First-Order Logic The kinship domain Numbers, sets, and lists The Wumpus world	253 - 260	2	
23	8-4 Knowledge Engineering in First-Order Logic Knowledge Engineering process	260 - 262	2	Explain detail
24	Exercises 2, 6, 7, 8, 11 Revision & Old question & Assignment	268-269	1	
25	Tutorial		1	