الجامعة الافتراضية السورية
SYRIAN VIRTUAL UNIVERSITY

Natural Language Processing

Course Definition

Information

Technology

Engineering

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Syrian Arab Republic		الجمهورية العربية السورية
Ministry of Higher Education and Scientific Research		وزارة التعليم العالـــي والبحث العلمي
Syrian Virtual University		الجامعة الافتراضية السورية

1. Basic Information:

Course Name	Natural Language Processing
Course Code	ANL601
Number of Presentational Sessions*	20
Number of Synchronous Sessions**	10
Number of Shorter Tests***	2
Number of Exams***	1
Theoretical Sessions Work Load (hrs.)	60
Practical Sessions Work Load (hrs.)	30
Credit Hours	6

***Each presentational session comprises both recorded lecture (1.5 hrs.) and interactive learning content (1.5 hrs.).**

****Each synchronous session comprises the interactive lecture carried out in real time in a virtual class (1.5 hrs.).**

*****Each shorter test is 0.5 hr. long. The final exam is 2 hrs. long.**

N.B.

Generally, each chapter requires two presentational sessions: one for the recorded content and one for the interactive content (unless the chapter is too long, in which case it may require more sessions (. This note applies to synchronous sessions as well, where each chapter requires one synchronous session generally.

2. Prerequisites courses:

Course	Code
Artificial Intelligence	BAI501
Neural Networks and Fuzzy Logic	ARB601
Machine Learning	AML601

3. Course Objectives:

The objective of this course is to familiarize the students with the basic concepts of natural language processing and to introduce the foundations of technologies in NLP and their application to practical problems, providing students with the knowledge and capacity to develop NLP projects that allow users to interact with the computer using a human language. Students will study methodologies used in the recognition of spoken speech, speech synthesis, as well as text processing at different levels: phonetic, morphological, syntactic, and semantic. Students will also explore a range of different applications that fall within this area.

4. Learning Outcomes (LO):

Upon completion of the course, the student must have:

- Understand the mechanisms of speech production and how to produce speech by computers.
- Build an Arabic text-to-speech system.
- Build a system that recognizes the speech in isolated words or recognizes the speaker.
- Understand different models to represent the language (on different levels: morphological, syntactic, and semantic) and suggest a suitable representation based on the studied problem.
- Understand different approaches to process the language, on the different levels, and suggest a suitable approach to solve the studied problem.
- Design, implement and test natural language processing systems within an interactive application between man and machine.

5. Assessment Results:

Chapter Number	Chapter Title	General Objectives	Assessment Type				
			Interactive Content & Recorded Sessions	Applied Activities (Synch. Sessions)	Final Exam*/ Shorter Tests**	Presentations and Interviews***	Reports****
CH1	Introduction to NLP	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH2	Speech Production, Hearing and Modeling	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH3	Speech Signal Characteristics	Comprehension	√	√	√	√	√

	in Time and Frequency	–Analytical Thinking – Tools and Application Hands– On					
CH4	Text to Speech	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH5	Speech and Speaker Recognition	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH6	Programming using Matlab and Praat	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√

CH7	Language Models	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH8	Morphological Processing	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH9	POS Tagging	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH10	Syntactic Processing	Comprehension –Analytical Thinking – Tools and	√	√	√	√	√

		Application Hands– On					
CH11	Semantic Processing	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH12	NLP systems: Applications & Approaches	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√

***The final exam is two hours long and is given at the end of the course.**

****Shorter tests are about 30 minutes long and are given after three or four lectures throughout the semester during synchronous sessions.**

*****Presentations, interviews, and reports are submitted once after each three or four lectures throughout the semester during synchronous sessions.**

6. Course Syllabus:

Chapter	Subject	Content	Number of Learning Objects	Number of synchronous Learning Objects
CH1	Introduction to NLP	1. Introduction 2. Applications of spoken and written language processing 3. Levels of natural language processing 4. Ambiguity types in language processing 5. Examples on language processing systems	5	2
CH2	Speech Production, hearing and modeling	1. Natural speech production. 2. Phonemes in Arabic 3. Hearing mechanism 4. Speech modeling (source–filter)	4	2
CH3	speech signal characteristics in time and frequency	1. Time domain speech signal analysis. 2. Fundamental frequency trajectories.	5	2

		3. Frequency domain speech signal analysis, and sonograms. 4. Formants trajectories. 5. Linear prediction analysis		
CH4	Text to Speech Synthesis	1. Text to speech applications. 2. Speech synthesis units. 3. Speech synthesis techniques 4. Synthetic speech prosody 5. Demo: Text based speech synthesis 6. Using statistics averaging in speech synthesis 7. Using deep learning in speech synthesis	**7**	**3**
CH5	Speech and speaker recognition	1. Speech recognition applications 2. Speech recognition units 3. Speech recognition techniques 4. Demo 5. Speaker recognition 6. Deep learning in speech recognition	**6**	**3**
CH6	programming using Matlab and Praat	1. Speech signal acquisition 2. Some time and frequency processing	**6**	**3**

		3. Using praat for signal demonstration 4. Time window spectrum amplitude calculation 5. Linear prediction coefficients and cepstrum coefficient computation. 6. Praat package		
CH7	Language Models	1. Introduction 2. N-gram models 3. Language embeddings 4. Pretrained language Models 5. Conclusion	**5**	**2**
CH8	Morphological Processing	1. Text regulating 2. Morphological Processing in English 3. Morphological analysis according to linguistic models 4. Morphological Processing in Arabic	**4**	**2**
CH9	POS tagging	1. Introduction 2. English language sets groups 3. POS tagging applications 4. POS tagging approaches	**4**	**2**
CH10	Syntactic Processing	1. Introduction 2. Analysis as research operation	**8**	**4**

		3. Ambiguity 4. Ambiguity facing research 5. Analysis methods using dynamic programming 6. Syntactic processing issues 7. Partial analysis 8. Best tree selection using Probabilistic approach		
CH11	Semantic Processing	1. Meaning representation 2. Semantic processing applications 3. Semantic analysis based on Syntax 4. Word Sense Disambiguation approaches	**4**	**2**
CH12	NLP systems: Applications & approaches	1. Information Retrieval 2. Machine Translation 3. Automatic Summarization 4. Question Answering System 5. Other applications	**5**	**2**

7. Practical Activity:

- **Tools and Labs:**

Tool Name	Description
FARASA	Stemming, POS tagging and syntactic analysis
CoreNLP / NLTK NLP Toolkit	Frameworks for NLP
Matlab	Signal Processing Software
Praat	Speech Processing Software

- **Practical Activities per Chapters:**

Chapter	Activities Type	Remarks
CH1	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH2	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	

CH3	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH4	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH5	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH6	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH7	☑ Exercises ☐ Homework	

	☐ Webinars ☑ Project ☐ Experiment ☐ Other	
CH8	☑ Exercises ☑ Homework ☐ Webinars ☑ Project ☐ Experiment ☐ Other	
CH9	☑ Exercises ☑ Homework ☐ Webinars ☑ Project ☐ Experiment ☐ Other	
CH10	☑ Exercises ☑ Homework ☐ Webinars ☑ Project ☐ Experiment ☐ Other	
CH11	☑ Exercises ☑ Homework ☐ Webinars ☑ Project	

	☐ Experiment ☐ Other	
CH12	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	

8. References:

- Jurafsky, Daniel, and James H. Martin. 2009. Speech and language processing: an introduction to natural language processing, computational linguistics, and speech recognition. London: Prentice Hall, Pearson Education International.
- Hobson Lane, Hannes Hapke, Cole Howard. 2019. Natural Language Processing in Action: Understanding, analyzing, and generating text with Python. Manning Publications.
- Jacob Benesty, M. Mohan Sondhi, Yiteng Huang (Eds.) 2008. Springer Handbook of Speech Processing. Springer
- Tomas Quatieri, 2002. Discrete Time Speech Signal Processing principles and practice, Printice Hall signal Processing Series.