جامعة محمد بن زايد للذكاء الاصطناعي
MOHAMED BIN ZAYED UNIVERSITY OF ARTIFICIAL INTELLIGENCE

Core Courses Syllabi

NLP702 - Advanced Natural Language Processing

Title	Advanced Natural Language Processing
Code	NLP702
Loading	4 Credit-hours
Prerequisites	• Basic Concepts in Linear Algebra, Calculus, Probability and Statistics • Programming in Python or similar language
Catalog Description	This course provides a comprehensive introduction to Natural Language Processing. It builds upon fundamental concepts in Natural Language Processing and assumes familiarization with Mathematical concepts and programming.
Goal	This graduate level course aims to instil a deeper and thorough understanding of advanced Natural Language Processing algorithms, to equip students with capabilities of researching, developing and implementing these algorithms.
Content	The course covers the following major modules: **(I)** Information Extraction, **(II)** Word Embedding, **(III)** Machine Translation **(IV)** Question and Answering and **(V)** Conversation Agent Systems
Recommended Textbooks	1. Chris Manning et al, *Foundation of statistical natural language processing*, MIT Press (1999) ISBN: 0262133601 2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. *Deep Learning*. MIT Press. ISBN: 9780262035613
Recommended References & Supplemental Material	Relevant research papers, technical reports, and surveys for each topic, where needed, are identified in the teaching plan ahead. In addition, the following textbook may be useful: Dan Jurafsky and James H. Martin, *Speech and Language Processing*, Prentice Hall, 2009. ISBN: 9780131873216

Teaching Week	Topics
1	**Course Overview** **Lecture** • Overview of research directions in word embedding, information extraction, machine translation, question answering and conversational agents • Neural probabilistic language model **Lab** • Demonstration of the development platform and libraries used for NLP (e.g. Tensorflow, PyCharm, NLTK, Spacy) • Warm-up exercise for Python and Jupyter Notebook • Start **project** work
2	**Word Embeddings: Basics** **Lecture** • Term Frequency and Inverse Document Frequency (TFIDF) • CBOW, Skipgram and GloVe embedding models • Senna embedding model **Lab** • Programming exercises for implementation of Skipgram and CBOW
3	**Word embeddings: Taxonomy based Embeddings** **Lecture** • TransE • Retrofitting word embeddings **Lab** • Programming exercises for implementation of TransE
4	**Information Extraction: Named Entity Recognition (NER)** **Lecture** • NER problems • Various types of NER problems • Neural models for NER • Recurrent Neural Network (RNN) • Convolutional Neural Network (CNN) • Conditional Random Field **Lab** • Programming exercises for implementation of Named Entity Recognition models • Assignment 1

Teaching Week	Topics
5	**Information extraction: relation extraction models** **Lecture** • Relation extraction problem • Different types of relation extraction methods • Neural model for various types of relation extraction tasks **Lab** • Programming exercises for implementation of neural relation extraction models
6	**Information Extraction: Coreference Resolution** **Lecture** • Coreference resolution problem • Types of coreference • General methodology of a coreference solver • End-to-end neural coreference resolution methods **Lab** • Programming exercises for implementation of coreference resolution models
7	**Information Extraction: Event Extraction** **Lecture** • Event extraction problem • Event extraction in different domains • Neural models for various types of event extraction tasks **Lab** • Programming exercises for implementation of neural event extraction models
8	**Revision on Information Extraction** **Lecture** • Summarize and compare information extraction **Lab** • Assignment 2

Teaching Week	Topics
9	**Machine Translation: Seq2seq** **Lecture** • Machine translation problem • Evaluation methods for machine translation • Seq2seq model • Attention model to jointly learn to align • Beam search decoding **Lab** • Programming exercises for implementation of Seq2seq+Attention model for machine translation
10	**Machine translation: Convnet** **Lecture** • Convnet for encoding a sequence in seq2seq models • Character level machine translation **Lab** • Programming exercises for implementation of Convnet
11	**Machine translation: using subword information** **Lecture** • Different methods for incorporating subword-level information into machine translation (e.g. CNN/RNN + morpheme/char N-gram model) • Performance comparison of various neural machine translation methods **Lab** • Programming exercises for implementation of CNN + Char N-gram models for machine translation
12	**Question Answering: reading comprehension** **Lecture** • Question answering task • Various types of question answering • Reading comprehension task • Neural models for reading comprehension **Lab** • Programming exercises for reading comprehension • Assignment 3

Teaching Week	Topics
13	**Question Answering: Open Domain Question** **Lecture** • Factoid question answering task • Knowledge Graph • Different methods for factoid question answering **Lab** • Programming exercises for implementation of similarity based factoid question answering
14	**Conversational Agents System: Utterance Understanding, Dialogue Management and Response Generation** **Lecture** • Models for dialog act classification (e.g. statement, rephrase, questions, etc) • Frameworks for dialogue management • Markov Decision Processes • Information state • Reinforcement learning • Seq2seq for response generation **Lab** • Programming exercises for implementation of dialog act classifier
15	**Conversational Agents System: Persona-based Chatbot** **Lecture** • Introduction of the dataset for training Persona-based chatbot • Models for training Persona-based chatbots (Attention model) • Seq2seq conditioning for Persona-based response generation **Lab** • Assignment 4 • Review and Exam Preparation