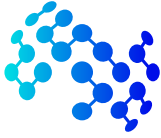


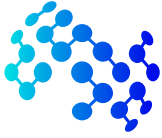
## Core Courses Syllabi

### NLP702 - Advanced Natural Language Processing

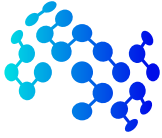
<b>Title</b>	Advanced Natural Language Processing
<b>Code</b>	NLP702
<b>Loading</b>	4 Credit-hours
<b>Prerequisites</b>	<ul style="list-style-type: none"> <li>• Basic Concepts in Linear Algebra, Calculus, Probability and Statistics</li> <li>• Programming in Python or similar language</li> </ul>
<b>Catalog Description</b>	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.
<b>Goal</b>	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.
<b>Content</b>	The course covers the following major modules: <b>(I)</b> Information Extraction, <b>(II)</b> Word Embedding, <b>(III)</b> Machine Translation <b>(IV)</b> Question and Answering and <b>(V)</b> Conversation Agent Systems
<b>Recommended Textbooks</b>	<ol style="list-style-type: none"> <li>1. Chris Manning et al, <i>Foundation of statistical natural language processing</i>, MIT Press (1999) ISBN: 0262133601</li> <li>2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. <i>Deep Learning</i>. MIT Press. ISBN: 9780262035613</li> </ol>
<b>Recommended References &amp; Supplemental Material</b>	<p>Relevant research papers, technical reports, and surveys for each topic, where needed, are identified in the teaching plan ahead. In addition, the following textbooks may be useful:</p> <p>Dan Jurafsky and James H. Martin, <i>Speech and Language Processing</i>, Prentice Hall, 2009. ISBN: 9780131873216</p>



Teaching Week	Topics
1	<p><b>Course Overview</b></p> <p><b>Lecture</b></p> <ul style="list-style-type: none"><li>• Overview of research directions in word embedding, information extraction, machine translation, question answering and conversational agents</li><li>• Neural probabilistic language model</li></ul> <p><b>Lab</b></p> <ul style="list-style-type: none"><li>• Demonstration of the development platform and libraries used for NLP (e.g. Tensorflow, PyCharm, NLTK, Spacy)</li><li>• Warm-up exercise for Python and Jupyter Notebook</li><li>• Start <b>project</b> work</li></ul>
2	<p><b>Word Embeddings: Basics</b></p> <p><b>Lecture</b></p> <ul style="list-style-type: none"><li>• Term Frequency and Inverse Document Frequency (TFIDF)</li><li>• CBOW, Skipgram and GloVe embedding models</li><li>• Senna embedding model</li></ul> <p><b>Lab</b></p> <ul style="list-style-type: none"><li>• Programming exercises for implementation of Skipgram and CBOW</li></ul>
3	<p><b>Word embeddings: Taxonomy based Embeddings</b></p> <p><b>Lecture</b></p> <ul style="list-style-type: none"><li>• TransE</li><li>• Retrofitting word embeddings</li></ul> <p><b>Lab</b></p> <ul style="list-style-type: none"><li>• Programming exercises for implementation of TransE</li></ul>
4	<p><b>Information Extraction: Named Entity Recognition (NER)</b></p> <p><b>Lecture</b></p> <ul style="list-style-type: none"><li>• NER problems</li><li>• Various types of NER problems</li><li>• Neural models for NER</li><li>• Recurrent Neural Network (RNN)</li><li>• Convolutional Neural Network (CNN)</li><li>• Conditional Random Field</li></ul> <p><b>Lab</b></p> <ul style="list-style-type: none"><li>• Programming exercises for implementation of Named Entity Recognition models</li><li>• Assignment 1</li></ul>



Teaching Week	Topics
5	<b>Information extraction: relation extraction models</b> <b>Lecture</b> <ul style="list-style-type: none"><li>• Relation extraction problem</li><li>• Different types of relation extraction methods</li><li>• Neural model for various types of relation extraction tasks</li></ul> <b>Lab</b> <ul style="list-style-type: none"><li>• Programming exercises for implementation of neural relation extraction models</li></ul>
6	<b>Information Extraction: Coreference Resolution</b> <b>Lecture</b> <ul style="list-style-type: none"><li>• Coreference resolution problem</li><li>• Types of coreference</li><li>• General methodology of a coreference solver</li><li>• End-to-end neural coreference resolution methods</li></ul> <b>Lab</b> <ul style="list-style-type: none"><li>• Programming exercises for implementation of coreference resolution models</li></ul>
7	<b>Information Extraction: Event Extraction</b> <b>Lecture</b> <ul style="list-style-type: none"><li>• Event extraction problem</li><li>• Event extraction in different domains</li><li>• Neural models for various types of event extraction tasks</li></ul> <b>Lab</b> <ul style="list-style-type: none"><li>• Programming exercises for implementation of neural event extraction models</li></ul>
8	<b>Revision on Information Extraction</b> <b>Lecture</b> <ul style="list-style-type: none"><li>• Summarize and compare information extraction</li></ul> <b>Lab</b> <ul style="list-style-type: none"><li>• Assignment 2</li></ul>



Teaching Week	Topics
9	<b>Machine Translation: Seq2seq</b> <b>Lecture</b> <ul style="list-style-type: none"><li>• Machine translation problem</li><li>• Evaluation methods for machine translation</li><li>• Seq2seq model</li><li>• Attention model to jointly learn to align</li><li>• Beam search decoding</li></ul> <b>Lab</b> <ul style="list-style-type: none"><li>• Programming exercises for implementation of Seq2seq+Attention model for machine translation</li></ul>
10	<b>Machine translation: Convnet</b> <b>Lecture</b> <ul style="list-style-type: none"><li>• Convnet for encoding a sequence in seq2seq models</li><li>• Character level machine translation</li></ul> <b>Lab</b> <ul style="list-style-type: none"><li>• Programming exercises for implementation of Convnet</li></ul>
11	<b>Machine translation: using subword information</b> <b>Lecture</b> <ul style="list-style-type: none"><li>• Different methods for incorporating subword-level information into machine translation (e.g. CNN/RNN + morpheme/char N-gram model)</li><li>• Performance comparison of various neural machine translation methods</li></ul> <b>Lab</b> <ul style="list-style-type: none"><li>• Programming exercises for implementation of CNN + Char N-gram models for machine translation</li></ul>
12	<b>Question Answering: reading comprehension</b> <b>Lecture</b> <ul style="list-style-type: none"><li>• Question answering task</li><li>• Various types of question answering</li><li>• Reading comprehension task</li><li>• Neural models for reading comprehension</li></ul> <b>Lab</b> <ul style="list-style-type: none"><li>• Programming exercises for reading comprehension</li><li>• Assignment 3</li></ul>



Teaching Week	Topics
13	<p><b>Question Answering: Open Domain Question</b></p> <p><b>Lecture</b></p> <ul style="list-style-type: none"><li>• Factoid question answering task</li><li>• Knowledge Graph</li><li>• Different methods for factoid question answering</li></ul> <p><b>Lab</b></p> <ul style="list-style-type: none"><li>• Programming exercises for implementation of similarity based factoid question answering</li></ul>
14	<p><b>Conversational Agents System: Utterance Understanding, Dialogue Management and Response Generation</b></p> <p><b>Lecture</b></p> <ul style="list-style-type: none"><li>• Models for dialog act classification (e.g. statement, rephrase, questions, etc)</li><li>• Frameworks for dialogue management</li><li>• Markov Decision Processes</li><li>• Information state</li><li>• Reinforcement learning</li><li>• Seq2seq for response generation</li></ul> <p><b>Lab</b></p> <ul style="list-style-type: none"><li>• Programming exercises for implementation of dialog act classifier</li></ul>
15	<p><b>Conversational Agents System: Persona-based Chatbot</b></p> <p><b>Lecture</b></p> <ul style="list-style-type: none"><li>• Introduction of the dataset for training Persona-based chatbot</li><li>• Models for training Persona-based chatbots (Attention model)</li><li>• Seq2seq conditioning for Persona-based response generation</li></ul> <p><b>Lab</b></p> <ul style="list-style-type: none"><li>• Assignment 4</li><li>• Review and Exam Preparation</li></ul>