

STUDY GUIDE

Deep Learning for Natural Language and Sequence Processing

Organised by
University of Mons (UMONS)



1. IDENTIFYING DATA.	
· Course Name.	<i>Deep Learning for Natural Language and Sequence Processing</i>
· Coordinating University.	<i>University of Mons (UMONS)</i>
· Partner University(ies) Involved.	-
· Course Field(s).	<i>Computer Sciences, Engineering, Artificial Intelligence, Machine Learning, Deep Learning, Natural Language Processing</i>
· Related Study Programme.	<i>Master program in Computer Sciences & Master program in Computer Engineering and Management</i>
· Course Code.	<i>S-INFO-810</i>
· ISCED Code.	<i>0613 & 0714</i>
· SDG.	<i>Goal 4: Quality Education Goal 8: Decent Work and Economic Growth</i>
· Study Level.	<i>Master (M)</i>

· Number of ECTS credits allocated.	3
· Mode of Delivery.	<i>Blended format (UMONS students on site; EUNICE students online)</i> - <i>Online synchronous theoretical sessions</i> - <i>Online intensive 2-day practical session</i>
· Language of Instruction.	- <i>Theoretical sessions: French with English supporting documents and articles.</i> - <i>Practical sessions: all in English</i>
· Delivery Period.	<i>Spring 2023 semester</i>
· Course Dates.	<i>February-May 2023</i>
· Precise Schedule of the Lectures.	<i>Online synchronous theoretical sessions:</i> - <i>10/02 Friday 08:15-10:15 CET</i> - <i>03/03 Friday 08:15-10:15 CET</i> - <i>10/03 Friday 08:15-10:15 CET</i> - <i>17/03 Friday 08:15-10:15 CET</i> - <i>21/04 Friday 08:15-10:15 CET</i> - <i>28/04 Friday 08:15-10:15 CET</i> - <i>05/05 Friday 08:15-10:15 CET</i> - <i>12/05 Friday 08:15-10:15 CET</i> - <i>19/05 Friday 08:15-10:15 CET</i> <i>Online intensive 2-days practicals sessions:</i> - <i>03-04/05 full time 08:15-17:30 CET</i> <i>Online Exam (hybrid written-oral online exam):</i>



	- 8 th June 2023 08:15-12:15 CET
· Key Words.	<i>deep learning, natural language processing, automatic translation, text classification, chatbots, human-computer interaction, big data, text generation, python, pytorch, spacy, data analysis, DNN, CNN, RNN, LSTM, GRU, Attention models, Transformers.</i>
· Catchy Phrase.	<i>“What we want is a machine that can learn from experience”, Alan Turing, 1947. Allan Turing also invented the so-called Turing test, suggesting intelligence could be assessed through language skills. This course deals with those topics, and the advances in artificial intelligence and deep learning applied to natural language processing. It combines theory and practice towards understanding and mastering the challenges and enormous opportunities of AI applied to natural language.</i>
· Link to Course Guide.	-

· Prerequisites and co-requisites.	<i>Mathematics for computer sciences, Programming languages, Algorithms. A basic knowledge of data processing might also be helpful. French B1 (intermediate level)</i>
· Number of EUNICE students that can attend the Course.	24
· Course inscription procedure(s).	Registrations through EUNICE website

2. CONTACT DETAILS.

· Department.	<i>Faculty of Sciences</i>
· Name of Lecturer.	<i>Prof. Stéphane DUPONT</i>
· E-mail.	<i>stephane.dupont@umons.ac.be</i>
· Office.	<i>15, Avenue Maistriau 7000 Mons</i>
· Other Lecturers.	-

3. COURSE CONTENT.

This course deals with advances in artificial intelligence through deep learning applied to the modeling of temporal sequences with long-term dependencies, and in particular to natural language processing:

- Contemporary AI using deep neural networks: DNN, CNN, RNN, LSTM, GRU, Attention, Transformers, GPT, generative models, GANs, auto-encoders, etc.





- Applications to natural language processing: natural language processing (NLP) and modeling, machine translation (neural machine translation), text classification and document information extraction, "chatbots" and answering questions, extraction and search of information in "big data" unstructured text / images, human-computer dialogue systems, situated interaction (language + vision) for example in games, text generation.
 - Artificial intelligence models comprising billions of parameters and able to memorize and exploit the structure of language as well as knowledge and facts; importance of studying the equity and biases of AI in this context.
 - You will also be offered articles for reading, in order to better understand the wide range of possible applications of these models.
- This course will include practicals to acquire the theory.*

4. LEARNING OUTCOMES.

At the end of this course, the student should have acquired theoretical knowledge and practical skills related to one of the major paradigms of AI: "deep learning". He/she should :

- know the major applications of artificial intelligence to natural language,
- know some of the most recent machine learning methods,
- be able to implement complex artificial neural networks
- know how to use generic software libraries for deep learning

5. OBJECTIVES.

The main objectives are to provide the fundamental knowledge and practical skills in deep learning applied to natural language processing, in order for the student to be able to coordinate, contribute and select the right methodologies and tools for industrial projects involving for instance information extraction from text and documents or sequences of data, human-computer interaction with language (chatbots), etc. Through that, the student will also become aware of machine learning concepts applied to sequence processing, which have a very large scope of applications in big data.

6. COURSE ORGANISATION.

UNITS

1.	<i>Introduction to NLP: NLP applications, embeddings, word2vec, ambiguities, etc.</i>
2.	<i>Introduction to deep learning: back-propagation, neural network model architectures, challenges, etc.</i>
3.	<i>Basic language models and recurrent neural networks</i>
4.	<i>Advanced sequence models such, gating, long short-term memory networks</i>
5.	<i>Attention models, Transformers models, latest scientific results</i>





6.	<i>Neural machine translation</i>
7.	<i>Text generation</i>
8.	<i>Human-computer interaction and dialog (chatbots)</i>
9.	<i>Parsing, co-reference resolution, named entity recognition, information extraction, etc.</i>
10.	<i>Programming using python, machine learning tooling (transformers, pytorch), data manipulation tooling (pandas), specialized NLP tools (spacy).</i>
11.	<i>Practical sessions</i>
LEARNING RESOURCES AND TOOLS.	
<i>Lecture notes, python notebooks, papers</i>	
PLANNED LEARNING ACTIVITIES AND TEACHING METHODS.	
<i>Lectures, individual work, scientific paper reading, individual and group practical sessions</i>	

7. ASSESSMENT METHODS AND CRITERIA.
<i>[Hybrid Written-Oral online exam, short oral presentation of a paper, evaluation of practicals achievement.</i>
OBSERVATIONS.
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8. BIBLIOGRAPHY AND TEACHING MATERIALS.
<i>To be provided at the start of the course.</i>

