GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Deep Learning (F000918)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	English	Gent	group work lecture seminar
B (semester 2)	English	Gent	group work lecture seminar

Lecturers in academic year 2024-2025

vanden Broucke, Seppe	EB24	lecturer-in-charge

Offered in the following programmes in 2024-2025	crdts	offering
Bridging Programme Master of Science in Bioinformatics(main subject Engineering)	6	A
Master of Science in Business Engineering(main subject Data Analytics)	6	A
Master of Science in Business Engineering (Double Degree)(main subject Data Analytics)	6	A
Master of Science in Bioinformatics(main subject Engineering)	6	A
Master of Science in Business Engineering (Double Degree)(main subject Operations Management)	6	A
Master of Science in Business Engineering(main subject Operations Management)	6	A
Master of Science in Data Science for Business	4	B
Master of Science in Statistical Data Analysis	6	A
Exchange Programme in Computer Science (master's level)	6	A

Teaching languages

English

Keywords

Deep learning, artificial neural networks, artificial intelligence

Position of the course

Deep learning is one of the most succesful techniques in artificial intelligence (machine learning) today. Like all techniques in machine learning, deep learning builds a model from example data. It does this by modeling the world in terms of a hierarchy of concepts, with each concept defined in terms of its relation to simpler concepts. This approach avoids having to formally specify all of the knowledge that the system needs.
In this course, we give the students a solid understanding and hands-on experience of the possibilities of deep learning for practical business applications in industry. After following this course, you are ready to use deep learning in practice, to understand and re-implement state-of-the-art techniques and adapt them to the needs of your application.

Contents

Deep learning builds on machine learning and artificial neural networks, hence, this course starts out with a summary of the basic concepts of machine learning and an in-depth explanation of ANNs, including convolutional neural networks and recurrent neural networks.
This course stresses:

1 The benefits of neural networks over other learning algorithms
2 The benefits of “deep” neural networks over “shallow” architectures
3 The practical steps in designing a suitable neural network for a given application
We apply simple and advanced neural network architectures to cases with economical relevance. We use deep learning on different types of data sets, such as: images, text, or time series.
Case studies are performed in Python, using common libraries such as Scikit-Learn and Keras.
Only for the students in the 6 credits version of the course:
After an exploration of the different techniques through dedicated assignments, we proceed to tackle a more realistic (difficult) problem on a large and complex data set.

Initial competences

Programming skills (preferably in Python)
Mathematics:
- linear algebra: matrix operations
- calculus: derivative, gradient
- analytic geometry: vector space, distance, inner product

Final competences

1 Determine when and how to use Deep Learning for solving complex problems with economical relevance (marketing and/or R&D).
2 Understand the structure and properties of basic neural network types (fully connected, convolutional, recurrent, dense) and their applications.
3 Be able too systematically design and optimise of standard deep neural network architectures in Keras and analyse of their performance, reliability and robustness.
4 Understand scientific literature about applications of Deep Learning. Validating the results of one's own research in comparison with the state-of-the-art for similar problems.
5 **Only for 6 credits version:** Use Deep Learning with industrially relevant complex data (e.g., images, audio, video, text), applying state-of-the art techniques based on literature and online sources.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, Seminar, Lecture

Extra information on the teaching methods

Contributing to the practical sessions with group work is mandatory
The concepts discussed in class are demonstrated in Jupyter notebooks, which can be altered by the students in order to get an active understanding.
In three graded programming assignments, students have to apply these concepts to unseen data sets. The results are discussed collectively in class, as well as through individual feedback, per group.
Only for the 6 credits version:
In the last part of the semester, an advanced problem is addressed in groups. Subjects are determined in mutual agreement, based on challenge, feasibility and the student's individual interests. Group progress is evaluated during contact sessions and feedback/support is provided. The final results are presented and evaluated at the end of the semester.

Study material

Type: Slides

Name: Slides
Indicative price: Free or paid by faculty
Optional: no
Language : English
Available on Ufora : Yes

References

- Goodfellow I, Bengio Y., Courville A. (2016), "Deep Learning", MIT Press.
- Chollet F. (2017), "Deep learning with Python"

Course content-related study coaching

Examples are discussed during lectures. There are specific graded assignments as well as an advanced assignment for the 6 credits version (both to be solved in teams).
Students receive coaching in the process of solving the assignments during support sessions and/or through an online discussion forum. Feedback is given and feedback afterwards (collectively, and/or by team).

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions

Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions

Examination methods in case of permanent assessment

Participation, Written assessment with open-ended questions, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

There are three graded assignments in group. For the 6 credits version there is also a final project in groups. Insufficient contribution to the group results can lead to failing for the course.
The written examination assesses knowledge and understanding of the principles of deep learning as well as practical understanding ackquired during the assignments.

For the students in the 4 credits version of the course, this exam is part of the permanent evaluation and takes place in week 7 of the semester.
For the students in the 6 credits version of the course, this exam takes place in the exam period.

Calculation of the examination mark

6 credits version:
NPE (70% - individual correction of group score is possible), written exam (30%)

4 credits version:
Group work (50% - individual correction of group score is possible)
Written exam: 50%

To pass, a student should pass both parts of the evaluation. If a student does not pass for both parts and the score is 10/20 or more, the score will be reduced to 9/20.