



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Neural networks and deep learning [S2ETI2>SNiUG]

Course

Field of study

Education in Technology and Informatics

Year/Semester

1/2

Area of study (specialization)

–

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

0

Laboratory classes

30

Other

0

Tutorials

0

Projects/seminars

0

Number of credit points

2,00

Coordinators

dr inż. Szymon Maćkowiak

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Lecturers

Prerequisites

Basic knowledge of Python programming, basic knowledge of mathematics and statistics, ability to solve simple mathematical and technical problems based on existing knowledge, basic knowledge of machine learning techniques, ability to obtain information from specified sources, understanding of the need for self-directed learning.

Course objective

1. Familiarizing students with the modeling, operation, and applications of neural networks. 2. Providing students with basic knowledge of selected neural network learning algorithms. 3. Familiarizing students with selected examples of the practical application of artificial neural networks in the context of data analysis and pattern recognition. 4. To familiarize students with selected processes that occur within artificial neural networks.

Course-related learning outcomes

Knowledge:

1. Students who pass this course will have advanced and detailed knowledge of selected topics in computer science, in particular neural networks and deep learning

2. Students who pass the course will be familiar with advanced methods, techniques, and tools used to solve complex engineering problems in a selected area of computer science and technology using neural networks and deep learning
3. Students who pass the course will have advanced general knowledge of algorithms, programming languages, artificial intelligence, databases, decision support, learning systems, software engineering, and structural and object-oriented programming
4. Students who pass the course will know and understand the main development trends and the most important achievements in the field of techniques and technologies relevant to the field of study of technical and IT education

Skills:

1. Students who pass this course will be able to use their knowledge of selected topics in mathematics, computer science, and materials engineering to formulate and solve complex and unusual problems and to perform tasks in non-standard conditions
2. Students who pass the course will be able to obtain information from literature, databases, and other sources (in Polish and English), integrate it, interpret and critically evaluate it, draw conclusions, and formulate and comprehensively justify opinions
3. Students who pass the course will be able to select and apply appropriate methods and tools, including advanced information and communication technologies and scientific studies on specific issues in the field of computer science, materials engineering, and technology
4. Students who pass the course will be able to formulate and test hypotheses related to engineering problems and simple research problems, as well as plan and conduct (computer) experiments using selected research methods, interpret the results obtained, and draw conclusions

Social competences:

1. Students who pass this course are ready to critically evaluate their knowledge and the content they receive in the fields of computer science, technology, and materials engineering, and understand the need for lifelong learning; they are able to inspire and organize the learning process for others
2. Students who pass the course are ready to recognize the importance of knowledge in solving cognitive and practical problems and to seek expert advice
3. Students who pass the course are ready to responsibly perform professional roles, taking into account their professional development, upholding the ethos of the profession, and observing and developing professional ethics in relation to current social needs, particularly in the context of issues related to the applications of artificial intelligence

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. Individual project.

Programme content

The course syllabus covers the following topics: neural network programming, activation functions, neural network learning algorithms and techniques, feed-forward neural networks and recurrent networks, applications of neural networks in solving selected problems (image recognition, text recognition and generation), overview of processes occurring within artificial neural networks.

Course topics

1. Configuring the environment for working in Python, reviewing the basics of Python, and overview of selected libraries (Tensorflow, PyTorch, Keras).
2. Programming and training Perceptron.
3. Studying activation functions.
4. Building and using a multilayer perceptron network for handwriting recognition.
5. Backpropagation algorithm and the basics of deep learning.
6. Convolutional neural networks and their application using Tensorflow or PyTorch libraries for image recognition.
7. Application of artificial neurons in so-called agent simulations.
8. Selected issues of nonlinear dynamics in the context of coupled neural networks.
9. Recurrent neural networks.

10. Programming and training Hopfield networks using Hebb's rule.
11. Investigation of recurrent neural networks - chaotic processes and phase transitions in neural networks.
12. Investigation of the associative properties of recurrent networks.
13. Boltzmann machines.
14. Data analysis using neural networks.

Teaching methods

1. Multimedia presentation - introduction to the implemented topic of laboratory (computer) exercises.
2. Laboratory (computer) exercises - execution of specialized programs, individual work, discussion.
3. Individual student project work, discussion.

Bibliography

Basic:

1. R. A. Kosiński, "Sztuczne sieci neuronowe dynamika nieliniowa i chaos", WNT, Warszawa 2004.
2. D. Osinga, "Deep Learning. Receptury", Helion, Gliwice, 2019.
3. S. Raschka, V. Mirjalili, Python. Uczenie maszynowe, wydanie 2, Helion 2019.

Additional:

1. A. Sweigart, Programowanie w Pythonie dla średnio zaawansowanych, Helion 2021.
2. C. Mayer, Kod Pythona w jednym wierszu, Helion 2021.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00