# SYLLABUS OF A MODULE

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|---|---|
| Polish name of a module | **GŁĘBOKIE SIECI NEURONOWE** |
| English name of a module | **DEEP NEURAL NETWORKS** |
| ISCED classification - Code | 0613 |
| ISCED classification - Field of study | Software and applications development and analysis |
| Languages of instruction | English |
| Level of qualification:<br>***1 – BSc (EQF 6)***<br>***2 – MSc (EQF 7)***<br>***3 – PhD (EQF 8)*** | *1* |
| Number of ECTS credit points | *5* |
| Examination:<br>***EO – exam oral***<br>***EW – exam written***<br>***A - assignment*** | *A* |
| Available in semester:<br>***S – Spring only***<br>***A – autumn only***<br>***Y - booth*** | *A* |

## Number of hours per semester:

| Lecture | Exercises | Laboratory | Seminar | E-learning | Project |
|---|---|---|---|---|---|
| 30 | | 30 | | | |

## MODULE DESCRIPTION

### MODULE OBJECTIVES

O1. Learning Advanced Methods for Training Artificial Neural Networks

O2. Learning Practical Aspects of Training Deep Neural Networks

### PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis and linear algebra
2. Knowledge of classical machine learning methods
3. Knowledge of basic machine learning techniques
4. Ability to program in a high-level language
5. Ability to work independently and in a team
6. Knowledge of English

### LEARNING OUTCOMES

LO 1 – The student possesses knowledge of contemporary methods for creating artificial neural networks and deep learning.

LO 2 – Can create models of artificial neural networks, including deep and convolutional ones.

LO 3 – Can think and act creatively and entrepreneurially.

**MODULE CONTENT**

| **Type of classes – lecture** | **Number of hours** |
|---|---|
| **Lec 1-5** - Review of Neural Networks and Advanced Architectures. Optimization Algorithms for Training Deep Models. Regularization and Dropout Techniques | **10** |
| **Lec 6,7** - Object Detection and Localization: Region-based CNNs | **4** |
| **Lec 8,9** - Sequence-to-Sequence Models and Attention Mechanisms | **4** |
| **Lec 10,11** - Generative Adversarial Networks (GANs) | **4** |
| **Lec 12,13** - Reinforcement Learning | **4** |
| **Lec 14,15** - Attention mechanism in neural networks | **4** |
| **Sum** | **30** |
| **Type of classes– laboratory.** | **Number of hours** |
| **Lab 1-5** - Neural Networks and Advanced Architectures. Optimization Algorithms for Training Deep Models. Regularization and Dropout Technique | **10** |
| **Lab 6-7** - Object Detection and Localization: Region-based CNNs | **4** |
| **Lab 8-9** - Sequence-to-Sequence Models and Attention Mechanisms | **4** |
| **Lab 10-11** - Generative Adversarial Networks (GANs) | **4** |
| **Lab 12-13** - Reinforcement Learning | **4** |
| **Lab 14-15 -** Attention mechanism in neural networks | **4** |
| **Sum** | **30** |

**TEACHING TOOLS**

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| 1. Lecture using multimedia presentations |
| 2. Preparation of reports on the implementation of the exercises |
| 3. Instructions for completing the laboratory exercises |
| 4. Laboratory equipped with PCs |

**WAYS OF ASSESSMENT ( F – FORMATIVE, S – SUMMATIVE**

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|---|
| **F1. -** assessment of preparation for laboratory exercises |
| **F2. -** assessment of the ability to apply the acquired knowledge while doing the exercises |
| **F3. -** evaluation of reports on the implementation of exercises covered by the curriculum |
| **F4. -** assessment of activity during classes |
| **S1. -** assessment of the ability to solve the problems posed and the manner of presentation obtained results - pass mark * |
| **S2. -** assessment of mastery of the teaching material being the subject of the lecture - exam |

*) in order to receive a credit for the module, the student is obliged to attain a passing grade in all laboratory classes as well as in achievement tests.

## STUDENT'S WORKLOAD

| L.p. | Forms of activity | Average number of hours required for realization of activity |
|---|---|---|
| **1.** | **Contact hours with teacher** | |
| 1.1 | Lectures | 30 |
| 1.2 | Tutorials | |
| 1.3 | Laboratory | 30 |
| 1.4 | Seminar | |
| 1.5 | Project | |
| 1.6 | Examination | |
| | Total number of contact hours with teacher: | 60 |
| **2.** | **Student's individual work** | |
| 2.1 | Preparation for tutorials and tests | 0 |
| 2.2 | Preparation for laboratory exercises, writing reports on laboratories | 25 |
| 2.3 | Preparation of project | 0 |
| 2.4 | Preparation for final lecture assessment | 0 |
| 2.5 | Preparation for examination | 16 |
| 2.6 | Individual study of literature | 24 |
| | Total number of hours of student's individual work: | 65 |
| | Overall student's workload: | 125 |
| **Overall number of ECTS credits for the module** | | 5 |
| Number of ECTS points that student receives in classes requiring teacher's supervision: | | 2.4 |
| Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects: | | 2.16 |

## BASIC AND SUPPLEMENTARY RESOURCE MATERIALS


1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press
2. http://www.deeplearningbook.org, 2016
3. Charu C. Aggarwal, Neural Networks and Deep Learning. A Textbook, Springer, 2018
4. James P. Coughlih, Robert H. Baran: Neural Computation in Hopfield Networks and Boltzmann


## MODULE COORDINATOR ( NAME, SURNAME, E-MAIL ADDRESS)


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