



COURSE CARD

1. Basic information

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|--|--|-------------------------------------|
| Course name in English: | Artificial Intelligence: Introduction and application in Engineering | |
| Course name in Polish: | Sztuczna Inteligencja: Wprowadzenie i zastosowania w inżynierii | |
| Number of hours: | 30 | |
| Type of course: | Elective course | |
| Form of course: | lecture | |
| Code of course: | W10IME-SD0033W / MEQ100421W | |
| Course leader: | Dr inż. Marek Sawicki | |
| Faculty of the course leader: | W10 Faculty of Mechanical Engineering | |
| Email address of the course leader: | Sawicki.marek@pwr.edu.pl | |
| Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course): | Architecture and urban planning | <input checked="" type="checkbox"/> |
| | Automation, electronic, and electrical engineering | <input checked="" type="checkbox"/> |
| | Information and communication technology | <input checked="" type="checkbox"/> |
| | Biomedical engineering | <input checked="" type="checkbox"/> |
| | Chemical engineering | <input checked="" type="checkbox"/> |
| | Civil engineering and transport | <input checked="" type="checkbox"/> |
| | Mechanical engineering | <input checked="" type="checkbox"/> |
| | Environmental engineering, mining, and energy | <input checked="" type="checkbox"/> |
| | Mathematics | <input type="checkbox"/> |
| | Chemical sciences | <input type="checkbox"/> |
| | Physical sciences | <input type="checkbox"/> |
| | Management and quality studies | <input type="checkbox"/> |

2. Objectives

- C1. To gain basic knowledge related to artificial intelligence.
- C2. To gain skills to determine problems possible to solve with artificial intelligence in student PhD work.
- C3. To gain skills to program basic models with implemented artificial intelligence.
- C4. To gain skills related to search information about artificial intelligence methods, algorithms and best practices.
- C5. To gain up-to-date knowledge about achievements in Engineering with usage of artificial intelligence

3. Content

Detailed information about the course content, including topics and form of classes.

| No. | Topic | Number of hours | Form of classes |
|-----|-------|-----------------|-----------------|
|-----|-------|-----------------|-----------------|



| | | | |
|----|--|---|---------|
| 1 | Introduction to Artificial Intelligence: Basic concepts, history of AI, trends and direction of AI development. Ethics of AI. | 2 | lecture |
| 2 | Introduction to regression, classification and clustering. Discussion about basic concepts and challenges of AI. | 2 | lecture |
| 3 | Presentation of current Integrated Developer Environments, AI platforms, and programming packages for implementation of AI algorithms. | 2 | lecture |
| 4 | Review of methods, models and algorithms. Discussion about implementation and application. | 2 | lecture |
| 5 | Application of AI in Mechanical Engineering: Review of current state of the art achievements in Mechanical Engineering based on literature review. | 2 | lecture |
| 6 | Application of neural network in Mechanical Engineering: Detail case study. | 2 | lecture |
| 7 | Parallel Coding lecture: Input Data preparation | 2 | lecture |
| 8 | Parallel Coding lecture: Regression Models | 2 | lecture |
| 9 | Parallel Coding lecture: Classification Models | 2 | lecture |
| 10 | Parallel Coding lecture: Simple Artificial Neural Network Models | 2 | lecture |
| 11 | Parallel Coding lecture: Convolutional Neural Network Models | 2 | seminar |
| 12 | PhD students presentation and discussion 1: Presentation of a possible application of AI in area related to the planned PhD thesis or Literature review of AI usage with respect to planned PhD research field | 2 | seminar |
| 13 | PhD students presentation and discussion 2: Presentation of a possible application of AI in area related to the planned PhD thesis or Literature review of AI usage with respect to planned PhD research field | 2 | seminar |
| 14 | PhD students presentation and discussion 3: Presentation of a possible application of AI in area related to the planned PhD thesis or Literature review of AI usage with respect to planned PhD research field | 2 | seminar |
| 15 | PhD students presentation and discussion 4: Presentation of a possible application of AI in area related to the planned PhD thesis or Literature review of AI usage with respect to planned PhD research field | 2 | seminar |

4. Prerequisites

List of prerequisites relating to knowledge, skills and other competences for course participants.

1. Basic knowledge in:
 - a) Information Technology
 - b) Programming (Python 3.x)
 - c) Mathematics and statistics
2. Pre-defined research topic of PhD



3. General knowledge in related field of Engineering at the second level of studies

5. Learning outcomes

List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).

| Symbol | Learning outcome | |
|--------|--|-------------------------------------|
| | <i>KNOWLEDGE. Doctoral student knows and understands:</i> | |
| SzD_W3 | the main trends in the development of the scientific or artistic disciplines covered in the curricula; | <input checked="" type="checkbox"/> |
| SzD_W4 | research methodology; | <input checked="" type="checkbox"/> |
| SzD_W5 | the rules for the dissemination of scientific results, including in open access mode; | <input type="checkbox"/> |
| SzD_W6 | the fundamental dilemmas of modern civilization; | <input type="checkbox"/> |
| SzD_W7 | the legal and ethical conditions of scientific activity; | <input type="checkbox"/> |
| SzD_W8 | the economic and other relevant conditions of scientific activity; | <input type="checkbox"/> |
| SzD_W9 | basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results. | <input type="checkbox"/> |
| | <i>SKILLS. Doctoral student is able to:</i> | |
| SzD_U2 | use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively, - draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres; | <input checked="" type="checkbox"/> |
| SzD_U3 | communicate on specialised topics to the extent that they enable an active participation in the international scientific community; | <input type="checkbox"/> |
| SzD_U4 | disseminate research results, including in popular forms; | <input type="checkbox"/> |
| SzD_U5 | initiate debates and participate in a scientific discourse; | <input checked="" type="checkbox"/> |
| SzD_U6 | be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment; | <input type="checkbox"/> |
| SzD_U7 | plan and implement an individual or collective research or creative activity, including in an international environment; | <input type="checkbox"/> |
| SzD_U8 | independently plan and act for one's own development and inspire and organize the development of others; | <input type="checkbox"/> |
| SzD_U9 | plan classes or groups of classes and implement them using modern methods and tools. | <input type="checkbox"/> |
| | <i>SOCIAL COMPETENCES. Doctoral student is ready to:</i> | |



| | | |
|--------|---|-------------------------------------|
| SzD_K3 | fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way; | <input type="checkbox"/> |
| SzD_K4 | maintaining and developing the ethos of research and creative environments, including: - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection. | <input checked="" type="checkbox"/> |

6. Evaluation

Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.

Evaluation is based on PhD student's presentation during seminar meetings.

7. Teaching methods

Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.

- N1. Lecture
- N2. Presentation
- N3. Discussion
- N4. Self work
- N5. Parallel coding with teacher

8. Literature

List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.

- [1] I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning. MIT Press, 2016.
- [2] C. M. Bishop, Pattern Recognition and Machine Learning. Springer New York, 2016.
- [3] A. Zhang, Z. C. Lipton, M. Li, and A. J. Smola, Dive into Deep Learning. 2020.

9. Other remarks

Additional remarks, comments, (e.g., language of the course)

Python programming language is a base of AI considerations.