



## COURSE CARD

### 1. Basic information

|                                                                                                                                        |                                                                                                       |                                     |
|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------|
| Course name in English:                                                                                                                | Interdisciplinary applications of artificial intelligence not requiring a computer science background |                                     |
| Course name in Polish:                                                                                                                 | Interdyscyplinarne zastosowania sztucznej inteligencji niewymagające wykształcenia informatycznego    |                                     |
| Number of hours:                                                                                                                       | 30                                                                                                    |                                     |
| Type of course:                                                                                                                        | Elective course                                                                                       |                                     |
| Form of course:                                                                                                                        | mixed forms (combination of lecture, seminar and laboratory)                                          |                                     |
| Code of course:                                                                                                                        |                                                                                                       |                                     |
| Course leader:                                                                                                                         | Paweł Zyblewski                                                                                       |                                     |
| Faculty of the course leader:                                                                                                          | W4 Faculty of Information and Communication Technology                                                |                                     |
| Email address of the course leader:                                                                                                    | pawel.zyblewski@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, electrical engineering and space technologies                                 | <input checked="" type="checkbox"/> |
|                                                                                                                                        | Information and communication technology                                                              | <input type="checkbox"/>            |
|                                                                                                                                        | Biomedical engineering                                                                                | <input checked="" type="checkbox"/> |
|                                                                                                                                        | Chemical engineering                                                                                  | <input checked="" type="checkbox"/> |
|                                                                                                                                        | Civil engineering, geodesy and transport                                                              | <input checked="" type="checkbox"/> |
|                                                                                                                                        | Materials engineering                                                                                 | <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 checked="" type="checkbox"/> |
|                                                                                                                                        | Physical sciences                                                                                     | <input checked="" type="checkbox"/> |
|                                                                                                                                        | Management and quality studies                                                                        | <input checked="" type="checkbox"/> |

### 2. Objectives

The course is dedicated to PhD students from outside the discipline of information and communication technology. The course is intended to provide doctoral students without a computer science background with necessary knowledge of the possibilities of using artificial intelligence



methods (in particular – machine learning) in research projects relating to their individual research areas. Students, with the help of the instructor, will develop a research plan combining artificial intelligence with a scientific issue of their interest, conduct preliminary experiments within it and present their results on the forum.

### 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                                              | 2               | lecture         |
| 2   | Review of exemplary interdisciplinary machine learning applications in science       | 2               | lecture         |
| 3   | Synthetic data generation & building classification models                           | 2               | laboratory      |
| 4   | Machine learning evaluation protocols                                                | 2               | laboratory      |
| 5   | Statistical analysis for machine learning                                            | 2               | laboratory      |
| 6   | Deep learning basics                                                                 | 2               | laboratory      |
| 7   | Identification of an interdisciplinary research problem                              | 2               | laboratory      |
| 8   | Data acquisition and machine learning problem definition                             | 4               | laboratory      |
| 9   | Asking research questions & designing experimental evaluation                        | 4               | laboratory      |
| 10  | Answering research questions – conducting experiments and analysing results obtained | 6               | laboratory      |
| 11  | Seminar on lessons learned                                                           | 2               | seminar         |

### 4. Prerequisites

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

The course requires no prerequisites above overall understanding of using a personal computer for work (skills), an honest interest in the topic of artificial intelligence as a science (knowledge) and at least average personal culture (other competences). Recommended to use your own computer for easier integration into the work procedures.



## 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                     |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
|        | <b>KNOWLEDGE. Doctoral student knows and understands:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                     |
| 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 checked="" 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"/>            |
|        | <b>SKILLS. Doctoral student is able to:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                     |
| 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: <ul style="list-style-type: none"> <li>- define the purpose and subject of scientific research, formulate a research hypothesis,</li> <li>- develop research methods, techniques and tools, and use them creatively,</li> <li>- draw conclusions on the basis of scientific research;</li> </ul> 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 checked="" type="checkbox"/> |
| SzD_U4 | disseminate research results, including in popular forms;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <input checked="" 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 checked="" 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"/>            |
|        | <b>SOCIAL COMPETENCES. Doctoral student is ready to:</b>                                                                                                                                                                                                                                                                                                         |                                     |
| 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 | <p>maintaining and developing the ethos of research and creative environments, including:</p> <ul style="list-style-type: none"><li>- carrying out scientific activities in an independent manner,</li><li>- respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection.</li></ul> | <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.*

The evaluation of learning outcomes will be based on two equal factors: the assessment of the quality of work during laboratory classes and the assessment of the final seminar presentation.

## 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.*

Multimedia presentations, discussion, consultations during laboratory classes, own work, development of a project description.

## 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] Michalski, Ryszard S., Jaime G. Carbonell, and Tom M. Mitchell. Machine Learning: An Artificial Intelligence Approach (Volume I). Vol. 1. Elsevier, 2014.
- [2] Duda, Richard O., and Peter E. Hart. Pattern classification. John Wiley & Sons, 2006.
- [3] LeCun, Yann, Yoshua Bengio, and Geoffrey Hinton. "Deep learning." nature 521.7553 (2015): 436-444.
- [4] Minsky, Marvin. Society of mind. Simon and Schuster, 1988.



## 9. Other remarks

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

The default language of the course is English. If the entire class group consists of students who know a language other than English as their main communication tool, the lecturer may consent to conducting classes in this language, provided that he knows it in a way that allows for effective transfer of knowledge.