



## Subject card

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|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|
| Subject name and code                       | Knowledge Engineering Systems, PG_00069095                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                          |                                                                                                                                                                                                                                                                                                                                      |                                     |                                                                                                                                                              |            |     |
| Field of study                              | Automation, Robotics and Control Systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          |                                                                                                                                                                                                                                                                                                                                      |                                     |                                                                                                                                                              |            |     |
| Date of commencement of studies             | February 2026                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                          | Academic year of realisation of subject                                                                                                                                                                                                                                                                                              |                                     | 2026/2027                                                                                                                                                    |            |     |
| Education level                             | second-cycle studies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                          | Subject group                                                                                                                                                                                                                                                                                                                        |                                     |                                                                                                                                                              |            |     |
| Mode of study                               | Full-time studies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | Mode of delivery                                                                                                                                                                                                                                                                                                                     |                                     | at the university                                                                                                                                            |            |     |
| Year of study                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | Language of instruction                                                                                                                                                                                                                                                                                                              |                                     | Polish                                                                                                                                                       |            |     |
| Semester of study                           | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | ECTS credits                                                                                                                                                                                                                                                                                                                         |                                     | 3.0                                                                                                                                                          |            |     |
| Learning profile                            | general academic profile                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | Assessment form                                                                                                                                                                                                                                                                                                                      |                                     | assessment                                                                                                                                                   |            |     |
| Conducting unit                             | Department of Intelligent and Decision Support Systems -> Faculty of Electrical and Control Engineering -> Faculties of Gdańsk University of Technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                          |                                                                                                                                                                                                                                                                                                                                      |                                     |                                                                                                                                                              |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | dr inż. Tomasz Rutkowski                                                                                                                                                                                                                                                                                                             |                                     |                                                                                                                                                              |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | dr inż. Tomasz Rutkowski                                                                                                                                                                                                                                                                                                             |                                     |                                                                                                                                                              |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Lecture                                                  | Tutorial                                                                                                                                                                                                                                                                                                                             | Laboratory                          | Project                                                                                                                                                      | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 15.0                                                     | 0.0                                                                                                                                                                                                                                                                                                                                  | 15.0                                | 15.0                                                                                                                                                         | 0.0        | 45  |
|                                             | E-learning hours included: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |                                                                                                                                                                                                                                                                                                                                      |                                     |                                                                                                                                                              |            |     |
|                                             | eNauczanie source address: <a href="https://enauczanie.pg.edu.pl/2025/course/view.php?id=919">https://enauczanie.pg.edu.pl/2025/course/view.php?id=919</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                          |                                                                                                                                                                                                                                                                                                                                      |                                     |                                                                                                                                                              |            |     |
| Learning activity and number of study hours | Learning activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Participation in didactic classes included in study plan |                                                                                                                                                                                                                                                                                                                                      | Participation in consultation hours |                                                                                                                                                              | Self-study | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 45                                                       |                                                                                                                                                                                                                                                                                                                                      | 5.0                                 |                                                                                                                                                              | 25.0       | 75  |
| Subject objectives                          | Acquiring basic knowledge related to the knowledge engineering domain. Getting to know the selected knowledge engineering systems and methods. Acquiring the ability to properly use the known issues in the design and implementation of the expert system for the purposes of solving simple engineering and research problems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          |                                                                                                                                                                                                                                                                                                                                      |                                     |                                                                                                                                                              |            |     |
| Learning outcomes                           | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          | Subject outcome                                                                                                                                                                                                                                                                                                                      |                                     | Method of verification                                                                                                                                       |            |     |
|                                             | [K7_W05] has knowledge of artificial intelligence computing techniques, inference, learning and solution-finding methods in algorithmic terms applied to automation and robotics systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | The student is able to use selected methods of inference and artificial intelligence methods in projects. The student is able to use software tools such as: Matlab/ Simulink, RMSE, ECLiPSe Constraint Programming System.                                                                                                          |                                     | [SW1] Assessment of factual knowledge<br>[SW3] Assessment of knowledge contained in written work and projects                                                |            |     |
|                                             | [K7_K06] is aware of the impact of engineering activities on the quality of applied solutions and the environment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | The student is able to combine knowledge from different fields. Describes the implementation of rules using classical logic and fuzzy logic. Explains the logic programming paradigm and the logic programming paradigm with constraints. Designs and implements simple expert systems based on the rule-model expert system - RMSE. |                                     | [SK2] Assessment of progress of work<br>[SK5] Assessment of ability to solve problems that arise in practice<br>[SK3] Assessment of ability to organize work |            |     |
| Subject contents                            | <p>Course content – lecture</p> <p>Definitions and basic concepts in the field of knowledge engineering systems. Expert systems. Selected methods of knowledge acquisition and representation. Examples of inference methods. Inference through searching the solution space: genetic algorithm, evolutionary strategies, swarm algorithms. Selected graph search strategies. Selected computational intelligence methods in expert systems: reinforcement learning, automatic construction of a fuzzy inference system. The paradigm of constraint logic programming (Constraint Logic Programming). Elements of data fusion.</p> <p>Course content – laboratory</p> <p>Building simple expert systems using the skeletal rule-model expert system RMSE with an elementary and detailed knowledge base. Inference through searching the solution space evolutionary strategies/particle swarm. Reinforcement learning / Automatic construction of a fuzzy control system.</p> <p>Course content – project</p> <p>Development and verification of a rule-based and fuzzy control system. Inference through searching the solution space using the A* algorithm. Basic issues of constraint logic programming solving selected test problems in the ECLiPSe Constraint Programming System environment.</p> |                                                          |                                                                                                                                                                                                                                                                                                                                      |                                     |                                                                                                                                                              |            |     |

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| Prerequisites and co-requisites                                |                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |
| Assessment methods and criteria                                | Subject passing criteria                                                                                                                                                                                                                                                                                                      | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Percentage of the final grade |
|                                                                | Lecture test                                                                                                                                                                                                                                                                                                                  | 50.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 50.0%                         |
|                                                                | Laboratory reports                                                                                                                                                                                                                                                                                                            | 50.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 25.0%                         |
|                                                                | Projects reports                                                                                                                                                                                                                                                                                                              | 50.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 25.0%                         |
| Recommended reading                                            | Basic literature                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"><li>• Russell S., Norvig P. (2023). Sztuczna inteligencja. Nowe spojrzenie. Wydanie IV. Tom 1. Helion.</li><li>• Russell S., Norvig P. (2023). Sztuczna inteligencja. Nowe spojrzenie. Wydanie IV. Tom 2. Helion.</li><li>• Niederliński A. (2006). Regułowo-Modelowe Systemy Ekspertowe. PKJS.</li><li>• Jackson P. Introduction To Expert Systems (1998). Addison Wesley.</li><li>• Hand D., Mannila H., Smyth P. (2005). Eksploracja danych. WNT, Warszawa.</li><li>• Koronacki J., Ćwik J. (2005). Statystyczne systemy uczące się. WNT, Warszawa.</li></ul> |                               |
|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"><li>• Marriott K., Stuckey P.J. (1999), Programing with constraints. The MIT Press, London</li><li>• Piegat, A. (1999), Modelowanie i sterowanie rozmyte, Akademicka Oficyna Wydawnicza EXIT, Warszawa.</li></ul>                                                                                                                                                                                                                                                                                                                                                |                               |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |
| Example issues/<br>example questions/<br>tasks being completed | <ul style="list-style-type: none"><li>• Present and describe selected methods of knowledge representation</li><li>• Present and describe basic inference algorithms</li><li>• Present and briefly describe the structure of a typical expert system</li><li>• Briefly describe constraint logic programing paradigm</li></ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |
| Practical activites within the subject                         | Not applicable                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |

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