

**SYLLABUS**  
Academic year 2024-2025

Dean,  
Prof. Dr. Eng. Vasile-Ion Manta

**1. Program data**

|                                       |  |
|---------------------------------------|--|
| 1.1 Higher education institution      | “Gheorghe Asachi” Technical University of Iași |
| 1.2 Faculty                           | Automatic Control and Computer Engineering     |
| 1.3 Department                        | Computers                                      |
| 1.4 Field of studies                  | Computers and Information Technology           |
| 1.5 The cycle of studies <sup>1</sup> | Master   |
| 1.6 Study program                     | Artificial Intelligence                        |

**2. Subject data**

|                                |   |                           |   |                                     |                   |                                  |    |
|--------------------------------|---|---------------------------|---|-------------------------------------|-------------------|----------------------------------|----|
| 2.1 Name of the subject / Code | <b>Knowledge Representation and Reasoning</b> ( <i>Reprezentarea cunoștințelor și metode de raționament</i> ) / <b>AI.103</b> |                           |   |                                     |                   |                                  |    |
| 2.2 Course coordinator         | Lect. Dr. Eng. Corina Cîmpanu   |                           |   |                                     |                   |                                  |    |
| 2.3 Application instructor     | Lect. Dr. Eng. Corina Cîmpanu   |                           |   |                                     |                   |                                  |    |
| 2.4 Year of study <sup>2</sup> | 1   | 2.5 Semester <sup>3</sup> | 1 | 2.6 Type of assessment <sup>4</sup> | <i>Colloquium</i> | 2.7 Type of subject <sup>5</sup> | DS |

**3. Estimated total time of daily activities** (hours per semester)

|  |     |              |    |           |  |                 |    |              |           |
|--|-----|--------------|----|-----------|--|-----------------|----|--------------|-----------|
| 3.1 Number of hours per week   | 2   | 3.2 lectures | 1  | 3.3a sem. |  | 3.3b laboratory | 1  | 3.3c project |           |
| 3.4 Total hours in curriculum <sup>6</sup>   | 28  | 3.5 lectures | 14 | 3.6a sem. |  | 3.6b laboratory | 14 | 3.6c project |           |
| Distribution of the time fund <sup>7</sup>   |     |              |    |           |  |                 |    |              | No. hours |
| Study by textbook, course support, bibliography and notes                                    |     |              |    |           |  |                 |    |              | 20        |
| Additional documentation in the library, on specialist electronic platforms and in the field |     |              |    |           |  |                 |    |              | 28        |
| Preparation of seminars/labs/projects, assignments, reports and portfolios                   |     |              |    |           |  |                 |    |              | 20        |
| Tutorial <sup>8</sup>  |     |              |    |           |  |                 |    |              |           |
| Examinations <sup>9</sup>  |     |              |    |           |  |                 |    |              | 4         |
| Other activities:  |     |              |    |           |  |                 |    |              |           |
| 3.7 Total hours of individual study <sup>10</sup>  | 72  |              |    |           |  |                 |    |              |           |
| 3.8 Total hours per semester <sup>11</sup>   | 100 |              |    |           |  |                 |    |              |           |
| 3.9 Number of credits  | 4   |              |    |           |  |                 |    |              |           |

**4. Prerequisites** (where applicable)

|                              |  |
|------------------------------|--|
| 4.1 curriculum <sup>12</sup> | Computational Logic, Discrete Mathematics, Artificial Intelligence |
| 4.2 competences              |  |

**5. Conditions** (where applicable)

|   |  |
|---|--|
| 5.1 conducting the lectures <sup>13</sup>                       | <ul style="list-style-type: none"> <li>Blackboard, video projector</li> </ul>                        |
| 5.2 conducting the seminar / laboratory / project <sup>14</sup> | <ul style="list-style-type: none"> <li>Laboratory room with computers and Internet access</li> </ul> |

**6. Specific competences accumulated<sup>15</sup>**

<sup>1</sup> Bachelor / Master

<sup>2</sup> 1-4 for Bachelor's, 1-2 for Master's

<sup>3</sup> 1-8 for Bachelors, 1-3 for Masters

<sup>4</sup> Exam, colloquium or VP A/R – from the curriculum

<sup>5</sup> DF - fundamental subject, DID - subject in the field, DS - specialized subject or DC - complementary subject - from the education plan

<sup>6</sup> It is equal to 14 weeksx number of hours from point 3.1 (similar for 3.5, 3.6abc)

<sup>7</sup> The lines below refer to the individual study; the total is completed at point 3.7.

<sup>8</sup> Between 7 and 14 hours

<sup>9</sup> Between 2 and 6 hours

<sup>10</sup> The sum of the values on the previous lines, which refer to the individual study.

<sup>11</sup> The sum of the number of hours of direct teaching activity (3.4) and the number of hours of individual study (3.7); must be equal to the number of credits allocated to the subject (point 3.9)x 24 hours per credit.

<sup>12</sup> Mention the subjects that must be passed previously or equivalent

<sup>13</sup> Blackboard, video projector, flipchart, specific teaching materials, etc.

<sup>14</sup> Computing technique, software packages, experimental stands, etc.

|                                 |      | Number of credits assigned to the subject <sup>16</sup> :   | 4 | Distribution of credits per competences <sup>17</sup> |
|---------------------------------|------|---|---|---|
| <b>Professional competences</b> | CP1  | Gaining the ability of modelling simple application domains in a logic-based language   |   | 0.7   |
|                                 | CP2  | Understanding a reasoning service specific concepts   |   | 0.8   |
|                                 | CP3  |   |   | 0.8   |
|                                 | CP4  | Hands-on experience creating and using knowledge representations  |   | 0.8   |
|                                 | CP5  | Utilisation of tools and technologies.  |   | 0.4   |
|                                 | CP6  |   |   |   |
|                                 | CPS1 |   |   |   |
|                                 | CPS2 |   |   |   |
| <b>Transversal competences</b>  | CT1  | Legislation compliant application of the intellectual property rights and of the principles, norms and values of the professional ethics code within their own strategies for rigorous, effective and responsible work. |   | 0.1   |
|                                 | CT2  | Application of communication techniques and effective group work; developing empathy, interpersonal communication skills and assuming leadership roles/functions in a multi-specialized team.                           |   | 0.2   |
|                                 | CT3  | Creating opportunities for continuous training and the effective utilisation of learning resources and techniques for personal development.   |   | 0.2   |
|                                 | CTS  |   |   |   |

### 7. Objectives of the subject (resulting from the grid of specific competences accumulated)

|                                      |  |
|--------------------------------------|--|
| 7.1 General objective of the subject | Understand the concepts and techniques specific to data analytics.   |
| 7.2 Specific objectives              | <ul style="list-style-type: none"> <li>Understand the categories of problems approached by knowledge reasoning and the main steps to be taken in design.</li> <li>Learning to develop</li> </ul> |

### 8. Contents

| 8.1 Course <sup>18</sup>  | Teaching methods <sup>19</sup>  | Remarks  |
|---|---|--|
| <ol style="list-style-type: none"> <li><b>Introduction to Knowledge Representation and Reasoning:</b> <ul style="list-style-type: none"> <li>problematics of Knowledge Representation in the field of artificial intelligence;</li> <li>characteristics;</li> <li>overview of the course</li> </ul> </li> <li><b>Representation in First-Order Logic:</b> <ul style="list-style-type: none"> <li>syntax and semantics of first-order logic;</li> <li>unification and resolution;</li> <li>Herbrand theorem;</li> <li>Skolemization</li> </ul> </li> <li><b>Description Logics:</b> <ul style="list-style-type: none"> <li>syntax and semantics of description logics;</li> <li>reasoning with description logics;</li> <li>TBox and ABox reasoning</li> </ul> </li> <li><b>Ontologies:</b> <ul style="list-style-type: none"> <li>introduction; types; characteristics;</li> <li>OWL and OWL dialects;</li> <li>RDF;</li> <li>Linked Data and SPARQL;</li> <li>reasoning with ontologies</li> </ul> </li> <li><b>Automatic Theorem Proving:</b> <ul style="list-style-type: none"> <li>resolution theorem proving;</li> <li>other theorem proving technique;</li> </ul> </li> </ol> | <p>The presentation of course-related materials using video-projected PowerPoint slides.</p> <p>Drawing connections with concepts from adjacent disciplines from both undergraduate and graduate programs of study, and verifying how the novel elements introduced are assimilated.</p> <p>Discussing the presented methods using numerous case studies and relevant examples.</p> | <p>Annual revisions of course materials</p> <p>All materials are available on the course website</p> |

<sup>15</sup> Competencies from the G1 and G1bis Grids of the study program, adapted to the specifics of the subject, for which credits are allocated (www.rncis.ro or the faculty website)

<sup>16</sup> From the education plan

<sup>17</sup> The credits allocated to the subject are distributed on professional and transversal competences according to the specifics of the subject

<sup>18</sup> Chapter and paragraph headings

<sup>19</sup> Exposition, lecture, blackboard presentation of the studied issue, use of video projector, discussions with students (for each chapter, if applicable)

|  |  |  |
|--|--|--|
| <ul style="list-style-type: none"> <li>- <i>model checking;</i></li> <li>- <i>first-order theorem proving</i></li> </ul> <p><b>6. Non-Monotonic Reasoning:</b></p> <ul style="list-style-type: none"> <li>- <i>default reasoning;</i></li> <li>- <i>autoepistemic logic;</i></li> <li>- <i>circumscription.</i></li> </ul> <p><b>TOTAL: 14 hours</b></p> |  |  |
|--|--|--|

**Course references:**

1. Brachman R.J., Levesque H.J., (2004). Knowledge Representation and Reasoning, in The Morgan Kaufmann Series in Artificial Intelligence, Morgan Kaufmann, Elsevier.
2. Croitoru M., Marquis P., Rudolph S., Stapleton G., (2018). Graph Structures for Knowledge Representation and Reasoning, in Lecture Notes in Computer Science, 10775, Springer International Publishing.
3. Kutsch S., (2021). Knowledge Representation and Inductive Reasoning using Conditional Logic and Sets of Ranking Functions, in Dissertations in Artificial Intelligence.

|   |   |                               |
|---|---|-------------------------------|
| 8.2a Seminar  | Teaching methods <sup>20</sup>                                | Remarks                       |
| 8.2b Laboratory   | Teaching methods <sup>21</sup>                                | Remarks                       |
| <ol style="list-style-type: none"> <li>1. The main in developing data analytics applications. (2h)</li> <li>2.</li> </ol> <p><b>TOTAL: 14 hours</b></p> | General and individual explanations, individual computer work | Annual revisions of materials |
| 8.2c Project  | Teaching methods <sup>22</sup>                                | Remarks                       |

**Applications references:**

**9. Corroboration of the contents of the subject with the expectations of representatives of the epistemic community, professional associations and representative employers in the field related to the program<sup>23</sup>**

- The course content was created in accordance with the syllabuses of related courses from prestigious international universities.
- The course content aims to prepare the students for research-advanced design projects and was drafted to be up to date with the relevant open problems in recent research.
- The course content illustrates the utility of data analytics in several complex applications.

**10. Evaluation**

| Type of activity | 10.1 Evaluation criteria   | 10.2 Evaluation methods   |      | 10.3 Weight in the final grade |
|------------------|--|---|------|--------------------------------|
| 10.4a Colloquium | Acquired theoretical and practical knowledge (quantity, correctness, accuracy)   | Periodic tests <sup>24</sup> :  |      | 70%<br>(minimum 5)             |
|                  |  | Homework:   |      |                                |
|                  |  | Other activities <sup>25</sup> :  |      |                                |
|                  |  | Final evaluation:<br>Written test, with problems and questions related to some study cases  | 100% |                                |
| 10.4b Seminar    |  |   |      |                                |
| 10.4c Laboratory | Knowledge of equipment, how to use specific tools; evaluation of tools or achievements, processing and interpretation of results | <ul style="list-style-type: none"> <li>• Written questionnaire</li> <li>• Oral presentation</li> <li>• Laboratory reports</li> <li>• Practical demonstration</li> </ul> |      | 30%<br>(minimum 5)             |
| 10.4d Project    |  |   |      |                                |

<sup>20</sup> Discussions, debates, presentation and/or analysis of papers, solving exercises and problems

<sup>21</sup> Practical demonstration, exercise, experiment

<sup>22</sup> Case study, demonstration, exercise, error analysis, etc.

<sup>23</sup> The connection with other subjects, the usefulness of the subject on the labor market

<sup>24</sup> The number of tests and the weeks in which they will be held will be specified.

<sup>25</sup> Scientific circles, professional competitions, etc.

10.5 Minimum performance standard<sup>26</sup>: grade 5 in the colloquium and applications.

Date of completion,  
10 January 2024

Signature of course coordinator,  
Lect. Dr. Eng. Corina Cîmpanu

Signature of application instructor,  
Lect. Dr. Eng. Corina Cîmpanu

Date of approval in the department,

Director of Department,  
Assoc. Prof. Dr. Eng. Andrei Stan

---

<sup>26</sup>*The minimum performance standard from the competences grid of the study program is customized to the specifics of the subject, if applicable.*