

## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                    |                                                          |                                         |                                     |                                                                          |            |     |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|-------------------------------------|--------------------------------------------------------------------------|------------|-----|
| Subject name and code                       | NoSQL Databases, PG_00208793                                                                                                                                                                                                                                                                                                                                                                       |                                                          |                                         |                                     |                                                                          |            |     |
| Field of study                              | Mathematics                                                                                                                                                                                                                                                                                                                                                                                        |                                                          |                                         |                                     |                                                                          |            |     |
| Date of commencement of studies             | October 2025                                                                                                                                                                                                                                                                                                                                                                                       |                                                          | Academic year of realisation of subject |                                     | 2026/2027                                                                |            |     |
| Education level                             | Master's studies                                                                                                                                                                                                                                                                                                                                                                                   |                                                          | Subject group                           |                                     | Obligatory subject group in the field of study<br>Optional subject group |            |     |
| Mode of study                               | full-time studies                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | Mode of delivery                        |                                     | at the university                                                        |            |     |
| Year of study                               | 2                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | Language of instruction                 |                                     | Polish                                                                   |            |     |
| Semester of study                           | 4                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | ECTS credits                            |                                     | 6.0                                                                      |            |     |
| Learning profile                            | academic                                                                                                                                                                                                                                                                                                                                                                                           |                                                          | Assessment form                         |                                     | exam                                                                     |            |     |
| Conducting unit                             |                                                                                                                                                                                                                                                                                                                                                                                                    |                                                          |                                         |                                     |                                                                          |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                 |                                                          | dr hab. Rafał Lutowski                  |                                     |                                                                          |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                           |                                                          |                                         |                                     |                                                                          |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                        | Lecture                                                  | Tutorial                                | Laboratory                          | Project                                                                  | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                              | 30.0                                                     | 0.0                                     | 30.0                                | 0.0                                                                      | 0.0        | 60  |
|                                             | E-learning hours included: 0.0                                                                                                                                                                                                                                                                                                                                                                     |                                                          |                                         |                                     |                                                                          |            |     |
| 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                                                                                                                                                                                                                                                                                                                                                                              | 60                                                       |                                         | 10.0                                |                                                                          | 80.0       | 150 |
| Subject objectives                          | <p>Familiarizing students with the following topics:</p> <ul style="list-style-type: none"><li>• basic types of non-relational databases;</li><li>• application areas of different database models;</li><li>• sample NoSQL database products;</li><li>• differences between non-relational databases;</li><li>• differences between non-relational data models and the relational model.</li></ul> |                                                          |                                         |                                     |                                                                          |            |     |

| Learning outcomes | Course outcome                                                                                                                                                                                                                                                                               | Subject outcome                                                                                                                                                                                                                                               | Method of verification                                                                                                                       |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
|                   | [MATMU2_U04] is able, at an advanced level and including modern mathematics, to apply and present, orally and in writing, methods of at least one selected branch of mathematics                                                                                                             | The student is able to apply and communicate (orally and in writing) methods of selected non-relational database models at an advanced level, including their mathematical foundations.                                                                       | [SU2] presentation/project/paper/report                                                                                                      |
|                   | [MATMU2_U07] is able to define his/her interests and develop them; in particular, is able to establish contact with specialists in his/her field, e.g. understand their lectures intended for young mathematicians                                                                           | The student knows the English nomenclature used in the area of non-relational databases.                                                                                                                                                                      | [SU4] test/exam - oral or written<br>[SU5] implementation of a problem task<br>[SU8] observation of student's independent or team work       |
|                   | [MATMU2_U03] can understand mathematical texts of various types from selected fields of mathematics                                                                                                                                                                                          | The student uses product documentation and Internet resources to build a database.                                                                                                                                                                            | [SU2] presentation/project/paper/report<br>[SU5] implementation of a problem task<br>[SU8] observation of student's independent or team work |
|                   | [MATMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct                                                                                                                                           | The student can work in a group, formulate his/her own conclusions, listen to the arguments of others and jointly build a strategy for solving the problems posed.                                                                                            | [SK8] observation of student's independent or team work                                                                                      |
|                   | [MATMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning                                                                                                                                                                                | The student understands the role and importance of mathematical reasoning in the analysis and design of non-relational database models.                                                                                                                       | [SW2] presentation/project/paper/report                                                                                                      |
|                   | [MATMU2_K01] is willing to acknowledge the limitations of his or her own knowledge and is willing to pursue further education                                                                                                                                                                | The student uses product documentation and Internet resources to build a database.                                                                                                                                                                            | [SK1] oral statement/conversation/discussion<br>[SK8] observation of student's independent or team work                                      |
|                   | [MATMU2_U01] can construct mathematical reasoning: prove theorems and refute hypotheses through construction and selection of counterexamples                                                                                                                                                | The student knows and understands the possibilities and limitations of distributed database systems.                                                                                                                                                          | [SU1] oral statement/conversation/discussion<br>[SU4] test/exam - oral or written                                                            |
|                   | [MATMU2_K02] is ready to precisely formulate questions to deepen his/her understanding of a given topic or find missing elements of reasoning                                                                                                                                                | Based on individual and team analysis of the problem, the student selects tools appropriate for modeling and working with the database.                                                                                                                       | [SK2] presentation/project/paper/report<br>[SK5] implementation of a problem task                                                            |
|                   | [MATMU2_W01] knows and understands in-depth the theory of selected areas of mathematics                                                                                                                                                                                                      | The student has an in-depth understanding of the mathematical foundations of non-relational database models (in particular, graph structures, set theory, and data algebras) and can apply this knowledge in the analysis and design of data storage systems. | [SW4] test/exam - oral or written<br>[SW2] presentation/project/paper/report                                                                 |
|                   | [MATMU2_U06] is able to apply methods and examples from a selected field of mathematics in related fields                                                                                                                                                                                    | The student knows how to choose a data model that is proper for solving a given problem.                                                                                                                                                                      | [SU2] presentation/project/paper/report<br>[SU4] test/exam - oral or written<br>[SU5] implementation of a problem task                       |
|                   | [MATMU2_K06] is ready to formulate opinions on basic mathematical issues                                                                                                                                                                                                                     | The student evaluates the suitability of individual non-relational database models for solving a specific problem.                                                                                                                                            | [SK2] presentation/project/paper/report<br>[SK4] test/exam - oral or written                                                                 |
|                   | [MATMU2_U05] can perform proofs in a selected field and, if necessary, also use tools from other areas of mathematics                                                                                                                                                                        | Based on the analysis of the problem and available data, the student selects the appropriate database model to solve it.                                                                                                                                      | [SU6] demonstration of practical skills<br>[SU8] observation of student's independent or team work                                           |
|                   | [MATMU2_W03] knows and understands in-depth a selected field of theoretical or applied mathematics and is able to understand the formulations of issues in this field that are still at the research stage and knows the connections of issues in this field with other areas of mathematics | The student understands the theoretical foundations of non-relational databases, interprets contemporary research problems, and recognizes their connections with other areas of mathematics.                                                                 | [SW4] test/exam - oral or written<br>[SW5] implementation of a problem task                                                                  |

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|                                                                | Course outcome                                                                                                                                                                                                                                                                                                                                                         | Subject outcome                                                                                                                                                                                                                                                                                                                                                                                  | Method of verification                                                                                                                       |
|                                                                | [MATMU2_K05] is ready to independently search for information in literature, also in foreign languages                                                                                                                                                                                                                                                                 | The student uses product documentation and Internet resources to build a database.                                                                                                                                                                                                                                                                                                               | [SK2] presentation/project/paper/report<br>[SK5] implementation of a problem task<br>[SK8] observation of student's independent or team work |
| Subject contents                                               | <div>1.<br/>Basic properties of the relational model and the origins of NoSQL.</div> <div>2.<br/>Additional modules for working with text data in relational databases.</div> <div>3.<br/>CAP theorem.</div> <div>4.<br/>Basic types of non-relational databases and their application areas.</div> <div>5.<br/>Discussion of selected non-relational databases.</div> |                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                              |
| Prerequisites and co-requisites                                |                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                              |
| Assessment methods and criteria                                | Subject passing criteria                                                                                                                                                                                                                                                                                                                                               | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                | Percentage of the final grade                                                                                                                |
|                                                                | exam                                                                                                                                                                                                                                                                                                                                                                   | 50.0%                                                                                                                                                                                                                                                                                                                                                                                            | 40.0%                                                                                                                                        |
|                                                                | homeworks                                                                                                                                                                                                                                                                                                                                                              | 80.0%                                                                                                                                                                                                                                                                                                                                                                                            | 30.0%                                                                                                                                        |
|                                                                | presentation                                                                                                                                                                                                                                                                                                                                                           | 50.0%                                                                                                                                                                                                                                                                                                                                                                                            | 30.0%                                                                                                                                        |
| Recommended reading                                            | Basic literature                                                                                                                                                                                                                                                                                                                                                       | <div>1.<br/>G. Harrison, Next generation databases, Apress Berkeley, CA, 2015</div> <div>2.<br/>P. Lake, P. Crowther, Concise Guide to Databases, Springer London, 2013</div> <div>3.<br/>A. Meier, M. Kaufmann, SQL &amp; NoSQL Databases, Springer Vieweg Wiesbaden, 2019</div> <div>4.<br/>L. Perkins, E. Redmond, R. Wilson, Seven databases in seven weeks, Pragmatic Bookshelf, 2018</div> |                                                                                                                                              |
|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                               | not applicable                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                              |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                              |
| Example issues/<br>example questions/<br>tasks being completed | <div>1.<br/>Explain NRW notation and its impact on consistency and availability.</div> <div>2.<br/>List the nonrelational database models and point out the differences between them.</div> <div>3.<br/>Explain the reasons for choosing a specific data model and present the steps for creating and working with a database.</div>                                   |                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                              |
| Work placement                                                 | Not applicable                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                              |

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