




Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

6 credits	30.0 h + 30.0 h	Q2
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Teacher(s)	Nijssen Siegfried ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	<ul style="list-style-type: none"> • Data Base Management Systems (objectives, requirements, architecture). • The Relational data model (formal theory, first-order logic, constraints). • Conceptual models (entity-relationship, object role modeling). • Logical database design (normal forms & normalization, ER-To-Relational) • Physical database design and storage (tables and keys, indexes, file structures). • Querying databases (Relational Algebra, Relational Calculus, data structures, query optimization, SQL) • ACID properties (Atomicity, Consistency, Isolation, Durability), Concurrency Control, Recovery techniques. • Programming database applications (JDBC, Database Cursors, Object-Relational Mapping). • Recent or more advanced trends in the database field (object-oriented databases, Big Data, NoSQL, NewSQL)
Aims	<p>Given the learning outcomes of the "Master in Computer Science and Engineering" program, this course contributes to the development, acquisition and evaluation of the following learning outcomes:</p> <ul style="list-style-type: none"> • INFO1.1-3 • INFO2.1-4 • INFO4.1-4 • INFO5.1-5 • INFO6.1, INFO6.4 <p>Given the learning outcomes of the "Master [120] in Computer Science" program, this course contributes to the development, acquisition and evaluation of the following learning outcomes:</p> <ul style="list-style-type: none"> • SIN1.M2 • SIN2.1-4 • SIN4.1-4 • SIN5.1-5 • SIN6.1, SIN6.4 <p>Given the learning outcomes of the "Master [60] in Computer Science" program, this course contributes to the development, acquisition and evaluation of the following learning outcomes:</p> <ul style="list-style-type: none"> • 1SIN1.M2 • 1SIN2.1-4 • 1SIN4.1-4 • 1SIN5.1-5 • 1SIN6.1, 1SIN6.4 <p>Students completing this course successfully will be able to :</p> <ul style="list-style-type: none"> • explain the scenarios in which using a database is more convenient than programming with data files; • explain the characteristics of the database approach, where they come from and contrast them with current trends in the database field • identify and describe the main functions of a database management system; • categorize conceptual, logical and physical data models based on the concepts they provide to describe the database structure; • understand the main principles and mathematical theory of the relational approach to database management; • design databases using a systematic approach, from a conceptual model through a logical level (i.e., a relational schema) into a physical model (i.e., tables and indexes); • Use SQL (DDL) to implement a relational database schema and distinguish from SQL facilities with respect to the logical vs. physical distinction. • query relational databases using SQL (DML) and contrast SQL with relational theory . • optimize the performance of databases. • understand the benefits and drawbacks of NoSQL databases. • use relational databases either directly or from a conventional programming language.

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Evaluation methods	<p>Due to the COVID-19 crisis, the information in this section is particularly likely to change.</p> <p>An exam will be organized at the end of the semester. Depending on the health situation, this exam may be done either on campus, online, using a take-home exam, or a combination of these modalities. In case of doubt about the final grade for the exam, the teacher reserves the right to ask a student to pass a complementary oral exam.</p> <p>If the grade for the exam is ≥ 10, the grade is calculated following a 75% / 25% rule (final written exam / participation and grade obtained to practical missions during the semester). 25% from practical missions applies in september too. If the exam is < 10, the grade is determined 100% by the exam.</p>
Teaching methods	<p>Due to the COVID-19 crisis, the information in this section is particularly likely to change.</p> <p>The objectives are organized along three main axes:</p> <ul style="list-style-type: none"> • Understand: both the historical context, and recent challenges and developments in the database field; relational theory, why is has been invented and how it fits in practice; implementation techniques and major algorithms for data organization, query and transaction processing. • Design: from conceptual modeling (e.g. Entity-Relationship, UML) down to physical database tuning (e.g. indexes, query plans), through logical database design (e.g. functional dependencies, normal forms, normalization algorithms) and reasoning (relational algebra, views and constraints). • Use: installing and configuring database management systems, creating and tuning databases, using query languages in practice (e.g. SQL), connecting to databases (e.g. call interfaces, ORMs), integrating database systems in software designs. <p>Theory and practice are acquired by students along those three axes as follows:</p> <ul style="list-style-type: none"> • Theory is dispensed in the traditional way, through lectures during the second quarter. The theoretical course follows Elmasri & Navathe's textbook [EN10]. • Practice is obtained by participating in 4 projects. These projects are either done individually, in groups of 2 or in larger groups. • Both theory and pratical missions are dispensed in English. <p>Even though preference will be given to face-to-face teaching sessions, depending on the health situation and the number of students enrolled, other forms of teaching (online, co-modal or hybrid) may be considered.</p>
Content	<ul style="list-style-type: none"> • Introduction to the entity-relationship model, • Bases of the relational model: data structures and algebra, • Logic-based relational languages to define and manipulate data, • Critical study of the SQL language, • Query optimization, • Database application programming, • Functions and architecture of database management systems, • Management of concurrent database accesses and associated techniques of recovery after failures, • NoSQL databases: graph databases, key-value stores, document stores, • Overview of other databases: spatio-temporal databases, data warehouses, OLAP
Inline resources	<p>https://moodleucl.uclouvain.be/course/view.php?id=5173</p>
Bibliography	<ul style="list-style-type: none"> • Ramez Elmasri and Shamkant Navathe Fundamentals of Database Systems. Addison-Wesley Publishing Company, USA, 7th edition, 2010. • Chris J. Date. An Introduction to Database Systems. Pearson Addison-Wesley, Boston, MA, 8 edition, 2004. • Hugh Darwen, An Introduction To Relational Database Theory, 3th Edition, Bookboon, 2009 • Jean-Luc Hainaut, Bases de Données, Concepts, Utilisation et Développement, 2e Edition, Dunod, 2012 • T.M. Connolly and C.E. Begg. Database Systems: A Practical Approach to Design, Implementation, and Management. Number v. 1 in International computer science series. Addison-Wesley, 2005.
Other infos	<p>Background:</p> <ul style="list-style-type: none"> • LSINF1225 or LINFO1225 : Basic knowledge of database management, • LSINF1121 or LINFO1121 : good abilities in programming.
Faculty or entity in charge	<p>INFO</p>

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Data Science : Statistic	DATS2M	6		
Master [120] in Computer Science and Engineering	INFO2M	6		
Master [120] in Computer Science	SINF2M	6		
Master [120] in Mathematical Engineering	MAP2M	6		
Master [120] in Agricultural Bioengineering	BIRA2M	6		
Master [120] in Forests and Natural Areas Engineering	BIRF2M	6		
Master [120] in Environmental Bioengineering	BIRE2M	5		
Master [120] in Data Science Engineering	DATE2M	6		
Master [120] in Data Science: Information Technology	DATI2M	6		
Master [120] in Biomedical Engineering	GBIO2M	6		
Master [60] in Computer Science	SINF2M1	6		