UCLouvain

lingi2172

2020

Databases

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

Teacher(s)	Nijssen Siegfried ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	• 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	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: • INFO1.1-3 • INFO2.1-4 • INFO4.1-4 • INFO5.1-5 • INFO6.1, INFO6.4 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: • SINF1.M2 • SINF2.1-4 • SINF4.1-4 • SINF5.1-5 • SINF6.1, SINF6.4 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: • 1SINF1.M2 • 1SINF2.1-4 • 1SINF4.1-4 • 1SINF5.1-5 • 1SINF6.1, 1SINF6.4 Students completing this course successfully will be able to : • 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	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** 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. 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.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The objectives are organized along three main axes: • 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. Theory and practice are acquired by students along those three axes as follows: • 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. 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.
Content	• 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	https://moodleucl.uclouvain.be/course/view.php?id=5173
Bibliography	• 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	Background: • LSINF1225 or LINFO1225 : Basic knowledge of database management, • LSINF1121 or LINFO1121 : good abilities in programming.
Faculty or entity in charge	INFO

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		