

Course guide

270212 - BD - Databases

Last modified: 19/07/2023

Unit in charge: Barcelona School of Informatics
Teaching unit: 747 - ESSI - Department of Service and Information System Engineering.

Degree: BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: ANTONI URPI TUBELLA

Others: Primer quadrimestre:
JOAQUIM MOTGER DE LA ENCARNACION - 13
MARIA CARME QUER BOSOR - 12
ANTONI URPI TUBELLA - 11, 12, 13

PRIOR SKILLS

To know the data structures in internal memory. To be able to implement programs of medium complexity.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

Generical:

CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

Transversal:

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Basic:

CB2. That the students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and problem solving within their area of ??study.

CB3. That students have the ability to gather and interpret relevant data (usually within their area of ??study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

TEACHING METHODOLOGY

Theory classes / problems

Autonomous learning: To prepare classes the student may have to read and understand materials and / or notes indicated by the teacher. Afterwards in class, the student needs to review and solve exercises on the topic of study.

Theory classes In lectures the teachers present a part of the contents of the subject. Normally, teachers use transparencies that students would be advised to obtain before classes, in order to do a better follow-up.

Problems classes In problem classes, students solve exercises about content presented during theory classes. These exercises are done in teams of two students according to a cooperative learning technique.

Laboratory classes

Autonomous learning: The contents that are worked on in the laboratory classes will be studied autonomously by the students. Each week before in the laboratory class students will have a homework assignment that will end with the resolution of a moodle / LearnSQL quiz.

Laboratory classes: Class work will be in teams of 2 students. Students have the opportunity to share doubts with their teammate about the work they have done at home, and if necessary, to ask questions that are not resolved to the teacher. Next the students do the activities that the teacher has indicated and finally solve the class questionnaire.

LEARNING OBJECTIVES OF THE SUBJECT

- 1.To have a general vision of what a database is, what is a database model, the types of users of databases and which are the categories of databases languages.
- 2.To know the objectives of a database management system and their architecture.
- 3.To understand the database relational model, their languages (SQL and relational algebra) and the usual components of a relational database.
- 4.To be able to define, create and manipulate usual relational database components.
- 5.To be able to build programs to manage relational databases.
- 6.To be able to apply some defined quality criteria to choose between several SQL statements, database components, or programs, that manage a database and implement the same functionality.
- 7.To have an overview of data warehouses and multidimensional databases, and to know how to express OLAP statements via SQL.
- 8.To be able to apply some defined quality criteria to choose between several SQL statements, database components, or programs, that manage a database and implement the same functionality.
- 9.To have a general vision of how the design of a database should be included in a software development process.
- 10.To be able to obtain a database relational model starting from a conceptual models in UML.
- 11.To know the concept of database transaction and its implications.
- 12.To know how to identify the different types of interference that can occur between database transactions and their relationship with the isolation levels that defines the SQL Standard.
- 13.To know the locking concurrency control technique.
- 14.To know the possible physical structures for storing data and its implications for in terms of efficiency.
- 15.To know the access methods to data and its implications in terms of efficiency.

STUDY LOAD

Type	Hours	Percentage
Hours small group	30,0	20.00
Self study	90,0	60.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

Introduction

Description:

Database concept. Database design and models. Types of users. Categories of languages. Concept of database management system (DBMS). Desirable goals for databases that DBMSs must provide. Architecture of the DBMS.

The relational model

Description:

Objectives and origin. Structure of data with which the relational databases are built. Operations provided by the relational model to manipulate and query the data. Integrity rules to be met by the data in a relational database.

Languages: Relational algebra and SQL

Description:

Introduction. Relational algebra: operations of relational algebra; queries. SQL: table creation; insertion, deletion and modification of rows in a table; queries on a database. Considerations about the implementation of queries.

Logical database components

Description:

Concept of a logical database component: data and control components. Introduction to the data components: schemes, tables and domains, assertions and views. Introduction to the control components: stored procedures, triggers and privileges.

Data Warehouses and OLAP

Description:

Introduction to data warehouses and multidimensional databases. SQL Extensions for OLAP

SQL Programming

Description:

Programming in Java and JDBC. Considerations and quality criteria in the design and implementation of programs that access databases.

Introduction to the design of relational databases

Description:

Stages in the design of a database. Introduction to the understanding of simple UML conceptual models. Translation of simple UML conceptual models to relational model databases

Transactions and concurrency

Description:

Concept of transaction. ACID properties of transactions. Interference between transactions. Serializability. Recoverability. Concurrency control techniques. Isolation Levels. Locking and isolation levels.

Physical storage structures, access methods and optimization

Description:

Introduction. Access methods to perform queries and updates in a database. Costs of the different access methods. Introduction to Query Optimization

ACTIVITIES

Study of the database introduction

Specific objectives:

1, 2

Related competencies :

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Full-or-part-time: 8h

Theory classes: 2h

Laboratory classes: 2h

Self study: 4h

Study of the databases introduction

Specific objectives:

3

Related competencies :

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

CB2. That the students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and problem solving within their area of study.

CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

Full-or-part-time: 4h

Theory classes: 2h

Self study: 2h

Study of the data logical components

Specific objectives:

3, 4, 6

Related competencies :

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

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Full-or-part-time: 11h

Theory classes: 5h

Self study: 6h

Study of the introduction to design of relational databases

Specific objectives:

9, 10

Related competencies :

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Full-or-part-time: 8h

Theory classes: 4h

Self study: 4h

Study of transactions and concurrency

Specific objectives:

11, 12, 13

Related competencies :

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Full-or-part-time: 11h

Theory classes: 5h

Self study: 6h

Study of storage, access methods and optimization

Specific objectives:

14, 15

Related competencies :

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CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Full-or-part-time: 17h

Theory classes: 7h

Self study: 10h

Study of the Relational Algebra and SQL

Specific objectives:

3, 4, 6

Related competencies :

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

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Full-or-part-time: 25h

Laboratory classes: 12h

Self study: 13h

Study of data warehouses and in OLAP

Specific objectives:

6, 7, 8

Related competencies :

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CB3. That students have the ability to gather and interpret relevant data (usually within their area of ??study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

Full-or-part-time: 6h

Laboratory classes: 2h

Self study: 4h

Study of stored procedures and triggers

Specific objectives:

3, 4, 6

Related competencies :

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

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CB3. That students have the ability to gather and interpret relevant data (usually within their area of ??study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

Full-or-part-time: 12h

Laboratory classes: 8h

Self study: 4h

Programming with SQL - JDBC

Specific objectives:

4, 5, 6

Related competencies :

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

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Full-or-part-time: 12h

Laboratory classes: 6h

Self study: 6h

Partial exam

Specific objectives:

1, 2, 3, 4, 6, 7, 9, 10

Related competencies :

CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

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Full-or-part-time: 18h

Guided activities: 2h

Self study: 16h

Final Exam

Specific objectives:

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Related competencies :

CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

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CB3. That students have the ability to gather and interpret relevant data (usually within their area of ??study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

Full-or-part-time: 18h

Guided activities: 3h

Self study: 15h

Reviews and resolution of doubts about the exams

GRADING SYSTEM

The qualification of the technical competences is based on:

- NL - Active participation in laboratory sessions. The classes in which students have participated will be taken into account in case of successfully submission of the exercises proposed in the class through LearnSQL. The grade will be calculated in proportion to the classes in which the students have actively participated.

- NEP - Partial exam grade. The partial exam includes the topics: 1, 2, 3, 4 (no stored procedures nor triggers), 5 and 7

- NEF - Final exam grade. The final exam includes the following topics: 4 (only stored procedures and triggers), 6, 8 and 9.

- $NF = 0.45 * NEP + 0.45 * NEF + 0.1 * NL$

- For students who can take the re-assessment, the re-assessment exam mark will replace NEF and NEP. In any case, the final mark will be the maximum between the ordinary mark and the re-evaluation mark.

BIBLIOGRAPHY

Basic:

- Garcia-Molina, Hector; Ullman, Jeffrey D; Widom, JenniferJ. Database systems: the complete book. Second edition, Pearson new international edition. Harlow, Essex: Pearson Education Limited, [2014]. ISBN 9781292024479.

- Ramakrishnan, R.; Gehrke, J. Database management systems. 3rd ed. McGraw-Hill, 2003. ISBN 0071151109.

- Melton, J.; Simon, A.R. SQL: 1999: understanding relational, language components. Morgan Kaufmann, 2002. ISBN 1558604561.

Complementary:



- Gulutzan, P.; Pelzer, T. SQL-99 complete, really. R & D books, 1999. ISBN 0879305681.
- Liu, L.; Özsu, M.T. Encyclopedia of database systems [on line]. New York ; London: Springer, 2009 [Consultation: 27/07/2023]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/referencework/10.1007/978-0-387-39940-9>. ISBN 9780387399409.
- Melton, J.; Eisenberg, A. Understanding SQL and Java together: a guide to SQLJ, JDBC, and related technologies. Morgan Kaufmann Publishers, 2000. ISBN 1558605622.