Course guide
270010 - BD - Databases

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

Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Compulsory subject).

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

LECTURER

Coordinating lecturer: MARIA CARME QUER BOSOR - ANTONI URPI TUBELLA

Others:

Primer quadrimestre:
BESIM BILALLI - 32
XAVIER BURGUÉS ILLA - 13
PAU CARBONELL VIVES - 41, 51
JORDI CASANOVAS MUÑOZ - 11, 12, 13
CARME MARTIN ESCOFET - 11, 21, 22, 23, 51, 52, 53
MARC MOLINUEVO GARCIA - 41, 53
SERGI NADAL FRANCESCH - 31, 32, 33
VICENTE PICORNELL ALANDETE - 12, 22
MARIA CARME QUER BOSOR - 31, 33, 41, 42
ANNA QUERALT CALAFAT - 23, 31
SANTIAGO RIVAS CONTRERAS - 42, 52
FRANCISCO MIGUEL RODERO BLÁNQUEZ - 33, 51
ANTONI URPI TUBELLA - 21, 31, 53

Segon quadrimestre:
ALBERTO ABELLO GAMAZO - 13
PAU CARBONELL VIVES - 42
MARÍA JOSÉ CASAÑ GUERRERO - 14
MARIA CARME QUER BOSOR - 14, 41, 42, 43
SANTIAGO RIVAS CONTRERAS - 41, 43
ANTONI URPI TUBELLA - 11, 12, 13, 14

PRIOR SKILLS

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

REQUIREMENTS

- Prerequisite PRO1
- Prerequisite PRO2

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CT2.2. To demonstrate knowledge and capacity to apply the characteristics, functionalities and structure of data bases, allowing an adequate use, design, analysis and implementation of applications based on them.
CT2.3. To design, develop, select and evaluate computer applications, systems and services and, at the same time, ensure its reliability, security and quality in function of ethical principles and the current legislation and normative.
CT2.4. To demonstrate knowledge and capacity to apply the needed tools for storage, processing and access to the information system, even if they are web-based systems.
CT8.6. To demonstrate the comprehension of the importance of the negotiation, effective working habits, leadership and communication skills in all the software development environments.
CT8.7. To control project versions and configurations.

Generical:
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

TEACHING METHODOLOGY

Theory/Problem classes (2.3 hours per week).
Independent learning: To prepare the classes, the students may have to read and understand some materials stated by the teacher. After classes, the student have to review and do exercices about the subject studied in class.
Theory classes. In the theory classes the teacher present a part of the contents of the course. Usually the teachers use slides, which the students should bring to the classes.
Problem classes. In the problem classes the students solve exercises on the content presented during the theory classes.

Laboratory classes (1.7 hours per week).
Independent learning activities: The contents that are the aim of the laboratory classes are studied independently and individually by students at home. Each week before the lab class students have home work to do that ends with the resolution of a questionnaire of moodle / LearnSQL.
Laboratory classes: The work at classes is in teams of 2 students. The students have the opportunity to share concerns with his/her teammate on the home work of the previous weed, and if it is necessary they ask the teacher questions unresolved. Then the students do the activities stated by the teacher and finally they solve a moodle/LearnSQL questionnaire.
Laboratory evaluation: In each class, the students answer a question individually to evaluate the work done at home previously and during the class. The evaluation is also based on the exercices solved during the class.

Resources related to laboratory classes:
All documents, materials and questionnaires related with the course are available to students through the platform moodle/LearnSQL.
Apart from the feedback that teachers give to students during classes, the platform moodle/LearnSQL includes a corrector of database exercises that provides feedback to students about exercises solutions.

Students will be evaluated just in case they assist to the GROUP WHERE ARE ENROLLED, both in classes of theory/problems and in classes of laboratory.

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 be able to apply some defined quality criteria to choose which types of database components or management programs are more suitable for the implementation of a certain behavior of a software.
8.To have a general vision of how the design of a database should be included in a software development process.
9.To be able to obtain a database relational model starting from a conceptual models in UML.
10.To know the concept of database transaction and its implications.
11.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.
12.To know the locking concurrency control technique.
13.To know the possible physical structures for storing data and its implications for in terms of efficiency.
14.To know the access methods to data and its implications in terms of efficiency.
15.To be able to participate with a proactive atitude in making exercices in teams of 2 or more students, according to the roles assigned to each student that can change during the execution of the exercises.
16.To be able to reach to a solution of the exercises that meets the quality criteria defined with limited time and resources.
17.To be able to configure the environment for the implementation and execution of database components and programs that access to databases, taking as input the resources offered to students.
18.Understand the main features of NOSQL databases systems, understand how they differ with respect to relational systems, and have seen a classification of types of NOSQL systems that exist today.

STUDY LOAD

Type	Hours	Percentage
Hours large group	24,0	16.00
Hours small group	30,0	20.00
Hours medium group	6,0	4.00
Self study	84,0	56.00
Guided activities	6,0	4.00

Total learning time: 150 h

CONTENTS

Introduction

Description:
Database Concept. Design models and databases. Types of users. Categories of database languages. Database Management Systems (DBMS). Desirable objectives for databases that DBMS should provide. Architecture of DBMS.

Relational model

Description:
Objectives and origin. Data structure with which to construct relational databases. Operations that provides the relational model to manipulate and query data. Integrity rules to be met by the data in a relational database.

Languages: Relational Algebra and SQL

Description:
Introduction. Relational Algebra: relational algebra operations; queries. SQL: create tables, insert, delete and update of rows in a table, queries on a database. Considerations and quality criteria about how to write 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.

Stored Procedures and Triggers

Description:
Implementation of stored procedures in PL/pgSQL language. Implementation of triggers in PostgreSQL. Considerations and quality criteria in the design and implementation of procedures and triggers.

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. Serialitzability. Recoverability. Concurrency control techniques. Isolation Levels. Locking and isolation levels.

Physical storage structures and access methods

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

NOSQL

Description:
Introducción. Diferencias con los SGBD relacionales tradicionales. Objetivos de los SGBD NOSQL. Ejemplos de sistemas que requieren este tipo de SGBD.

ACTIVITIES

T/P. Study of the databases introduction

Description:
The contents related with the subject are presented

Specific objectives:
1, 2

Full-or-part-time: 4h
Theory classes: 2h
Self study: 2h

T/P. Study of the databases relational model

Description:
The contents related with the subject are presented. The exercises proposed by the teachers are done.

Specific objectives:
3

Full-or-part-time: 4h
Theory classes: 2h
Self study: 2h

T/P. Study of the data logical components

Description:
The contents related with the subject are presented. The exercises proposed by the teachers are done.

Specific objectives:
3, 4

Full-or-part-time: 4h
Theory classes: 2h
Self study: 2h

T/P. Study of control logical components

Description:
The contents related with the subject are presented. The exercises proposed by the teachers are done.

Specific objectives:
3, 4, 7

Full-or-part-time: 3h
Theory classes: 1h
Self study: 2h

T/P. Exercises: Privileges, views and assertions

Description:
Exercises are solved in class with the help of the teacher.

Specific objectives:
3, 4, 7

Full-or-part-time: 5h
Theory classes: 3h
Self study: 2h

T/P. Study of the introduction to design of relational databases

Description:
The contents related with the subject are presented. The exercises proposed by the teachers are done.

Specific objectives:
8, 9

Full-or-part-time: 4h
Theory classes: 2h
Self study: 2h

T/P. Exercises: Translation from UML to relational model

Description:
Exercises are solved in class with the help of the teacher.

Specific objectives:
8, 9

Full-or-part-time: 4h
Theory classes: 2h
Self study: 2h

T/P. Study of transactions and concurrency

Description:
The contents related with the subject are presented. The exercises proposed by the teachers are done.

Specific objectives:
10, 11, 12

Full-or-part-time: 4h
Theory classes: 2h
Self study: 2h

T/P. Exercises: Transactions and Concurrency

Description:
Exercises are solved in class with the help of the teacher.

Specific objectives:
10, 11, 12

Full-or-part-time: 7h
Theory classes: 3h
Self study: 4h

T/P. Study of storage and access methods

Description:
The contents related with the subject are presented. The exercises proposed by the teachers are done.

Specific objectives:
13, 14

Full-or-part-time: 7h
Theory classes: 3h
Self study: 4h

T/P. Exercises: Storage and access methods

Description:
Exercises are solved in class with the help of the teacher.

Specific objectives:
13, 14

Full-or-part-time: 5h
Theory classes: 2h
Self study: 3h

T/P NOSQL

Description:
The contents related with the subject are presented.

Specific objectives:
1, 18

Full-or-part-time: 2h
Theory classes: 1h
Self study: 1h

T/P. Review

Description:
Questions are answered on the topics of the subject

Specific objectives:
3, 4, 5, 6

Full-or-part-time: 7h
Laboratory classes: 2h
Self study: 5h

L: Environment preparation and preliminary study

Description:
Prepare the environment for deployment, creation and execution of database components from resources provided by the teacher. Preliminary study of the database that will be used in the first laboratory classes and of some basic SQL sentences.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Study of SQL 1

Description:
Laboratory teams are created. The way of working in laboratory classes is presented. The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
3, 4, 6

Full-or-part-time: 2h
Laboratory classes: 2h

L. Study of SQL 2

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
3, 4, 6, 15, 16, 17

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Exercises: SQL

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
3, 4, 6, 15, 16, 17

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Study of relational algebra

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
3

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Study of SQL and relational algebra

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
3, 4, 6, 15, 16, 17

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Study: Algebra and SQL

Description:
Students review laboratory exercises and SQL and relational algebra exams.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Exercises: Stored Procedures basics

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
3, 4, 6, 15, 16, 17

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Exercises: Triggers basics

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
4, 6, 15, 16, 17

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Exercises: Stored Procedures / Triggers.

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
4, 6, 15, 16, 17

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L: Lab study on Stored Procedures and Triggers.

Description:
Students review laboratory exercises and exams on Stored Procedures and Triggers.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Exercises: Programming with SQL - JDBC basics

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
4, 6, 15, 16, 17

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Exercises: Programming with SQL - JDBC

Description:
The teams solve a laboratory questionnaire on the topic in class. An individual paper question is answered on the topic in class.

Specific objectives:
3, 5, 15, 16, 17

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Lab study on Programming with SQL - JDBC

Description:
Students review laboratory exercises and exams on Programming with SQL - JDBC

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

L. Partial exam

Description:
Students: Solve the exam individually. It is not possible to use any material.

Specific objectives:
1, 2, 3, 4, 6, 8, 9, 16

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 17h
Guided activities: 2h
Self study: 15h

Final exam

Description:
The student: Solves the exam individually. It is not possible to use any material.

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18

Related competencies :
G8. APPROPIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

Full-or-part-time: 19h
Guided activities: 3h
Self study: 16h

GRADING SYSTEM

The grade of the course is based on technical competencies:

- NLB: Laboratory grade. It is based on:
. Satisfactory resolution of the questionnaire corresponding to each class.
. Grades of the question answered during each class.

- NEP - Partial exam grade. The partial exam includes the topics: 1, 2, 3, 4 (without stored procedures and triggers), and 7.

- NEF: Final exam grade. The final exam includes the following topics: 4 (only stored procedures and triggers), 5, 6, 8, 9 and 10.

Course grade = 0.45*NEP + 0.45*NEF + 0.1*NL

Students will be evaluated just in case they assist to the GROUP WHERE ARE ENROLLED.

Any attempt of fraud during the course will imply the application of the general academic regulations of the UPC

Grades of the generic competence: The possible grades are A, B, C or D (where A corresponds to an excellent level of accomplishment, B corresponds to a desired level of accomplishment, C corresponds to a sufficient level of accomplishment and D corresponds to a level not sufficient). A good evaluation of this competence will be for the students that:
- Act with rigor in the classes (their attitude in class is appropriate according to the guidelines given for different types of class, either theory, problems or laboratory).
- Act with respect towards peers, and in case of teams work with positive interdependence respect to the other team members.
- Collaborate actively in the activities of cooperative learning in teams or pairs that are made. Accept and perform the roles assigned to the team members during these activities.
- Do exercises arriving to solutions (in the laboratory study questionnaires) that pass all the test games (no matter how many attempts they need).
- Do exercises arriving to solutions (in the exams) that meet the quality criteria established in the course for each type of exercise.
- In general, complete the exercises in the time and resources provided.

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

Complementary:
- Gulutzan, P.; Pelzer, T. SQL-99 complete, really. R & D books, 1999. ISBN 0879305681.
- Melton, J.; Eisenberg, A. Understanding SQL and Java together: a guide to SQLJ, JDBC, and related technologies. Morgan Kaufmann Publishers, 2000. ISBN 1558605622.
- Liu, L.; Özsu, M.T. (eds.). Encyclopedia of database systems. New York ; London: Springer, 2009. ISBN 9780387399409.
- Elmasri, Ramez; Navathe, Shamkant. Fundamentals of database systems. 7th ed. Pearson Education Limited, 2016. ISBN 9781292097626.
- Professorat de les assignatures de bases de dades de la FIB. Material de l'assignatura de bases de dades.

RESOURCES

Hyperlink:
- https://www.upc.edu/learn-sql- http://www.postgresql.org/