Course guide
270082 - DBD - Database Design

Last modified: 30/01/2024

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). (Optional subject).

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

LECTURER

Coordinating lecturer: XAVIER BURGUÉS ILLA

Others: Primer quadrimestre:
XAVIER BURGUÉS ILLA - 11, 12, 13
MARC ORIOL HILARI - 12

Segon quadrimestre:
XAVIER BURGUÉS ILLA - 11, 12, 13, 21, 22
MARC ORIOL HILARI - 22
VICENTE PICORNELL ALANDETE - 12, 13

PRIOR SKILLS

Being able to list the software engineering process steps
Ability to understand UML class diagrams
Ability to create, query and manipulate databases using SQL

REQUIREMENTS

- Prerequisite BD
- Pre-Corequisite IES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CES1.1. To develop, maintain and evaluate complex and/or critical software systems and services.
CES1.2. To solve integration problems in function of the strategies, standards and available technologies
CES1.5. To specify, design, implement and evaluate databases.
CES1.6. To administrate databases (CIS4.3).
CES3.2. To design and manage a data warehouse.
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.
CT2.4. 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.
CT7.2. To evaluate hardware/software systems in function of a determined criteria of quality.

Generical:
G3. THIRD LANGUAGE: to know the English language in a correct oral and written level, and accordingly to the needs of the graduates in Informatics Engineering. Capacity to work in a multidisciplinary group and in a multi-language environment and to communicate, orally and in a written way, knowledge, procedures, results and ideas related to the technical informatics engineer profession.
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

During theory sessions the teacher sets theory concepts relevant to the subject contents. Students should work on these concepts and, optionally, propose examination questions through the virtual campus (using the mechanism in Moodle to create glossaries). Students participating in the proposal of questions will earn an up to 20% bonification in the examen mark, depending on the quality of the participation. Some concepts of some contents are not exposed by the teacher but the students have to work on the material published in the campus by the teacher.

In the lab sessions the teacher opens a questionnaire on the virtual campus that students must solve in pairs. In the days before the session, the same couples have had the opportunity to work in a questionnaire similar to the one of the laboratory session. They can do so from anywhere with internet access getting feedback from the automatic correction tool. In addition, the same module allows the partners to discuss about the exercises without having to meet physically.

LEARNING OBJECTIVES OF THE SUBJECT

1.Being able to design and obtain information from multidimensional databases
2.Being able to implement a logical design onto a physical design analysing and choosing the best mechanism to include integrity constraints in the DB.
3.Being able to decide which materialized views must be defined according to the expected operations
4.Being able to decide which indexes to be defined according to the expected operations
5.Being able to list the optimization options regarding policies, methods and time, together with advantages, disadvantages and application conditions.of each one.

6.Being able to obtain the access plan for a query according to given optimization criteria
7.Being able to replicate the execution of the algorithms involved in a process tree and to estimate their cost
8.Being able to list the main options and parameters that affect concurrency and to justify the effect of modifying their values
9.Being able to list the main options and parameters that affect the recovery of the database and to justify the effect of modifying them.
10.Being able to list the subsystems of an organization and the information generated and needed by them.
11.Being able to enumerate the stages of database development and the result of each one
12.Being able to detect and correct defects in a logical design.
13.Being able to perform the logical design of an IS database.
14.Ability to acquire concepts and skills in an autonomous way.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Introduction

Description:
Concepts related to design and administration.
Life Cycle of a DB. Alternatives.
Decisional and operational DB.

Decision suport systems

Description:
Data Warehouses.
Multidimensional Databases (OLAP tools)

Logical design. The transition to the relational model.

Description:
The decisional case.
The operational case starting from UML.

Correctness of design

Description:
Normalisation.
Validation.
Conditions required to aggregate.

Physical Design

Description:
Materialized views.
Constraints.

Optimization

Description:
Semantic opt.
Syntactic opt.
Physical opt.
Amount estimation.

Estructuras de acceso

Description:
B +.
Cluster.
Hash.

Algorithms

Description:
Selection.
Sorting.
Join.
Projection.

Advanced indexing

Description:
Multiatribute.
Bitmaps.
Index-only query answering
Join indexes

Administration

Description:
Definitions, objectives and tasks.
Access Plan.
Workload optimization.
Transactions.
Recovery.
Concurrence.
Virtual and physical spaces

Beyond the relational model

Description:
Basic knowledge on NOSQL databases. Differences with respect to the relational model. Main kinds of NOSQL BD .

ACTIVITIES

Introduction

Description:
Students must prepare their computer according to one of the alternatives proposed to carry out the activities that will arise during the course. Basically, they must have access to Moodle, and Oracle.

Specific objectives:
14

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

Study of the introductory concepts

Description:
Studying exposed contents and proposing exam questions using the glossary Moodle module

Specific objectives:
10, 11

Full-or-part-time: 4h
Theory classes: 1h
Laboratory classes: 1h
Self study: 2h

Study of concepts related to decision support systems

Description:
Studying exposed contents and self-study materials. Resolving exercises and proposing exam questions using the glossary Moodle module

Specific objectives:
1, 14

Related competencies :
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Full-or-part-time: 16h
Theory classes: 1h
Self study: 15h

Study of concepts related to logical design

Description:
Studying exposed contents and self-study materials. Resolving exercises and proposing exam questions using the glossary Moodle module

Specific objectives:
13

Full-or-part-time: 16h
Theory classes: 2h
Laboratory classes: 2h
Self study: 12h

Study of concepts related to the correctness of the design

Description:
Studying exposed contents and proposing exam questions using the glossary Moodle module

Specific objectives:
12

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 3h
Self study: 5h

SQL training

Description:
The session is identical to the advanced SQL session but this one does'nt have any impact on the evaluation.

Specific objectives:
13

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

Session 1: Advanced SQL Queries

Description:
Students, in pairs, must answer a Moodle questionnaire that is corrected instantly by LEARN-SQL. Every time that students send an answer to a question receive a rating. Students may decide to submit new answers in order to improve the previous ones. Every new submission yelds a penalty.
Students must also answer some questions in writing.
The teacher will review the written answers and the mark provided by LEARN-SQL will be refined accordingly.
During the previous week, students will solve a remote training Moodle questionnaire with the same partner.

Specific objectives:
13

Full-or-part-time: 4h
Guided activities: 2h
Self study: 2h

Study of concepts related to physical design

Description:
Studying exposed contents and proposing exam questions using the glossary Moodle module

Specific objectives:
2, 3

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

Study the concepts related to optimization

Description:
Studying exposed contents and self-study materials. Resolving exercises and proposing exam questions using the glossary Moodle module

Specific objectives:
5, 6

Full-or-part-time: 8h
Theory classes: 1h
Self study: 7h

Translation and normalization training

Description:
The session is identical to the translation and normalization session but this one does'nt have any impact on the evaluation.

Specific objectives:
12, 13

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

Session 2: relational translation and normalization

Description:
Students, in pairs, must answer a Moodle questionnaire that is corrected instantly by LEARN-SQL. Every time that students send an answer to a question receive a rating. Students may decide to submit new answers in order to improve the previous ones. Every new submission yelds a penalty.
Students must also answer some questions in writing.
The teacher will review the written answers and the mark provided by LEARN-SQL will be refined accordingly.
During the previous week, students will solve a remote training Moodle questionnaire with the same partner.

Specific objectives:
12, 13

Full-or-part-time: 4h
Guided activities: 2h
Self study: 2h

Study of concepts related to access structures

Description:
Studying exposed contents and proposing exam questions using the glossary Moodle module

Specific objectives:
4

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

Study of concepts related to algorithms

Description:
Studying exposed contents and proposing exam questions using the glossary Moodle module

Specific objectives:
7

Full-or-part-time: 6h
Theory classes: 3h
Self study: 3h

Study of concepts related to advanced indexing

Description:
Studying exposed contents and proposing exam questions using the glossary Moodle module

Specific objectives:
4

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

Correctness and views training

Description:
The session is identical to the correctness and views session but this one does'nt have any impact on the evaluation.

Specific objectives:
2, 3, 12

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

Session 3: correctness and views

Description:
Students, in pairs, must answer a Moodle questionnaire that is corrected instantly by LEARN-SQL. Every time that students send an answer to a question receive a rating. Students may decide to submit new answers in order to improve the previous ones. Every new submission yelds a penalty.
Students must also answer some questions in writing.
The teacher will review the written answers and the mark provided by LEARN-SQL will be refined accordingly.
During the previous week, students will solve a remote training Moodle questionnaire with the same partner.

Specific objectives:
2, 3, 12

Full-or-part-time: 4h
Guided activities: 2h
Self study: 2h

Study of concepts related to administration

Description:
Studying exposed contents and self-study materials. Resolving exercises and proposing exam questions using the glossary Moodle module

Specific objectives:
8, 9, 14

Related competencies :
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Full-or-part-time: 15h
Theory classes: 6h
Self study: 9h

Indexes and cost of queries including joins training

Description:
The session is identical to the indexes and cost of queries including joins session but this one does'nt have any impact on the evaluation.

Specific objectives:
4, 7

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

Session 4: indexes and cost of queries including joins

Description:
Students, in pairs, must answer a Moodle questionnaire that is corrected instantly by LEARN-SQL. Every time that students send an answer to a question receive a rating. Students may decide to submit new answers in order to improve the previous ones. Every new submission yelds a penalty.
Students must also answer some questions in writing.
The teacher will review the written answers and the mark provided by LEARN-SQL will be refined accordingly.
During the previous week, students will solve a remote training Moodle questionnaire with the same partner.

Specific objectives:
4, 7

Full-or-part-time: 4h
Guided activities: 2h
Self study: 2h

Access structures training

Description:
The session is identical to the acces structures session but this one does'nt have any impact on the evaluation.

Full-or-part-time: 2h
Self study: 2h

Session 5: access structures

Description:
Students, in pairs, must answer a Moodle questionnaire that is corrected instantly by LEARN-SQL. Every time that students send an answer to a question receive a rating. Students may decide to submit new answers in order to improve the previous ones. Every new submission yelds a penalty.
Students must also answer some questions in writing.
The teacher will review the written answers and the mark provided by LEARN-SQL will be refined accordingly.
During the previous week, students will solve a remote training Moodle questionnaire with the same partner.

Specific objectives:
4, 6, 7

Full-or-part-time: 4h
Guided activities: 2h
Self study: 2h

Workload optimization training

Description:
The session is identical to the workload optimization session but this one does'nt have any impact on the evaluation.

Specific objectives:
4, 6, 7

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

Session 6: workload optimization

Description:
Students, in pairs, must answer a Moodle questionnaire that is corrected instantly by LEARN-SQL. Every time that students send an answer to a question receive a rating. Students may decide to submit new answers in order to improve the previous ones. Every new submission yelds a penalty.
Students must also answer some questions in writing.
The teacher will review the written answers and the mark provided by LEARN-SQL will be refined accordingly.
During the previous week, students will solve a remote training Moodle questionnaire with the same partner.

Specific objectives:
4, 6, 7

Full-or-part-time: 4h
Guided activities: 2h
Self study: 2h

Study of concepts related to NOSQL

Description:
Studying exposed contents and self-study materials. Resolving exercises and proposing exam questions using the glossary Moodle module

Specific objectives:
10, 11, 13, 14

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

Examination

Description:
Some questions may be drawn from the set of questions proposed by students voluntarily through the mechanism of the glossary.

Specific objectives:
2, 4, 5, 8, 9, 10, 11

Full-or-part-time: 2h
Guided activities: 2h

Review of laboratory sessions

Description:
Students may ask for explanations on the evaluation or submit claims following the established guidelines .

Examination review

Description:
Students may ask for explanations on the evaluation or submit claims following the established guidelines .

Normalization II (beyond BCNF)

Description:
Studying exposed contents and proposing exam questions using the glossary Moodle module. Application in the laboratory.

Specific objectives:
12, 13

Full-or-part-time: 5h
Theory classes: 2h
Laboratory classes: 2h
Self study: 1h

GRADING SYSTEM

Final mark = 70% min(10,P) + 20% E + 10%M

E = final exam grade. Students participating in the proposal of questions will earn an up to 20% bonification in the examen mark, depending on the quality of the participation
P = weighted average grade of questionnaires and lab sessions
M = peer evaluation

Calculation of P:
1) Multiply the grade from activity by a weight equal to 1, 2, 4 or 8 (depending on the content of the corresponding activity)
2) Divide the sum of these values by the sum of weights assigned minus 4

Calculation of M: students will have multiple partners during the semester and they will evaluate them at the end. Based on these evaluations, the teacher will assign a grade.

The rating of the generic skill "right attitude to the work" will be A (passed with excellence), B (competence level exceeded the expected), C (competence at basic level) or D (failed to achieve the competence). This grade is computed as the combination of M (peer evaluation) and the attitude evaluation made by the teacher (participation in activities during classes).

The competence "third language" is evaluated by means of the grade in activities based on material written in english.

BIBLIOGRAPHY

Basic:
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- Lewis, J. Cost-based oracle fundamentals. Apress, 2006. ISBN 978-1-59059-636-4.