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Computer Science Department
CS 557 / CS 457 - Database Software Design
Course outline
Winter 2021

Professor:

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Office: Pol 314

Office hours: Online via Microsoft Teams

Marker: To be determined

Schedule:

Lecture: Online and Asynchronous

Description

Objective: To learn the concepts of relational databases and to design a software database management system.

Content This course covers how one can implement a Database Management system. Major topics are Storage management, Query processing, and Transaction management. As a basic assumption, data will not all fit in main memory, so algorithms and data structures appropriate for effective disk storage and quick access must be used. For example, one may use index structures such as B-trees or hash tables. We cover parsing of queries and optimizing of query plans. Finally, we cover durability of transactions using logging, and concurrency control for isolation of transactions. Additional topics in distributed databases are also presented. Students are expected to develop a database software application with Java or a Web application in PHP.

Credits 3

Organization Three hours of lecture per week
Six hours of personal work per week

1 Overview

1.1 Context

Databases play a central role in the development of information systems. They can store information about an application domain, preserve its integrity, extract it using a high-level language, process multiple transactions simultaneously, and distribute the data transparently across multiple domains. The aim is to ensure the security and the recovery of data.

1.2 Detailed content

Topic	Content	Assignments
1	Introduction to Databases <ul style="list-style-type: none">Databases and Database Users,Database System Concepts and Architecture,	Assignment 1
2	Conceptual Modeling and Database Design <ul style="list-style-type: none">Data Modeling Using the Entity-Relationship (ER) Model;The Enhanced Entity-Relationship (EER) Model;Relational Database Design by ER- and EER-to-Relational Mapping;Practical Database Design Methodology and Use of UML Diagrams.	
3	The Relational Data Model and SQL <ul style="list-style-type: none">The Relational Algebra and Relational Calculus;The Relational Data Model and Relational Database Constraints;Basic SQL;More SQL: Complex Queries, Triggers, Views, and Schema Modification.	Assignment 2
4	File Structures, Indexing, and Hashing <ul style="list-style-type: none">Disk Storage, Basic File Structures, and Hashing;Indexing Structures for Files.	
5	Query Processing and Optimization, and Database Tuning <ul style="list-style-type: none">Algorithms for Query Processing and Optimization;Physical Database Design and Tuning.	Assignment 3

6	Transaction Processing, Concurrency Control, and Recovery <ul style="list-style-type: none"> • Introduction to Transaction Processing Concepts and Theory; • Concurrency Control Techniques; • Database Recovery Techniques. 	
7	Additional Database Topics: Security and Distribution <ul style="list-style-type: none"> • Database Security; • Distributed Databases 	
8	Object, Object-Relational, and XML: Concepts, Models, Languages, and Standards <ul style="list-style-type: none"> • Object and Object-Relational Databases; • XML: Extensible Markup Language. 	Assignment 4 and assignment 5
9	Database Programming Techniques <ul style="list-style-type: none"> • Introduction to SQL Programming Techniques; • Web Database Programming Using PHP. 	
10	Data warehouses and Business intelligence (if time allows it)	

2 Organization

2.1 Teaching method

A week includes three hours of lectures. Most classroom presentations will be done using slides available on Moodle. Lectures on designing GUI components with Java will be added to help the students to implement their final project. Throughout the session, the student will implement the concepts seen in class through five assignments, a quiz, a final project, and a final exam.

2.2 Evaluation

Assignments and quiz : 40%

Final project: 20%

Final exam: 40%

Unless otherwise stated, the assignments can be done in teams in up of three students. Special instructions will be given for each assignment. The submission of assignment must be performed using Moodle. Subjects will be available on Moodle. The delivery of work is done before midnight of the due day. Failure to submit an assignment before the deadline will result in a penalty of 10% per day late, including Saturday and Sunday.

No assignment can be submitted by email. Plagiarized or undelivered assignment will be automatically attributed the grade zero.

For the final project, a team of two students can do it. The subjects of final project will be available on Moodle by the third week of January.

3 Course Material

The course slides will be available on Moodle.

No manual is required.

4 Bibliography

- [1] Ramez Elmasri, Shamkant B. Navathe. Fundamentals of Database Systems (6th Edition). Pearson, 2010.
- [2] Carlos Coronel, Steven Morris. Database Systems: Design, Implementation & Management (12th Edition). Course Technology, 2014.