

Introduction to Database Systems

Course Outline and Organisation

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Aims

To be able to use Database Management Systems (DBMSs) successfully, one has to understand the concepts on which they are based.

The aims of this course are to

- familiarise you with the basic concepts underlying a DBMS;
- show how they are realized in specific systems such as the PostgreSQL DBMS;
- give you some hands-on experience in using a DBMS.

Course Content (1)

- Fundamental Database Concepts
- The Entity Relationship (= ER) Model
(the most common approach to conceptual database design)
- The Relational Data Model
 - Relations
 - Integrity Constraints (keys, foreign keys, etc.)
- Logical Database Design
(ER to relational schemas)
- Relational Algebra
(an algebraic query language for the relational model)

Course Content (2)

- SQL: Querying and Manipulating Data
 - SQL Data Definition Language
 - Single Block Queries
 - Aggregation
 - Joins and Outer Joins
 - Nesting
 - Negation
- Transaction Management and Concurrency Control
- Database Access from a Programming Language: JDBC

Course Content (3)

- Data Storage and Indexing
 - File Organisation and Indexes
 - Tree-structured Indexing: B+-trees
 - Hash-based Indexing
 - Indexes in PostgreSQL
- Query Evaluation
 - Sorting
 - Evaluation of Relational Operators
 - Query Optimisation
 - Physical Database Design

Course Content (4)

- Query Plans in PostgreSQL
- Functional Dependencies and Normalisation

Course Format

- Lectures
 - introduce new concepts, give examples
- Labs
 - exercises (→ preparation for exam questions)
 - support for group projects
- Group Projects
 - develop a toy database application
 - 3 to 4 students

Lectures

- Main textbook
A First Course in Database Systems
by Jeff Ullman and Jennifer Widom
- Lectures on data storage and indexing will follow
Database Management Systems
by Raghu Ramakrishnan and Johannes Gehrke
- Slides will be made available at course web site
`www.inf.unibz.it/~nutt/IDBs1011`
and at Teleacademy under the course resources:
`www.teleacademy.it`

Labs and Teaching Assistants

- Start in week 3 (12/13 October)
- Teaching assistants
 - Marius Kaminskas
 - Lina Lubyte
- All members of a project group attend the same lab
- Support for projects during lab session
- Also, meetings by appointment

Group Projects

- Groups of three or four students
- You register for group work under Doodle
- We define groups and inform you to which group you belong
- Each group develops an “Individual Database Application” on a topic of their choice
- Each group will have a joint account on the faculty PostgreSQL server

Project Steps

Mimic the development of a “real” database

- Writing up **data requirements**
- Designing a **conceptual model** in the form of an Entity Relationship diagram
- Translating the conceptual model into a **relational schema**
- Implementing the relational schema in **PostgreSQL** and **populating** the database
- **Querying** and **modifying** the database by SQL statements
- Writing a **Java client** that accesses the DB via JDBC
- Optimising the access to data by adding **indexes** to the relational schema

Project Wiki

- Each group will have a project wiki at Teleacademy
- You upload your work for the project milestones to your wiki
- All students on the course can see the work of all projects

Milestones

Week 2: Group registered and topic of project defined

Week 4: **Data requirements** and **conceptual model**

Week 6: Translation into **relational schema**, implementation of the schema, **population** of the schema with data

Week 8: SQL **queries** over the database

Week 10: **JDBC client** runs transactions on the database

Week 12: **Physical design**, analysis of query execution plans, performance analysis

Submission

- The deadline for each milestone is
Monday 23:30 hrs
following the respective week
- You submit your work by publishing it at your project Wiki
- You will receive a mark for the work that can be found at that time at your home page
- The tutors will also publish comments on your submissions (but marks are confidential)

Registration of Project Topic

- To register the topic of your group, send a mail to
 lubyte@inf.unibz.it and nutt@inf.unibz.it
containing
 - the topic of the project
 - a short description
- All groups have to work on different topics
- If two groups choose the same topic, the group that registered second will have to choose a different one

Presentation in Lab

The lab in week 4 (19/20 October) will be devoted to the conceptual model and the relational schema

- Each group gives a short presentation
- All participants of the tutorial are encouraged to discuss the projects presented
- The tutor asks questions about the planned project so that problems with the design can be identified at an early stage

Assessment

- Each project gets a mark
- The marks for individual students will be *confirmed* in a project discussion at the end of the semester
- There will also be a written exam
- Final mark = $\max \{ 30\% \times \text{project} + 70\% \times \text{exam}, \text{exam} \}$