

Database Management Systems

Rationale

Database Management Systems (DBMS) are vital components of modern information systems. Database applications are pervasive and range in size from small in-memory databases to terabytes or even larger in various applications domains. The course focuses on the fundamentals of knowledgebase and relational database management systems, and the current developments in database theory and their practice.

Course Description

The course reviews topics such as conceptual data modelling, relational data model, relational query languages, relational database design and transaction processing and current technologies such as semantic web, parallel and noSQL databases. It exposes the student to the fundamental concepts and techniques in database use and development as well provides a foundation for research in databases.

The course assumes prior exposure to databases, specifically to the relational data model and it builds new technologies on this foundation. In the first half of the course the relational data model, relational query languages, relational database design and conceptual data modeling are reviewed. It then focuses on XML, RD, OWL, parallel, and noSQL databases. It also bridges databases and knowledgebases which is the current trend.

The course requires a term project in which the student implements a database application or explores a database issue.

We will use PostgreSQL as the database platform for doing the assignments.

Topic List

Topics can include but are not limited to:

- Database concepts
- Relational model

- Relational query languages
 - Relational Algebra and Calculus
 - Datalog
 - SQL
 - QBE
- Triggers
- Embedded SQL
- Recursion
- Web database programming
- Conceptual data modeling
- E/R data model
- OO data model
- Relational database design
 - Normal Forms (NF)
 - 1-4NF
 - Lossless join decomposition
- XML, XPath and XQuery
- Ontology and Data Model
- Semantic Web
- RDF, RDF Schema, and OWL
- Storage and indexing
- Query processing and optimization
- Parallel and distributed databases
- NoSQL databases

- Transaction processing and database recovery
- Database security
- Current developments in knowledgebase
- Big data and Hadoop.

Learning Goals

The course content is balanced on theory and practice, the course aims at achieving the following learning outcomes:

- An appreciation of pervasive use of Knowledgebase and DBMS in different application domains
- Skill for developing database applications
- Skills for devising data models and query languages
- Skills for developing web database applications
- Learning storage and indexing of data
- Learning transaction processing and database recovery
- Learning knowledge representation and semantic web technologies
- Skills to integrate knowledge to databases

Assessment

Class participations, discussions and attendance are a critical component of the course and accounts 10

Written assignments will provide the students the opportunity to appreciate the theoretical underpinnings of the databases systems and comprise 20% of the term grade. These are on data modeling (Entity/Relationship data model), query languages (Relational Algebra and Relational Calculus), database design, and Resource Definition Framework or Ontology Web Language for knowledge representation.

Two programming assignments and a term project will provide the opportunity for the students to develop technical skills and comprise 20% of the term grade. The first project is on Structured Query Language and the second one is on the web database programming. The database project involves a complete database application development from design to implementation or a deeper investigation of a topic in databases and knowledgebases.

A mid-term and a final exam, each is 25%. Individual Assignments or Quizzes 20% Term Projects 15% Midterm Exams 30% Final Exam 35%