CS 3375 Database Systems Fall 2016

Enabled:  Statistics Tracking

DESCRIPTION

This course covers database design and applications. Main emphasis is given to the theoretical foundations of the Relational Data Model, including relational algebra, dependencies, and normal forms. SQL programming is taught through programming assignments and team projects. The course will also explore current trends and developments driven by the emergence of Big Data.

Office Hours:

Mon and Wed: 12.30 pm – 1.30 pm, Room 215 in the Math building.

COURSE OBJECTIVES AND RULES

OBJECTIVES

Understand theoretical foundations of the relational data model and database design

• data representation
• relational algebra
• entity-relational modeling
• functional dependencies and database normalization
• data integrity, including referential integrity

Learn to program in SQL

• efficient data queries
• DML: data manipulation language
• DDL: data definition language
• foreign key constraints
• indexes
• transaction processing and the ACID model
• access control and database administration
• application programming

Understand limitations of present-day relational databases and motivations behind new, non-relational databases for Big Data.

GRADING

• Assignments 15%
• Programming projects 35%
• Midterm Exams 2 × 15%
• Final Exam 20%

• 93% = A
• 90% = A–
• 87% = B+
• 84% = B
• 80% = B–
• 76% = C+
• 72% = C
• 68% = C−
• 64% = D+
• 60% = D
• <60% = F

TEXTBOOK AND FACILITIES


Programming assignments will require accessing a database server (MySQL or PostgreSQL) that will be hosted online and accessed with user credentials given by the instructor.

Students will also develop simple programs in Python 3. No prior knowledge of Python is required as sufficient instruction and examples will be provided.

LESSONS

Introduction

• Evolution of databases, overview of current systems and trends. Design requirements, features, architectures.
• Set up database accounts, client interfaces, programming environments, and homework submission. Try simple database queries.
• Chapters 1 and 2.

August 29, 2016

Relational Model and SQL

Relational Data Model

• E. F. Codd (1970)
• SQL standards and implementations
• Relations/tables. Fields/attributes. Rows/tuples. Domains and data types

Basic SQL

• CREATE/DROP TABLE, INSERT, SELECT, UPDATE, DELETE
• Primary keys. Indexes. Foreign keys.
• Chapters 5, 6, and 7

Relational Algebra

• Chapters 8

Intermediate SQL

• Joins, Aggregation
• Views
• Integrity constraints
• Privileges
• Nested Queries
• EXISTS, ANY, ALL

EXAM 1

September 26, 2016

Database Design

Entity-relationship to Relational Modeling

• Entity-relationship modeling
• Referential constraints
• Chapters 3, 4, 9

Database normalization

• Functional dependencies
• INSERT, UPDATE, and DELETE anomalies
• Database normalization
• Chapters 14, 15
October 17, 2016

Query optimization

- Query processing algorithms
- Indexes and underlying data structures
- Chapters 18, 19

October 24, 2016

Transaction management

- ACID model
- concurrency control
- recovery
- Chapters 20, 21, 22

EXAM 2

October 31, 2016

Application programming

- ODBC, JDBC
- Object-relational mappings
- Application frameworks
- Web programming
- Security
- Chapters 10, 11, 30

November 14, 2016

NoSQL, NewSQL, Big Data

- distributed databases
- Big Data
- CAP Theorem
- document databases: MongoDB
- key-value store: Cassandra, DynamoDB
- NewSQL
- Hadoop, MapReduce
- Column-oriented DBMS

FINAL EXAM

December 5, 2016