Course Outcomes	CSC 4402

CSC 4402: Introduction to Database Management Systems

Credit Hours: 3 hours

Prerequisites:

CSC 3102

Perquisites by Topic:

Math foundations: elementary set theory, concepts of relations and functions, propositional logic, mathematical induction.

Data structures: trees, B-trees, linear data structures, dictionaries, graphs.

Algorithms: Basic algorithm design methods and techniques for algorithm complexity analysis

Programming languages: a general purpose programming language

Catalog Course Description:

Network, hierarchical, and relational, and entity-relationship models; data definition, manipulation languages, and conversion among these models; relational database design theory, efficient query evaluation, elementary query optimization techniques.

Course Outcomes

1. Master the basic concepts and appreciate the applications of database systems.
2. Master the basics of SQL and construct queries using SQL.
3. Be familiar with a commercial relational database system (Oracle) by writing SQL using the system.
4. Be familiar with the relational database theory, and be able to write relational algebra expressions for queries.
5. Mater sound design principles for logical design of databases, including the E-R method and normalization approach.
6. Be familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B-tree, and hashing.
7. Master the basics of query evaluation techniques and and query optimization.
8. Be familiar with the basic issues of transaction processing and concurrency control.
9. (optional) Master working successfully on a team by design and development of a database application system as part of a team.

Texts and Other Course Materials:

Database System Concepts, Avi Silberschatz , Henry F. Korth , and S. Sudarshan. 0-07-295886-3. *Fifth Edition*. McGraw-Hill .

Major Topics By Text Chapters

- **Basic Concepts** Chapter 1.
  This part introduces basic terminology, the notion of database systems, data independence, data abstraction, the advantage of database systems, data models (E-R model, the relational model, etc.), data storage and query processing, and database system architecture.
- **The Relational Data Model.** Chapter 2.
  This part deals with the formal theory underlying relational database systems. The three aspects of the relational data model, namely, relational data structure, relational data manipulation, relational data integrity, are discussed. We will cover relational algebra in this part.
- **The SQL language.** Chapters 3 and 4.
- **Database Design.** Chapters 6 and 7.
  We will discuss E-R modeling method for database design. The functional dependency based normalization approach to relational databases design is discussed in detail. This includes the notion of normal forms, the algorithms to perform decomposition to 3NF, to BCNF, etc.
- **Storage and Query Processing.** Chapters 11, 12, 13, 14. RAID, Storage access, indexing and hashing, query processing and query optimization.
- **Transaction Processing and Concurrency Control.** Chapters 15 and 16.
  Transactions, ACID properties of transactions, schedules, serializability, locking protocols, two-phased locking, dead-lock detection.

Assignments/Projects/Laboratory Projects/Homework

Project: The task for the project is to design and implement a relational database application for a suitable (real world or prototype) application domain. The implementation will be done on the Sun workstation using the ORACLE (version 9.i) database system. Specifically, we will use the SQL-PLUS supported by the ORACLE system.

Example Homework:
A. Write Relational Algebra expressions (not SQL) for the following queries with respect to the database below (primary key attributes are **boldfaced** and *underlined*:

D: (**DEPT** DNAME BUDGET) for departments
T: (**T#** TNAME CITYDEPT) for teachers
S: (**S#** SNAME CITY DEPT DEGREE) for students
C: (**C#** CNAME DEPT T#) for courses
E: (**S#** **C#** GRADE) for enrollments

Note: Here ¢ECE¢, ¢MATH¢, ¢CSC¢ are values of the attribute "DEPT" rather than "DNAME".

(A.1) Get S#, SNAME for ¢New Orleans¢ students from ¢CSC¢ department.
(A.2) Get C#, Cname for courses which are taken by a student from ¢CSC¢ department.
(A.3) Get S# for students who are either from ¢Baton Rouge¢ or taking the course (C#=) ¢C9¢ (or both).
(A.4) get S#, T# pairs such that the student and the teacher are from **the same** city and the student takes a course taught by the teacher.
(A.5) Get T# for teachers who have taught a course which is **NOT** taken by **any** student from ¢MATH¢ department.

B. Exercise question 2.5 (page 72) of the text book.

Curriculum Category Content (estimated in semester hours)

Area	Core	Advanced	Area	Core	Advanced
Algorithms	4	8	Data Structures	2	6
Software Design	2	3	Prog. Languages	2	4
Computer Architecture	1	2	Mathematical foundation	1	6

Relationship to Criterion 3 Outcomes

A	B	C	D	E	F	G	H	I	J	K
*		*		*	*	*	*		*	*

Math Fundamentals -- 1 hr core/6 hr advanced
Review of logic, set-theoretic operations, relational database theory, including relations, relational algebra and integrity rules.

Data Structures -- 2 hr core/6 hr advanced
Storage structures – B-trees, B+-trees, hashing, indexing.

Algorithms and Software – 6 hr core/11 hr advanced
Algorithms for computing attribute closure and canonical covers of functional dependency set. Algorithms for 3NF and BCNF decompositions in normalization, for testing equivalence of sets of functional dependencies. Algorithms for query evaluation and query optimization. Database design issues and analysis of problems caused by incorrect database design choices. Case-studies for relational database design by E-R modeling and normalization. Analysis of SQL

query and relational algebra expressions for expressing database queries. SQL query design for problem solving.

Computer Organization and Architecture -- 1 hr core / 2hr advanced
RAID, Disk management, file organizations, data clustering

Concepts of Programming Languages -- 2 hr core/4 hr advanced
Database Data Definition Language, Data Manipulation Language, SQL (interactive and embedded)

Social and Ethical Issues: (40 minutes)
Some discussions in class on the impact of database technology on the society and everyday life of ordinary citizens. Roughly the time spent on this discussion is around half a lecture time.

Oral Communication (presentations):

Written Communication: Seven (7) home works, some of them require quite amount of descriptive writing to express ideas, understanding and discussions.

One (optional) project which requires a complete written report documenting the database application background, the database design process, and the queries.

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