

# COMPSCI 751 S1 C – Lab 01

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## DATABASES AND DATABASE USERS, DATABASE SYSTEM CONCEPTS AND ARCHITECTURE

1. What are the advantages of using a database solution as compared to the traditional file storage mechanism? What is the role of DBMS to a database system?

A database is used for storing related, structured data, with well-defined data formats in an efficient manner for all sorts of query needs. While a file storage mechanism is a more unstructured data storage for storing arbitrary, probably unrelated data. The file system is more general, and databases are built on top of the general data storage services provided by file systems.

Database Management System (DBMS) is a software package to help to build and/or maintain the database system.

2. Explain the concept of data model, database schema and database state with distinguishing on their relationships.

Data model is to describe the structure of a database, the operations for manipulating these structures, and certain constraints that the database should obey.

Database Schema is the description of a database, which includes descriptions of the database structure, data types, and the constraints.

Database state is the actual data stored in a database at a particular moment in time.

Database state contains actual data at a certain time in a database, whereas the database schema contains list of attributes and instructions to tell the database engine how data is organized. However, on a higher level, data model is a collection of conceptional tools for describing data, data-relationship and consistency constraints.

3. What is the 'Three-Schema Architecture'? What is the difference between the 'Three-Schema Architecture' and the 'Three Tier Client-Server Architecture'?

Three-schema architecture is an idea in relational database design that breaks a database down into three different schemas,

- 1) Internal schema at the internal level to describe physical storage structures and access paths. It typically uses a physical data model.
- 2) Conceptual schema at the conceptual level to describe the structure and constraints for the whole database for a community of users. It uses a conceptual or an implementation data model.
- 3) External schemas at the external level to describe the various user views.

While three tier client-server architecture is generally for web-based applications. In order to increase the security, a middle layer called application server or web server, is designed to prevent users directly accessing database server.

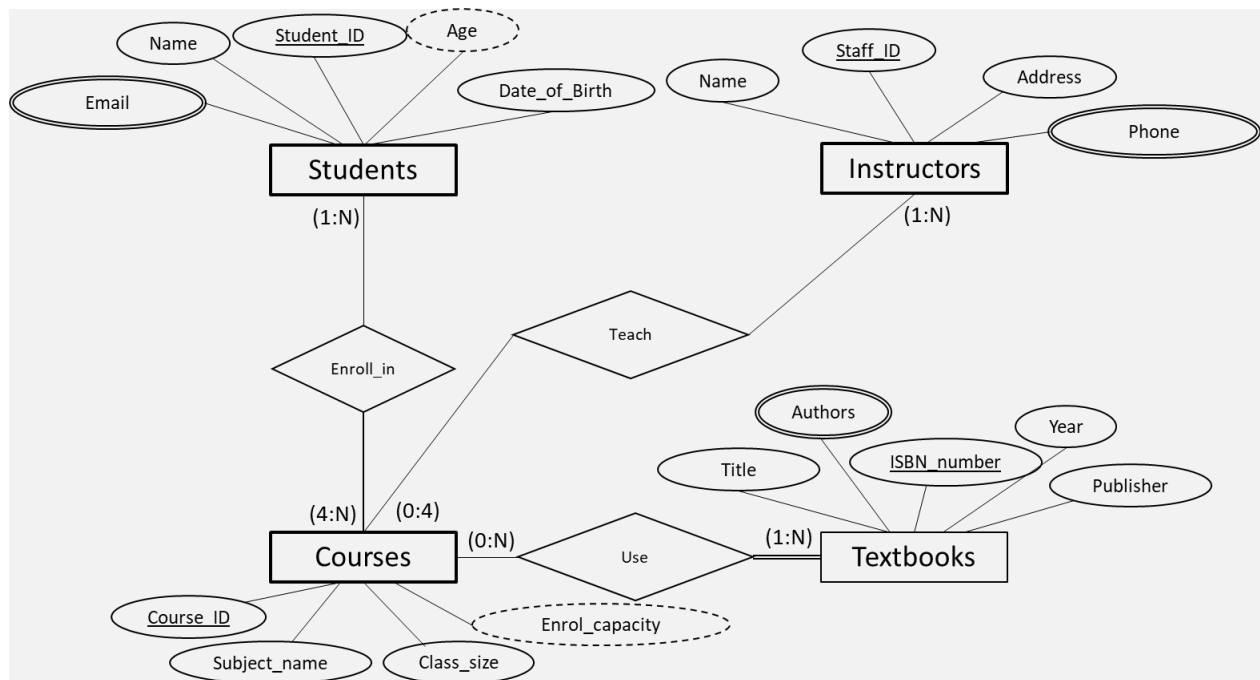
Three tier client-server architecture has a database layer with a user layer and a middle layer in between; while three schema architecture is a database designed with three different schemas.

## DATA MODELING USING THE ENTITY-RELATIONSHIP (ER) MODEL

4. Consider the following simplified data requirements of a course management system.

- the set of students: each records information of name, ID number, date of birth, age, email address;
- the set of courses: each records information of course ID, subject name, class size; enrolment capacity;
- the set of textbooks: each records information of book title, authors, publisher, year, ISBN number;
- the set of instructors: each records information of name, staff ID, address, phone number.
- the relationships among the entities include: students enroll in courses, instructors teach courses, courses use textbooks.

Draw an ER diagram based on above information to represent the conceptual data model. Specify key attributes of each entity type and structural constraints on each relationship type.



This ER diagram has 4 entities, student, instructors, courses and textbooks, with (min, max) notation for relationship constraints.

The Key attributes have student\_ID, staff\_ID, course\_ID and ISBN\_number of textbooks.

The multivalued attributes are email, phone and authors.

The derived attributes are age which can be derived from date\_of\_birth, and enrol\_capacity which is equal to the class\_size.

A few assumptions:

- 1, One student can enroll at least one course per semester to maximum of N courses per semester.
- 2, One course has at least 4 students.
- 3, One instructor can teach at least one class to maximum N classes.
- 4, One course can have no instructor (e.g., Integrity course) to maximum 4 instructors (to ensure the teaching quality and consistency).
- 5, One course can use 0-N textbooks, and a textbook need to be used by at least one course, otherwise it will not be purchased as textbook. There is an exist dependency in between.