



Department of Computer Science and Engineering  
CSI 222: Database Management Systems Laboratory  
Laboratory Manuals

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## *Experiment No. 1*

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### *Introduction to the Relational Database and the Platform*

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A database is a means of storing information in such a way that information can be retrieved from it. In simplest terms, a relational database is one that presents information in tables with rows and columns. A table is referred to as a relation in the sense that it is a collection of objects of the same type (rows). Data in a table can be related according to common keys or concepts, and the ability to retrieve related data from a table is the basis for the term relational database. A Database Management System (DBMS) handles the way data is stored, maintained, and retrieved. In the case of a relational database, a Relational Database Management System (RDBMS) performs these tasks. DBMS as used in this book is a general term that includes RDBMS<sup>1</sup>.

In this class, we will implement relational database using SQL servers.

## **Environment Set UP**

To work with relational databases, a number of database servers are available. Detailed set up for the servers can be found here.

- MySQL: XAMPP installation in Windows can be found in <https://premium.wpmudev.org/blog/setting-up-xampp/>
- MySQL: XAMPP installation in Linux can be found in <http://thelinuxfaq.com/92-how-to-install-xampp-in-ubuntu/>
- MySQL: installation in Mac OS can be found in <https://dev.mysql.com/doc/refman/5.6/en/osx-installation-pkg.html>

## **Home Work:**

Make your personal computer ready to work with SQL/MYSQL.

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<sup>1</sup><https://docs.oracle.com/javase/tutorial/jdbc/overview/database.html>

## *Experiment No. 2*

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### *Implementation and Manipulation of Relational Database Based on Case Study*

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Case: We are going to implement and work with the university database from the text book of CSI 221. Detail of the database can be found in authors website<sup>1</sup>. The schemas of the database are,

- classroom(building, room\_number, capacity)
- department(dept\_name, building, budget)
- course(course\_id, title, dept\_name, credits)
- instructor( ID, name, dept\_name, salary)
- section(course\_id, sec\_id, semester, year, building, room\_number, time\_slot\_id)
- teaches( ID , course\_id, sec\_id, semester, year)
- student( ID , name, dept\_name, tot\_cred)
- takes( ID , course\_id, sec\_id, semester, year, grade)
- advisor(s\_ID , i\_ID )
- time\_slot(time\_slot\_id, day, start\_time, end time)
- prereq(course\_id, prereq\_id)

To implement the database in SQL we need to know about the Data Definition Language (DDL) commands.

## Syntax of Different DDL Command

### Table Creation

Syntax:

```
Create table <table name> (  
    <attribute1> <datatype>(<size>),  
    <attribute2> <datatype>(<size>),  
    .....  
  
    <constraint1> <constraint name> <constraint parameter>,  
    <constraint2> <constraint name> <constraint parameter>,  
    .....  
);
```

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<sup>1</sup><http://db-book.com/>

Example:

```
Create table department (  
    dept_name varchar(50),  
    building varchar(50),  
    budget numeric(12, 2) not null,  
  
    primary key (dept_name),  
    constraint check (budget>0)  
);
```

## Table Modification

### Syntax for Column Addition:

```
Alter table <tablename> add (  
    <new attribute1> <datatype>(<size>),  
    <new attribute2> <datatype>(<size>)  
);
```

Example:

```
Alter table department add (  
    test varchar(50)  
);
```

### Syntax for Column Dropping:

```
Alter table <tablename> drop column <attribute>;
```

Example:

```
Alter table department drop column test;
```

### Syntax for Column Modification:

```
Alter table <tablename> modify(  
    <attribute> <newdatatype> (<newsized>)  
);
```

Example:

```
Alter table department modify(  
    building varchar(100)  
);
```

### Syntax for Table Renaming:

```
Rename <old table name> to <new table name>;
```

Example:

```
rename department to university_department;
```

## Table Dropping

Syntax

```
Drop table <tablename>;
```

Example:

```
Drop table university_department;
```

## Data Types in SQL

- Numeric: NUMBER, NUMBER(s,p), INTEGER, INT, FLOAT, DECIMAL
- Character: CHAR(n), VARCHAR(n), VARCHAR2(n), CHAR VARYING(n)
- Bit String: BLOB, CLOB
- Boolean: true, false, and null
- Date and Time: DATE (YYYY-MM-DD) TIME( HH:MM:SS)
- Timestamp: DATE + TIME
- USER Defined types

## Constraints in SQL

- Key Constraints: Primary Key, Foreign Key.
- Domain Constraints.

To deal with data with an implemented database we need Data Manipulation Language (DML) commands.

## Syntax of Different DML Command

### Data Insertion into a Table

Syntax

```
Insert into <table name> ( attribute1, attribute2, ...)
                        values ( <value for attribute1>, <value for attribute2>, ...)
```

Example:

```
Insert into department ( dept_name, building, budget)
                        values ( 'CSE', 'Main Campus', 1000000)
```

### Data Modification in a Table

Syntax

```
Update <table name>
Set <attribute name> = <new value>
Where Condition;
```

Example:

```
Update department
set budget = 1500000
where dept_name = 'CSE';
```

### Data Deletion from a Table

Syntax

```
Delete from <table name>
Where Condition;
```

Example:

```
Delete from department
Where budget<10000;
```

## Home Assignment

- Implement all the Table from the given case study.
- Make a comparative report on DDL and DML.

## *Experiment No. 3*

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### *Basic Search Syntax, Pattern Matching and Logic in SQL*

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Basic Search syntax in SQL is

```
Select expression1, expression2, ...
  From <Single Source Table>
  Where Condition
  Group By Attribute1, Attribute2, ...
  Having <Group Condition>
  Order By Attribute1, Attribute2, ...
```

## Syntax for Different Search Clause

SQL SELECT Statement

```
SELECT attribute1, attribute2, ...
  FROM <table name>;
```

SQL DISTINCT Clause

```
SELECT DISTINCT attribute1, attribute2, ...
  FROM <table name>;
```

SQL Where Clause

```
SELECT attribute1, attribute2, ...
  FROM <table name>
  Where Condition;
```

## Conditions in SQL

Conditions in SQL works as other languages. Moreover, SQL is not a case sensitive language. Different mathematical operators like <, >, <=, >=, =, !=, <>, +, -, \*, /, % and logical operators (AND, OR, NOT) work as well<sup>1</sup>. We can also use (in, between, ...) to make conditions.

## Patterns in SQL

Strings in SQL tested in two ways. One of the broad category is pattern matching. To match a pattern 'like' key word is used. In pattern matching the character '\_' is used to identify any single character whereas '%' is used to identify any string. Some examples can be found in [torialspoint.com](https://www.tutorialspoint.com)<sup>2</sup>.

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<sup>1</sup><https://www.tutorialspoint.com/sql/sql-operators.htm>

<sup>2</sup><https://www.tutorialspoint.com/sql/sql-like-clause.htm>



Class Exam 1.

Topic:

1. Implementation and Manipulation of Relational Database Based on Case Study.
2. Basic Search Syntax, Pattern Matching and Logic in SQL.

## *Experiment No. 4*

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### *SQL Joining*

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Joining is one of the most important topic in SQL queries. There are various types of join in SQL<sup>1</sup>.

- CROSS JOIN: Join two or more table with all possible combination of rows.

```
Select expression1, expression2, ...  
  From Table1, Table2, ....
```

- (INNER) JOIN: Select records that have matching values in both tables.

```
Select expression1, expression2, ...  
  From Table1 inner join Table2 on (condition)
```

- NATURAL JOIN: Joins two tables when all the common named attributes contain equal values.

```
Select expression1, expression2, ...  
  From Table1 natural join Table2
```

- LEFT (OUTER) JOIN: Select records from the first (left-most) table with matching right table records.

```
Select expression1, expression2, ...  
  From Table1 left outer join Table2
```

- RIGHT (OUTER) JOIN: Select records from the second (right-most) table with matching left table records.

```
Select expression1, expression2, ...  
  From Table1 right outer join Table2
```

- FULL (OUTER) JOIN: Selects all records that match either left or right table records.

```
Select expression1, expression2, ...  
  From Table1 full outer join Table2
```

## **Home Assignment**

- Practice from the exercise of the text book.
- Find out the syntactical differences among different database servers.

[Class Exam 2.](#)

Topic:

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<sup>1</sup><http://www.dofactory.com/sql/join>

1. SQL Joining.

Quiz 1.

Topic:

1. Implementation and Manipulation of Relational Database Based on Case Study.
2. Basic Search Syntax, Pattern Matching and Logic in SQL.
3. SQL Joining.

## *Experiment No. 5*

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### *Aggregate Functions, Grouping, Ordering and Set Operations*

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Aggregate Function are used to calculate the values from a set of values. Most commonly used aggregate functions are<sup>1</sup>:

- AVG calculates the average of a set of values.
- COUNT counts rows in a specified table or view.
- MIN gets the minimum value in a set of values.
- MAX gets the maximum value in a set of values.
- SUM calculates the sum of values.

Most of the time aggregate functions are used with group by<sup>2</sup> clause along with having<sup>3</sup> for filtering purposes. Group by helps to make multiple group of the source table where having uses to filter out the unwanted results.

Moreover, Order By is used to sort the result in ascending or descending order according to one or multiple attributes.

A number of set operation is supported in SQL.

- UNION: Merge two results into a single table. The tables must be comparable with the cardinality of its attributes<sup>4</sup>.
- INTERSECTION: Find the common results from two resultant tables<sup>5</sup>.
- EXCEPT: Find the set difference result of two resultant tables<sup>6</sup>.

Class Exam 3.

Topic:

1. Aggregate Functions.
2. Group Operations.

Quiz 2.

Topic:

1. Aggregate Functions.
2. Group Operations.
3. Ordering.
4. Set Operations.

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<sup>1</sup><http://www.zentut.com/sql-tutorial/sql-aggregate-functions/>

<sup>2</sup><http://www.zentut.com/sql-tutorial/sql-group-by/>

<sup>3</sup><http://www.zentut.com/sql-tutorial/sql-having/>

<sup>4</sup><http://www.dofactory.com/sql/union>

<sup>5</sup><https://www.tutorialspoint.com/sql/sql-intersect-clause.htm>

<sup>6</sup><https://www.tutorialspoint.com/sql/sql-except-clause.htm>

## *Experiment No. 6*

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### *SubQueries in SQL*

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Subquery<sup>1</sup> is the query inside a query. Subquery can be used in different clause.

- SubQuery in Select: It assigns a column value for each row.
- SubQuery in From: It makes a result from another query which is used as source for another query.
- SubQuery in Where: the results here are used as value to make conditions.

more details can be found here <https://community.modeanalytics.com/sql/tutorial/sql-subqueries/>  
Class Exam 4.

Topic:

1. Basic sub queries.

Class Exam 5.

Topic:

1. Nested sub queries

Quiz 3.

Topic:

1. Sub queries.

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<sup>1</sup><http://www.dofactory.com/sql/subquery>

## *Experiment No. 7*

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### *Database Security*

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Database security can be maintained using user hierarchy. User privilege can be set according to the need.

- ALL PRIVILEGES- as we saw previously, this would allow a MySQL user full access to a designated database (or if no database is selected, global access across the system)
- CREATE- allows them to create new tables or databases
- DROP- allows them to delete tables or databases
- DELETE- allows them to delete rows from tables
- INSERT- allows them to insert rows into tables
- SELECT- allows them to use the SELECT command to read through databases
- UPDATE- allow them to update table rows
- GRANT OPTION- allows them to grant or remove other users' privileges

User privilege helps to secure the database from unwanted access and modification. Details can be found here <https://www.digitalocean.com/community/tutorials/how-to-create-a-new-user-and-grant-permissions-in-mysql>.

## **Home Assignment**

Make two users one (User1) with full privilege and other (User2) with insert privilege only. Try to delete some values from the database from User2. Point out the problems you faced when doing the task.

## *Experiment No. 8*

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### *Project Development*

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Sufficient instruction will be provided to start project as well as develop from time to time. At the end of the trimester, a complete project must be presented according to the instruction.

## Required Minimum Hardware and Software

Hardware		Software	
Processor	Pentium Processor	Operating System	Windows, Linux, Mac
RAM	4 GB	DB Server	Oracle 11g/12g, MySql, SQL Server
HDD	50 GB	Web Server	Apache, Tomcat, IIS

## Mark Distribution

Breakdown of the total mark distribution is given below:

Assessment Method	Assigned Marks	Remarks
Attendance	10	$\min(10, \frac{10 \times 100}{85} \times \frac{\#of\text{AttendedClasses}}{\#of\text{TotalClasses}})$
Quizzes	25	2 out of 3 Quizzes
Class Performance	20	4 out of 5 Class Exams
	10	Home Assignments
Project (Update)		
Phase 1	3	Up to 25% Completion
Phase 2	3	Up to 50% Completion
Phase 3	4	Up to 75% Completion
Phase 4	5	Up to 90% Completion
Project (Completion)		
Completion	2	
Presentation/Showcasing	3	It is mandatory to pass the course
External Evaluation	5	External includes other faculties, senior students, industry experts etc.
Report		
ERD	4	Based on the project proposal.
Schema	2	Based on the proposed ERD.
DDL	2	Based on the prepared Schema Diagram.
Final Report Submission	2	<b>Must be submitted using Latex.</b>

## References

- Reading: <http://sqlzoo.net/>
- Advance Reading: <http://www.complexsql.com/>
- Online Practice: <https://www.hackerrank.com/domains/sql/select>
- Online Practice: <http://sqlfiddle.com/>