Introduction

Definition of a database and DBMS in Professor Notes.

CSC 365-07: Introduction to Database Systems	Spring 2023
Lecture 2: Relational Data Model	
Instructor: Alex Dekhtyar	*Ishaan Sathaye*

Relational Data Model

Definition 1 *Relational data model is an approach to organizing collections of data*

- Relation
    - Relational Table $\longrightarrow$ **Name + Schema**
        * Schema: List of attribute name + attribute type pairs
- Relational Database $\longrightarrow$ **Collection of Relations tables**
- **Table Instance**: set of records with instantiated values of the attributes
    - Finite
    - Records, rows, tuples

One unit of data is called a **datum**.

Object, entity, event: description of one object, entity, event

- **Records** consist of attributes or fields (rows in the table).
- **Attributes** is a named container for a value of a specific type.

Database Table Constraint

Definition 2 *Limitations of table instances*

- **Candidate Key**: set or lists of attributes that uniquely define a record in a table, **minimal such set of attributes**, made up of multiple attributes sometimes.
    - **Every attribute is necessary.**

Examples

CSC 365 Example

Course Object:

- Prefix: CSC $\longrightarrow$ **String**

- Course #: 365 $\longrightarrow$ **Integer**

- Name: Introduction to Database Systems $\longrightarrow$ **String**

- Description: Basic Principles, ... $\longrightarrow$ **String**

- Units: 4 $\longrightarrow$ **Integer**

Department Object:

- Name: Computer Science and Software Engineering

- Abbreviation: CSSE

- Building: 14

- Room: 245

- College: CENG

Stringing these objects together based on relationship would make a **network model**.

Schema Example

```
Course(Prefix String, Course# Integer, Name String, Description
String, Units Integer)
```

Prefix	Course#	Name	Description	Units
CSC	365	Introduction to Database Systems	Basic Principles, ...	4
CSC	357	Systems Programming	...	4

```
Department(Name, College, Building, Room): Department would also have a table as well.
```

CSC 365-07: Introduction to Database Systems	Spring 2023
Lecture 3: RDM Cont.	
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Relational Data Model

What makes a record unique?

- **Superkey**: any set of attributes that uniquely defines a record in a table

- **Primary Key**: candidate key chosen by you

CSC 365-07: Introduction to Database Systems	Spring 2023
Lecture 4: SQL DDL and DML	
Instructor: Alex Dekhtyar	*Ishaan Sathaye*

MySQL Access

1. Server Address = host: **mysql.labthreesixfive.com**

2. Port: 3306

3. username

4. password

MySQL Database

- Namespace

- Collection of Tables

- Set of Permissions

Case Sensitivity

Case Sensitive

- Table Names

- Database Names

Not Case Sensitive

- Attribute Names

- SQL Keywords

Types

- **Numeric Types**
  - **Integer Types**
    * TINYINT
    * SMALLINT
    * MEDIUMINT

- ∗ **INT**
- ∗ BIGINT
  - **Floating Point Types**
    - ∗ **FLOAT**
    - ∗ **DOUBLE(P, D)**
    - ∗ **DECIMAL**

- **String Types**

  - **Character Types**
    - ∗ **CHAR(N)** ⟶ **Fixed Length**
    - ∗ **VARCHAR(N)** ⟶ **Variable Length**
    - ∗ TINYTEXT
    - ∗ **TEXT** ⟶ for storing large amounts of text
    - ∗ MEDIUMTEXT
    - ∗ LONGTEXT

- **Date and Time Types**

  - **Date Types**
    - ∗ DATE
    - ∗ DATETIME
    - ∗ TIMESTAMP
    - ∗ TIME
    - ∗ YEAR

Data Definition Language (DDL)

Commands from DDL act upon the schema

- CREATE TABLE

- DROP TABLE

- ALTER TABLE

Define a Relational Table

Aspects needed to define a table:

- Table Name

- Attributes: Name + Type

- Constraints

```
CREATE TABLE <table_name> (
    <attribute_name> <sql_type> [<single_line_constraints>],
    ...,
    <attribute_name> <sql_type> [<single_line_constraints>] [,
    <constraints>[,
    <constraints>]
]);
```

Data Manipulation Language (DML)

Commands from DML act upon the instance.

- INSERT

- DELETE

- UPDATE

Inserting Data

```
INSERT INTO <table_name>(<attribute_name>, ...)
    VALUES (<value>, ...);
```

Supply values in order of attribute declarations in CREATE TABLE statement. Can omit the attribute names if values supplied are in the same order. If need to omit a value then omit that attribute name as well.

More on Constraints

- [**NOT**] **NULL** - attribute cannot be null

- **UNIQUE**

- **PRIMARY KEY**

- **FOREIGN KEY**

- **DEFAULT** <**exp**> - default value for attribute

- **AUTO_INCREMENT** - means that the attribute is an integer and is automatically incremented

Lab 2

MySQL Server

- LabThreeSixFive.com

- mysql command line client

- IDE (DatGrip)

- mysql connectivity from Python

Lab 2 uses Create Table, Drop Table, and Insert.

Code from Lab

```
show tables

CREATE TABLE Departments (

    DeptId INT PRIMARY KEY,
    Abbr VARCHAR(20) UNIQUE, -- UNIQUE makes candidate key
    Name VARCHAR(128) UNIQUE,
    College CHAR(10),
    Building INT,
    Room CHAR(6),
    -- set multiple candidate keys at the bottom
    UNIQUE(Building, Room),
    -- foreign key always a separate line statement:
    -- FOREIGN KEY(College) REFERENCES colleges(abbr)

);

describe colleges;
SELECT * FROM colleges;

show CREATE TABLE colleges;

show CREATE TABLE Departments;

INSERT INTO Departments
    VALUES(1, 'CSSE', 'Computer Science and Software Engineering', 'CENG', 14, '245');

INSERT INTO Departments(DeptId, Abbr, Name, College, Building, Room)
    VALUES(1, 'CSSE', 'Computer Science and Software Engineering', 'CENG', 14, '245');
```

DML

Updating Data

```
UPDATE <table_name>
    SET <attribute_name> = <value>
    WHERE <condition>;
```

Example

```
UPDATE colleges
    SET abbr = 'COSAM'
    WHERE abbr = 'COASM'
```

WHERE clause is a filter that determines which rows are updated.

Deleting Data

```
DELETE FROM <table_name> -- just this is a valid command to delete all rows
    WHERE <condition>;
```

DDL

Altering Tables

```
ALTER TABLE <table_name>
    <Command> <parameters>;
```

Commands

- ADD - add a column/attribute/key

- DROP

- MODIFY

- RENAME

Parameters

- COLUMN

- CONSTRAINT

- FOREIGN KEY

- PRIMARY KEY

- UNIQUE

Adding an attribute, dropping/adding a constraint, renaming a table, disable/enabling keys, and modifying attributes examples are in this professor notes: `4-SQLDDLDML.pdf`

CSC 365-07: Introduction to Database Systems	**Spring 2023**
Lecture 6: DML/DDL Cont., WHERE Clause., and MySQL Conn.	
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Announcements

Running Scripts for Lab 2

Can run from command line using mysql command or using mysql client. For running using mysql command need to specify the database if not using default database.

```
source script.sql
```

DML/DDL

Data Manipulation works on instance and Data Definition works on schema.

Altering a Table

Modifying the schema. ALTER examples in class.

For CREATE TABLE, you can name constraints:

```
CREATE TABLE Example (
    Id int PRIMARY KEY,
    X INT,
    Y INT,
    CONSTRAINT Point UNIQUE (X, Y)
);
```

Updating and Deleting from Table: WHERE Clause

Ex. Deleting in Table

```
DELETE FROM test02
    WHERE b > c
```

This deletes rows where b is greater than c.

Ex. Deleting with Scope

```
DELETE FROM test02
```

```
FOR EACH ROW in test01
DO
    DELETE FROM test02 -- delete(row, condition)
    WHERE b > c
```

SQL Boolean Expressions

- 0, 1

- Builtin: IN(...) $\longrightarrow$ returns bool

- $< Expression > < op1 > < op2 >$ // can also use IN or LIKE

- $< Expression >$ AND $< Expression >$

- $< Expression >$ OR $< Expression >$

- NOT $< Expression >$

MySQL Connectivity

Breifly went over the Python examples on Course webpage that connect to MySQL server.