MSiA-413 Introduction to Databases and Information Retrieval

Lecture 12
Creating and Updating SQL Databases

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Slides adapted from Steve Tarzia

Last Lecture

- Showed how indexes are added to tables
- Explained how multiple indexes can co-exist
- Described composite indexes
- Gave guidelines for when to index columns
- Showed which columns should be indexed to speed-up some example queries

Modifying SQL databases

- Define tables
- Add rows to tables
- Delete rows from tables
- Update columns in a row
- Alter tables by adding or removing:
  - Columns
  - Indexes
  - Foreign keys
- … and much more

- `CREATE TABLE …`
- `INSERT INTO …`
- `DELETE FROM …`
- `UPDATE …`
- `ALTER TABLE …`

I'll be showing the SQLite dialect in these slides. For homework, look up the detailed syntax online:
https://sqlite.org/lang.html

Deleting rows

Just like SELECT

- DELETE command deletes rows in a table matching some criterion
- Very similar to the `SELECT` statements you are familiar with
- Just replace `SELECT` with `DELETE` and don't specify any columns
- This deletes all the rows in the Classes table for classes in a certain room:
```
DELETE FROM Classes WHERE ClassRoomID=12
```
- If you do not include a WHERE clause, all the rows in that table will be deleted: 🚷😰
```
DELETE FROM Classes
```
- To be safe, run a `SELECT` query first to see what will be deleted:
```
SELECT * FROM Classes WHERE ClassRoomID=12
```

Foreign Keys affect deletions

- SchoolScheduling database
  - Foreign key in the *Classes* table refers to the *Class_Rooms* table
  - What happens if we try to delete a classroom that has several associated classes?
- If you try to delete a row that is a parent to another row there are several possible results, depending on the particular foreign key settings:
  - `RESTRICT` is the default behavior: it would block the deletion
    - You would have to delete the classes first, then the classrooms
  - `CASCADE` causes the child rows to be deleted as well
    - Classes would be deleted
  - `SET NULL` causes the child rows to have the column set to null
    - Classes would remain, but with a NULL ClassRoomId

Updating rows

- `UPDATE` command is used to change one or more columns in the rows that match some criterion

```
UPDATE Departments SET DeptName="Social Studies”
  WHERE DeptName="History"
```

- Just like `DELETE`, a single `UPDATE` command can affect many rows and it can use subqueries:

```
UPDATE Students SET StudMajor=
  (SELECT MajorID FROM Majors WHERE Major="English")
```

- Can also refer to existing column values and use math functions:

```
UPDATE Student_Schedules SET Grade=Grade+5 WHERE ClassID=1500
```

Updating multiple columns

- Use a comma-separated list to update multiple columns at once:

```
UPDATE my_table
  SET column1=value1,
      column2=value2,
      column3=value3
  WHERE id=123
```

Inserting new rows

- `INSERT` command creates one row with the column values specified
- List the column values in the same order that the columns were defined:

```
INSERT INTO Buildings VALUES ("FD", "Ford", 5, 1, 0);
```

- Or, explicitly list the columns being set (this is more clear):

```
INSERT INTO Buildings (BuildingName, BuildingCode,
         NumberOfFloors, ElevatorAccess, SiteParkingAvailable)
  VALUES ("Ford", "FD", 5, 1, 0);
```

- Unspecified columns will get the default value specified when the table was created (more on this later)

Bulk loading data

Several options for inserting lots of rows:

1. Write code in a programming language like R or Python to read the source data and run lots of `INSERT` statements or one really big `INSERT` statement:
   ```
   INSERT INTO table VALUES (1, "cat", 5), (2, "dog", 2), (3, "mouse", 9) …
   ```
2. Insert values that exist in some database
   ```
   INSERT INTO table SELECT …
   ```
3. Import a CSV file
   - CSV (**C**omma **S**eparated **V**alues) is a very simple, standard spreadsheet format
   - Exact import steps are different for each DBMS
   - In DB Browser for SQLite use *File* → *Import* → *Table from CSV file*
4. Use an ETL software package (**E**xtract, **T**ransform, **L**oad)

Creating tables

- `CREATE TABLE` command defines:
  - Table name
  - Column names
  - Column types (int, float, text, etc.)
  - Whether columns are optional or required (NOT NULL)
  - Primary key
  - Foreign keys
  - Unique keys
  - Indexes (non-unique keys)
- In other words, everything that we drew in the data model diagrams

CREATE TABLE syntax examples from SchoolScheduling.sqlite

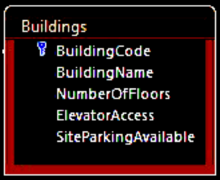


Table name

Required column, not optional

```
CREATE TABLE Buildings (
  BuildingCode nvarchar (3) NOT NULL,
  BuildingName nvarchar (25),
  NumberOfFloors smallint,
  ElevatorAccess bit NOT NULL DEFAULT 0,
  SiteParkingAvailable bit NOT NULL DEFAULT 0,
  PRIMARY KEY (BuildingCode)
);
```

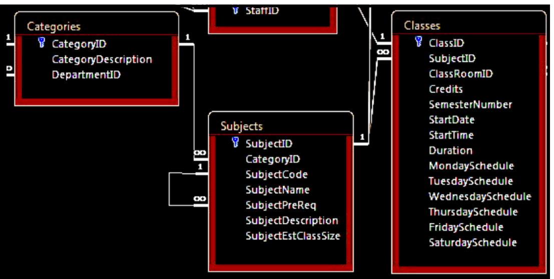
Columns

Text with at most 25 characters

Column cannot be NULL, but it will take a value of zero if none is specified.

Description of types in SQLite: **http://www.sqlite.org/datatype3.html**

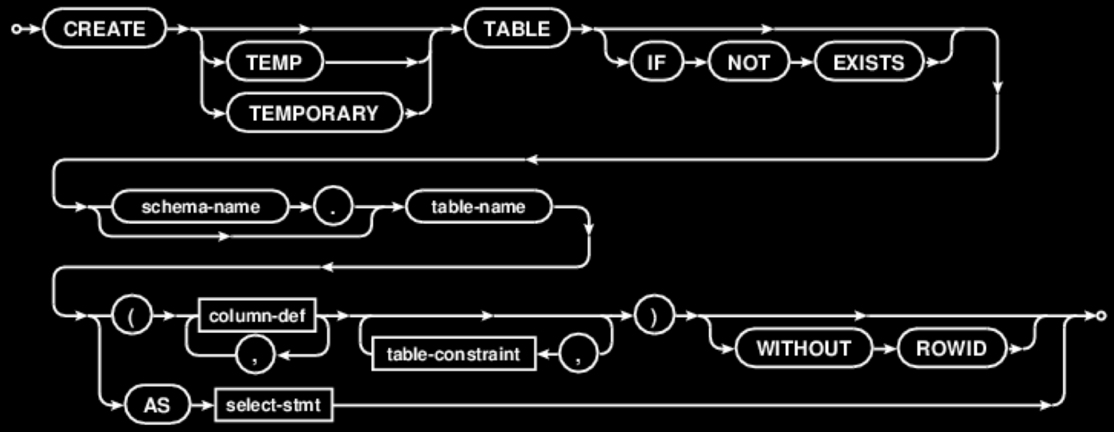
CREATE TABLE syntax examples from SchoolScheduling.sqlite



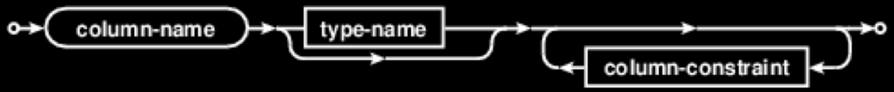
```
CREATE TABLE Subjects (
  SubjectID int NOT NULL DEFAULT 0 ,
  CategoryID nvarchar (10)
      REFERENCES Categories(CategoryID),
  SubjectCode nvarchar (8),
  SubjectName nvarchar (50),
  SubjectPreReq nvarchar (8) DEFAULT NULL
      REFERENCES Subjects(SubjectCode),
  SubjectDescription text,
  SubjectEstClassSize smallint NOT NULL DEFAULT 0,
  PRIMARY KEY (SubjectID),
  UNIQUE (SubjectCode)
);
```

Foreign keys

CREATE TABLE syntax diagram



column-def:



Details: **https://www.sqlite.org/lang_createtable.html**

Column constraint syntax

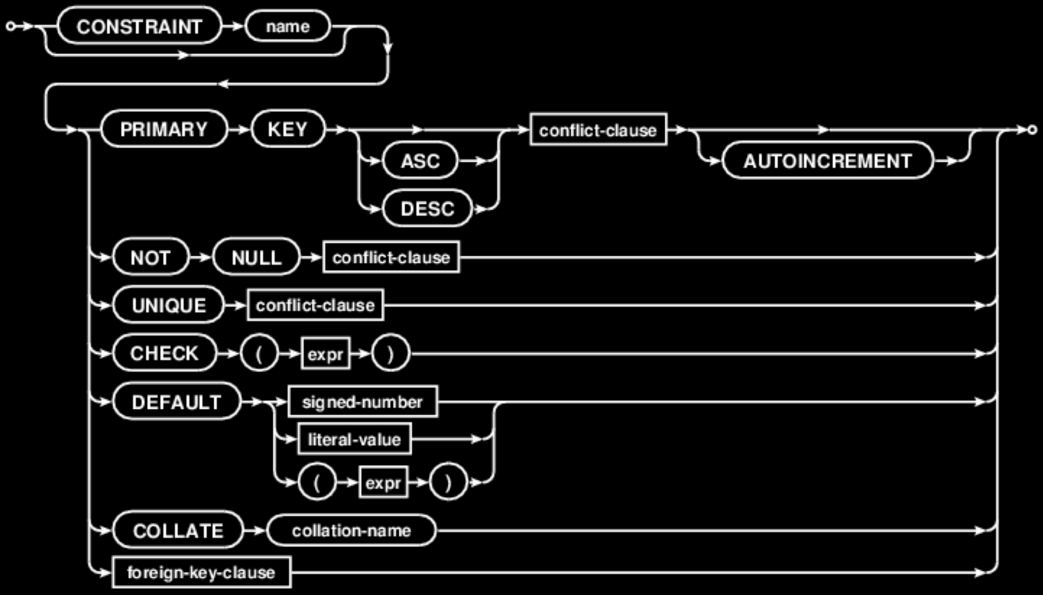
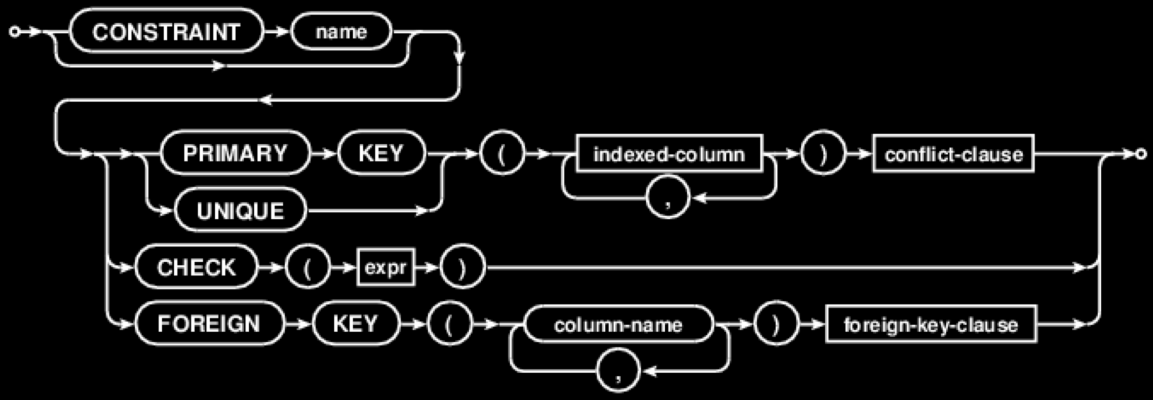


Table constraint syntax

at the end of query



Changing the schema with `ALTER TABLE`

- Add column:
  - `ALTER TABLE ADD COLUMN …`
  - Default value will be filled-in for existing rows (perhaps NULL)
- Remove a column
  - `ALTER TABLE DROP COLUMN …`
- Some DBMSs (but not SQLite) allow changing name or type of column:
  - `ALTER TABLE ALTER COLUMN …`

Creating indexes

- Indexes are usually defined when the table is created
  - Usually define at least a *primary key*
- But you may later realize that certain queries are too slow
  - Without proper indexes, DBMS will have to examine every row in the table to find the relevant rows
  - Adding one or more indexes may dramatically speed up a query

Basic syntax:

```
CREATE INDEX index_name ON table_name (column_name)
```

For more information...

- Check SQL as Understood by SQLite at:
- **https://sqlite.org/lang.html**