

SQL: Part 2

DDL+

Lecture 4



Outline

1. Transactions: **BEGIN, COMMIT/ROLLBACK**
2. Schemas: **CREATE/DROP/ALTER, USE**
3. Authorization: **GRANT/REVOKE**



Caution

Note that the specific syntax/functionality of all commands in this lecture are highly dependent upon the chosen DBMS (and possibly even the version)

These slides should be taken as an overview of common options; for actual implementation you should reference DBMS documentation



Transactions

- Review: ACID
- In most DBMSs, each individual query, by default, is a transaction
- To group multiple operations:
 - Start: **BEGIN**
 - End: **COMMIT** (default) or **ROLLBACK**



Schema Specification

SQL is used to create/edit/delete a ...

- Database
- Table
- Column
- Data type/domain
- Primary/foreign/unique key(s)
- Other (more later)
 - Index, view
 - Trigger, assertion
 - User, role, privilege

Schema description is stored in the *catalog*
(sometimes represented/accessible as tables)



Database

```
CREATE { DATABASE | SCHEMA }  
[IF NOT EXISTS] database_name;
```

```
DROP { DATABASE | SCHEMA }  
[IF EXISTS] database_name;
```

After, common to need a **USE** database_name or similar statement to indicate active database context (in multi-database DBMSs)



Table

```
CREATE TABLE [IF NOT EXISTS] table_name (  
    column_name1 TYPE [OPTIONS],  
    column_name2 TYPE [OPTIONS],  
    {constraint},  
    ...  
);
```

High-level notes

- If an option applies to a single column, it can go with the column; else separate entry, or sometimes separate command
- Separate elements may/not have name (for later manipulation)
- Change: **ALTER TABLE** table_name **ADD/ALTER/DROP** ...;



Table: Common Data Types

- **BIT**
- **INT** (capacity, length, signed)
- **REAL/DOUBLE/FLOAT** (size, digits)
- **DATE/TIME/DATETIME/TIMESTAMP**
- **CHAR** (length)
- **VARCHAR** (length)
- **TEXT/CLOB**
- **BINARY/BLOB**



Table: Custom Data Types

- **CREATE DOMAIN**
 - Name, base type, constraint(s) via CHECK
- **CREATE TYPE**



Table: Common Column Options

- **[NOT] NULL**
- **DEFAULT <value>**
- **UNIQUE**
- **PRIMARY KEY**
- **CHECK <expr>**
- **AUTOINCREMENT**
 - DBMS-specific



Table: Keys

Separate line required if multi-column.

Optional: **CONSTRAINT** **constraint_name**

PRIMARY KEY (c_name1, c_name2, ...)

FOREIGN KEY

(l_c_name1, l_c_name2, ...)

REFERENCES table_name(f_c_name1, ...)

[**ON** <**DELETE/UPDATE**> <**CASCADE/SET NULL**>]



Index (1)

- Supplementary data structure used to make some operations faster
- Defined on a sequence of field(s) of a single table
 - May optionally enforce uniqueness
- More detail in physical tuning
 - When to use, types, tradeoffs



Index (2)

```
CREATE [UNIQUE] INDEX index_name  
ON table_name (c_name1, ...)  
[OPTIONS];
```

Notes

- Ordering of columns is VERY important
- Options often refer to the type of index being used (e.g. btree, hash, spatial – VERY important)



View

A “virtual” table defined via a SELECT query over *base* table(s) and/or other views

```
CREATE VIEW view_name  
AS SELECT ...;
```

Common uses

- Convenience/code re-use: if multiple queries rely upon a common data transformation
- Security: users only see the data they “need” to see (e.g. calculation/join/aggregation over base data)
- Performance: a view may optionally be **materialized** (sometimes **indexed**), meaning the DBMS actually stores its contents on disk – can reduce query time via caching complex operations/aggregations (more in physical tuning)



Assertion

Declarative constraint that is outside the scope of *implicit/explicit* constraints

Typically cross-table
– Else **CHECK**

```
CREATE ASSERTION assertion_name  
CHECK (multi-table expr);
```



Trigger

Part of an *active database* – specifies actions that automatically occur as a result of database events

Typically composed of three components

1. Database update **event(s)**
2. Before/after the event(s) occur, the **condition** that determines if the rule action applies
3. The **action** to be taken, typically a set of SQL statements

```
CREATE TRIGGER trigger_name  
<BEFORE/AFTER> <INSERT/UPDATE/DELETE>  
ON table_name FOR EACH ROW  
{body};
```



Stored Procedure/Function

- Some DBMSs support the ability to store code modules within the database, for access via SQL or library API
 - Reduces duplication
 - Decreases latency
 - More complex constraints than SQL
- **SQL/PSM** (SQL/Persistent Stored Modules) is a standard for such modules, but each DBMS varies widely
 - **CREATE FUNCTION/PROCEDURE ...**



Discretionary Access Control

- Create/remove users
 - **CREATE USER** ...
 - **DROP USER** ...
- Grant/revoke privilege(s)
 - GRANT/REVOKE** <privilege list>
 - ON** <database/table>
 - TO/FROM** user
- **WITH GRANT OPTION** supports propagation of grant privilege



Summary

- You have now been exposed to a selection of SQL DDL components
 - **BEGIN, COMMIT/ROLLBACK**
 - **CREATE/DROP/ALTER, USE**
 - **GRANT/REVOKE**
- These commands are very DBMS-specific and are used to create/modify/remove...
 - Schema elements (e.g. table, column, data types)
 - Physical implementation (e.g. indexes, views)
 - Constraints (e.g. keys, assertions)
 - Access (e.g. users, privileges)

