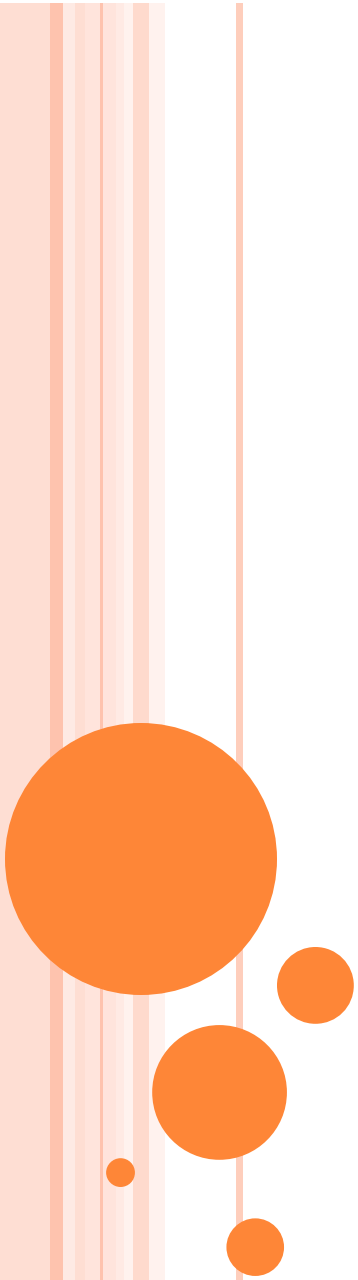


Database Lab

MySQL

SQL

- SQL stands for **S**tructured **Q**uery **L**anguage
- A special purpose programming language designed for managing data in a relational database system
- Initially developed at IBM by Donald D. Chamberlin and Raymond F. Boyce in early 1970s
- Initially it was known as SEQUEL and later changed to SQL

MYSQL

- MySQL is an open source relational database management system
- It runs as a server to provide multi user access to a number of databases
- MySQL is a popular choice of database for use in web application

Some useful links-
https://www.tutorialspoint.com/mysql/index.htm
https://www.w3schools.com/sql/default.asp
https://www.techonthenet.com/mysql/index.php

Basic MySQL Commands

- At first, we will learn the commands to do the followings-
  - How to create a database?
  - How to add users?
  - How to create tables?
  - How to insert data into the table?
  - How to check the contents of a table?

CREATE DATABASE

- It is used to create a database
- A name will be associated with it
  - Example, if we want to create a database named *dblab* then we may use the following command-
  - sql> CREATE DATABASE dblab;
- To check all databases, use *SHOW databases* command
  - sql> SHOW DATABASES;
- To create tables under a specific database, then we have to provide *USE databaseName* command
  - sql> USE DATABASE dblab;

CREATE USER

- It is used to create a new user
- For each user-
  - username and password are required
  - Example, if we want to create a user named *bob* with password *devil* then we may use the following command-
  - sql> CREATE USER 'bob'@'localhost' IDENTIFIED BY 'devil';

User bob can login locally where the server is installed

- But the new user has no permission to access anything

GRANTING PERMISSION

- Type of permissions
  - ALL PRIVILEGES: provides all access
  - CREATE: allows to create new tables and databases
  - DROP: allows user to delete tables or databases
  - DELETE: allows user to delete rows of tables
  - INSERT: allows user to insert rows into tables
  - SELECT: allows user to use the SELECT command
  - UPDATE: allows user to update table rows
  - GRANT OPTION: allows user to grant or remove other users' privileges

GRANT & REVOKE COMMAND

- Grant command is used to provide permission
- GRANT [type of permission] ON [database name].[table name] TO '[username]'@'localhost';
  - To give access to any database or any table, (*) can be used in place of database name and table name
- Revoke command is used to revoke permission
- REVOKE [type of permission] ON [database name].[table name] FROM '[username]'@'localhost';

CREATE TABLE

- To create table under a database name, we have to use *CREATE TABLE* command
- For example, to create a table for land entity-

```
sql> CREATE TABLE land(
        land_id char(10),
        address varchar(30),
        land_type varchar(15),
        region varchar(15));
```

DATA TYPES

- Frequently used text data types-
  - char(size): holds a fixed length upto 255 character
  - varchar(size): holds a variable length upto 255 character
  - text: holds a maximum length of 65,535 characters

DATA TYPES

- Frequently used number data types-
  - int(size):
    - range from -2147483648 to 2147483647 normal. 0 to 4294967295 unsigned
    - Size is maximum number of digits
  - smallint(size):
    - range from32768 to 32767 normal. 0 to 65535 unsigned
  - float(size,d):
    - A small number with a floating decimal point.
    - The maximum number of digits may be specified in the size parameter.
    - The maximum number of digits to the right of the decimal point is specified in the *d* parameter

DATE TYPES

- Frequently used date/time data types-
  - date():
    - A date. Format: YYYY-MM-DD
  - datetime():
    - A date and time combination. Format: YYYY-MM-DD HH:MM:SS
  - time():
    - A time. Format: HH:MM:SS

DESCRIBE COMMAND

- Once a table has been created, the schema definition can be seen using **DESC** (or describe) command
- Check the schema description of table *land*
  - sql> **DESC** land;

Insertion

- Newly created table is empty
- Add a new tuple to *account*

  insert into *account*
  values (9732, 'Park Road', 1200)

  - Insertion fails if any integrity constraint is violated

INSERTION

- Multiple rows can also be inserted using single insert command
- Example:
  - Sql> **insert into** *account*
    values (9732, 'Park Road', 1200),
    (1332, 'Buchtel Blvd', 1560),
    (1991, 'Exhibition Rd', 2560)

UPDATE

- The *UPDATE* command is used to update records in a table
- For example, if we want to update the mobile_no of a student with roll_no = '2009CS01'
  - Sql> **update** student
    set mobile_no=9876543210
    where roll_no = '2009CS01'
- When using update operation care must be taken to specify appropriate condition in *where* clause

DELETION

- The *DELETE* command is used to delete rows a table
- Example 1: to delete record from *student* table with roll_no '2009CS01'
  - Sql> **delete from** student
    where roll_no ='2009CS01'
- Example 2: to delete all records from student table
  - sql> **delete from** student

DROP COMMAND

- The **drop table** command is used to delete a table from the database
  - sql> **drop table** table_name
- The **drop database** command is used to delete a database
  - sql> **drop database** database_name

SQL Query

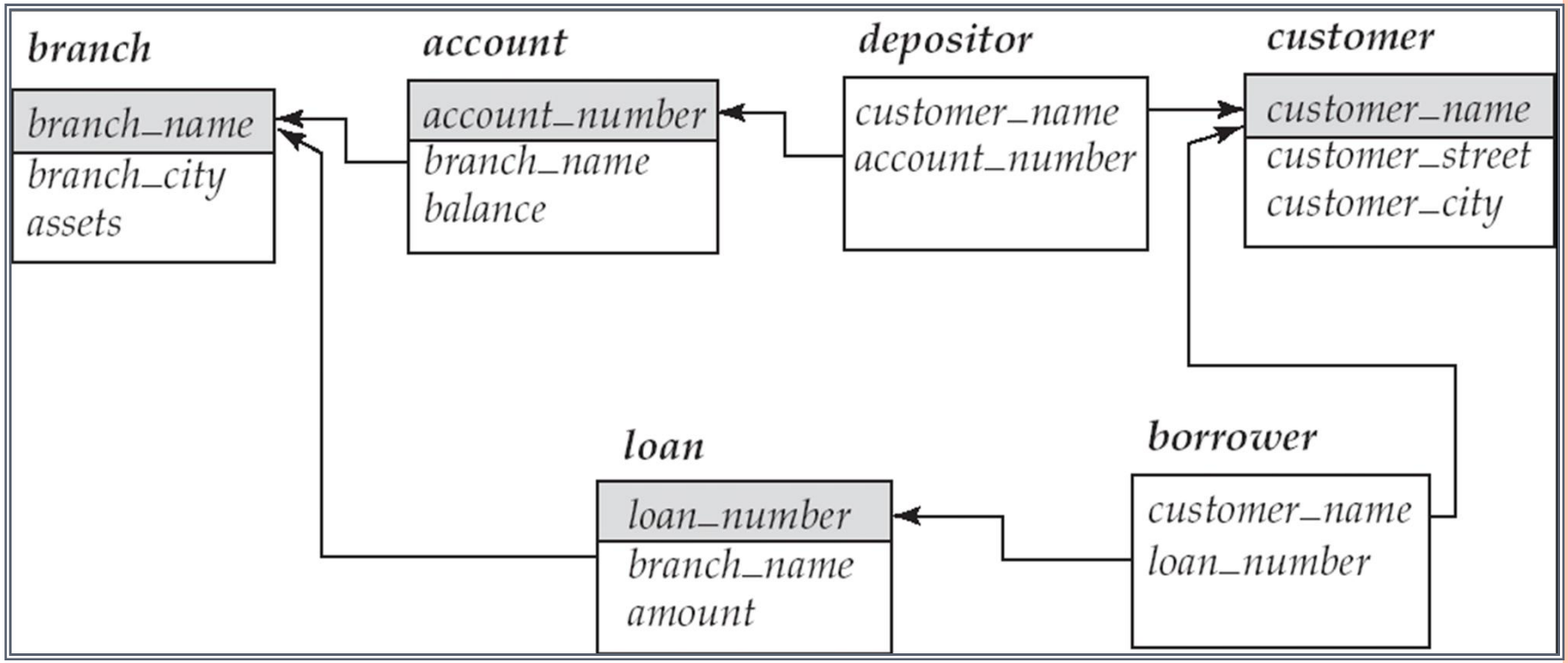
- Basic form

```
SELECT <attributes>
FROM   <one or more relations>
WHERE  <conditions>
```

SQL **commands** are case insensitive

Call this a **SFW** query.

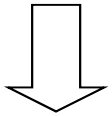
Bank Example



Simple SQL Query: Selection

Selection is the operation of filtering a relation's tuples on some condition

account_number	branch_name	balance
1009	Boring Rd	19.99
1233	PU	29.99
2124	Patliputra	149.99
8721	PU	203.99



```
SELECT *
FROM   account
WHERE  branch_name = 'PU'
```

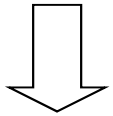
account_number	branch_name	balance
1233	PU	29.99
8721	PU	203.99

In SELECT clause, '*' indicates all attributes

Simple SQL Query: Projection

Projection is the operation of producing an output table with tuples that have a subset of their prior attributes

account_number	branch_name	balance
1009	Boring Rd	19.99
1233	PU	29.99
2124	Patliputra	149.99
8721	PU	203.99



```
SELECT account_number, balance
FROM   account
WHERE  branch_name = 'PU'
```

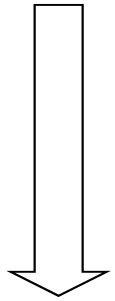
account_number	balance
1233	29.99
8721	203.99

NOTATION

Input schema

account(account_number, branch_name, balance)

```
SELECT account_number, balance
FROM   account
WHERE  branch_name = 'PU'
```



Output schema

Answer(account_number, balance)

SQL QUERY: DUPLICATE ELIMINATION

- SQL allows duplicates in relations as well as in query results
- To force the elimination of duplicates, insert the keyword **distinct** after SELECT clause.
- Find the names of all branches in the *account* relations, and remove duplicates

```
SELECT DISTINCT branch_name
FROM account
```

More features of Select clause

- The **SELECT** clause can contain arithmetic expressions involving the operation, +, –, *, and /, and operating on constants or attributes of tuples.
- E.g.:

SELECT *account_number, branch_name, balance* * 100
FROM *account*

THE WHERE CLAUSE

- The **where** clause can include multiple conditions
- To find all loan number for loans made at the "Patliputra" branch with loan amounts greater than1200.

```
SELECT loan_number
FROM loan
WHERE branch_name = 'Patliputra'  and amount > 1200
```

- Comparison results can be combined using the logical connectives **and, or,** and **not.**

The from Clause

- The **from** clause can also include multiple relations involved in the query
- Find all the possible combinations of *borrower and loan* relations
  - **SELECT** *
    FROM *borrower, loan*
- Find the name, loan number and loan amount of all customers having a loan at the Patliputra branch.
  - **SELECT** *customer_name, borrower.loan_number, amount*
    FROM *borrower, loan*
    WHERE *borrower.loan_number = loan.loan_number*
    AND *branch_name* = 'Patliputra'

The Rename Operation

- SQL allows renaming relations and attributes using the **as** clause:

  old-name **as** *new-name*

- E.g. Find the name, loan number and loan amount of all customers; rename the column name *loan_number* as *loan_id*.

SELECT *customer_name, borrower.loan_number* **AS** *loan_id, amount*
FROM *borrower, loan*
WHERE *borrower.loan_number = loan.loan_number*

Integrity Constraints on Tables

- **not null**
- **unique**
- **primary key**
- **foreign key**

SPECIFYING PRIMARY KEY

- Example:

```
create table branch(
    branch_name   char(15) primary key,
    branch_city        char(30) not null,
    assets             integer);
```

- Example:

```
create table branch(
    branch_name   char(15),
    branch_city        char(30),
    assets             integer,
 primary key (branch_name));
```

Specifying Primary Key

```
create table branch(
        branch_name   char(15),
        branch_city   char(30),
        assets        integer,
        constraint branch_pk
        primary key (branch_name));
```

Explicitly mentioning the constraint name

SPECIFYING FOREIGN KEY

- Example:
  - **Sql> create table** *account(*

account_no **integer primary key**,
branch_name **char**(15)**,**
branch_city **char(**30),
assets **float(8,2),**

constraint account_fk1 foreign key (branch_name)
references branch(branch_name))

SPECIFYING UNIQUE CONSTRAINT

- Like primary key, *UNIQUE* constraint uniquely identifies each record in a database table
- Unlike primary key, a table can have more than one *UNIQUE* constraint
- Example:
  - Sql> **create table** student(
    roll_no **char(10)** ,
    name **varchar(20) not null**,
    mobile_no **int(10) unique**,
    primary key (roll_no));

ALTER TABLE

- The **alter table** command is used to add attributes to an existing relation:
  - **Sql> alter table** *student*
    add *dob date*;
  - All tuples in the relation are assigned *null* as the value for the new attribute.
  - **Sql> alter table** *student*
    add *dob date* **first**;

  Positions the new column at the beginning
  - **Sql> alter table** *student*
    add *dob date* **after stud_name**;

  Positions the new column after a specific column

ALTER TABLE

- The **alter table** command is used to drop attributes from an existing relation:
  - **Sql> alter table** *student*
    drop *dob;*

  Drops the specified column

  However, this drop clause will not work if the column is the only one left in the table

ALTER TABLE

- The **alter table** command can also be used to modify existing attributes of a relation:
- Suppose we want to increase the size of name attribute of student relation from 15 to 30
- Using modify clause
  - **Sql> alter table** *student*

    modify *name varchar(30)*
- Using change clause
  - **Sql> alter table** *student*

    change *name stud_name varchar(30)*

  Allows to change the column name as well

ALTER TABLE

- Changing the column's default value
  - **Sql> alter table** *account*
    alter *balance* **set default** *100;*

- Removing the column's default constraint
  - **Sql> alter table** *account*
    alter *balance* **drop default***;*

ALTER TABLE

- Renaming a table
  - **Sql> alter table** *account*
    rename to *acounts;*

ADDING PRIMARY KEY

- Command **alter table** can be used to add primary key in an existing table
- Example:

```
alter table ac_type
    add primary key (account_no)
```

or

```
alter table ac_type
    add constraint ac_type_pk primary key
(account_no)
```

ADDING FOREIGN KEY

- Foreign key can also be added in an existing table using **alter table** command
- Example:

alter table ac_type

add foreign key (account_no) **references** account (account_no)

or

alter table ac_type

add constraint ac_type_fk1 foreign key (account_no) **references** account (account_no)

Dropping Primary key

- One relation can have at most one primary key. So without using the primary key name, the constraint can be dropped.
- Example:

```
alter table ac_type
  drop primary key
```

Dropping foreign key

- Foreign key needs to be dropped using the foreign key name
- Example:

```
alter table ac_type
  drop foreign key ac_type_fk1;
```

To check the constraint name

- The following command can be used to check the constraint names of a table
- SHOW CREATE TABLE account;

OPERATOR 'LIKE'

- 'like' operator can be used to compare a pattern
- For character data types, two wild cards are frequently used-
  - '%': allows to match any string of length (including zero)
  - '_' :allows to match a single character
- Example:

```
SELECT * FROM customer
WHERE name LIKE '_avi%'
```

OPERATOR 'NOT LIKE'

- Similar to like operator but in this case we are interested in not selecting some specific pattern using NOT LIKE operator
- Example:

```
SELECT * from CUSTOMER
WHERE name NOT LIKE '_avi%'
```

REGEXP

- regexp can be used to catch some specific patterns
- Following characters can be used
  - ^ to match beginning
  - $ to match end
  - . to match each instance
  - a* matches 0 or more instances of a
  - a+ matches 1 or more instances of a
  - [abc] matches patterns containing a,b,or c
  - [a-e] matches characters say a to e
  - [^a-e] not matches a-e characters
  - ^…$ matches exactly 3 characters
  - ^.{3}$ also matches exactly 3 characters

REGEXP

- Case insensitive pattern
- Example: Find the names which contain ‘w’ (w or W)
  - **SELECT** cust_name
    FROM customer
    WHERE cust_name REGEXP ‘w‘
- Case sensitive pattern
- Use ‘binary’ option
- Example: Find the names which contain ‘w’ (lowercase w)
  - **SELECT** cust_name
    FROM customer
    WHERE cust_name REGEXP binary ‘w‘

OPERATOR 'IN'

- Allows to specify multiple values in a 'where' clause
- Example:

```
SELECT *
FROM customers
WHERE city IN ('Dhanbad', 'New Delhi')
```

OPERATOR 'BETWEEN'

- To select a range of data between two values in a 'where' clause
- The values can be number, text or dates
- Example:

```
SELECT * FROM account
WHERE account_no BETWEEN 1234 and 5555
```

BETWEEN operator is inclusive, i.e., includes both start and end values

OPERATOR 'NOT BETWEEN'

- Not to select a range of data between two values in a 'where' clause
- Example:

```
SELECT * FROM account
WHERE account_no NOT BETWEEN 1234 and 5555
```

AGGREGATE FUNCTIONS

- SQL aggregate functions return a single value, calculated from values in a column.
- Some useful functions are
  - AVG() - Returns the average value
  - COUNT() - Returns the number of rows
  - MAX() - Returns the largest value
  - MIN() - Returns the smallest value
  - SUM() - Returns the sum

Aggregate Function

- AVG function returns the average value of a numeric column
  - SELECT AVG(amount) as avg
    FROM account
- COUNT function returns the number of rows that match a given criterion
  - SELECT COUNT(*) FROM account; //counts the number of rows in the table
  - SELECT COUNT(account_number) FROM account;

Aggregate Function

- SUM function returns the total sum of a numeric column
  - SELECT SUM(amount) as total
    FROM account
- MAX function returns the largest value of a selected column
  - SELECT MAX(balance) FROM account;
- MIN function returns the smallest value of a selected column
  - SELECT MIN(balance) FROM account;