

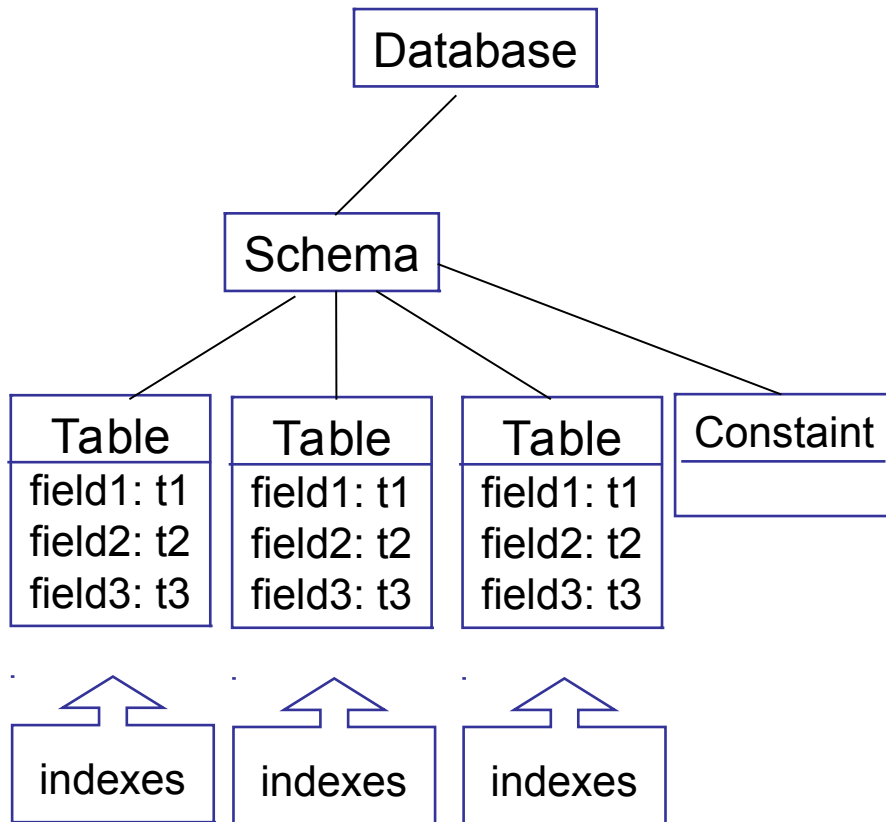


Intro to Relational Databases

A very basic introduction

James Brucker

A Database Structure



A database contains **schema**, which describe the organization of the database.

A schema can contain:

tables - containing the data

index files - for fast lookup

constraints on data

stored procedures

triggers - actions that cause events

Table

- A table contains the actual data in **records** (rows).
- A record is composed of **fields** (columns).
- Each record contains one set of data values.

ID	Name	CCode	District	Populatn
3320	Bangkok	THA	Bangkok	6320174
3321	Nonthaburi	THA	Nonthaburi	292100
3323	Chiang Mai	THA	Chiang Mai	171100

records
(rows)

fields (columns)

Structure of a Table

Every field has:

- a name
- a data type and length

To view the structure of a table use:

```
DESCRIBE tablename
```

```
sql> DESCRIBE City;
```

Field	Type	Null	Key	Default	Extra
ID	int(11)	NO	PRI		auto_increment
Name	char(35)	NO			
CountryCode	char(3)	NO			
District	char(20)	NO			
Population	int(11)	NO		0	

Fields have Data Types

Each field has a data type that identifies the kind of data it can store.

The data type also determines the size of the field.

INTEGER usually 4 byte integers

FLOAT usually 8 byte (like Java double)

DECIMAL like Java BigDecimal

BOOLEAN

CHAR(10) string of size 10 chars

VARCHAR(40) variable length string

Primary Key - field to Identify Rows

- A table usually has a **primary key** field that **uniquely identifies** each row (record) of data.
- Each record must have a **distinct value** of primary key
- The primary key is used to relate (**join**) tables.

ID is the **primary key** in City table.

ID	Name	CCode	District	Populatn
3320	Bangkok	THA	Bangkok	6320174
3321	Nonthaburi	THA	Nonthaburi	292100
3323	Chiang Mai	THA	Chiang Mai	171100

Primary Key is usually just a number

- **Primary key** is usually a meaningless integer assigned by the database system.

Example: ID of City table is an arbitrary number.

ID is the primary key

ID	Name	CCode	District	Populatn
3320	Bangkok	THA	Bangkok	6320174
3321	Nonthaburi	THA	Nonthaburi	292100
3323	Chiang Mai	THA	Chiang Mai	171100

...but it may have meaning

Primary key can be a part of the data, **if** you can guarantee it always has unique, non-null value.

- Not necessarily a number (but integers are preferred).

Example: CountryCode (3-letter) is PK for Country

Primary Key

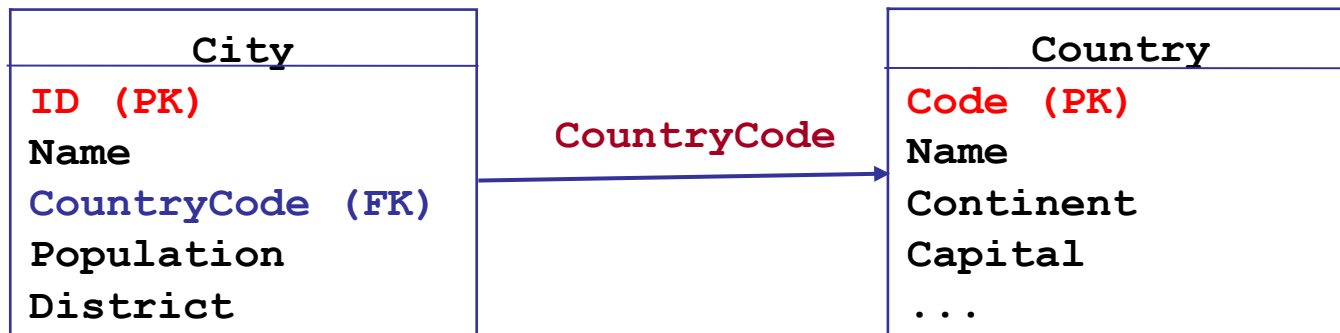
Code	Name	Continent	Population
AFG	Afghanistan	Asia	
NLD	Netherlands	Europe	
THA	Thailand	Asia	
USA	United States..	North America	

Relating Data in Tables

A relational database lets you connect data in different tables using expressions.

This is the power of a **relational database**.

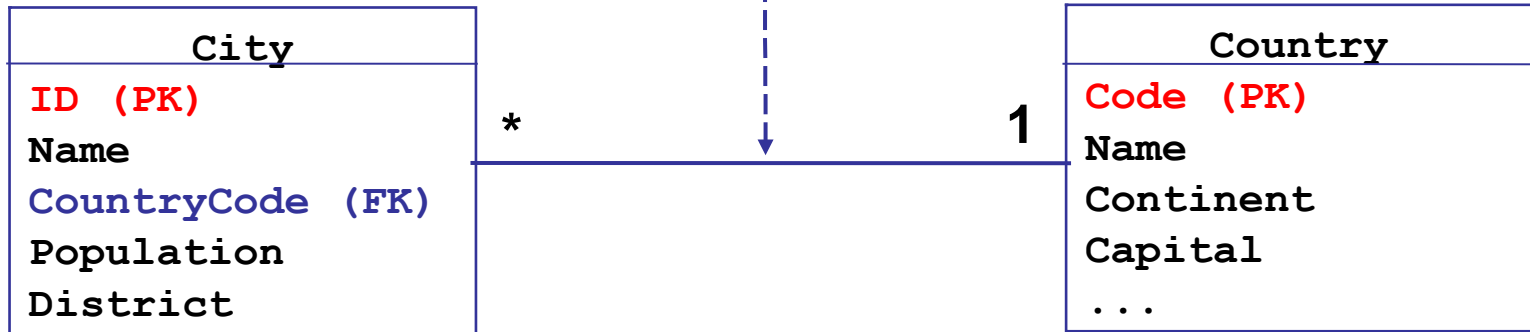
Example: The `CountryCode` (in `City` table) tells you which `Country` the city is part of.



Joining Tables

- Relate or "join" tables using a condition (an expression).
- Use "table.field" to qualify a field name:

City.countrycode = Country.code



What Can You Do?

Databases provide **4 basic operations**:

- Save data (Create)
- Find and Retrieve data
- Update existing data
- Delete

Characteristics

Databases do more than just collect data.

Database servers provide:

- Access control (who can read/write)
- Guarantee data integrity
- All-or-nothing updates
- Transaction processing & logging

... and more.

Database Software

There are many high quality, scalable database software applications... even **for free**.

Q1: Name a database program you know.

Q2: Have you used it? How?

Two Kinds of Database Apps

Embedded (Light-weight) - the database provider is *included in your application*.

- no separate server
- access locally, in code
- can create a database at run-time

Client-Server - a server manages access to database(s).
Client (application) connects to server.

- server often runs on its own machine
- can access over a network
- must set-up server in advance

Common Databases

Embedded (Light-weight)

Apache Derby

H2

HSQldb

SQLite

Client-Server

MariaDB

MySQL

Postresql

IBM DB2

Microsoft SQL Server

No-SQL Database

CouchDB

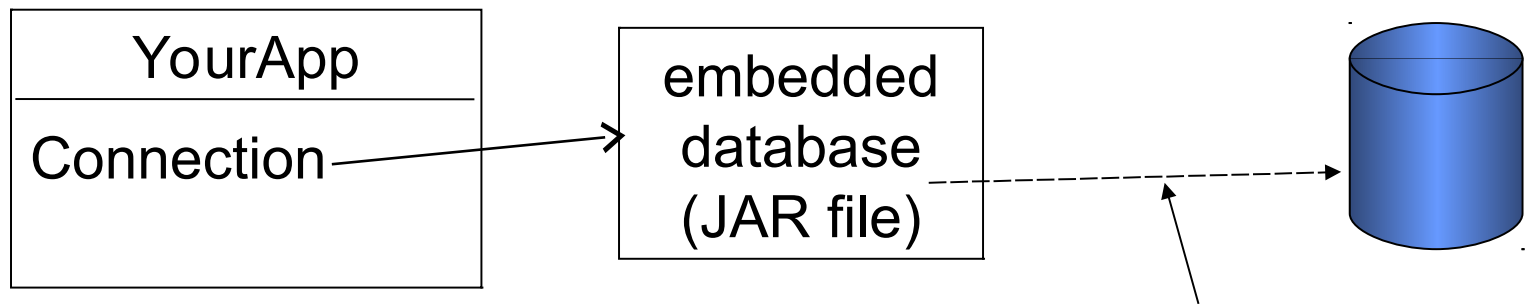
FireBase

MongoDB

Embedded Databases

"Embedded" database manager is **included** in your application. In Java, its a JAR file.

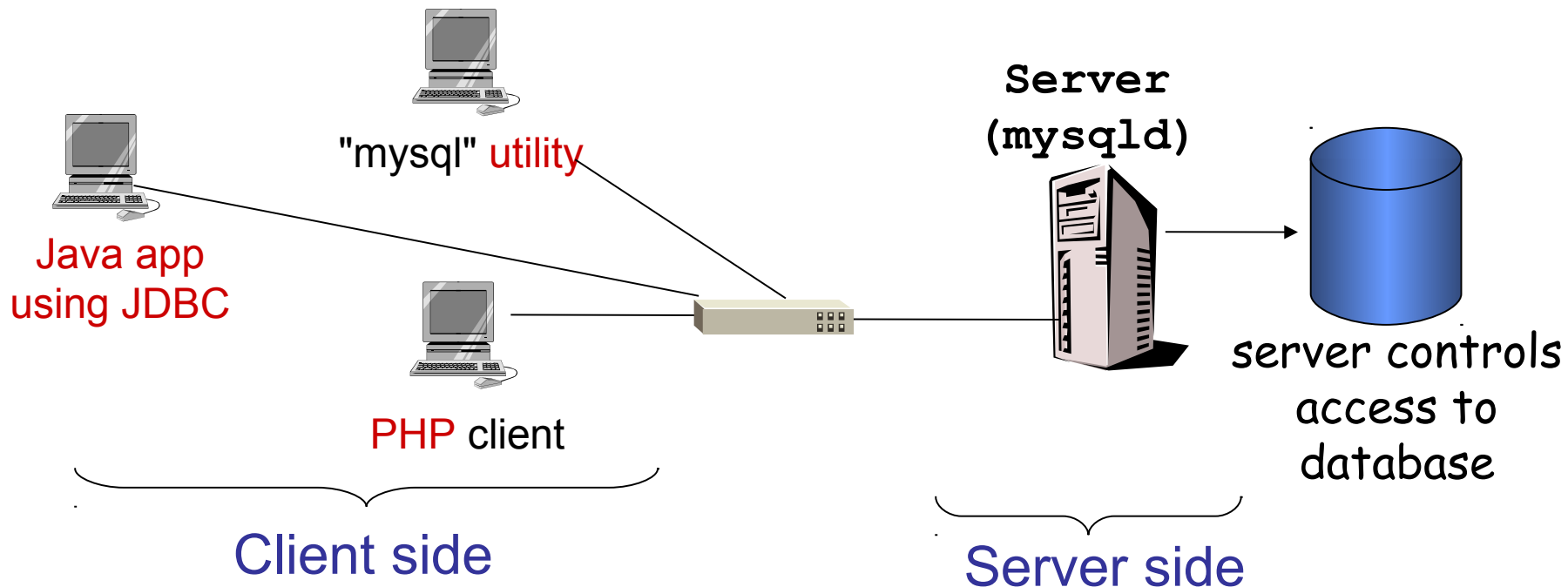
- No separate database server
- You can create & manage database in your app
- Usually *light-weight* (don't use much memory/cpu)



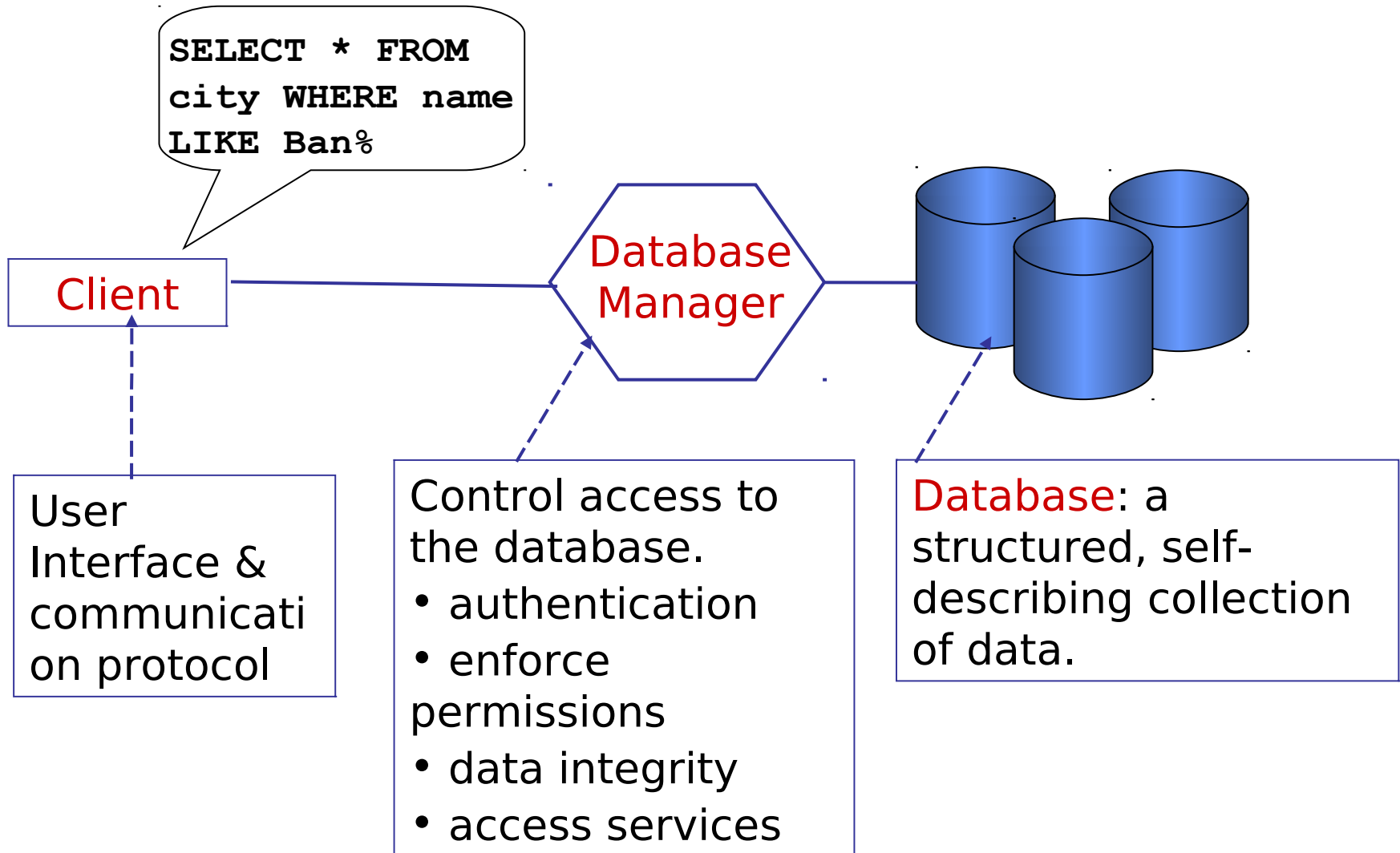
Software in JAR creates and manages database.

Client - Server Databases

- Database **Server** is a separate *process* running on a host.
- **Clients** can run on *any machine*.
- Many programs may be *clients* using a **standard API**.



Database Management System



Why the "d" in mysqld ?

The MySQL server is named "mysqld".

- Other programs ending in "d":

ftpd - ftp server

httpd - Apache HTTP server

sshd - Secure Shell server

Why the "d"?

