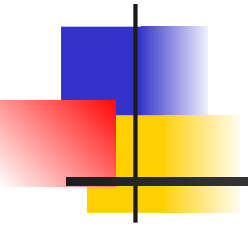
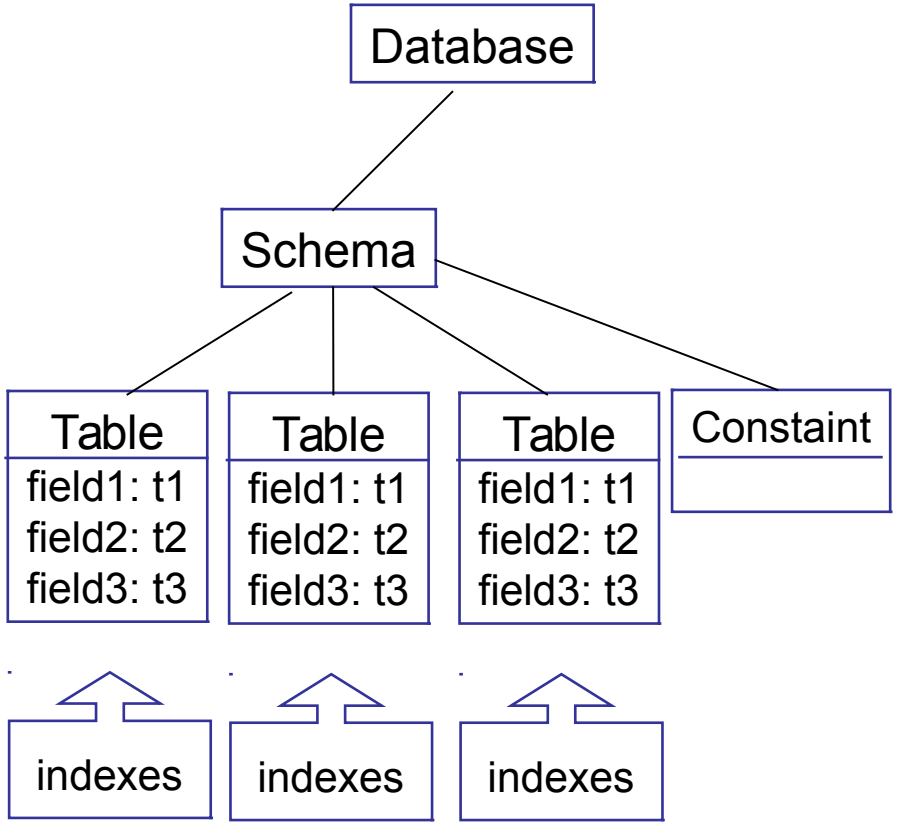


Intro to Relational Databases

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.

records

(rows)

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

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.

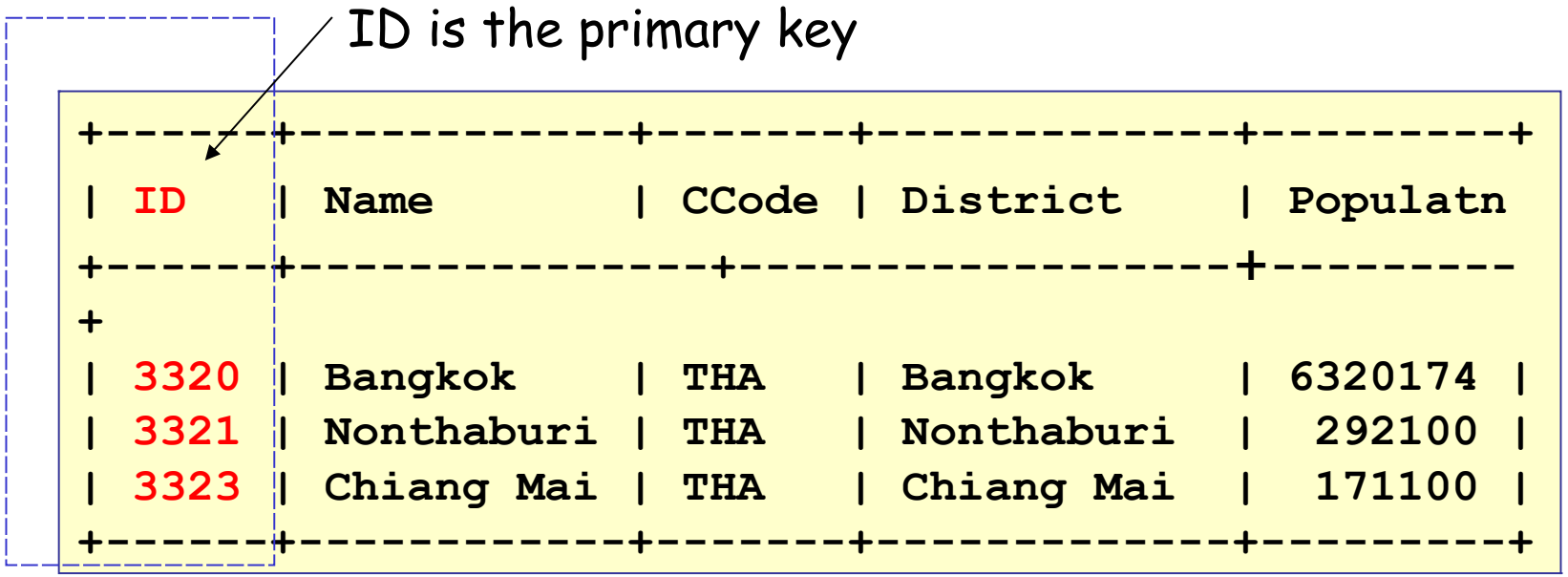
ID is the primary key in City table.

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 has is arbitrary number.



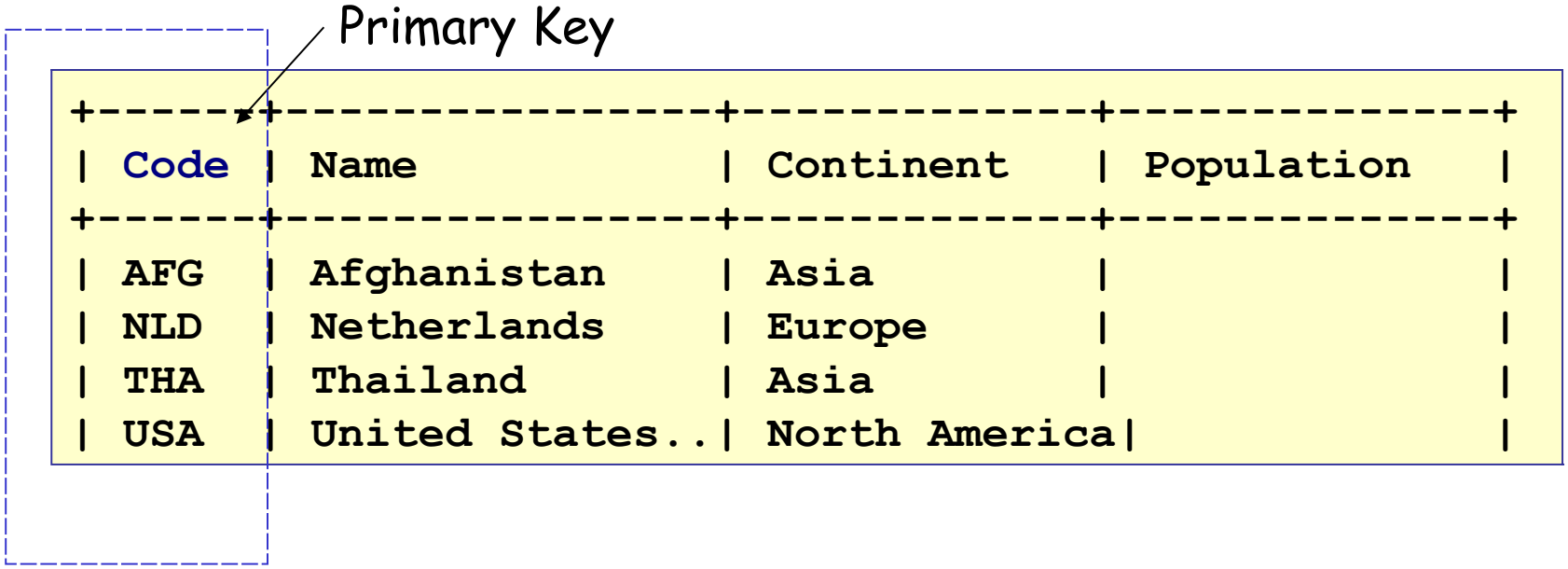
ID	Name	CCode	District	Populatn
3320	Bangkok	THA	Bangkok	6320174
3321	Nonthaburi	THA	Nonthaburi	292100
3323	Chiang Mai	THA	Chiang Mai	171100

...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

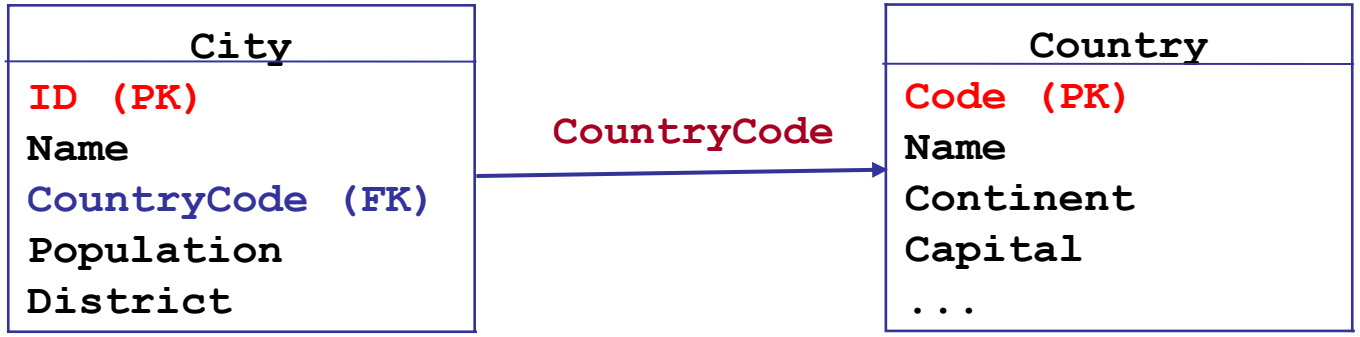


Relating Data in Tables

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

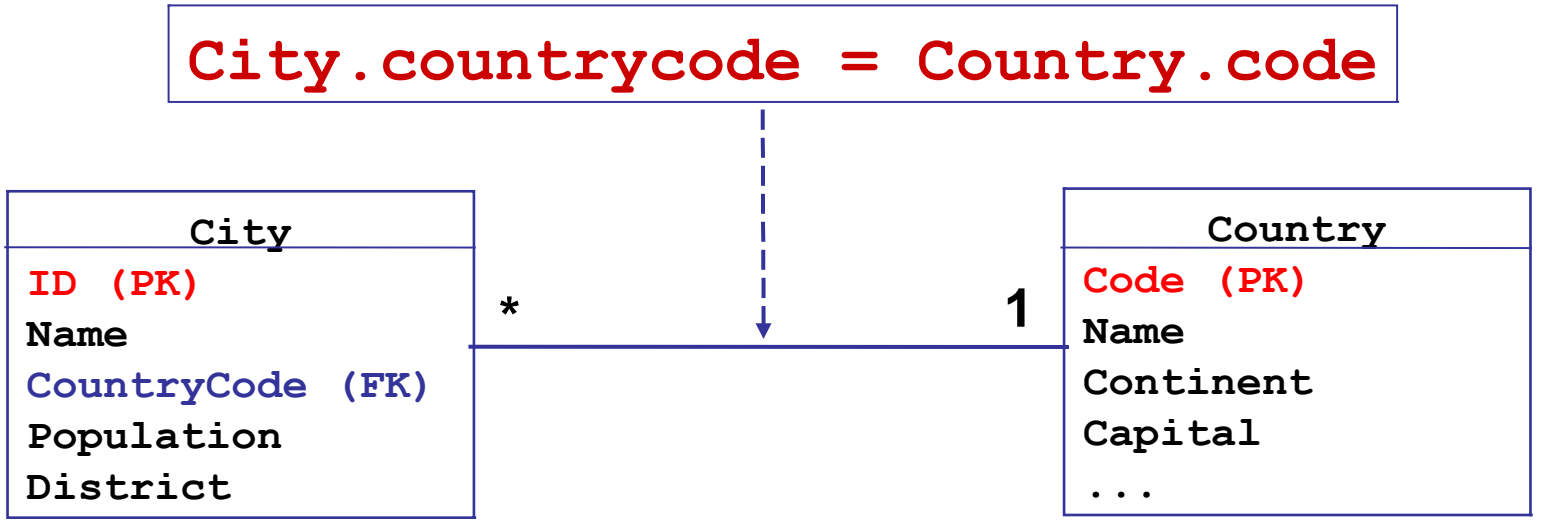
This is the power of a relational database.

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:



What Can You Do?

Databases provide 4 basic operations:

- Save data
- Find and retrieve data (search)
- Update existing data
- Delete

Characteristics

Databases do more than just collect data.

Database servers provide:

- Access control (who can read/write)
- Gaurantee 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

Client-Server: a server manages one or more databases, and controls access.

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

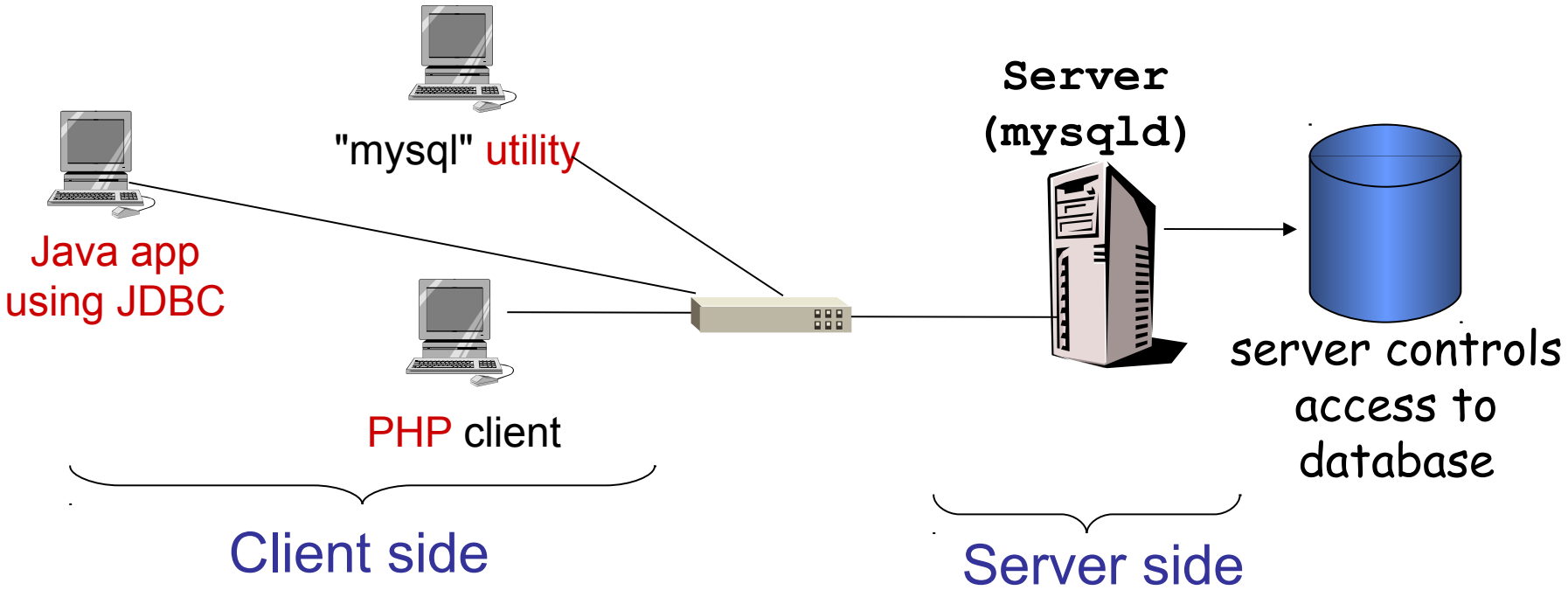
Embedded: the database provider is ***included in your application***.

- no separate server
- access locally, in code
- no need to set-up a server

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.

Examples: MySQL, MariaDB, Postgresql, Oracle



Why the "d" in `mysqld` ?

The MySQL server is named "mysqld".

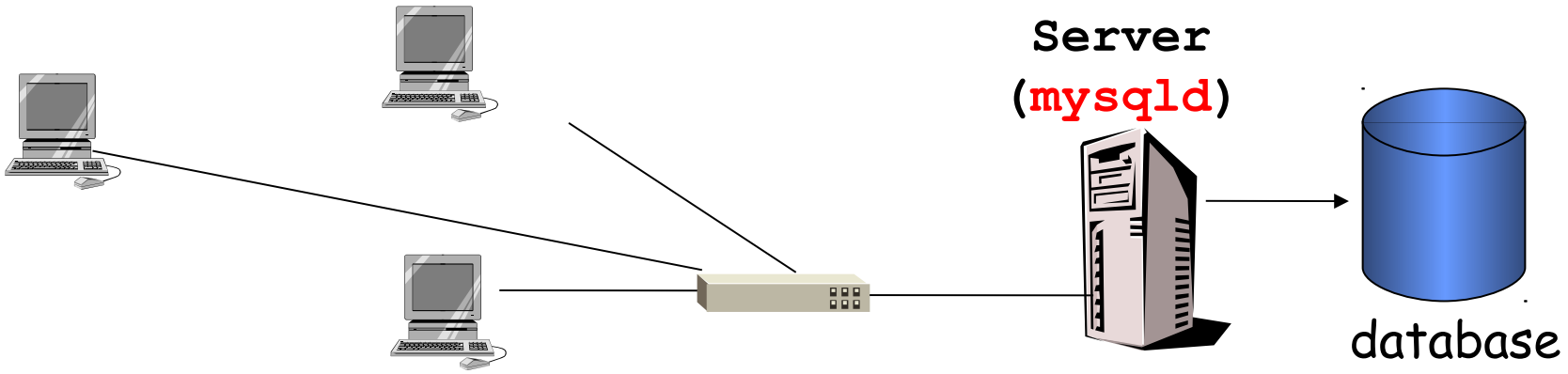
Question: Why "d"?

- Other programs ending in "d":

  `ftpd` - ftp server

  `httpd` - Apache HTTP server

  `sshd` - Secure Shell server

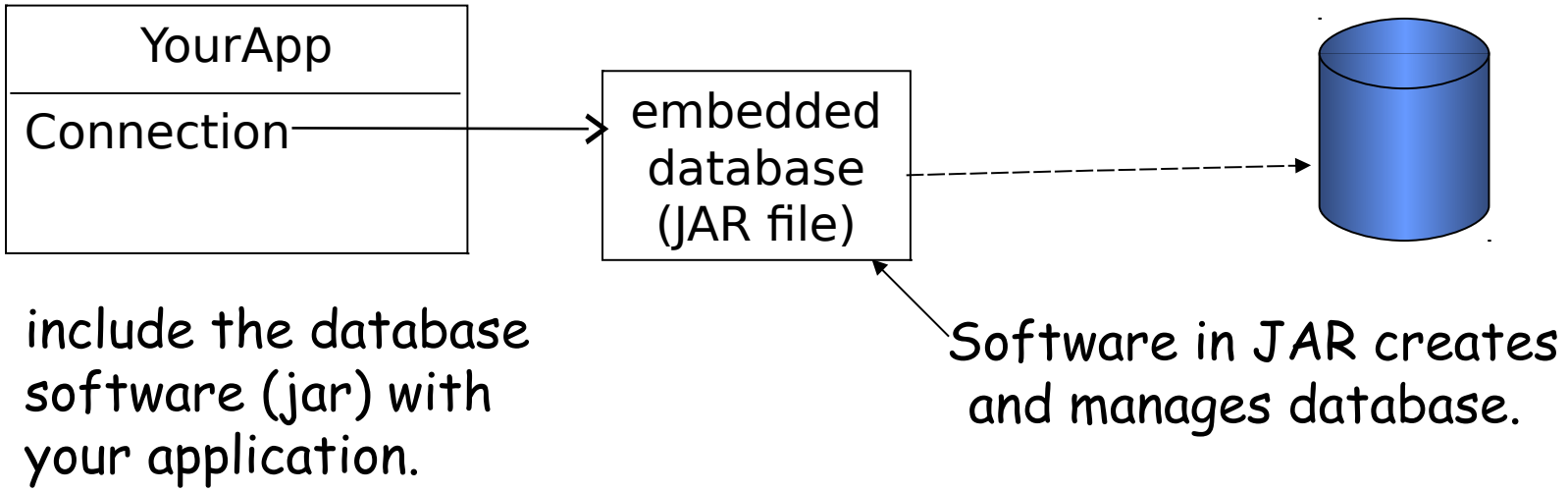


Embedded Databases

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

- No separate database server
- Usually *light-weight* (don't use much memory/cpu)

Examples: Derby, H2, HyperSQL, SQLite



Database Management System