

Basic Concepts of Relational Databases

The Meaning of Databases

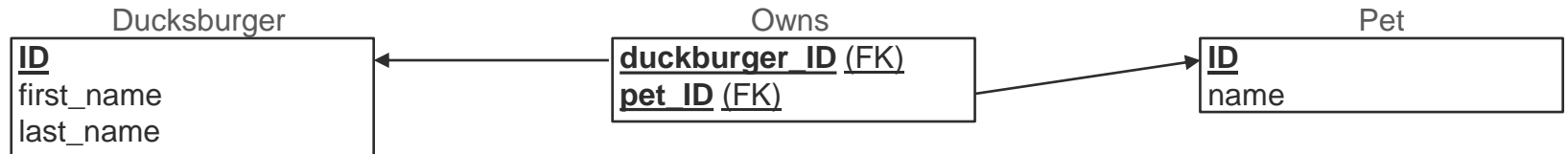
- For storing vast amounts of data
 - On this course we will start with a small database (Duckburg)
 - 3 tables
 - A few data records (a few rows of data)
 - The same concepts are then applied to a slightly larger database (Airport game)
 - 5 tables
 - Around 70 000 records (or rows of data)

The Main Concept of Databases

- For handling data where data records also have relations with other data records
- Besides storing the actual data, also "metadata" can be stored: a description of what type of data exists in the database and the relations between data items.
- Requires software that manages both the data as well as the metadata. Such software is called a database management system (DBMS). On this course we are using MariaDB.

Relational Model

- It's time to introduce the relational model of Duckburg



- Based on this simple model we will cover
 - Metadata
 - Tables
 - Columns
 - Data types
 - Primary key
 - Foreign key
 - Data
 - Records

Metadata: Tables

- Data is stored in tables.
- One table consists of data that logically belong together.

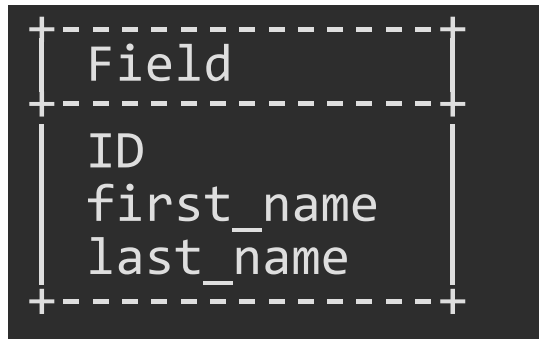
```
MariaDB [duckburg]> show tables;
```

```
+-----+
| Tables_in_duckburg |
+-----+
| duckburger          |
| pet                 |
| owns                |
+-----+
```

- The **duckburger** table in the database consists of data that relates to the citizens of Duckburg (first name, last name).
- The **pet** table contains data relating to the pets of duckburgers (name).
- The **owns** table stores the information on pet ownership: which citizen owns which pet.

Metadata: Columns

- The data in tables is divided into columns. The name of the columns corresponds to the data stored in that column.



Field
ID
first_name
last_name

- The image above shows the columns in the duckburger table. (Field)

Metadata: Data Types

- Each column stores a specific data type

Field	Type
ID	int(11)
first_name	varchar(40)
last_name	varchar(40)

- For example, here the ID field is an integer but first_name and last_name are strings.

Metadata: Primary Key

- Each table must have a column (or a combination of several columns) that unambiguously identifies each row of data (record).

```
+-----+-----+-----+-----+  
| ID      | int(11) | NO    | PRI |  
+-----+-----+-----+-----+
```

- Here the ID field is set as the primary key (PRI)

Metadata: Primary Key

- In the owns table the primary key consist of two columns.

```
MariaDB [duckburg]> desc owns;
```

Field	Type	Null	Key	Default	Extra
pet_ID	int(11)	NO	PRI	NULL	
duckburger_ID	int(11)	NO	PRI	NULL	

- Also the following information is shown in the table:
 - Can the field be empty (NULL)
 - Does the field have a default value
 - Extra (We will use "auto_increment" in the extra field at times. This will be discussed later.)

Metadata: Foreign Key

- The relations between tables are expressed using foreign keys.
- The foreign key always points to the primary key of another table.
- Our owns table has two foreign keys:
 - pet_ID
 - duckburger_ID

Metadata: Foreign Key

- The pet_ID field in the owns table points to the primary key field ID of the pet table.
- The duckburger_ID field in the owns table points to the primary key field ID of the duckburger table.

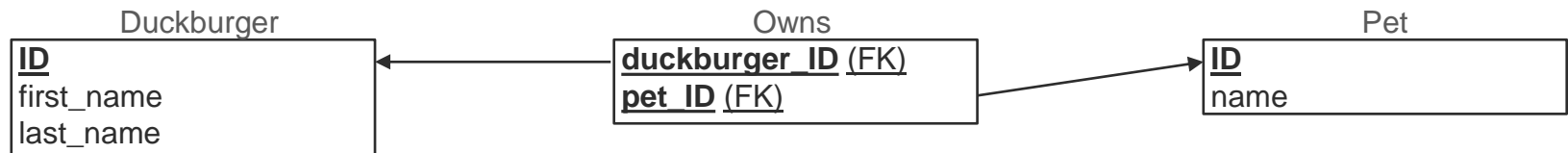
```
MariaDB [duckburg]> desc owns;
```

Field	Type	Null	Key	Default	Extra
pet_ID	int(11)	NO	PRI	NULL	
duckburger_ID	int(11)	NO	PRI	NULL	

- Here the same fields work as a composite primary key as well as individual foreign keys.
- If the foreign keys were not part of the composite primary key, the key field would show "MUL".

Relational Model

- Let's take another look at the relational model. We notice that it describes:
 - Tables
 - Columns
 - Primary keys (underlined)
 - Primary keys (FK)
 - Table relations (arrows)



Data

```
MariaDB [duckburg]> select * from duckburger;
```

ID	first_name	last_name
1	Donald	Duck
2	Scrooge	McDuck
3	Huey	Duck
4	Magica	De Spell
5	Mickey	Mouse

- The query *select * from duckburger* fetches all data from the duckburger table
- One row of data is called a record.

ID	first_name	last_name
1	Donald	Duck