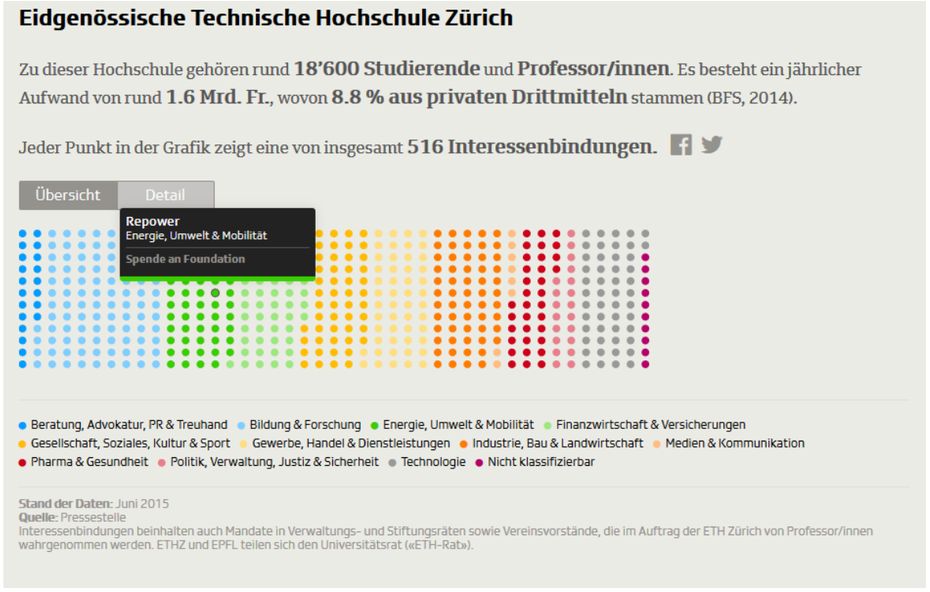
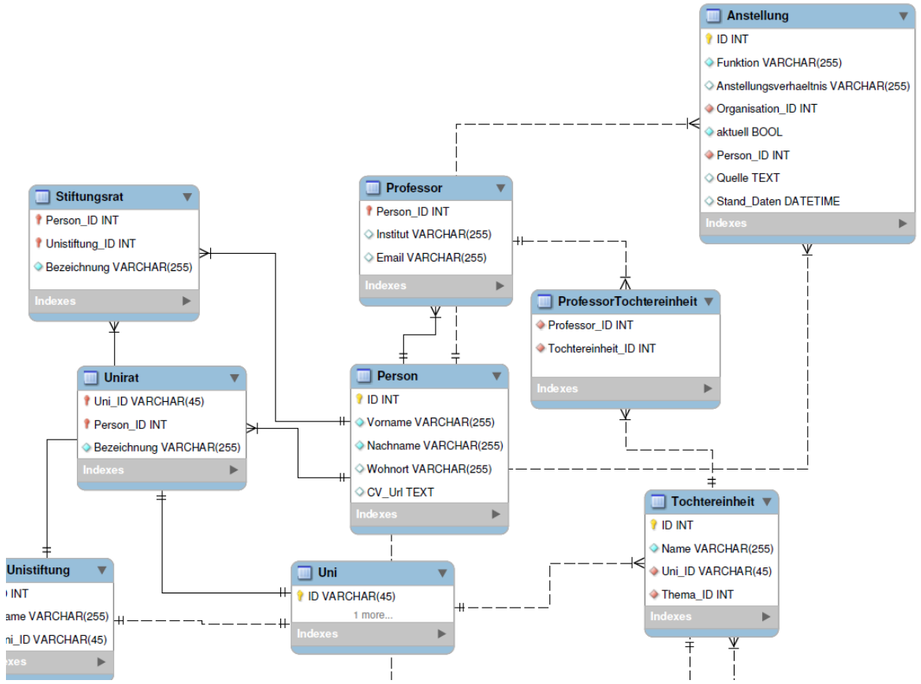
INTRODUCTION TO RELATIONAL DATABASES IN SQL

Your first database

Timo Grossenbacher
Data Journalist

Investigating universities in Switzerland





A relational database:

- real-life *entities* become *tables*
- reduced redundancy
- data integrity by *relationships*

- e.g. `professors`, `universities`, `companies`
- e.g. only one entry in `companies` for the bank "Credit Suisse"
- e.g. a `professor` can work at multiple `universities` and `companies`, a `company` can employ multiple `professors`

Throughout this course you will:

- work with the data I used for my investigation
- create a relational database from scratch
- learn three concepts:
  - *constraints*
  - *keys*
  - *referential integrity*

You'll need: Basic understanding of SQL, as taught in Intro to SQL for Data Science.

Your first duty: Have a look at the PostgreSQL database

```
SELECT table_schema, table_name
FROM information_schema.tables;
```

tables: information about all tables in your current database
columns: information about all columns in all of the tables in your current database

```
    table_schema    |              table_name
--------------------+----------------------------------------
 pg_catalog         | pg_statistic
 pg_catalog         | pg_type
 pg_catalog         | pg_policy
 pg_catalog         | pg_authid
 pg_catalog         | pg_shadow
 public             | university_professors
 pg_catalog         | pg_settings
 pg_catalog         | pg_hba_file_rules
 pg_catalog         | pg_file_settings
 pg_catalog         | pg_config
...
```

information_schema database is available in PostgreSQL by default.
information_schema is a meta-database that holds information about your current database. information_schema has multiple tables you can query with the known SELECT * FROM syntax:

tables: information about all tables in your current database
columns: information about all columns in all of the tables in your current database
…

Have a look at the columns of a certain table

```
SELECT table_name, column_name, data_type
FROM information_schema.columns
WHERE table_name = 'pg_config';
```

```
 table_name | column_name | data_type
------------+-------------+-----------
 pg_config  | name        | text
 pg_config  | setting     | text
```

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Let's do this.

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Tables: At the core of every database

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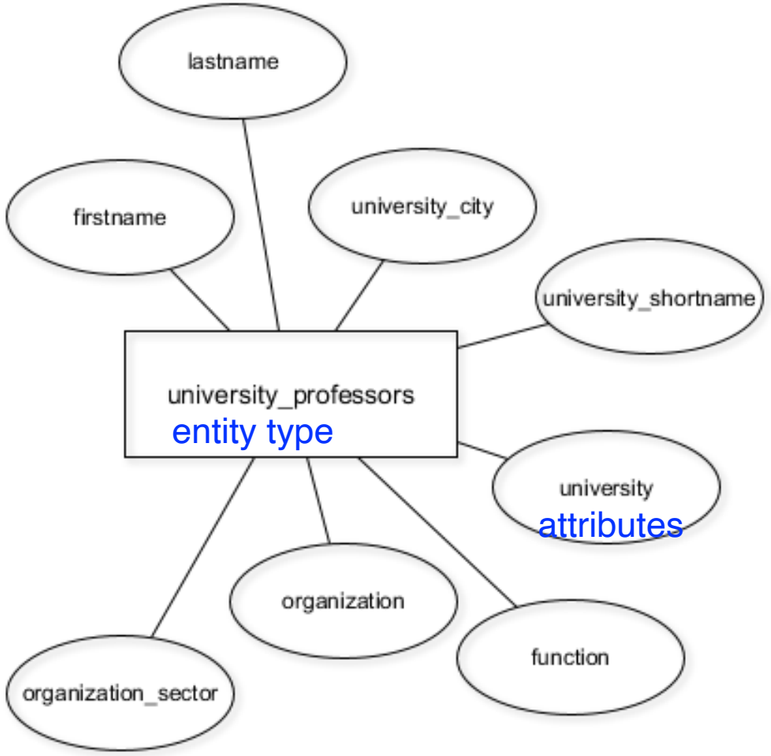
Redundancy in the university_professors table

```
SELECT * FROM
FROM university_professors
LIMIT 3;
```

Redundancy in the university_professors table

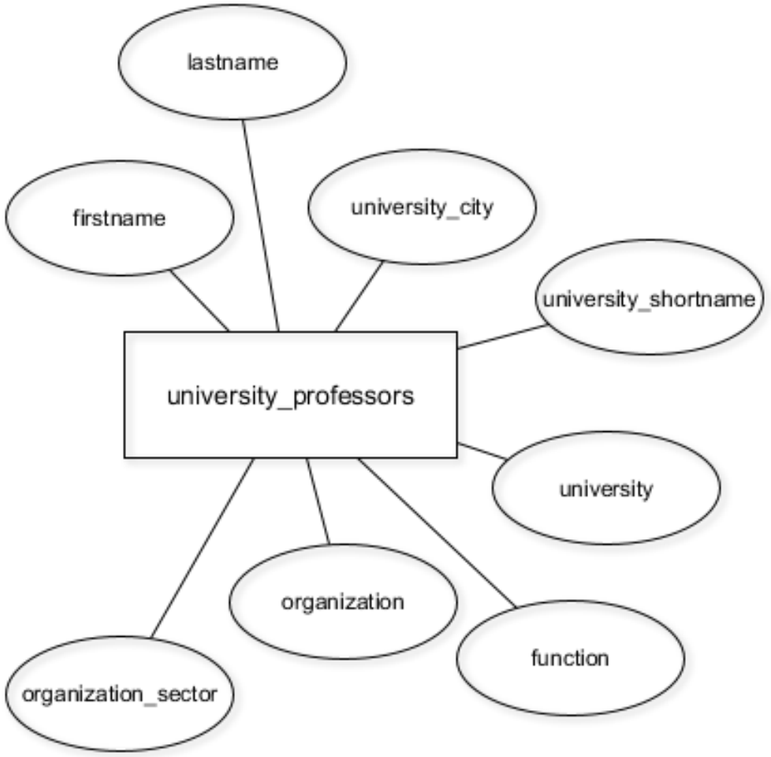
```
-[ RECORD 1 ]-------+-----------------------------------
firstname           | Karl
lastname            | Aberer
university          | ETH Lausanne
university_shortname | EPF
university_city     | Lausanne
function            | Chairman of L3S Advisory Board
organisation        | L3S Advisory Board
organisation_sector | Education & research
-[ RECORD 2 ]-------+-----------------------------------
firstname           | Karl
lastname            | Aberer
university          | ETH Lausanne
university_shortname | EPF
university_city     | Lausanne
function            | Member Conseil of Zeno-Karl Schindler Foundation
organisation        | Zeno-Karl Schindler Foundation
organisation_sector | Education & research
-[ RECORD 3 ]-------+-----------------------------------
firstname           | Karl
lastname            | Aberer
(truncated)
function            | Member of Conseil Fondation IDIAP
organisation        | Fondation IDIAP
(truncated)
```

Currently: One "entity type" in the database

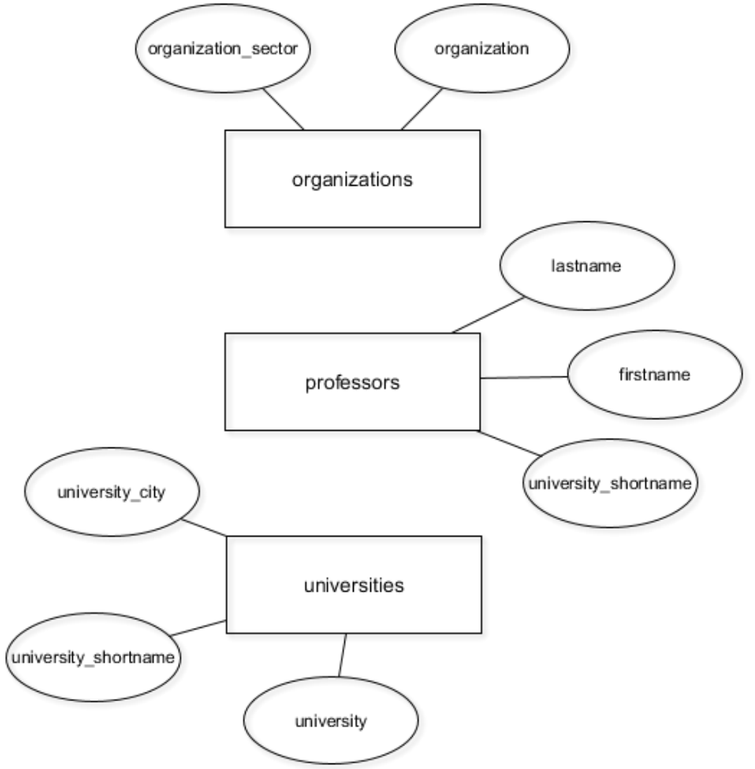


A better database model with three entity types

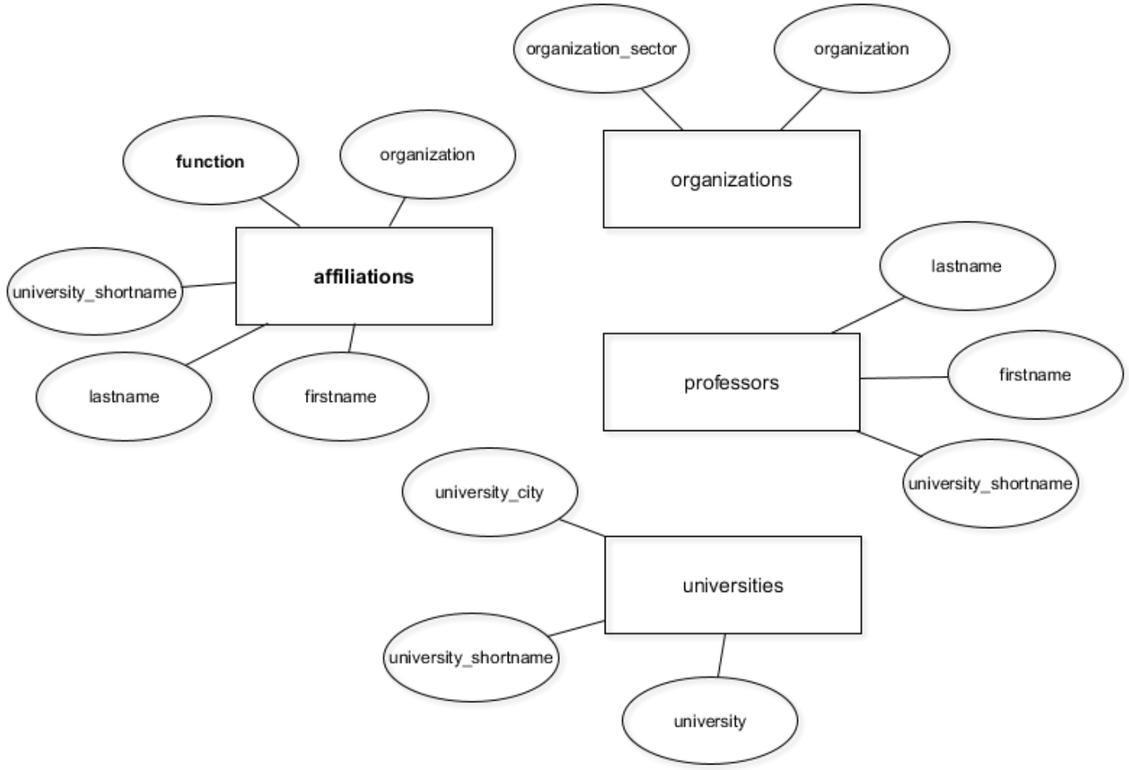
Old:



New:



A better database model with four entity types



Create new tables with CREATE TABLE

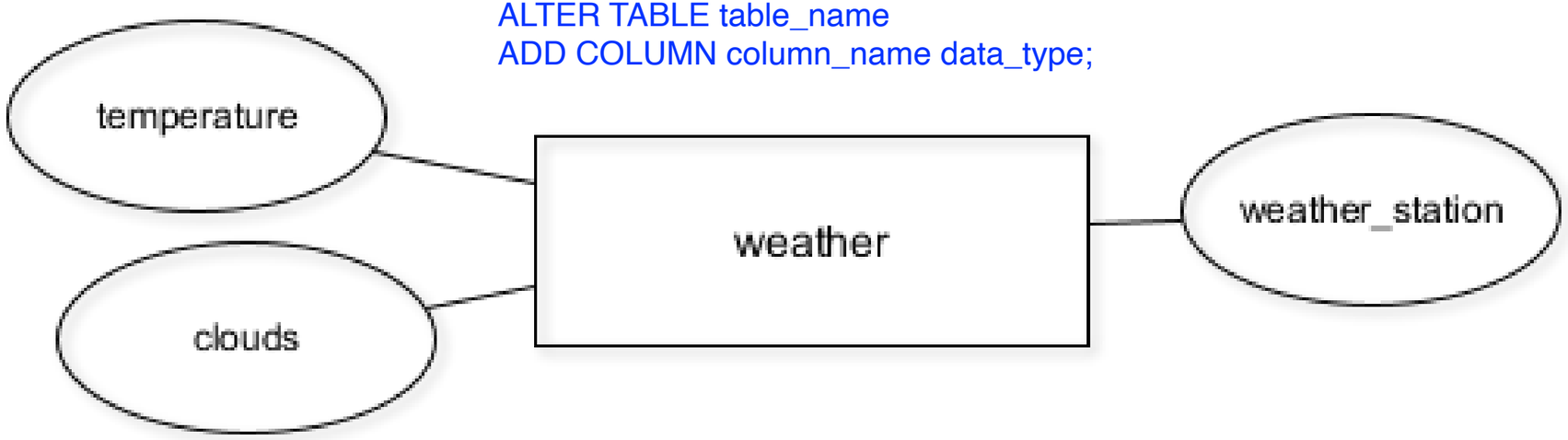
```
CREATE TABLE table_name (
 column_a data_type,
 column_b data_type,
 column_c data_type
);
```

Create new tables with CREATE TABLE

```
CREATE TABLE weather (
 clouds text,
 temperature numeric,
 weather_station char(5)
);
```

To add columns you can use the following SQL query:

ALTER TABLE table_name
ADD COLUMN column_name data_type;



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Let's practice!

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Update your database as the structure changes

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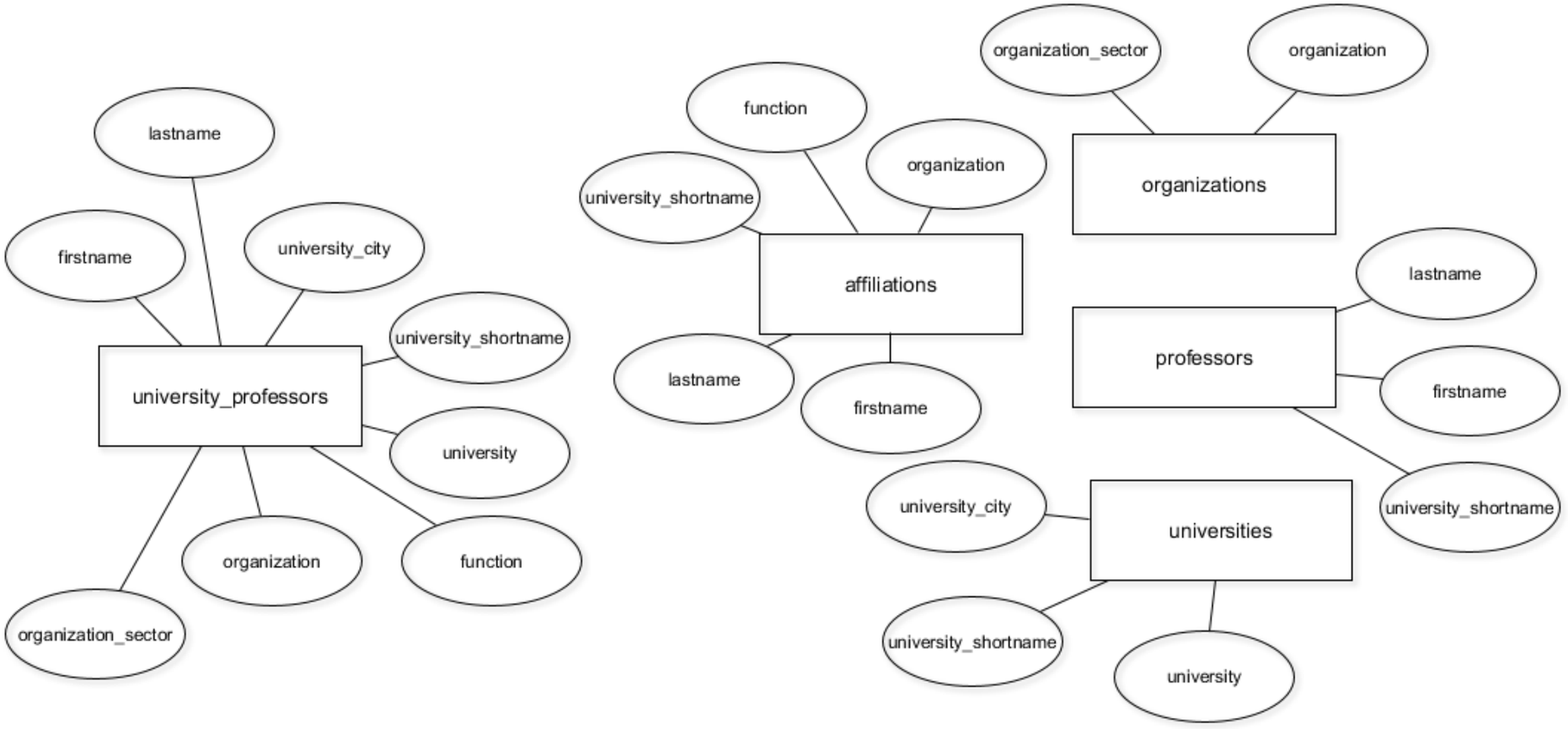
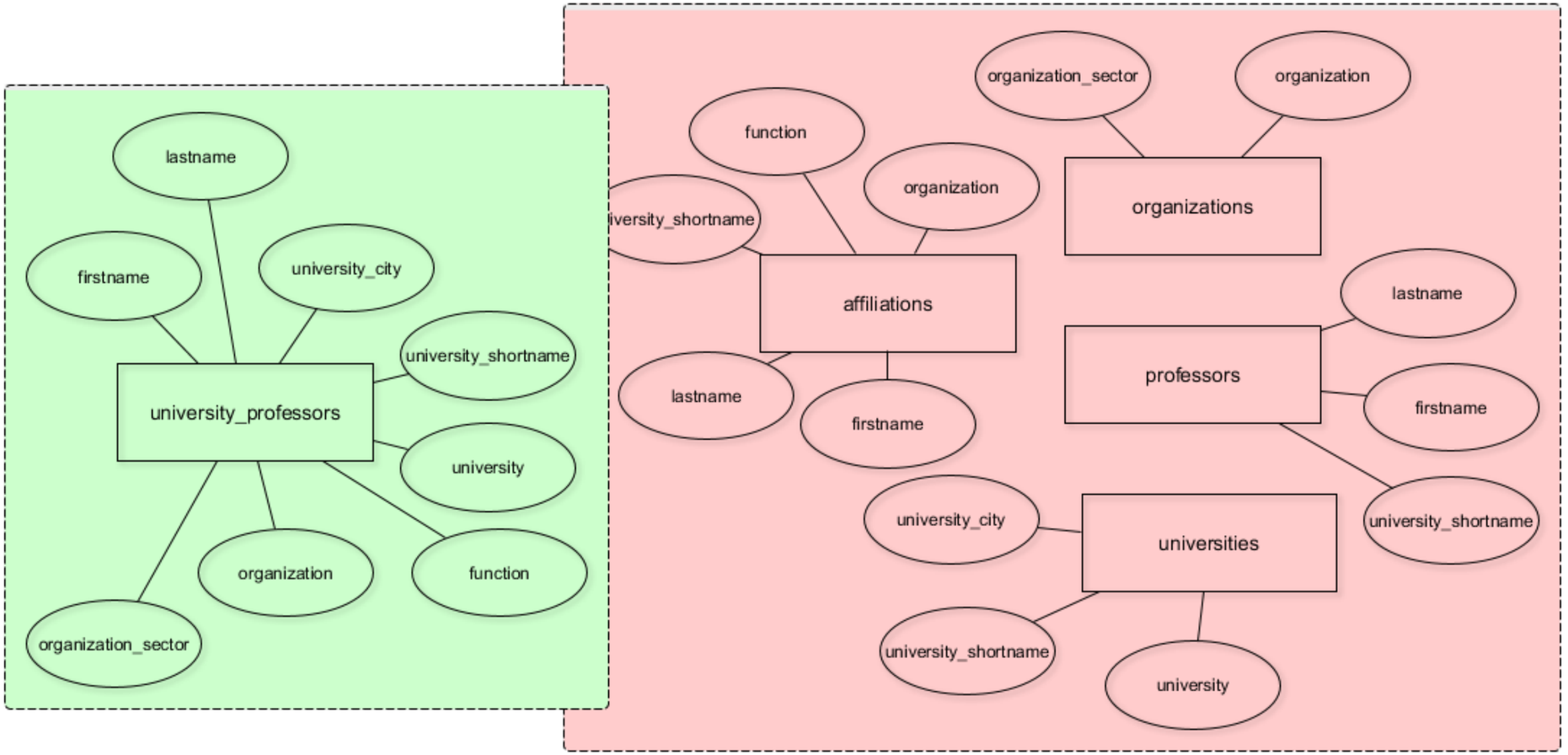
The current database model



The current database model



Only store DISTINCT data in the new tables

```
SELECT COUNT(*)
FROM university_professors;
```

```
 count
-------
  1377
```

```
SELECT COUNT(DISTINCT organization)
FROM university_professors;
```

```
 count
-------
  1287
```

INSERT DISTINCT records INTO the new tables

```
INSERT INTO organizations
SELECT DISTINCT organization,
    organization_sector
FROM university_professors;
```

```
Output: INSERT 0 1287
```

```
INSERT INTO organizations
SELECT organization,
    organization_sector
FROM university_professors;
```

```
Output: INSERT 0 1377
```

The INSERT INTO statement

```
INSERT INTO table_name (column_a, column_b)
VALUES ("value_a", "value_b");
```

RENAME a COLUMN in affiliations

```
CREATE TABLE affiliations (
 firstname text,
 lastname text,
 university_shortname text,
 function text,
 organisation text
);
```

```
ALTER TABLE table_name
RENAME COLUMN old_name TO new_name;
```

DROP a COLUMN in affiliations

```
CREATE TABLE affiliations (
 firstname text,
 lastname text,
 university_shortname text,
 function text,
 organization text
);
```

```
ALTER TABLE table_name
DROP COLUMN column_name;
```

A professor is uniquely identified by firstname, lastname only

```
SELECT DISTINCT firstname, lastname,
    university_shortname
FROM university_professors
ORDER BY lastname;
```

```
-[ RECORD 1 ]--------+-------------
firstname            | Karl
lastname             | Aberer
university_shortname | EPF
-[ RECORD 2 ]--------+-------------
firstname            | Reza Shokroll
lastname             | Abhari
university_shortname | ETH
-[ RECORD 3 ]--------+-------------
firstname            | Georges
lastname             | Abou Jaoudé
university_shortname | EPF

(truncated)

(551 records)
```

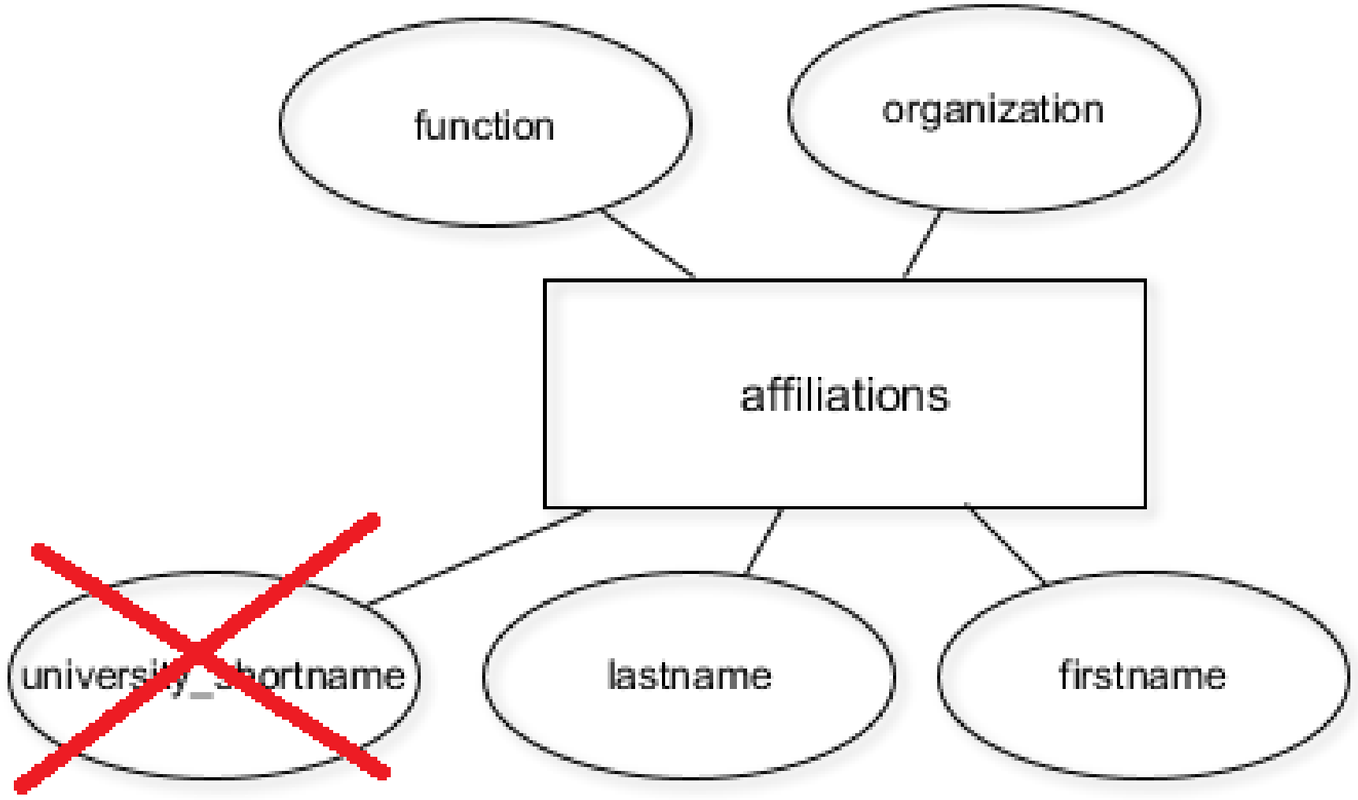
```
SELECT DISTINCT firstname, lastname
FROM university_professors
ORDER BY lastname;
```

```
-[ RECORD 1 ]----------------------
firstname | Karl
lastname  | Aberer
-[ RECORD 2 ]----------------------
firstname | Reza Shokrollah
lastname  | Abhari
-[ RECORD 3 ]----------------------
firstname | Georges
lastname  | Abou Jaoudé

(truncated)

(551 records)
```

A professor is uniquely identified by firstname, lastname only



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Let's get to work!