



INTRODUCTION TO RELATIONAL DATABASES IN SQL

Your first database



Timo Grossenbacher
Data Journalist

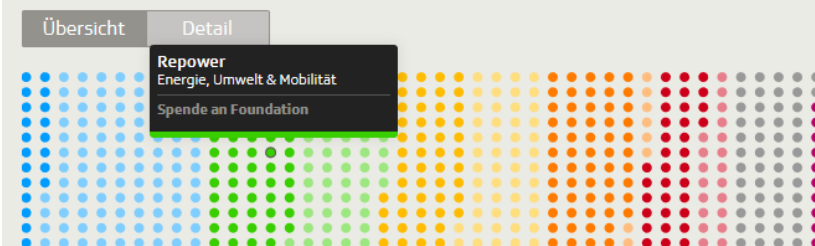


Investigating universities in Switzerland

Eidgenössische Technische Hochschule Zürich

Zu dieser Hochschule gehören rund **18'600 Studierende** und **Professor/innen**. Es besteht ein jährlicher Aufwand von rund **1.6 Mrd. Fr.**, wovon **8.8 %** aus **privaten Drittmitteln** stammen (BFS, 2014).

Jeder Punkt in der Grafik zeigt eine von insgesamt **516 Interessenbindungen**.  

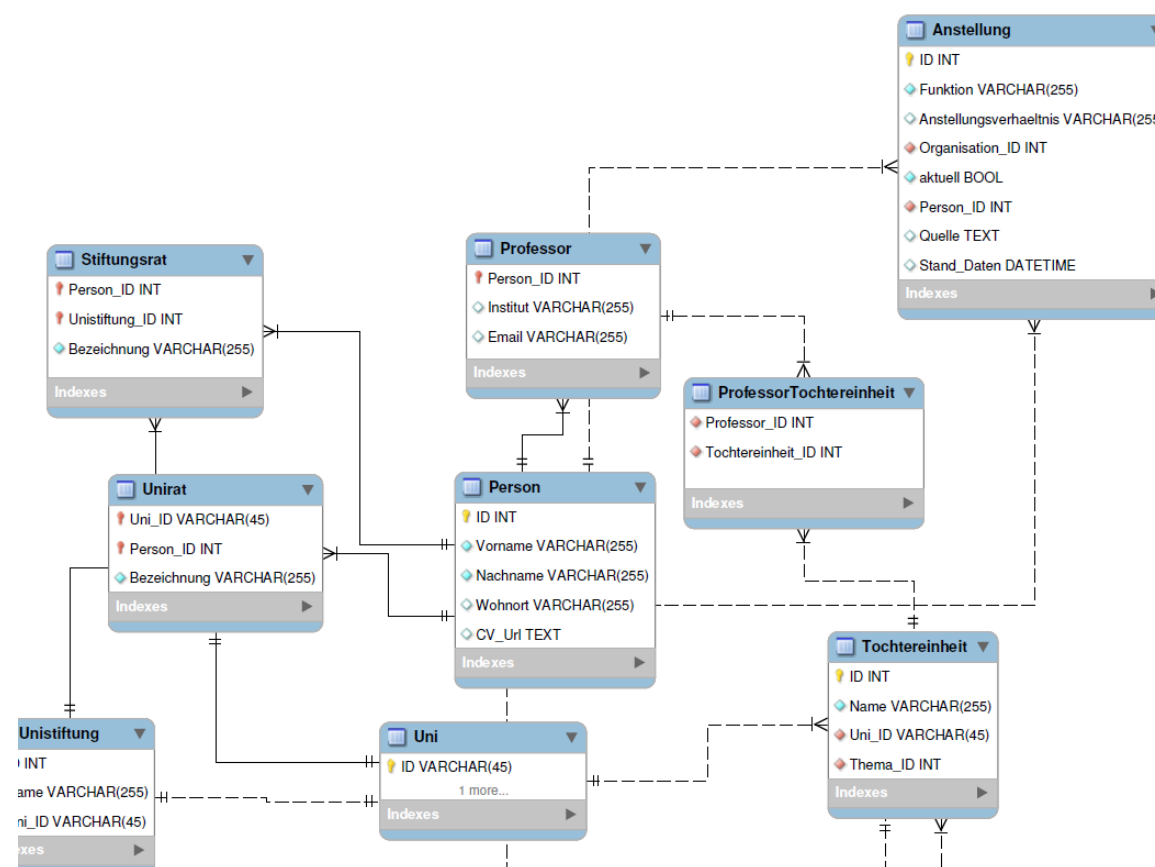


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● Gesellschaft, Soziales, Kultur & Sport ● Gewerbe, Handel & Dienstleistungen ● Industrie, Bau & Landwirtschaft ● Medien & Kommunikation
● Pharma & Gesundheit ● Politik, Verwaltung, Justiz & Sicherheit ● Technologie ● Nicht klassifizierbar

Stand der Daten: Juni 2015

Quelle: Pressestelle

Interessenbindungen beinhalten auch Mandate in Verwaltungs- und Stiftungsräten sowie Vereinsvorstände, die im Auftrag der ETH Zürich von Professor/innen wahrgenommen werden. ETHZ und EPFL teilen sich den Universitätsrat («ETH-Rat»).





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;
```

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
...	



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  
university_professors  
LIMIT 3;
```



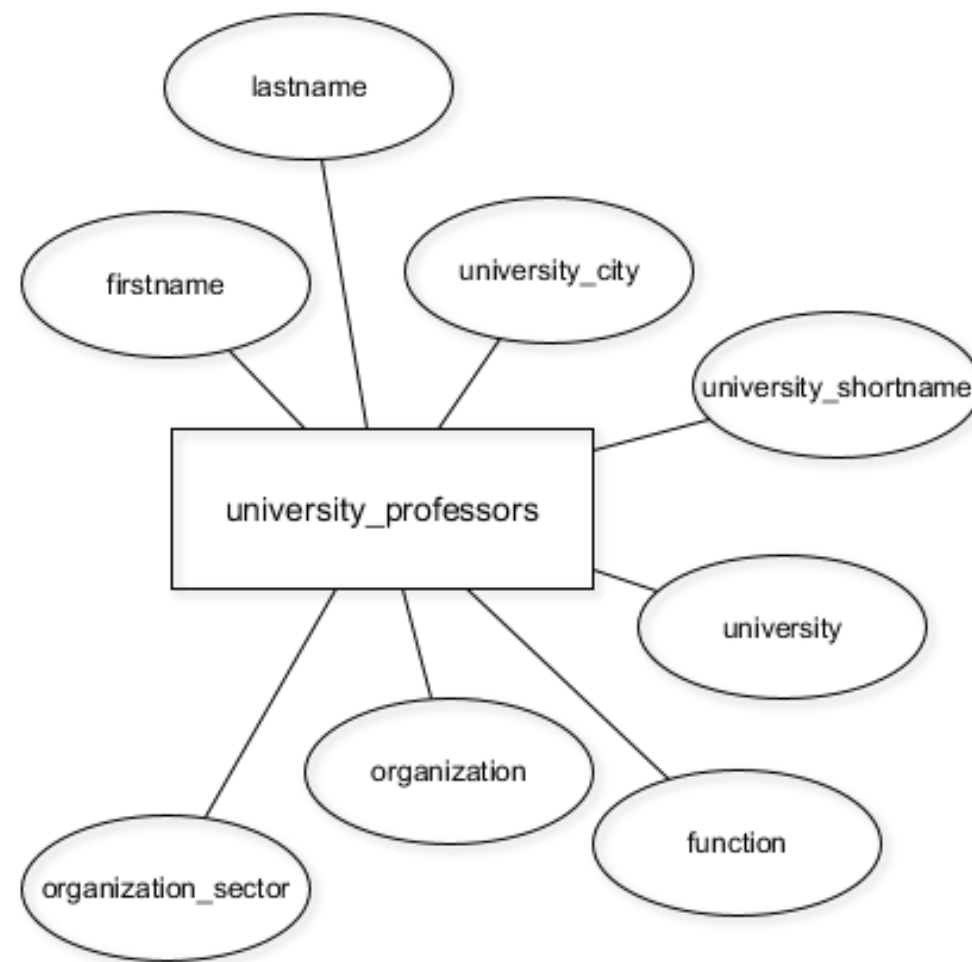
Redundancy in the university_professors table



```
-[ 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)
```

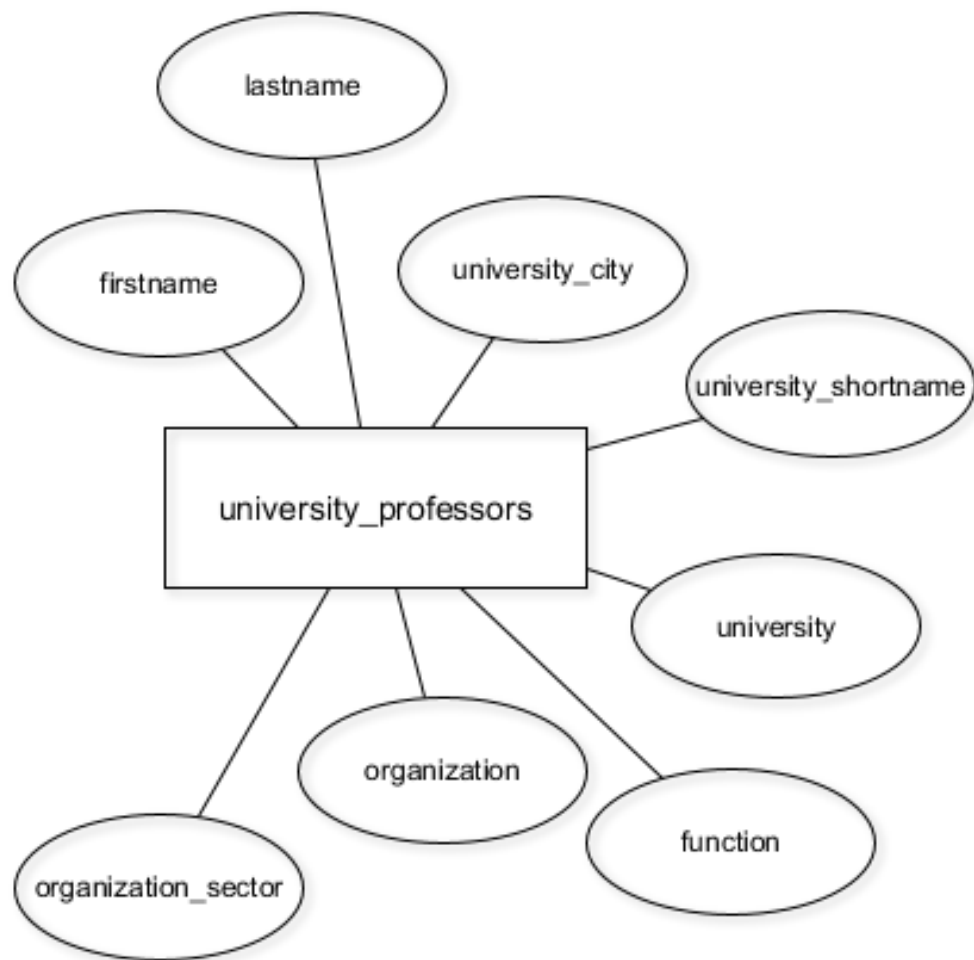


Currently: One "entity type" in the database

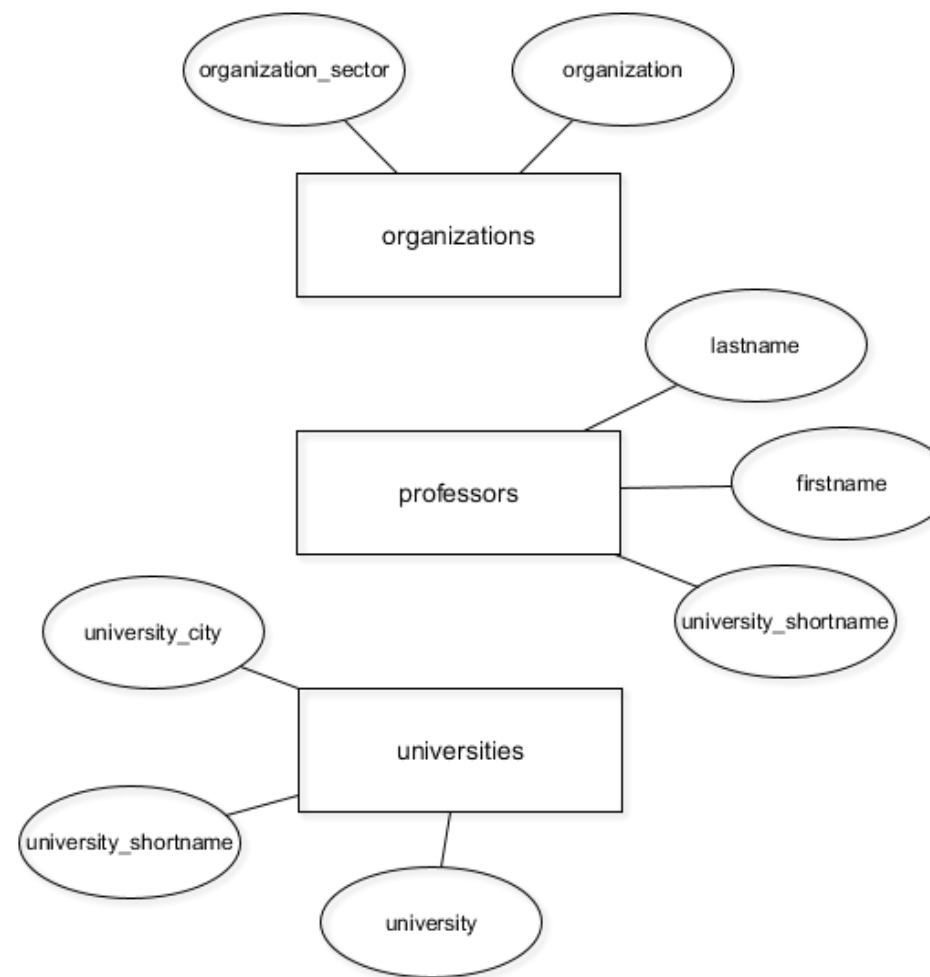


A better database model with three entity types

Old:

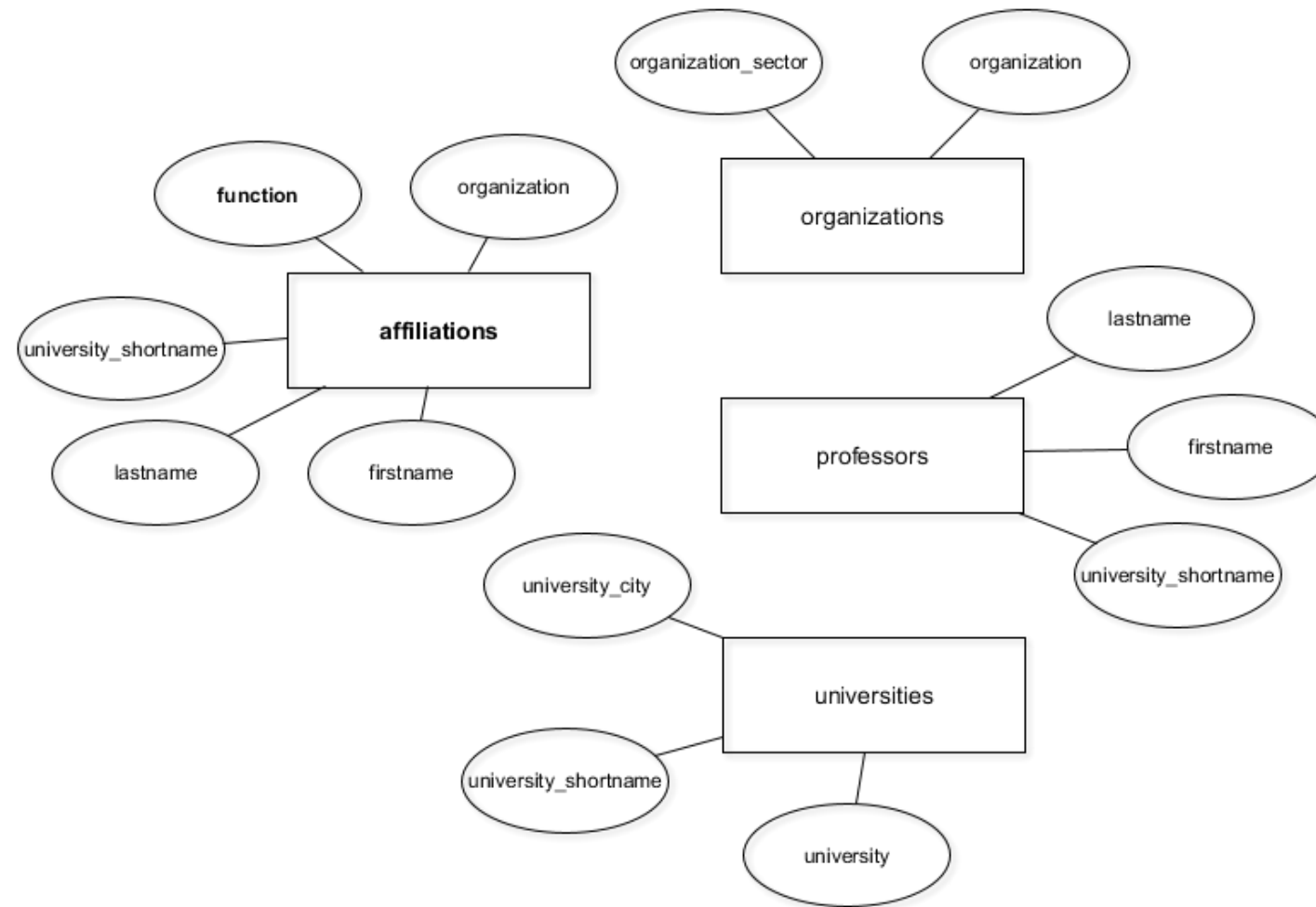


New:





A better database model with four entity types





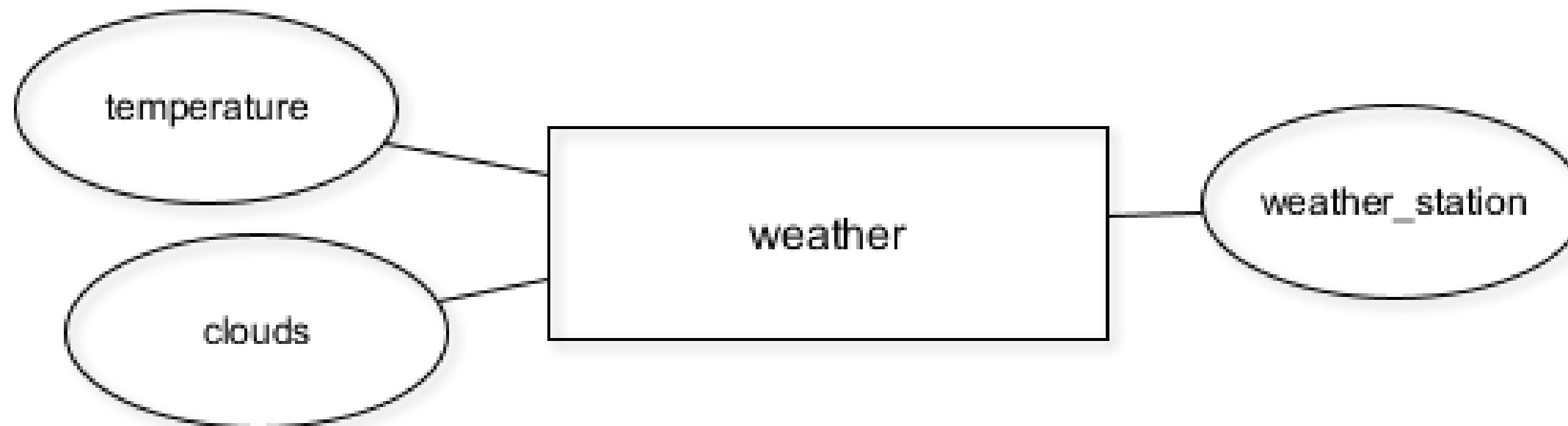
Create new tables with CREATE TABLE

```
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)  
);
```





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Let's practice!



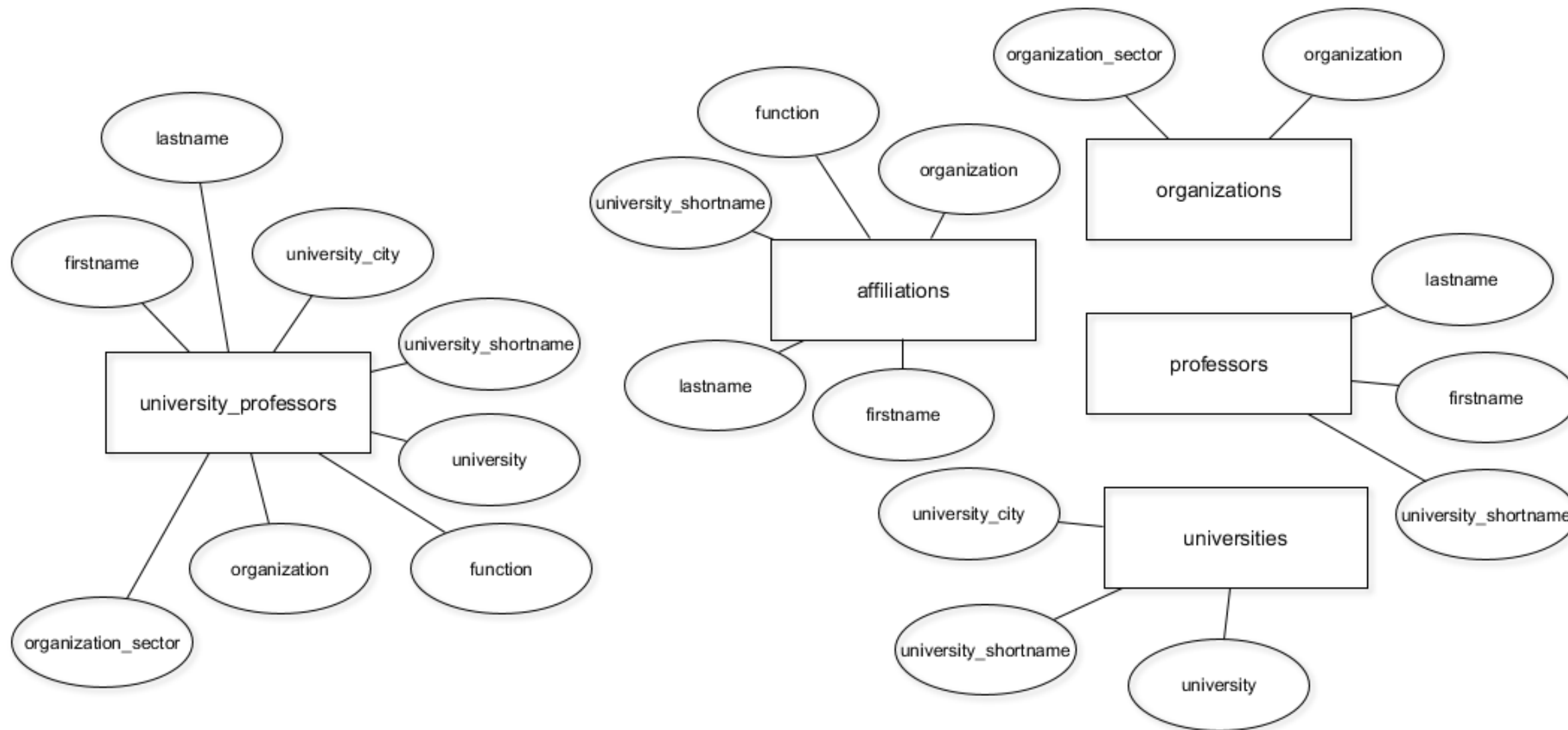
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Update your database as the structure changes

Timo Grossenbacher
Data Journalist

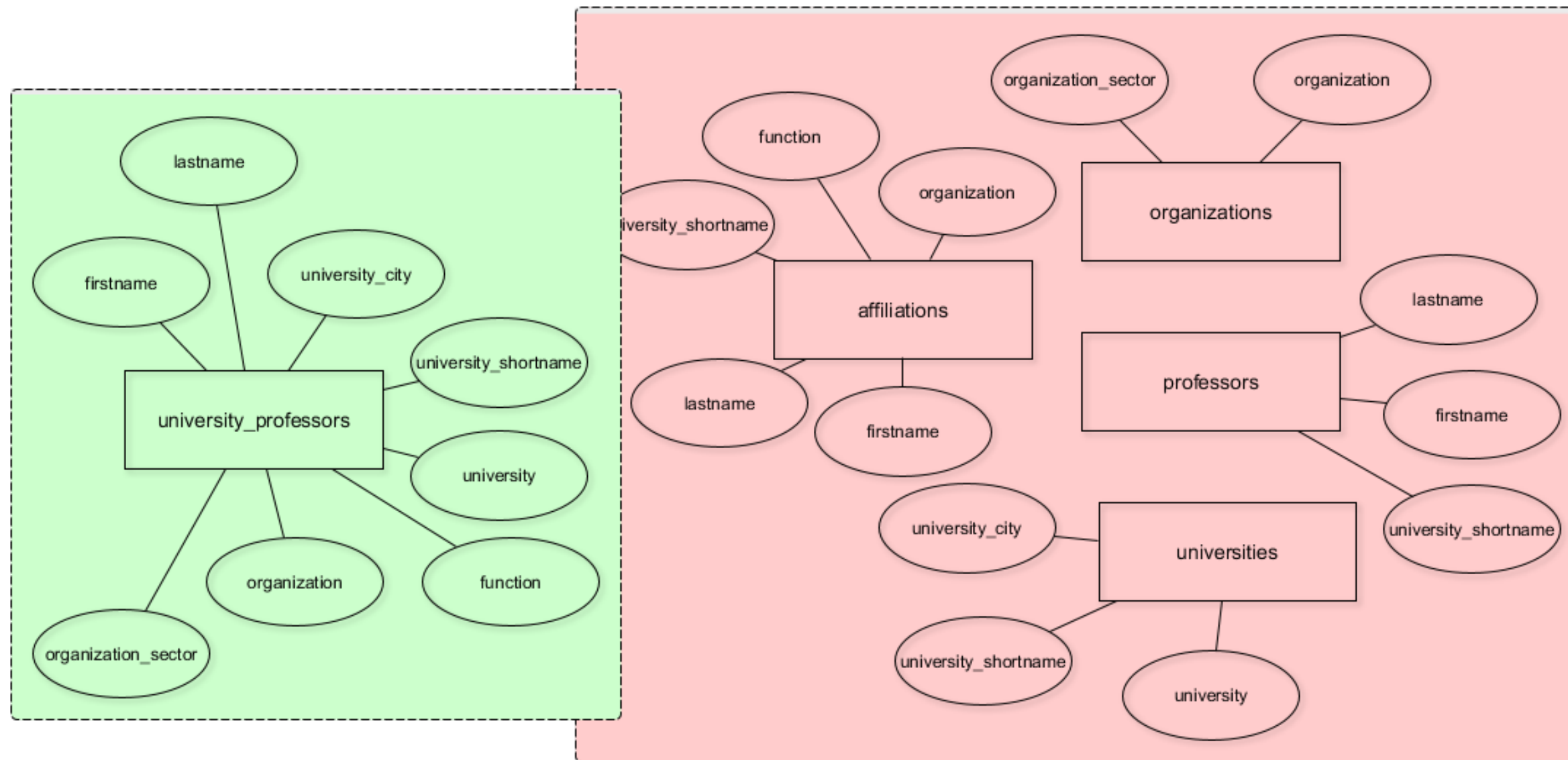


The current database model





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_shortcode 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_shortcode 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_shortcode  
FROM university_professors  
ORDER BY lastname;
```

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

(truncated)

(551 records)

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

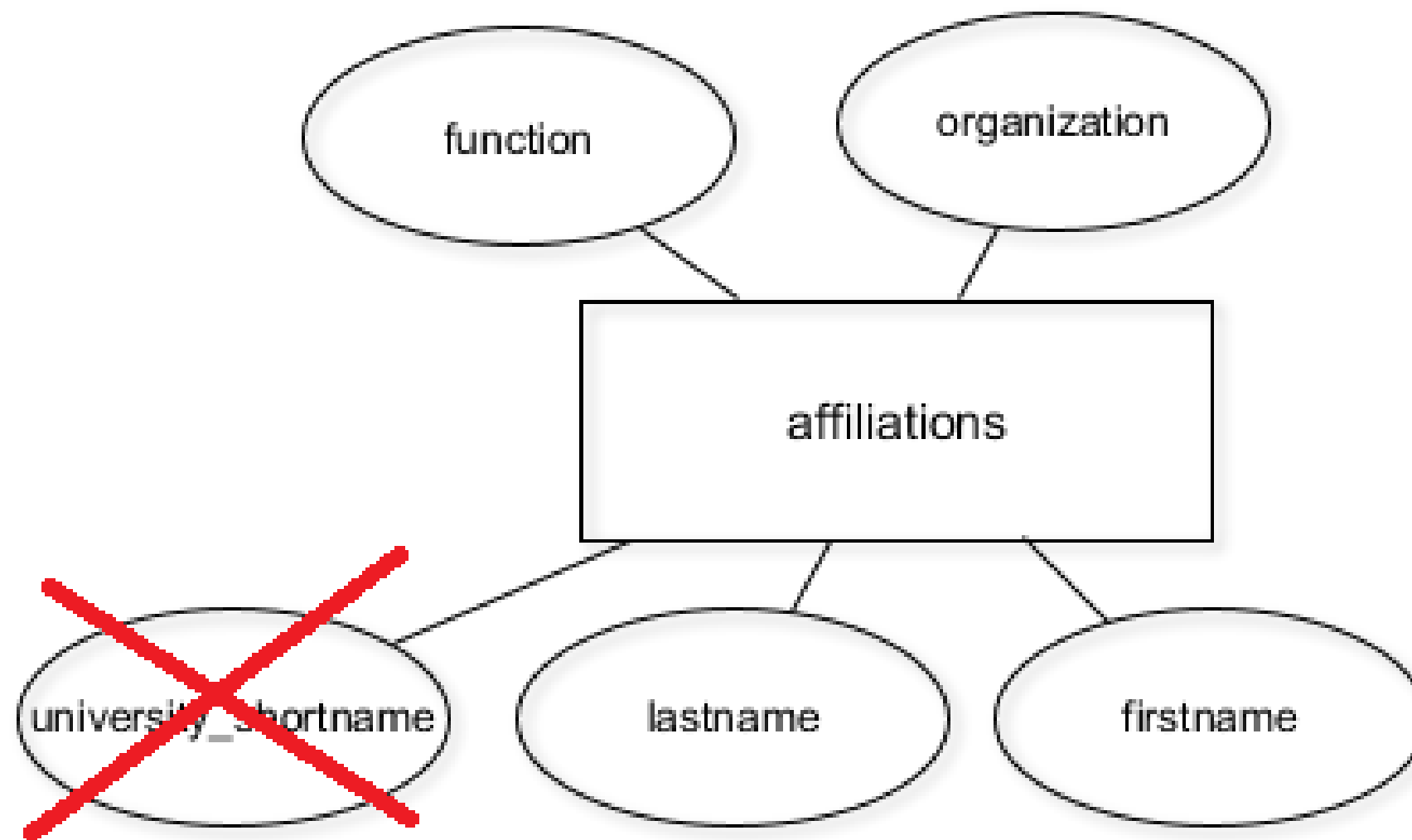
```
-[ RECORD 1 ]-----  
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```

(truncated)

(551 records)



A professor is uniquely identified by firstname, lastname only





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Let's get to work!