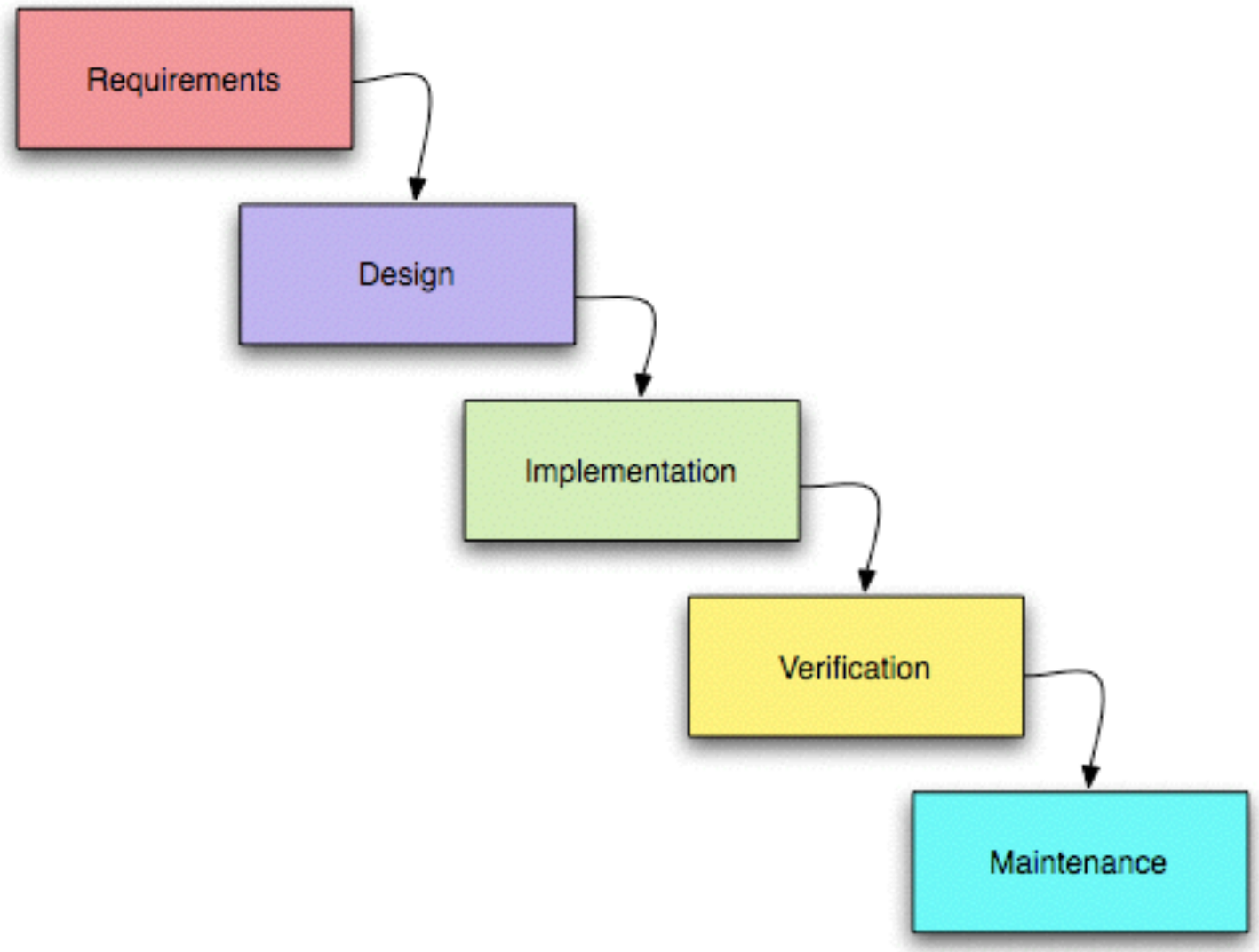
Introduction to Relational Databases

What is a database?

*A **database** (**DB**) is an organized **collection of data** which models relevant aspects of reality.*

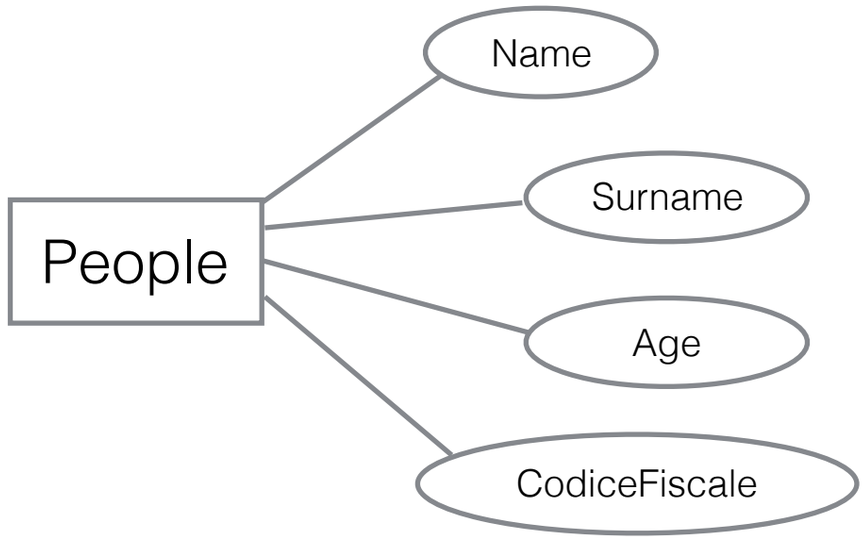
*A **database management system** (**DBMS**) is a **computer software application** that interacts with the user, other applications, and the database itself to capture and analyze data. A general-purpose DBMS is designed to allow the definition, creation, querying, update, and administration of databases*

In a Software development process..



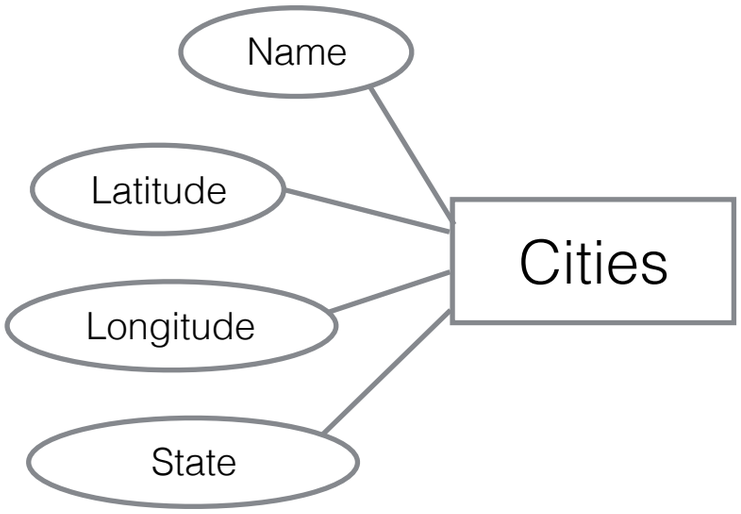
ER Models

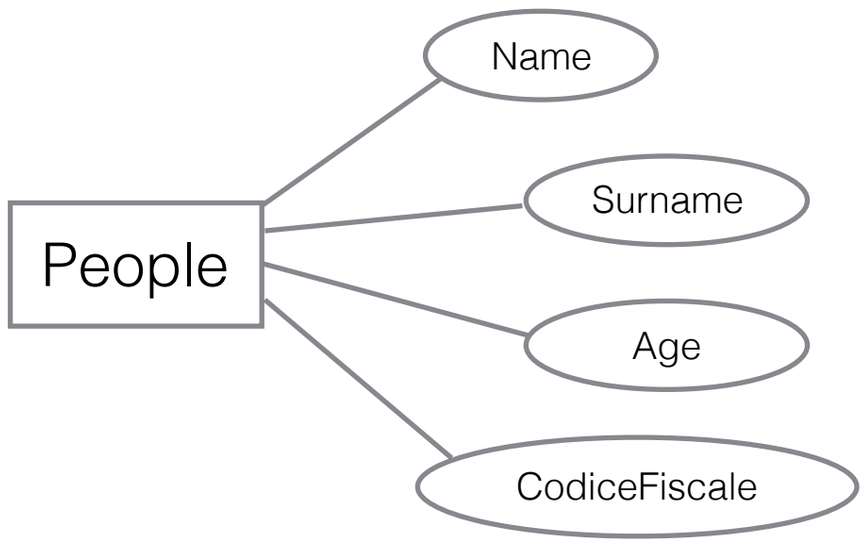
entity–relationship model



ER Models

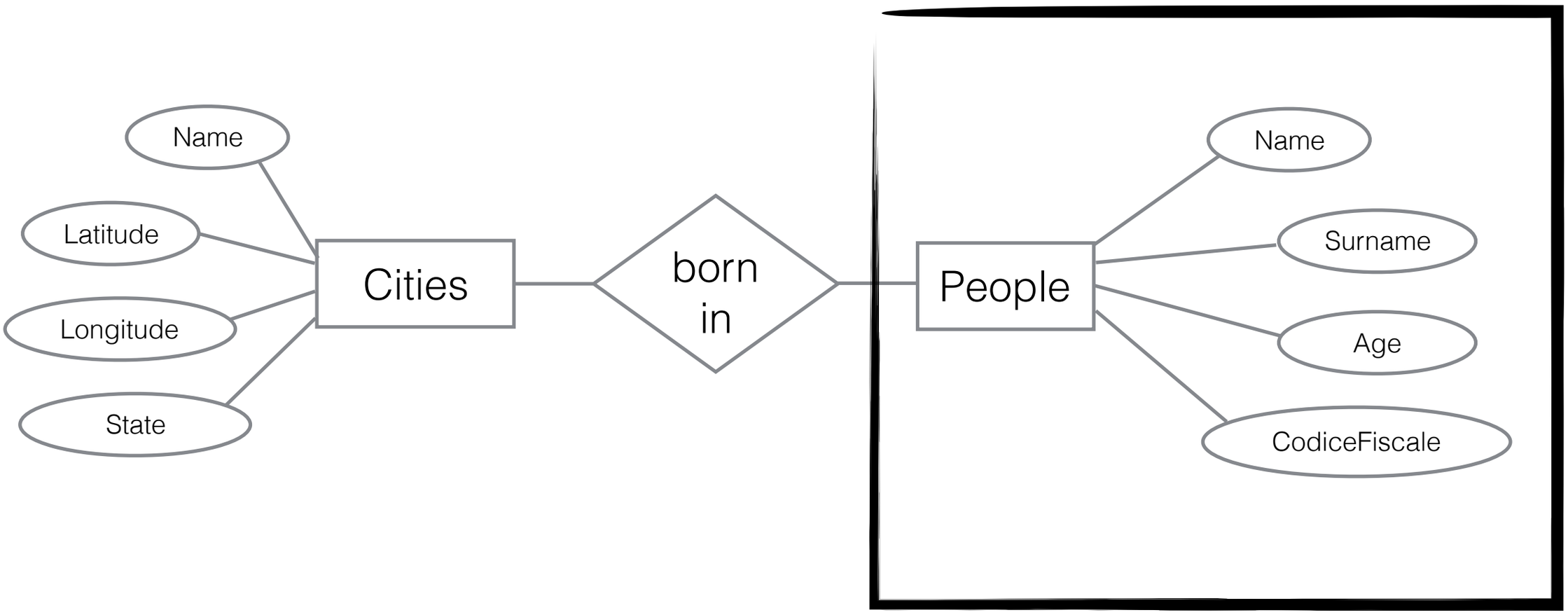
entity–relationship model





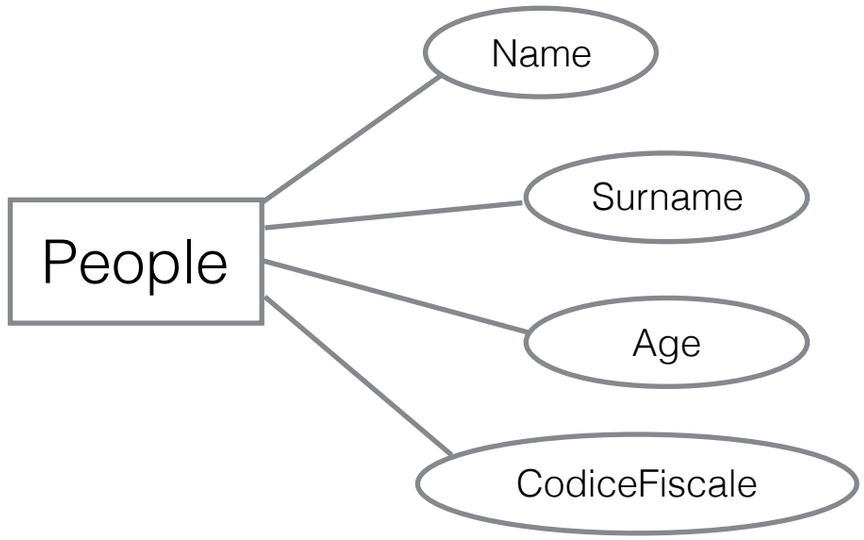
ER Models

entity–relationship model



ER Models

entity–relationship model



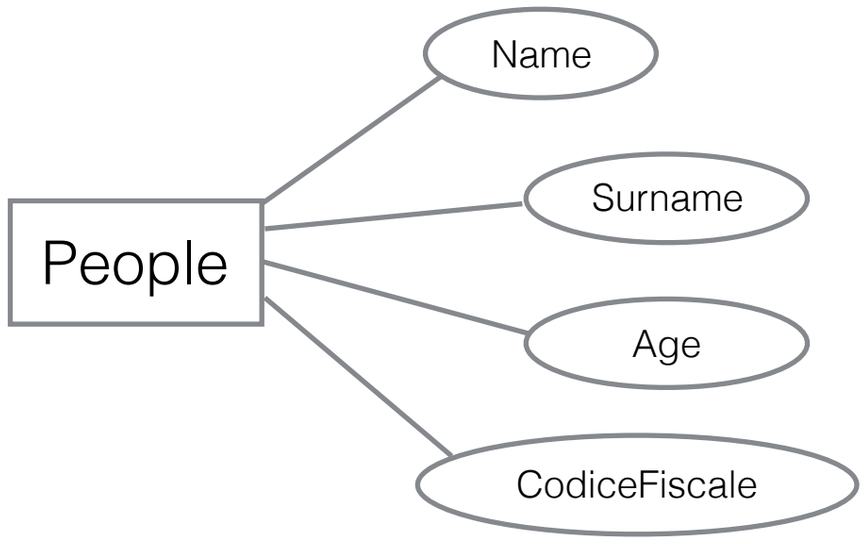
ER Models

entity–relationship model

People

Name	Surname	Age	CodiceFiscale
Paolo	Verdi	23	vrdpla…
Marco	Rossi	45	rssmca…
Matteo	Bianchi	21	…
…	…	…	…

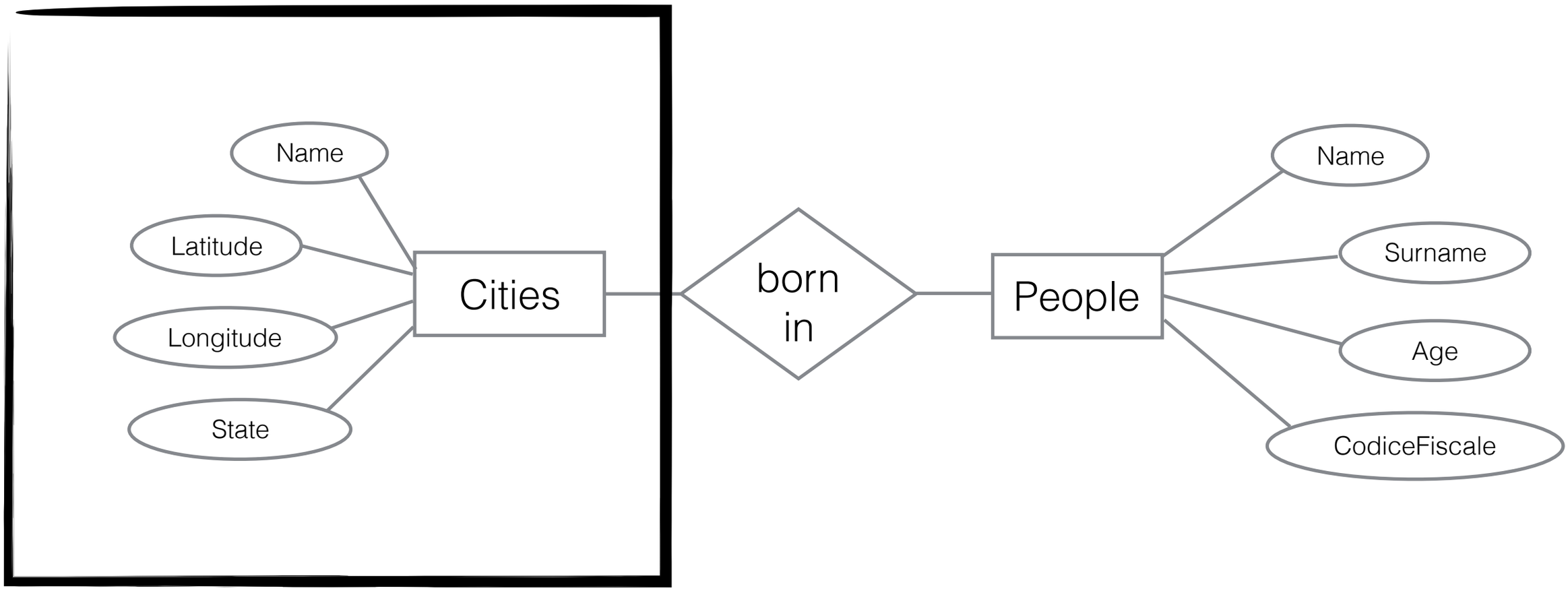
tupla →



Rossi is a single value

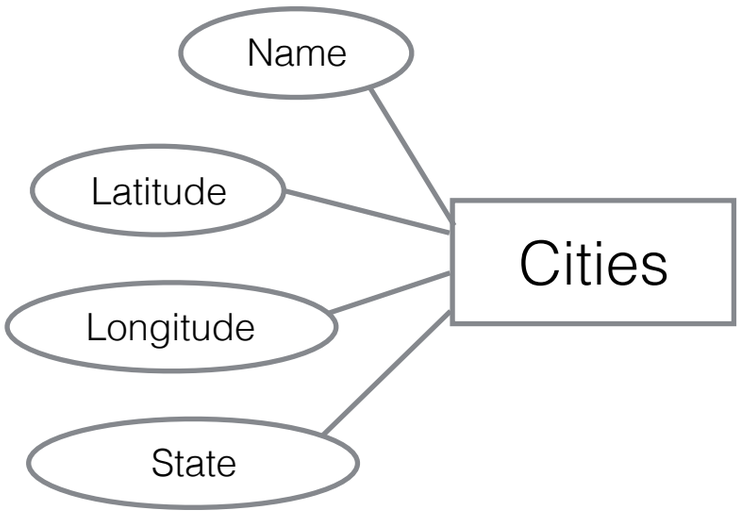
ER Models

entity–relationship model



ER Models

entity–relationship model

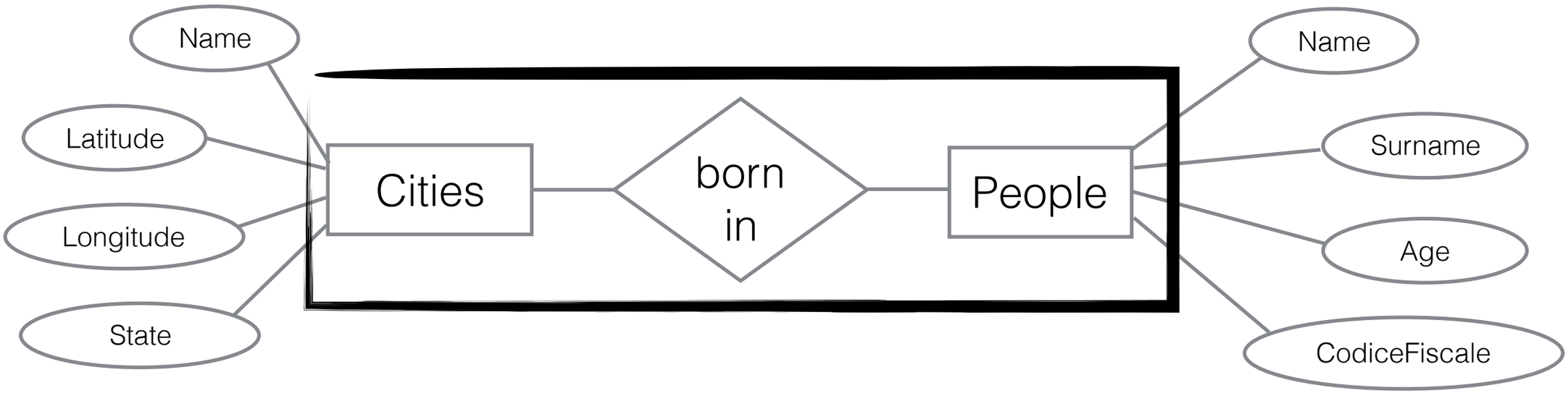


Cities

Name	Latitude	Longitude	State
Pergine V.	46.0667	11.2333	Italy
Trento	46.0667	11.1167	Italy
Bassano del Grappa	45.7667	11.7333	Italy
…	…	…	…

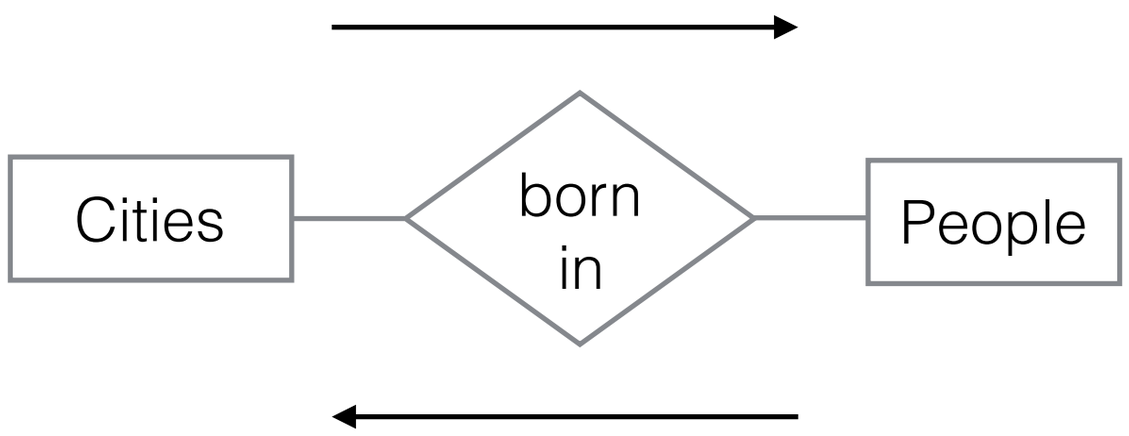
ER Models

entity–relationship model



ER Models

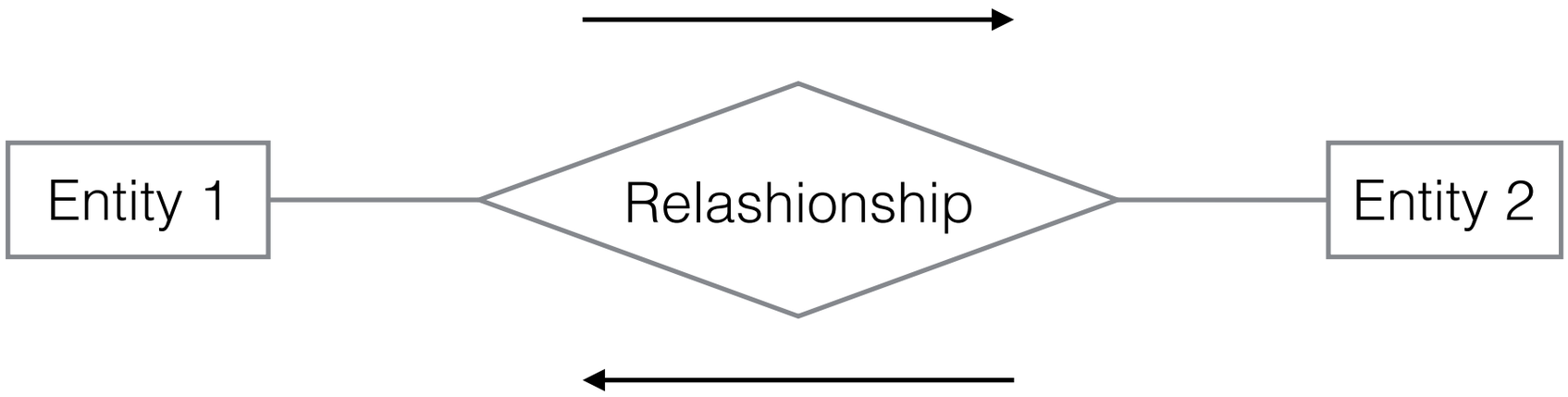
entity–relationship model



Cardinality?

ER Models

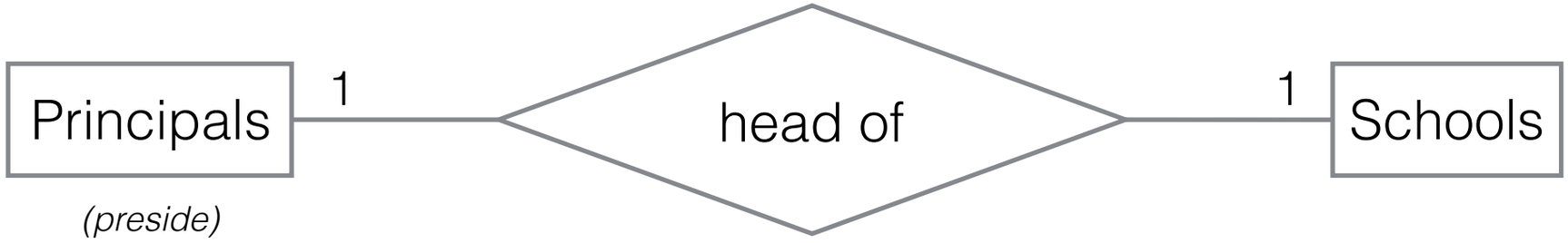
entity–relationship model



one-to-one
one-to-many
many-to-many

ER Models

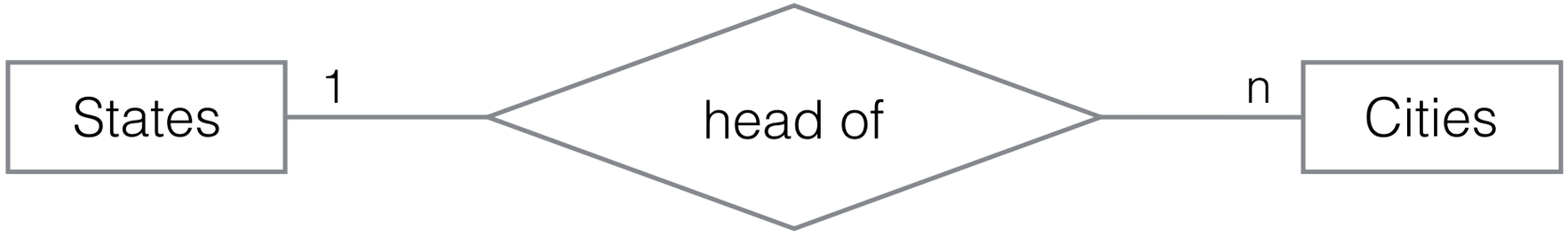
entity–relationship model



one-to-one

ER Models

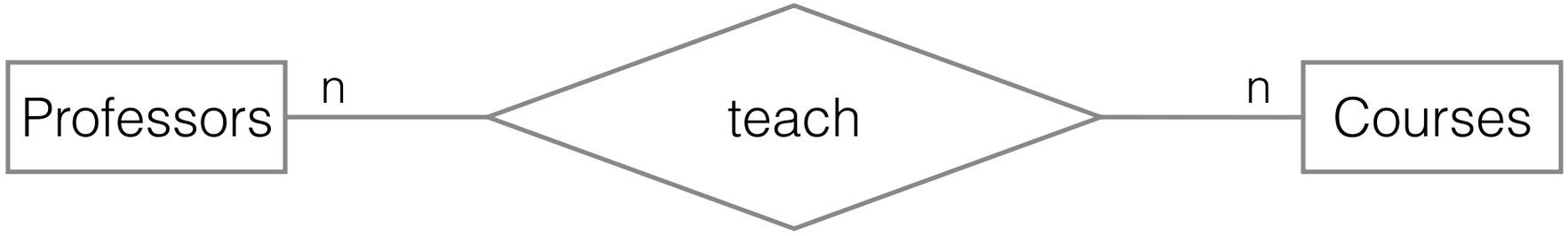
entity–relationship model



one-to-many / many-to-one

ER Models

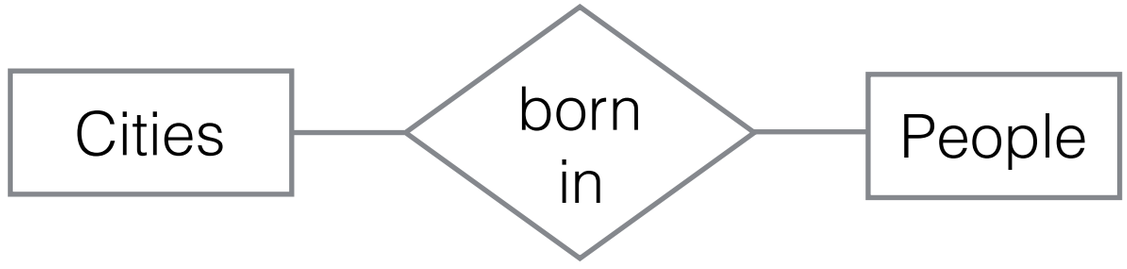
entity–relationship model



many-to-many

ER Models

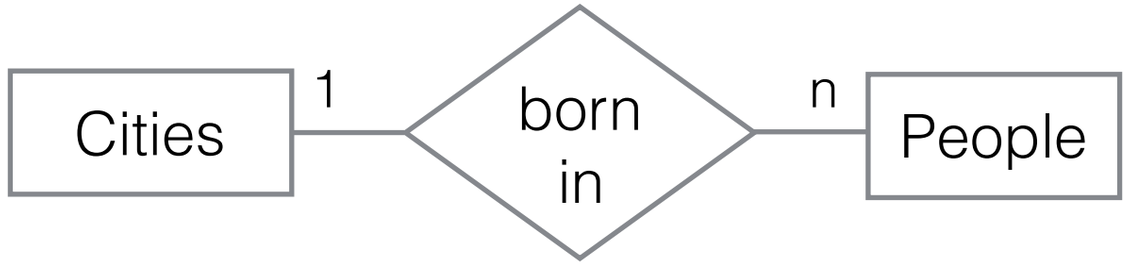
entity–relationship model



Cardinality?

ER Models

entity–relationship model



one-to-many

ER Models

entity–relationship model

People

Name	Surname	Age	CodiceFiscale
Paolo	Verdi	23	vrdpla…
Marco	Rossi	45	rssmca…
Matteo	Bianchi	21	…
…	…	…	…

Cities

Name	Latitude	Longitude	State
Pergine V.	46.0667	11.2333	Italy
Trento	46.0667	11.1167	Italy
Bassano del Grappa	45.7667	11.7333	Italy
…	…	…	…

ER Models

entity–relationship model

Primary keys, **F**oreign keys

ER Models

entity–relationship model

People

Name	Surname	Age	CodiceFiscale
Paolo	Verdi	23	vrdpla…
Marco	Rossi	45	rssmca…
Matteo	Bianchi	21	…
…	…	…	…

Cities

Name	Latitude	Longitude	State
Pergine V.	46.0667	11.2333	Italy
Trento	46.0667	11.1167	Italy
Bassano del Grappa	45.7667	11.7333	Italy
…	…	…	…

ER Models

entity–relationship model

People

Id	Name	Surname	Age	CodiceFiscale
1	Paolo	Verdi	23	vrdpla…
2	Marco	Rossi	45	rssmca…
3	Matteo	Bianchi	21	…
4	…	…	…	…

Cities

Id	Name	Latitude	Longitud	State
1	Pergine V.	46.0667	11.2333	Italy
2	Trento	46.0667	11.1167	Italy
3	Bassano del Grappa	45.7667	11.7333	Italy
4	…	…	…	…

ER Models

entity–relationship model

People

Id	Name	Surname	Age	CodiceFiscale
1	Paolo	Verdi	23	vrdpla…
2	Marco	Rossi	45	rssmca…
3	Matteo	Bianchi	21	…
4	…	…	…	…

Cities

Id	Name	Latitude	Longitude	State
1	Pergine V.	46.0667	11.2333	Italy
2	Trento	46.0667	11.1167	Italy
3	Bassano del Grappa	45.7667	11.7333	Italy
4	…	…	…	…

ER Models

entity–relationship model

People

Id	Name	Surname	Age	CodiceFiscale	**City**
1	Paolo	Verdi	23	vrdpla…	1
2	Marco	Rossi	45	rssmca…	1
3	Matteo	Bianchi	21	…	3
4	…	…	…	…	

Primary key

Foreign key

Cities

Id	Name	Latitude	Longitude	State
1	Pergine V.	46.0667	11.2333	Italy
2	Trento	46.0667	11.1167	Italy
3	Bassano del Grappa	45.7667	11.7333	Italy
4	…	…	…	…

Primary key

ER Models

entity–relationship model

NOT the opposite way!

ER Models

entity–relationship model

People

Id	Name	Surname	Age	CodiceFiscale
1	Paolo	Verdi	23	vrdpla…
2	Marco	Rossi	45	rssmca…
3	Matteo	Bianchi	21	…
4	…	…	…	…

Primary key

Cities

Id	Name	Latitude	Longitude	State	**Person**
1	Pergine V.	46.0667	11.2333	Italy	**1,2, ….**
2	Trento	46.0667	11.1167	Italy	
3	Bassano del Gr.	45.7667	11.7333	Italy	3
4	…	…	…	…	

Primary key

ER Models

entity–relationship model

Another example!

ER Models

entity–relationship model

Professors

Id	Name	Surname	Age	CodiceFiscale
1	Paolo	Verdi	23	vrdpla…
2	Marco	Rossi	45	rssmca…
3	Matteo	Bianchi	21	…
4	…	…	…	…

Courses

Code	Name	Description	Hours
1	Math	blabla…	48
2	Statistics	bloblo…	48
3	Economics	blublu…	36
4	…	…	…

ER Models

entity–relationship model

Professors

Id	Name	Surname	Age	CodiceFiscale
1	Paolo	Verdi	23	vrdpla…
2	Marco	Rossi	45	rssmca…
3	Matteo	Bianchi	21	…
4	…	…	…	…

Courses

Code	Name	Description	Hours
1	Math	blabla…	48
2	Statistics	bloblo…	48
3	Economics	blublu…	36
4	…	…	…

teachings

Id	**Code**
1	1
1	2
2	2
2	3

ER Models

entity–relationship model

Professors

Id	Name	Surname	Age	CodiceFiscale
1	Paolo	Verdi	23	vrdpla…
2	Marco	Rossi	45	rssmca…
3	Matteo	Bianchi	21	…
4	…	…	…	…

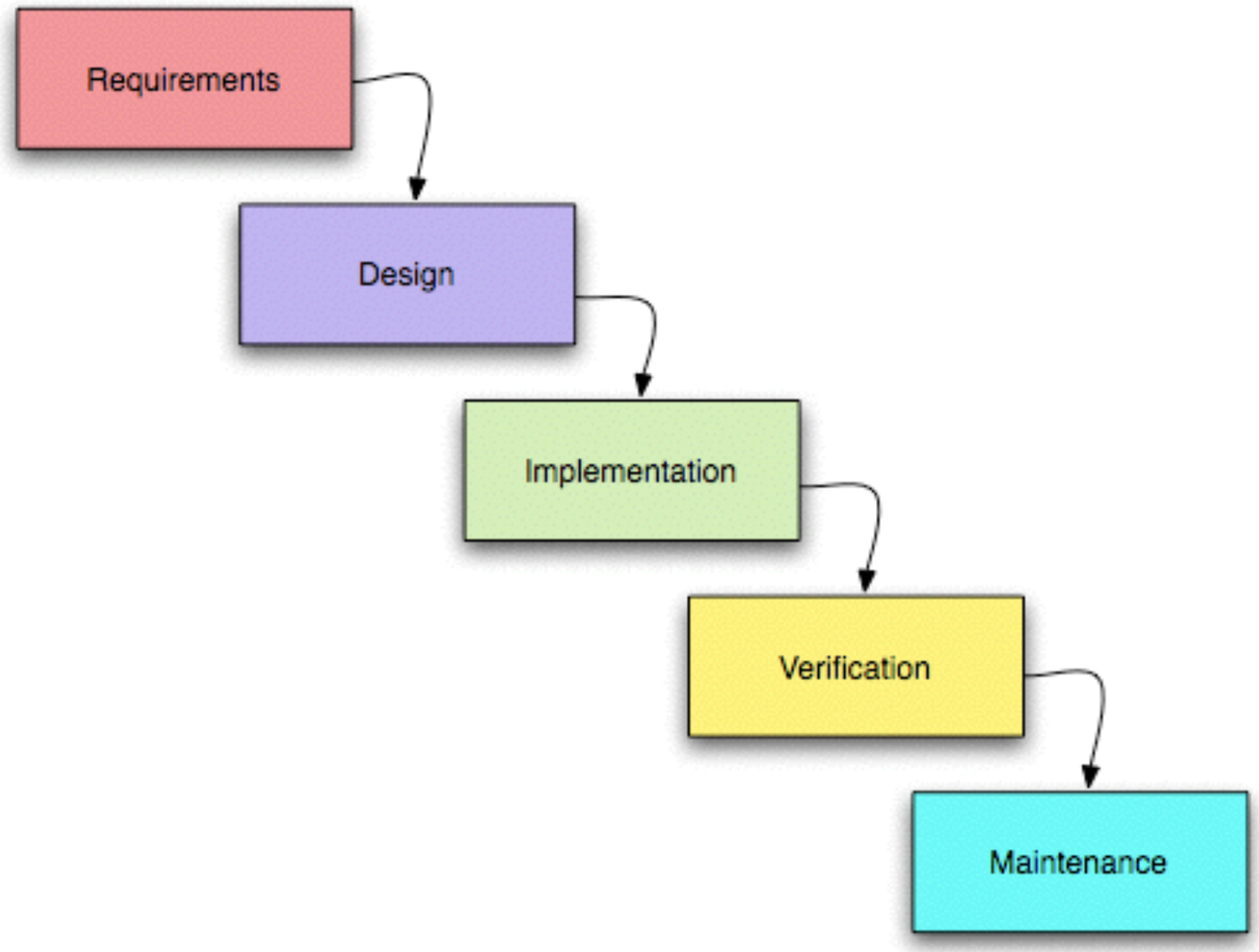
Courses

Code	Name	Description	Hours
1	Math	blabla…	48
2	Statistics	bloblo…	48
3	Economics	blublu…	36
4	…	…	…

teachings

Id	**Code**	**Role**
1	1	Assistant
1	2	Assistant
2	2	Tutor
2	3	Assistant

In a Software development process..



SQL

Structured Query Language

SQL consists of a data definition language, data manipulation language, and a data control language.

Data Definition Language (**DDL**)

```
CREATE TABLE `People` (
  `Id` INT NOT NULL AUTO_INCREMENT,
  `Name` VARCHAR(40) NOT NULL,
  `Surname` VARCHAR(40) NOT NULL,
  `Age` INT NOT NULL,
);
```

The Data Definition Language (DDL) manages table and index structure. The most basic items of DDL are the `CREATE`, `ALTER`, `RENAME`, `DROP` and `TRUNCATE` statements:

Data Manipulation Language (**DML**)

```
SELECT ... FROM ... WHERE ...
INSERT INTO ... VALUES ...
UPDATE ... SET ... WHERE ...
DELETE FROM ... WHERE ...
```

A **data manipulation language** (**DML**) is a family of syntax elements similar to a computer programming language used for selecting, inserting, deleting and updating data in a database.

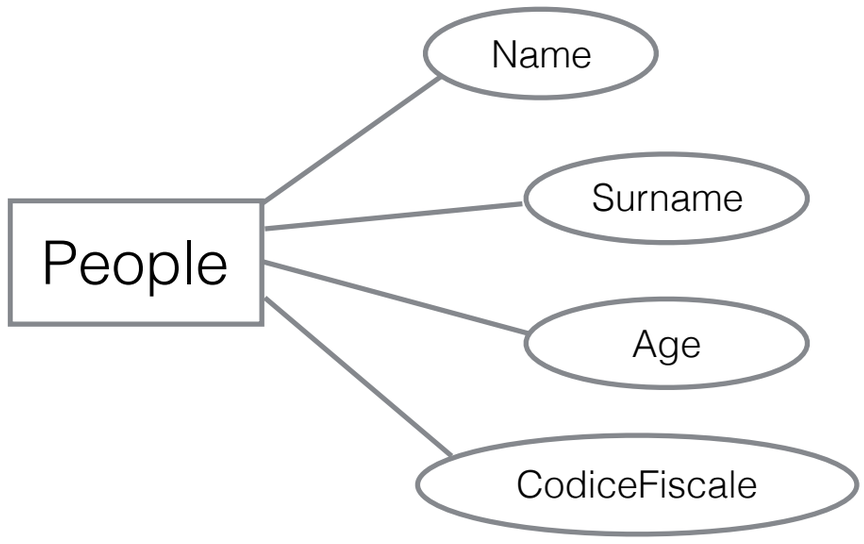
ER Models

entity–relationship model

People

tupla →

Name	Surname	Age	CodiceFiscale
Paolo	Verdi	23	vrdpla…
Marco	Rossi	45	rssmca…
Matteo	Bianchi	21	…
…	…	…	…



ER Models

entity–relationship model

People

Name	Surname	Age	CodiceFiscale
Paolo	Verdi	23	vrdpla…
Marco	Rossi	45	rssmca…
Matteo	Bianchi	21	…
…	…	…	…

tupla →

In rails **People** is an “**Object**”.

DEMO