

INF1343, Winter 2012

Data Modeling and Database Design

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Week 3

The ER Model

The Relational Model

species

Human	humanoid	1.7
Hutt	gastropod	3.5

persona

Jabba	Hutt
Obiwan Kenobi	Human

species_type

gastropod	0
humanoid	2

Good DB Design

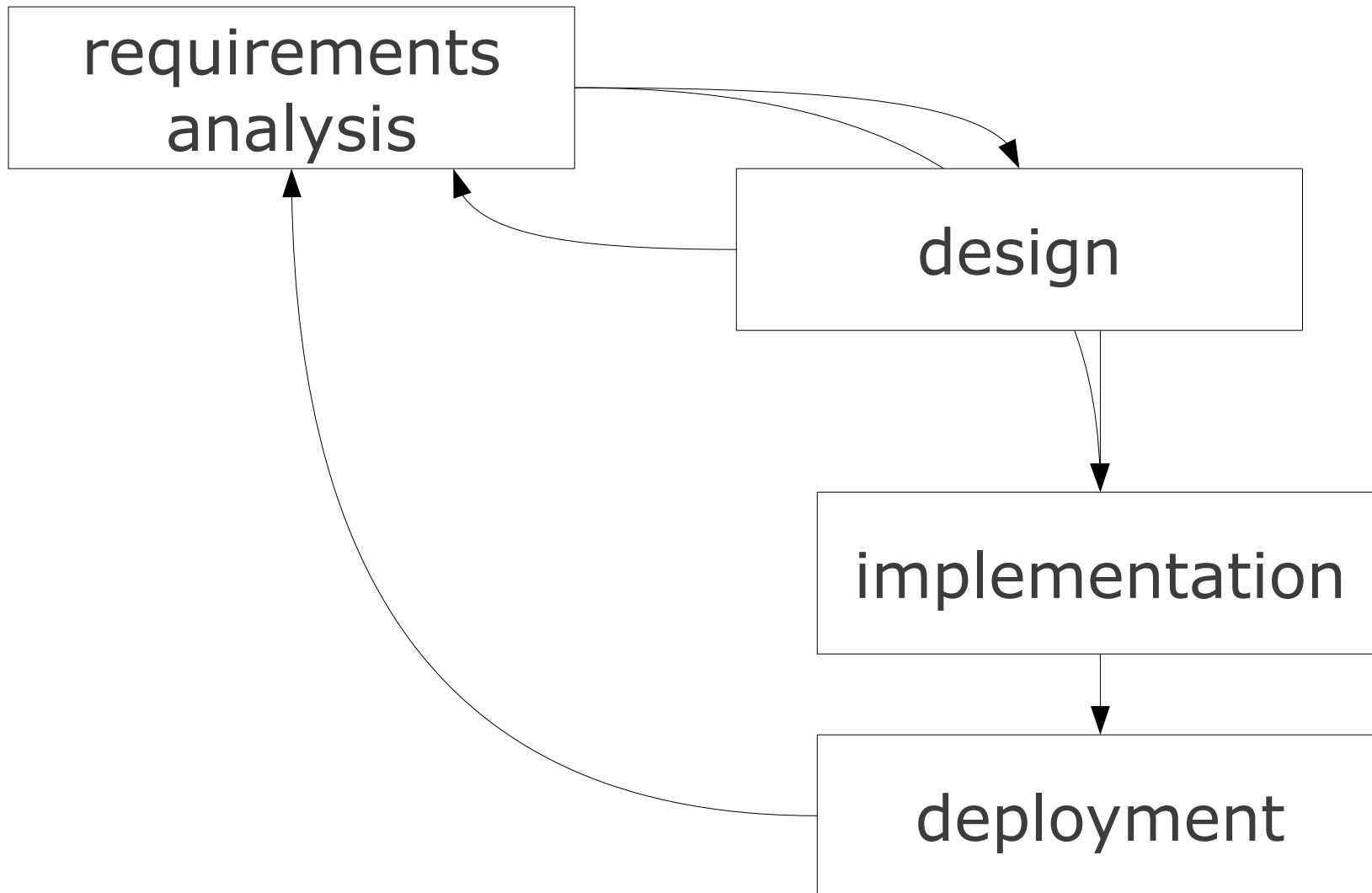
1. Serves the purpose.
2. Simplifies updates.
3. Avoids “anomalies”.

Two Approaches

1. Start with whatever, then fix it
2. Start by modeling

ER Modeling

The DB Lifecycle



client

you

database

users



Functional Specifications

What is the system going to do?
(Not **how**, but **what**.)

Course Enrollment

What do we want from a course enrollment system?

“Use Cases”

A student wants to enroll in a course for the next semester. The student goes to the website for the enrollment system and logs in. The student is presented with a list of courses there he or she is enrolled in. There is a button next to each course to un-enroll from it. There is also a search box that the student can use to look for courses that they are not enrolled in. The student can find the course by the course code or course title...

ER Model

E is for “Entities”

R is for “Relationships”

(“relationships” != “relations”)

(A visual / diagramming language.)

Other Diagrams

Flowcharts

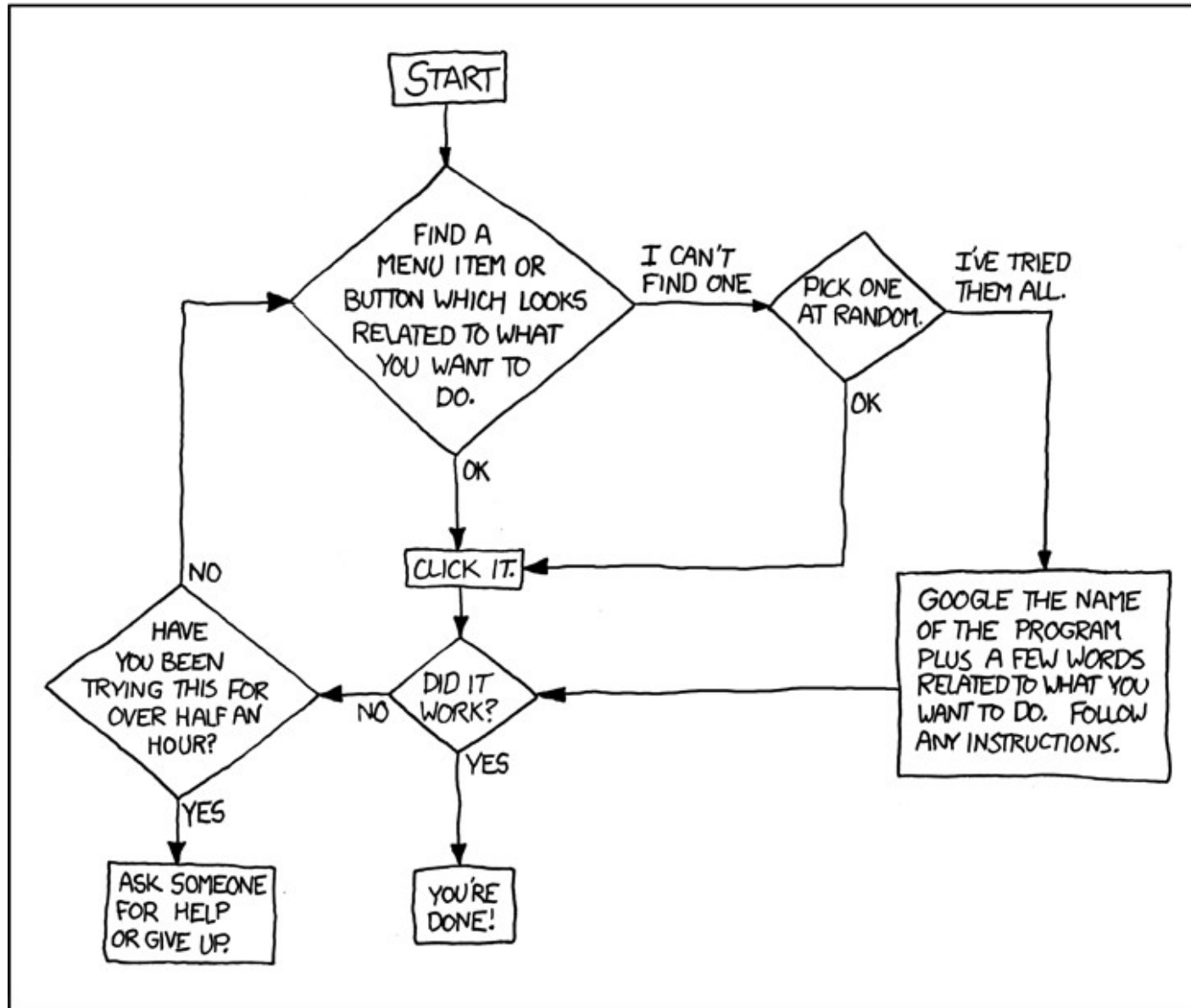
Sequence diagrams

Data flow diagrams

All of those are
NOT ER diagrams

DEAR VARIOUS PARENTS, GRANDPARENTS, CO-WORKERS,
AND OTHER "NOT COMPUTER PEOPLE."

WE DON'T MAGICALLY KNOW HOW TO DO EVERYTHING IN EVERY
PROGRAM. WHEN WE HELP YOU, WE'RE USUALLY JUST DOING THIS:



Not an
ERD!

PLEASE PRINT THIS FLOWCHART OUT AND TAPE IT NEAR YOUR SCREEN.
CONGRATULATIONS; YOU'RE NOW THE LOCAL COMPUTER EXPERT!

client

you

database

users

the problem

functional specification

clarification

a design

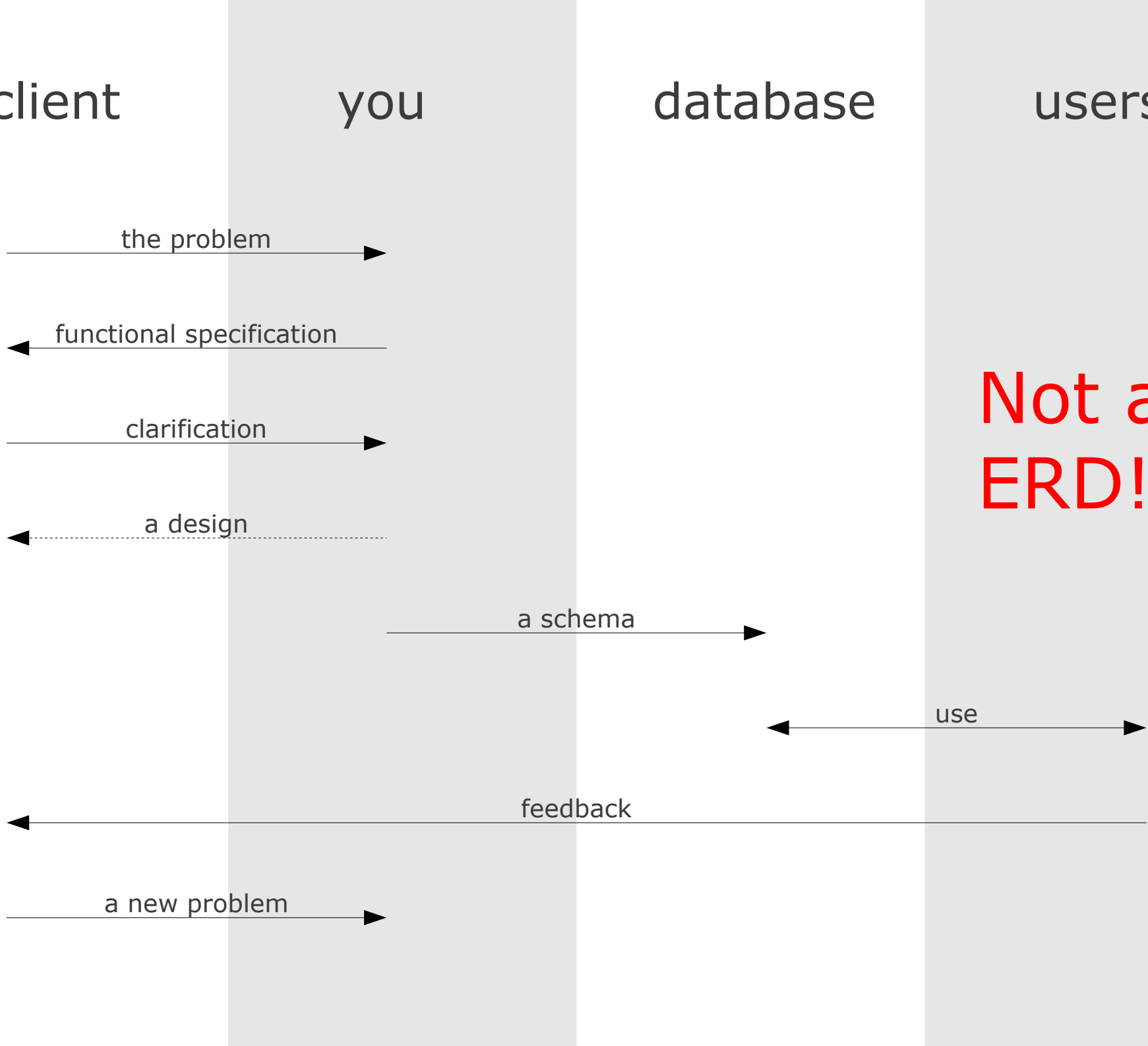
a schema

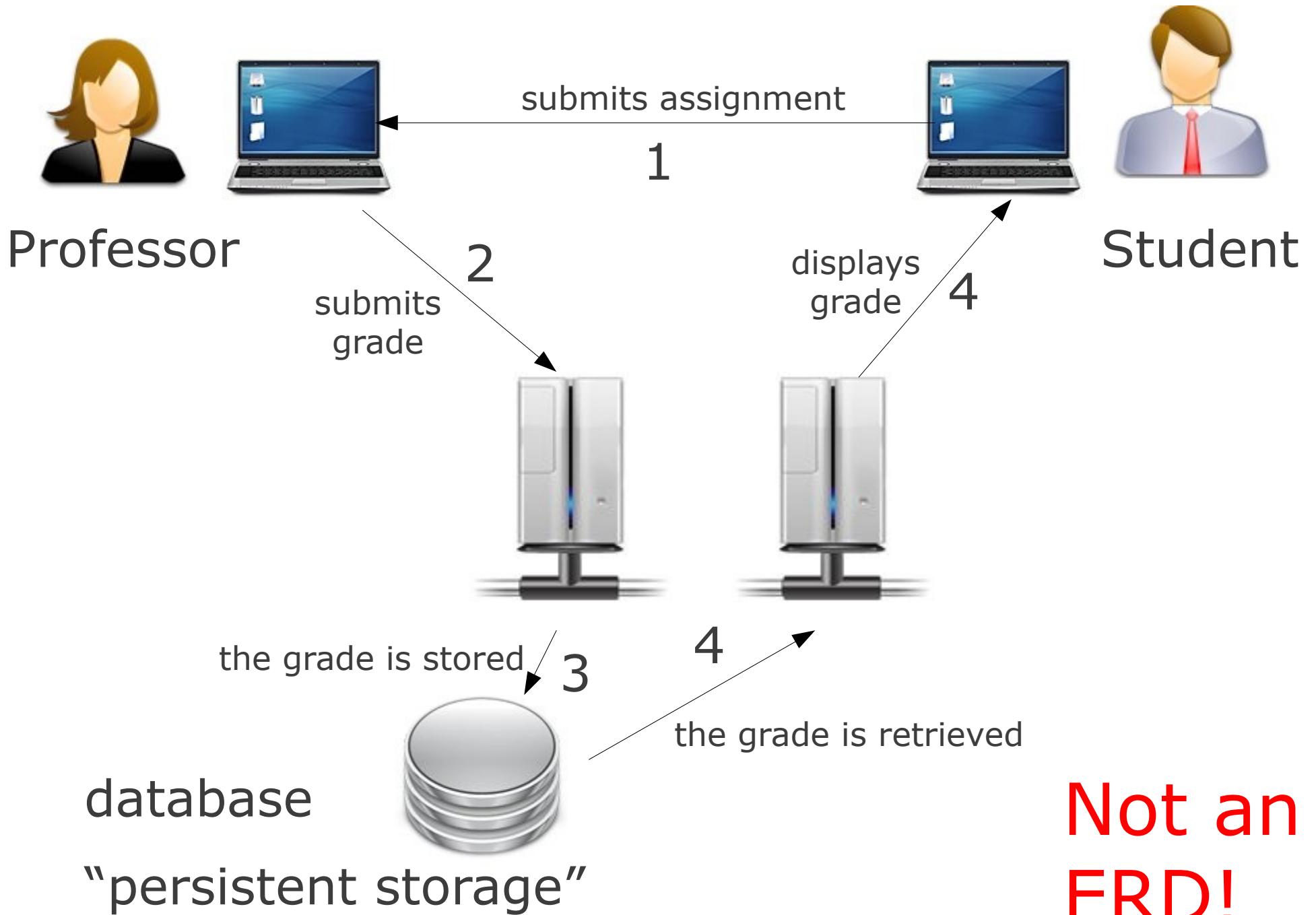
use

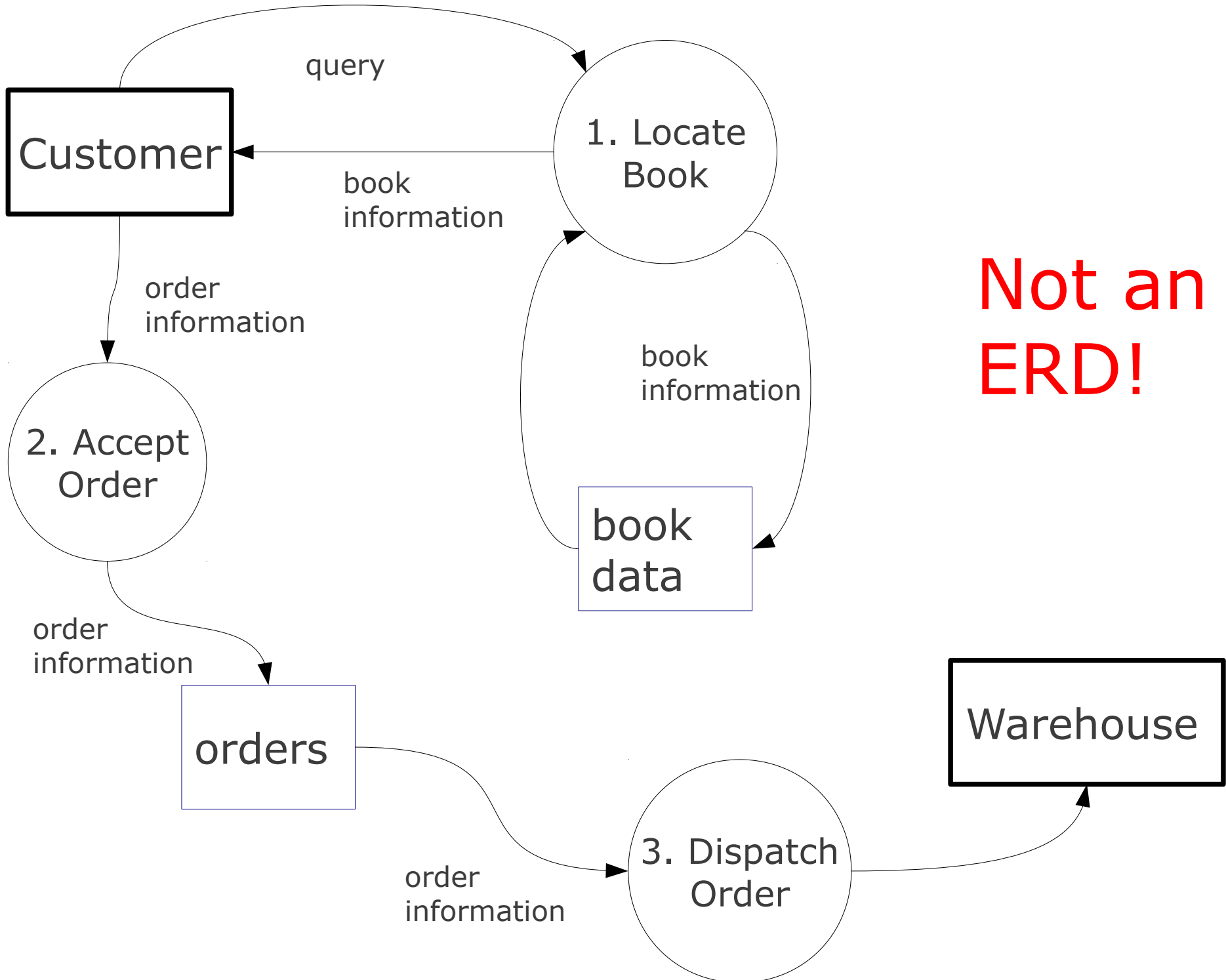
feedback

a new problem

Not an ERD!







Not an ERD!

ER Diagrams

Not what **happens** to the data, but the **structure** of the data itself.

Normally does not show actors or repositories, but objects (“entities”) about which we have information. (The relationships between the entities is one kind of information about them.)

Entities

The “things” we need to keep track of in our database.

“Use Cases”

A **student** wants to enroll in a **course** for the next **semester**. The student goes to the **website** for the **enrollment system** and logs in. The student is presented with a list of courses there he or she is enrolled in. There is a **button** next to each course to un-enroll from it. There is also a **search box** that the student can use to look for courses that they are not enrolled in. The student can find the course by the **course code** or **course title**...

Entities

Entities in a course enrollment system:

students

courses

instructors

rooms

time slots

attributes

last name

first name

utorid

date of birth

student

program

payment

course

other entities

Entities vs Attributes

Attributes

usually atomic values, e.g.
a number, a string, a date

Entities

bundles of values

(But are dates really atomic?)

One Entity or Two?

The book and its author?

The book and its title?

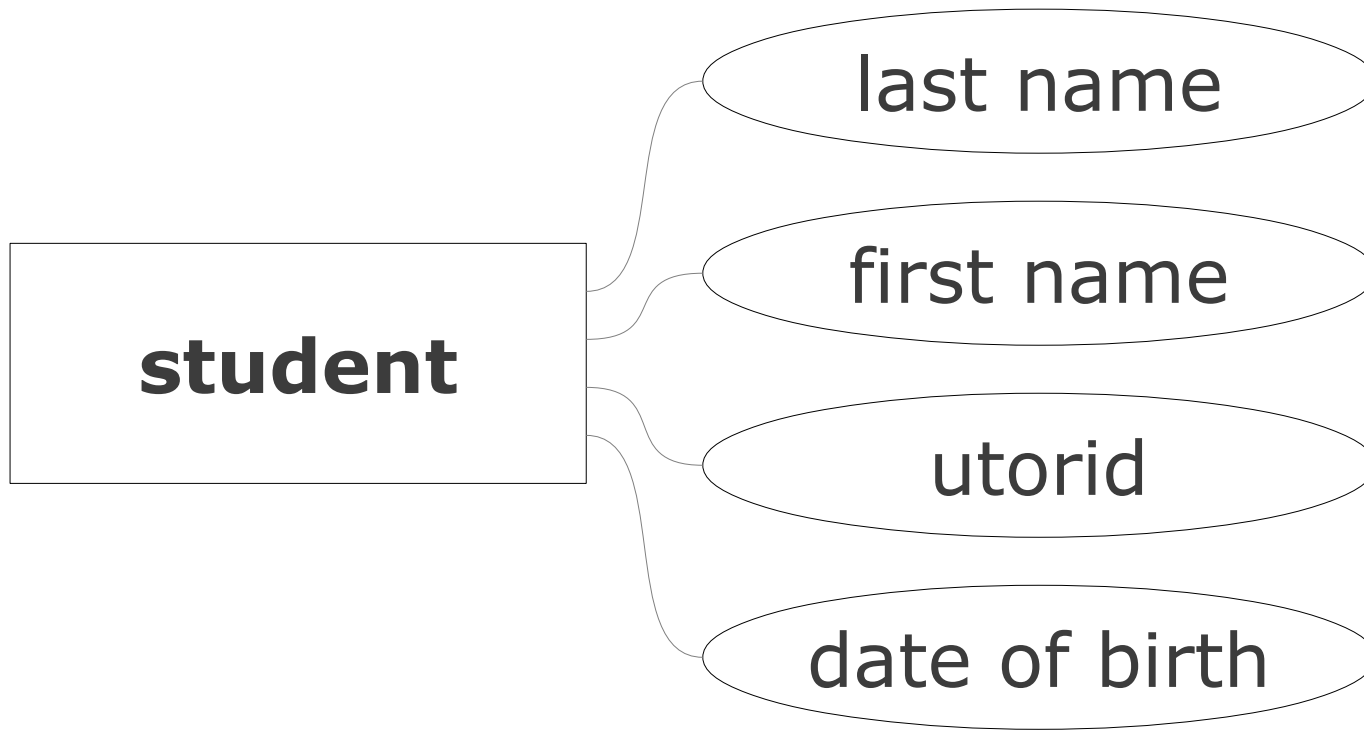
The film and its director?

The film and its title?

The city and its population?

The city and its mayor?

The user and their account?



“Chen’s notation”

student

last name

first name

utorid

date of birth

“UML notation”
(simplified)

Type vs Instance

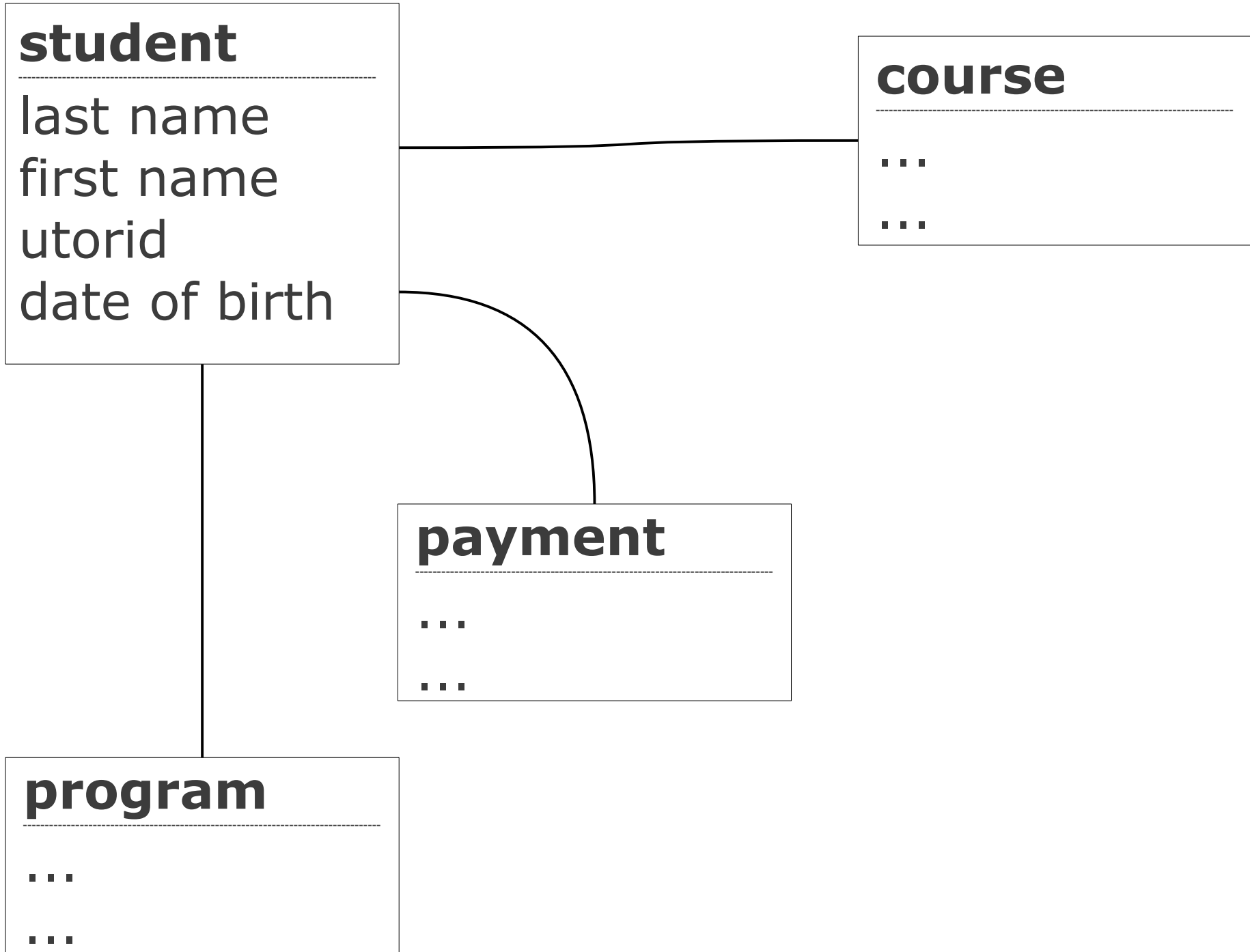
Entity as a type

When we say “student” we really mean “students” as a type.

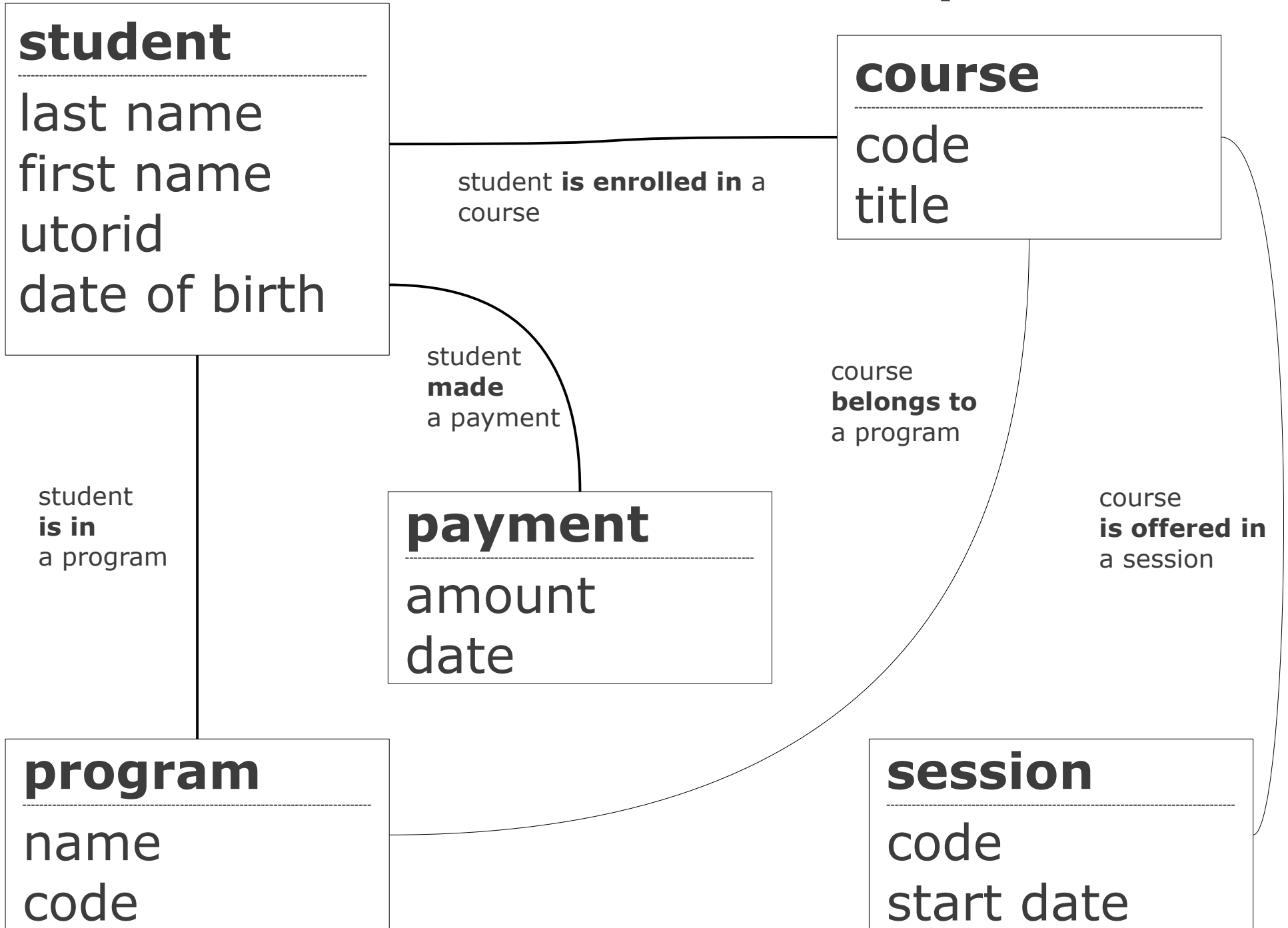
Instances of entities

Individual students’ records are instances of the “student” entity.

(Like rows in a table.)



Each relationship is a **fact**.



ER vs Data Flow Diagrams

ER Diagrams

The structure of the data itself

Data Flow Diagrams

The flow of data between the different processing steps.

Compare:

John wants to enroll in INF1343.

John goes to the website.

John clicks on a button.

VS

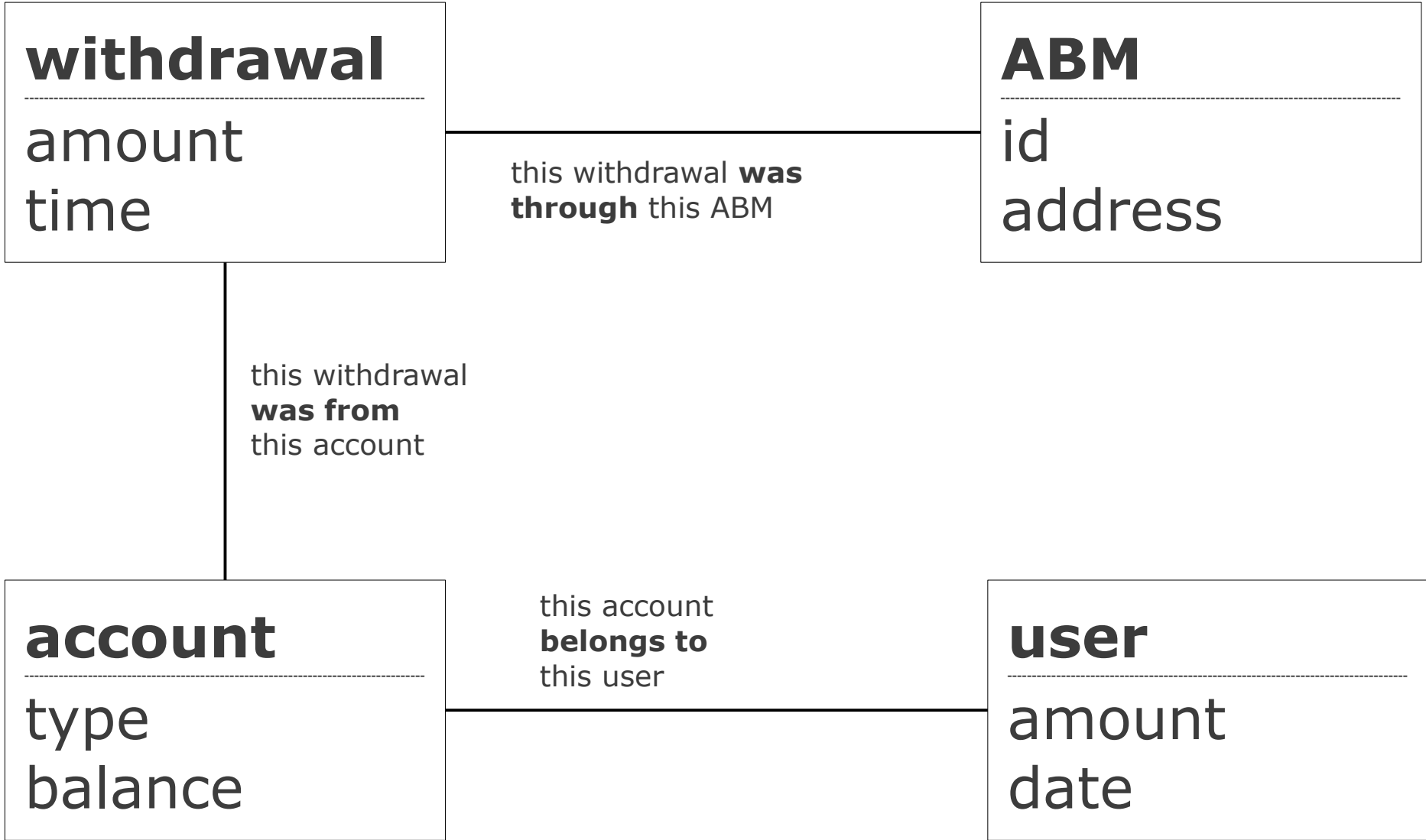
“John Doe is enrolled in INF1343.”

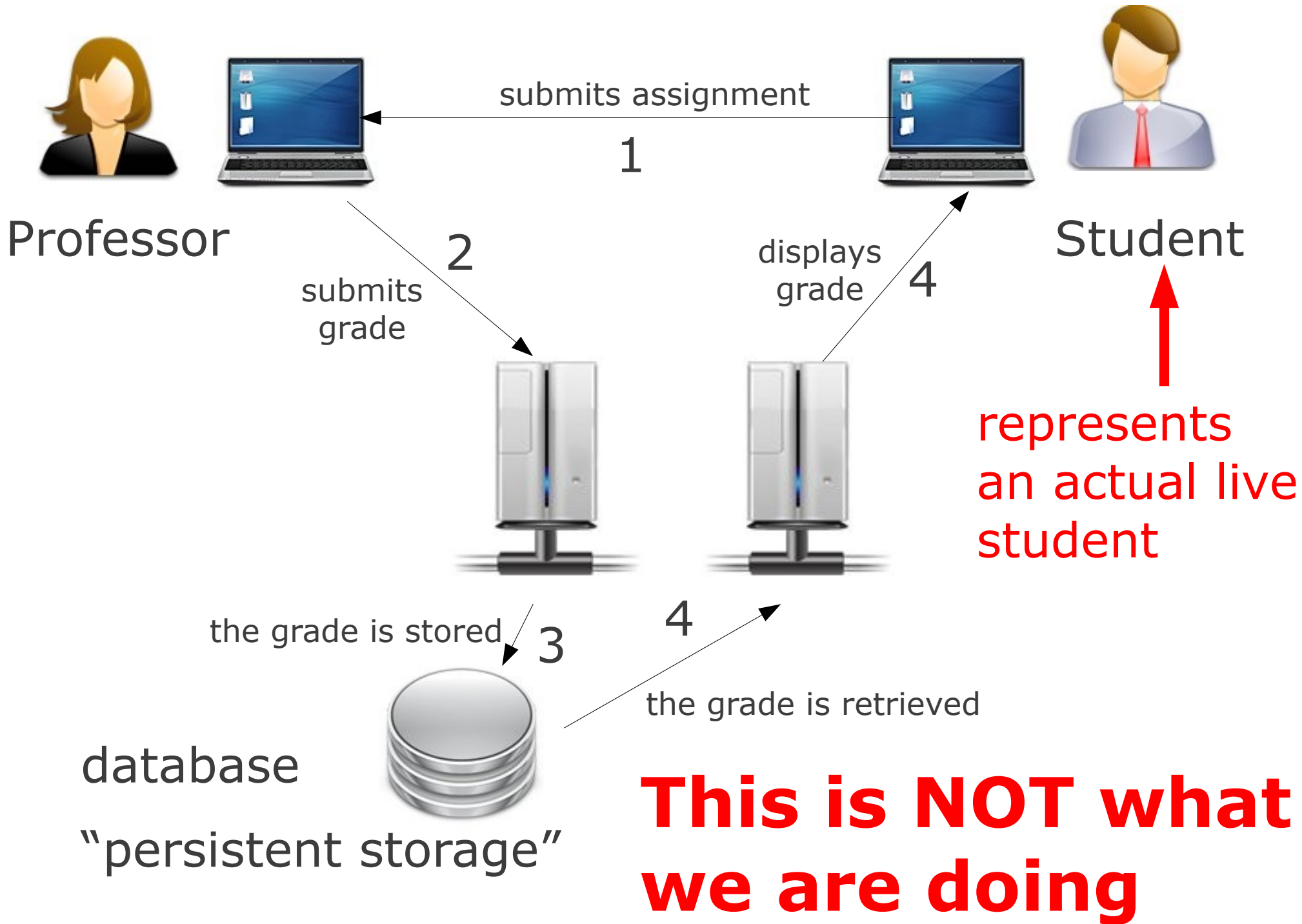
Compare:

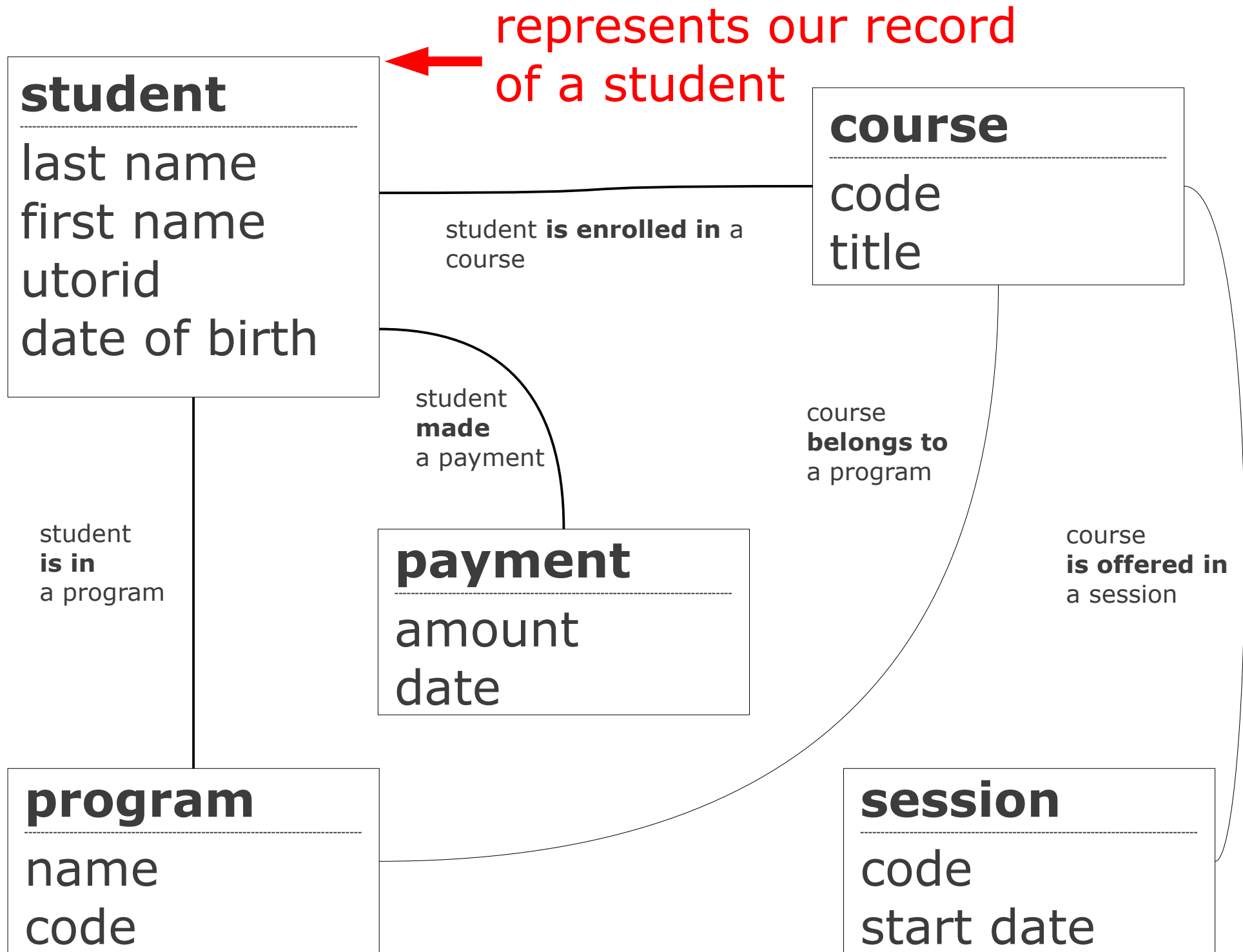
User gets money from an ABM.

VS

“A cash withdrawal of \$200 from account was made 10291192 at 10:10.”







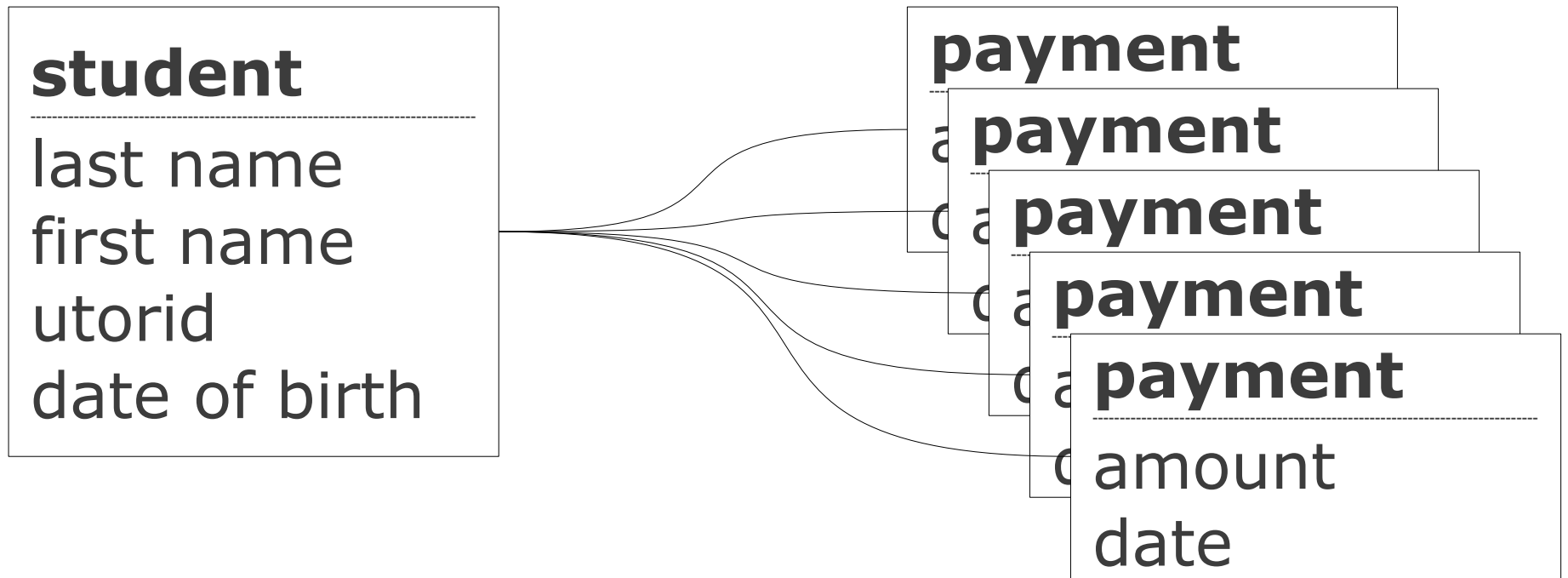
Two Degrees

1. A box in an IR diagram represents a type of record.
2. Records stores information about things in the real world.

A Movie Database

What are the entities?
Which are related?

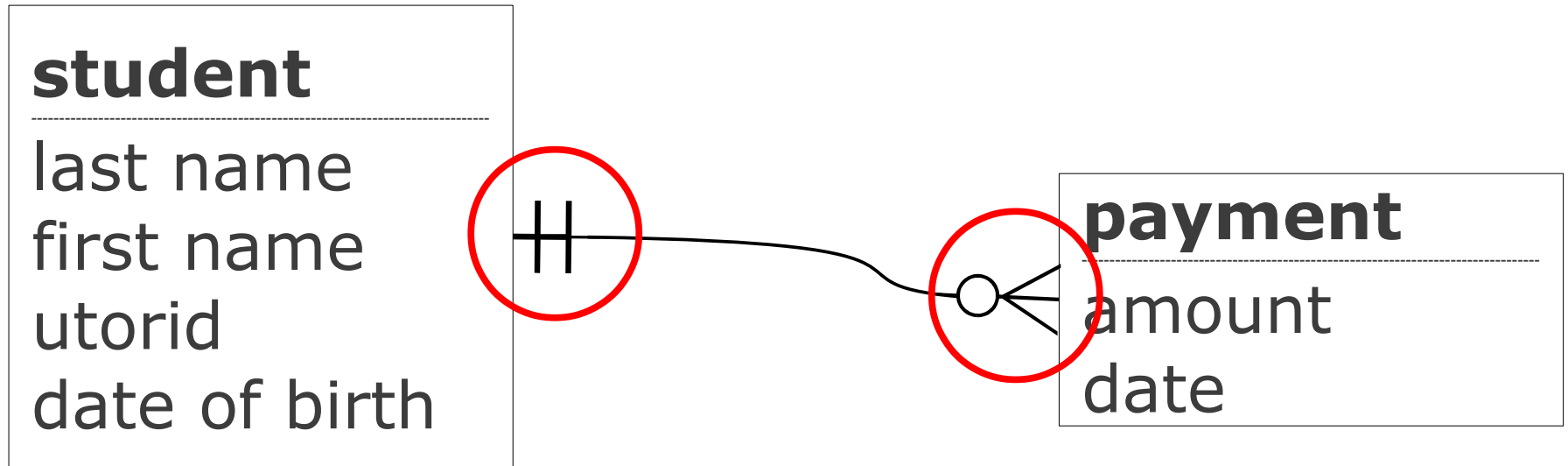
Cardinality



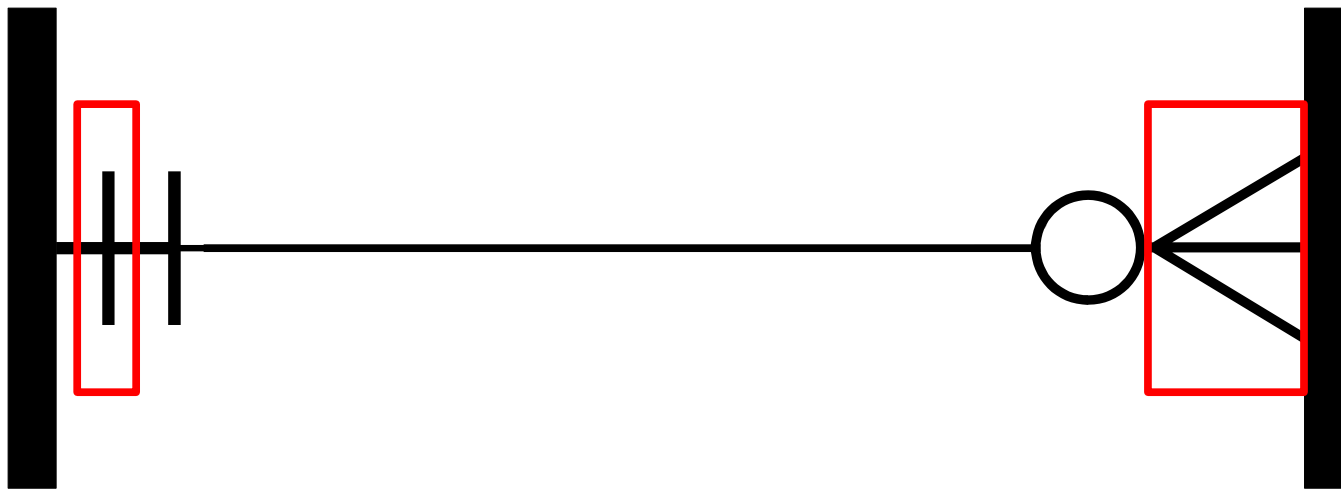
one student, many payments

“one-to-many” relationship

“Crow’s Foot Notation”



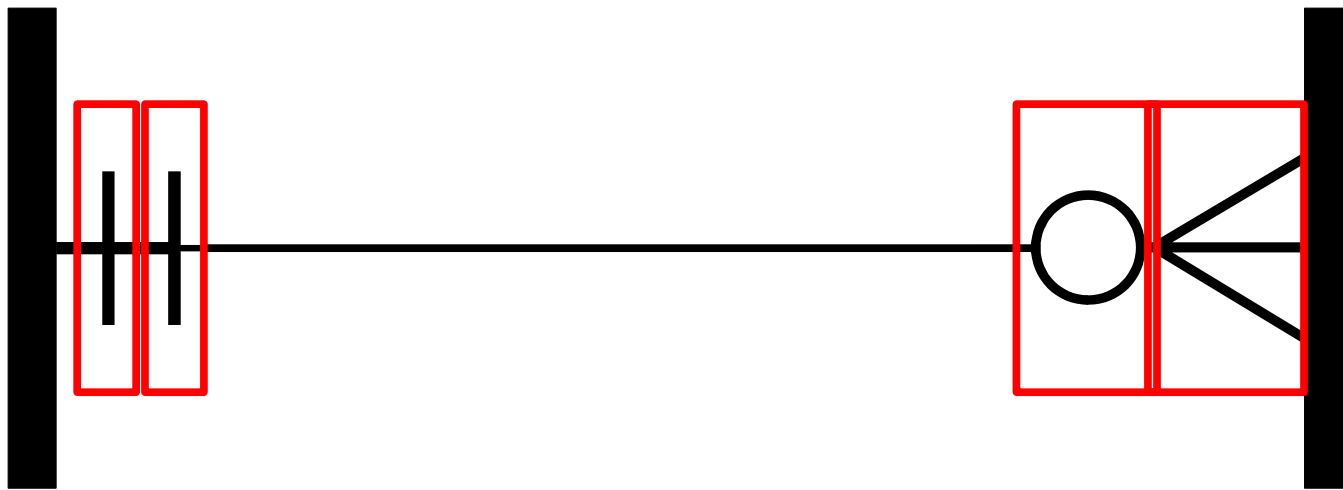
“Crow’s Foot Notation”



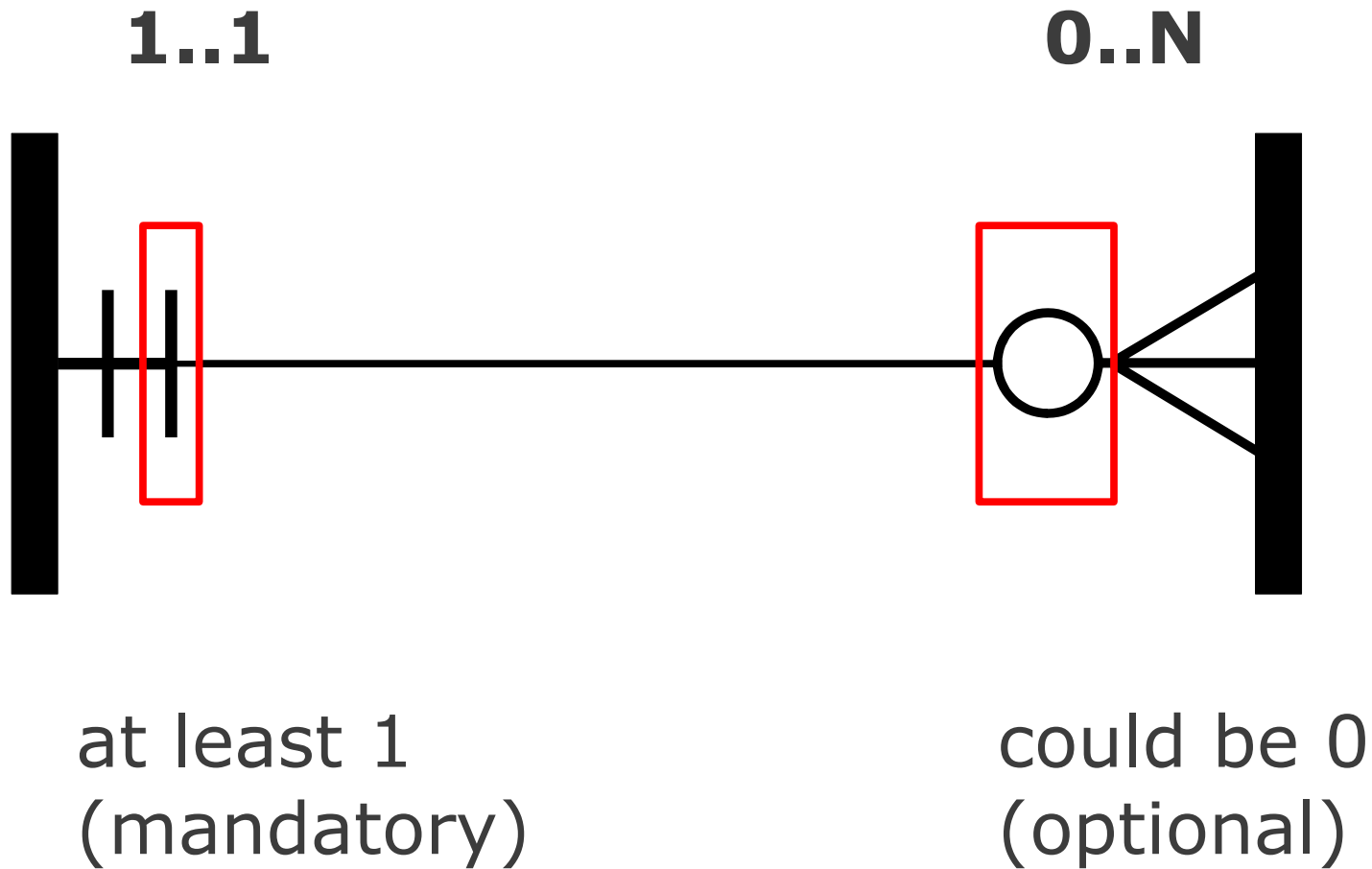
not more than 1

many

“Crow’s Foot Notation”



“Crow’s Foot Notation”



“UML Notation”

1..1

0..N

1..1

0..N

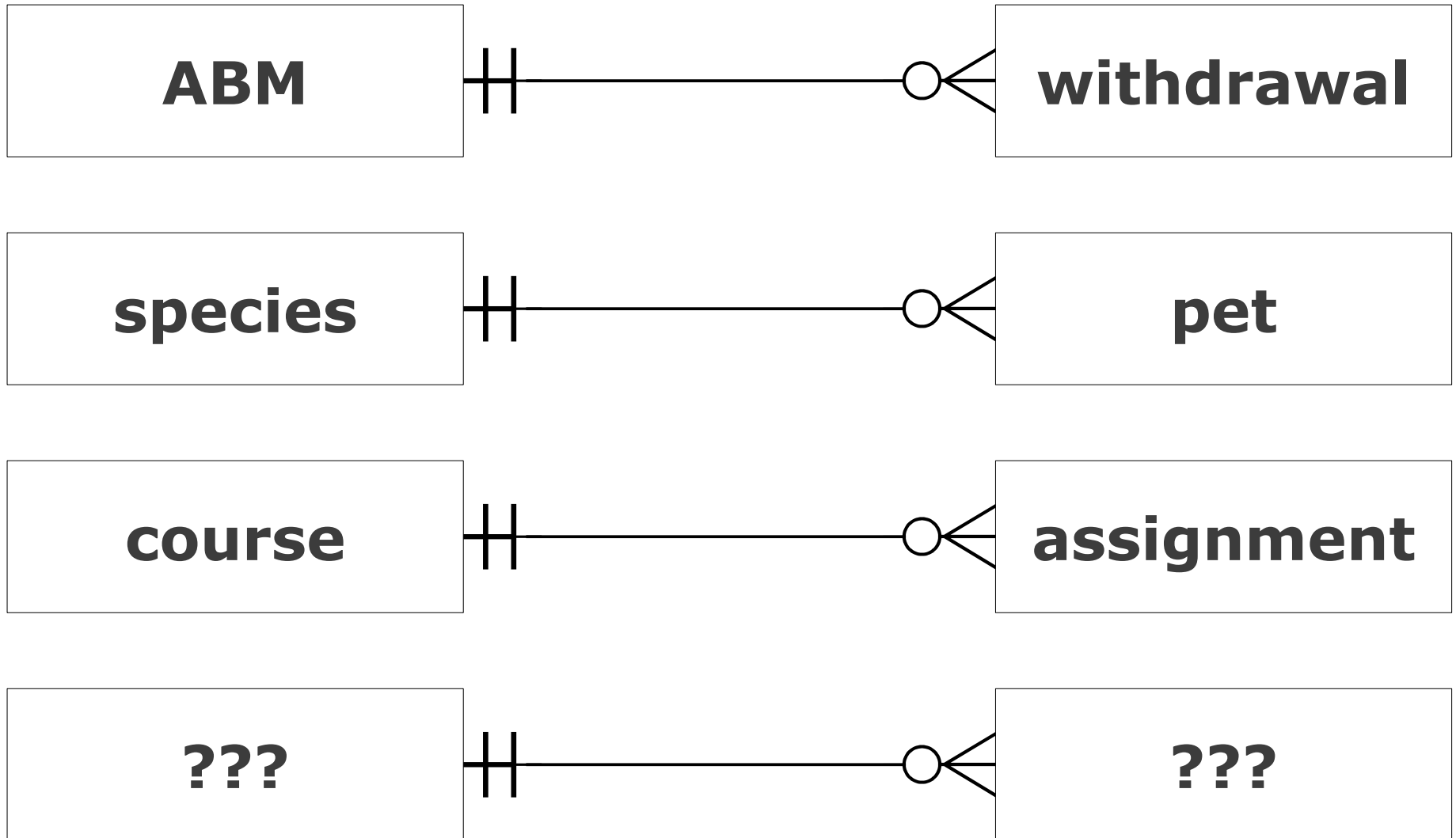
or just “1”

or “0..*”

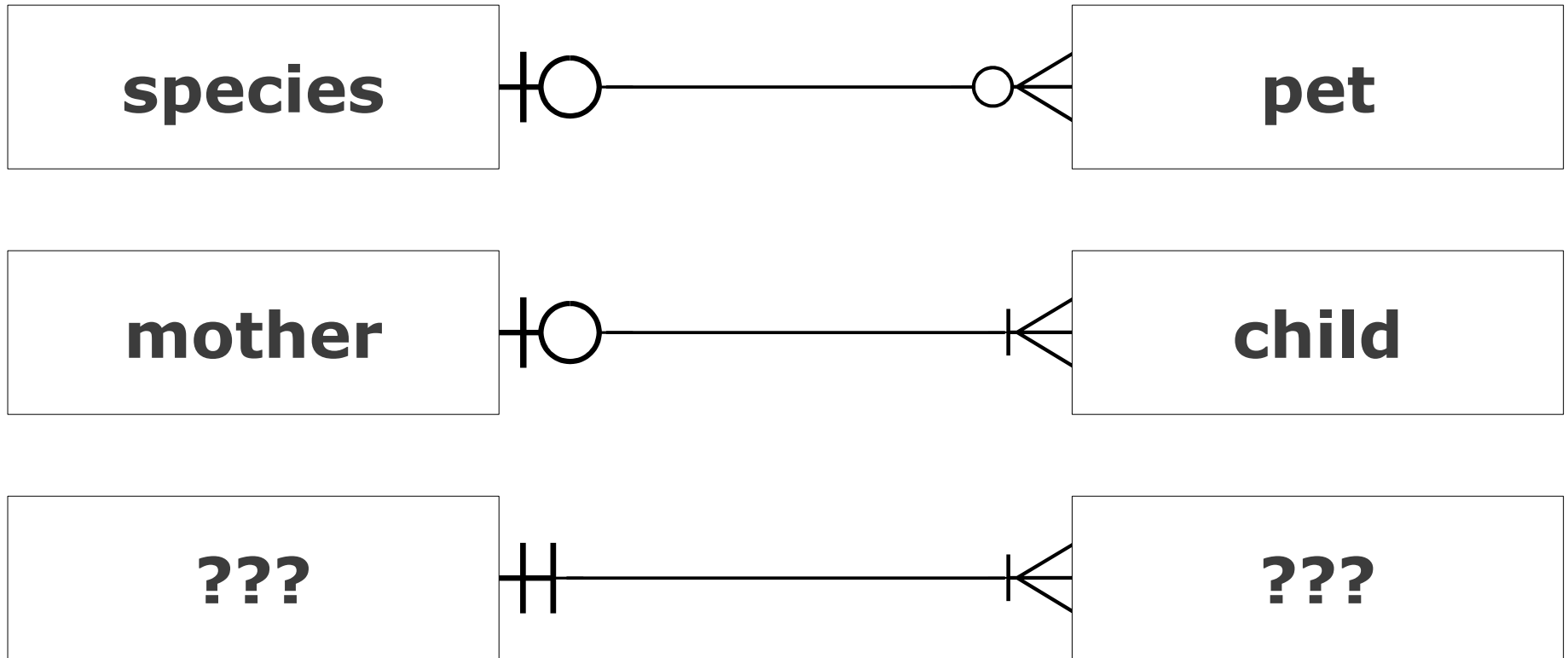
just
one

zero or
many

More Examples



Variations



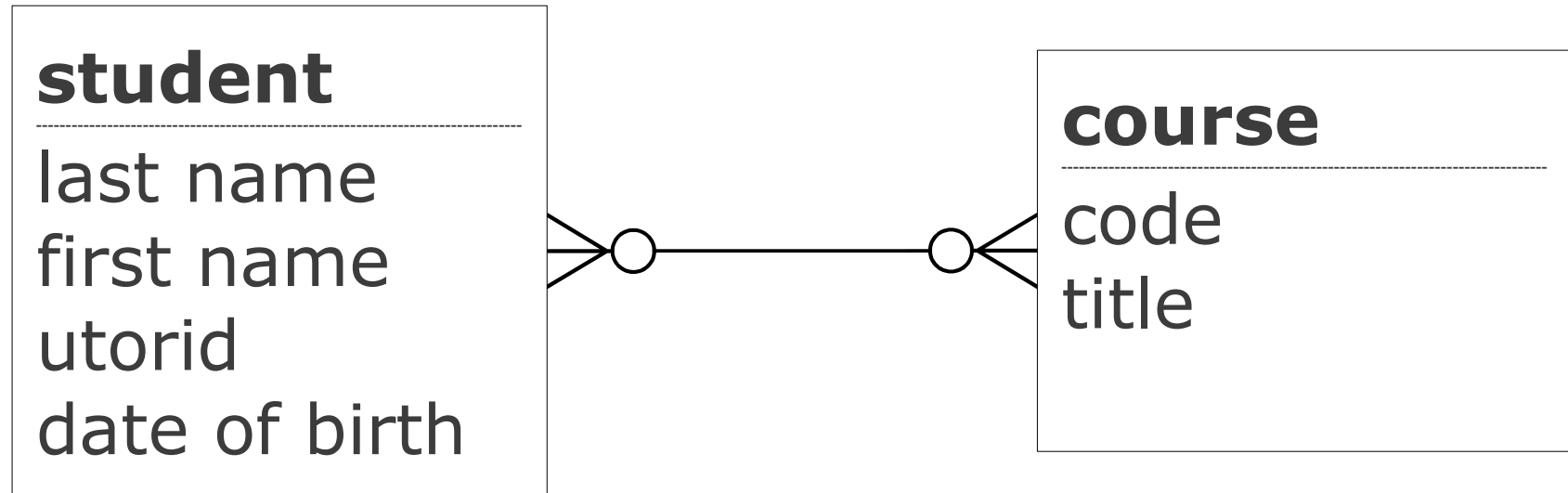
Questions on 1:M?

We 

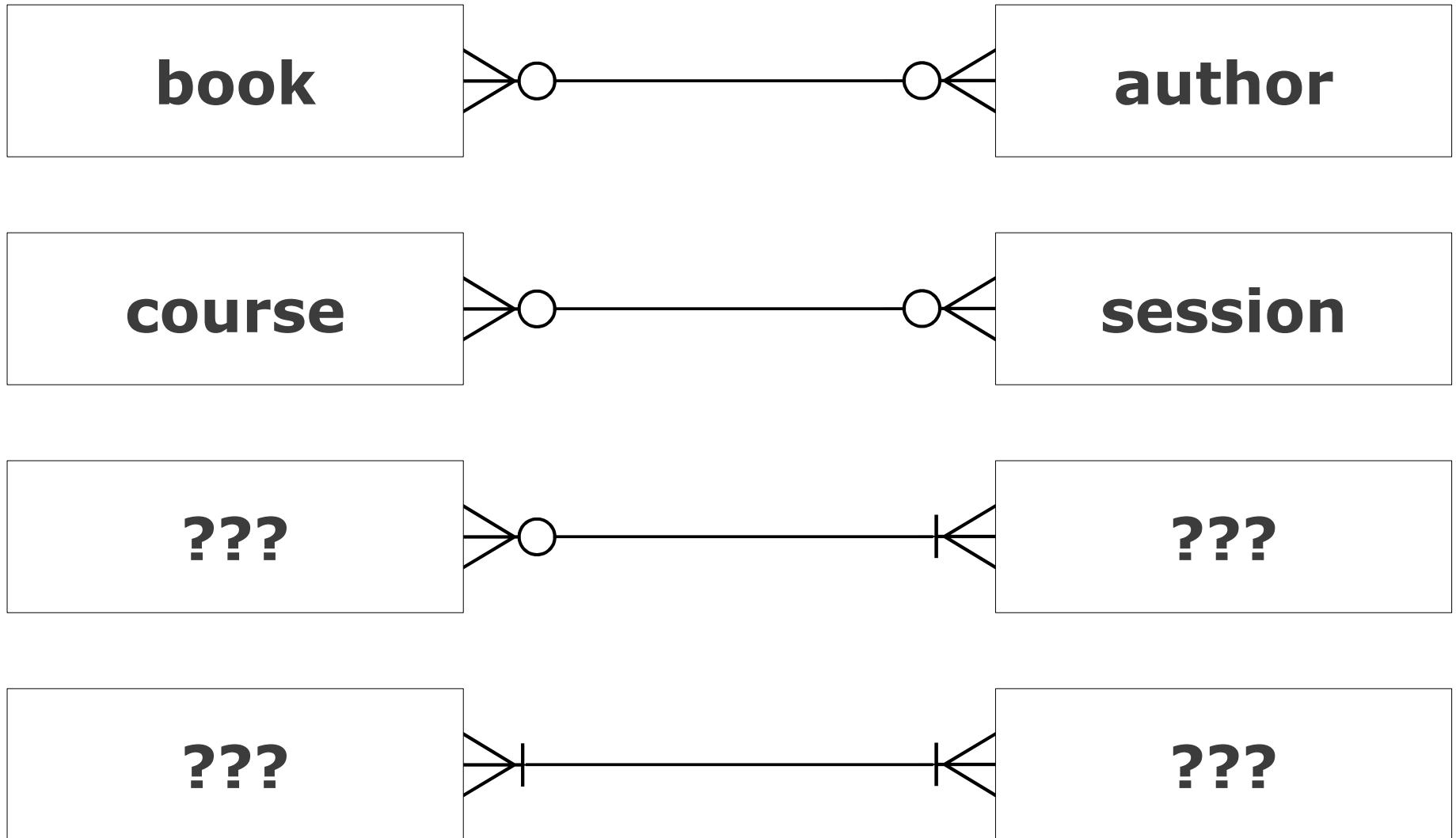
1:M

Because they are really
easy to represent in a
relational database.

Many-to-Many



Examples



Movie Database

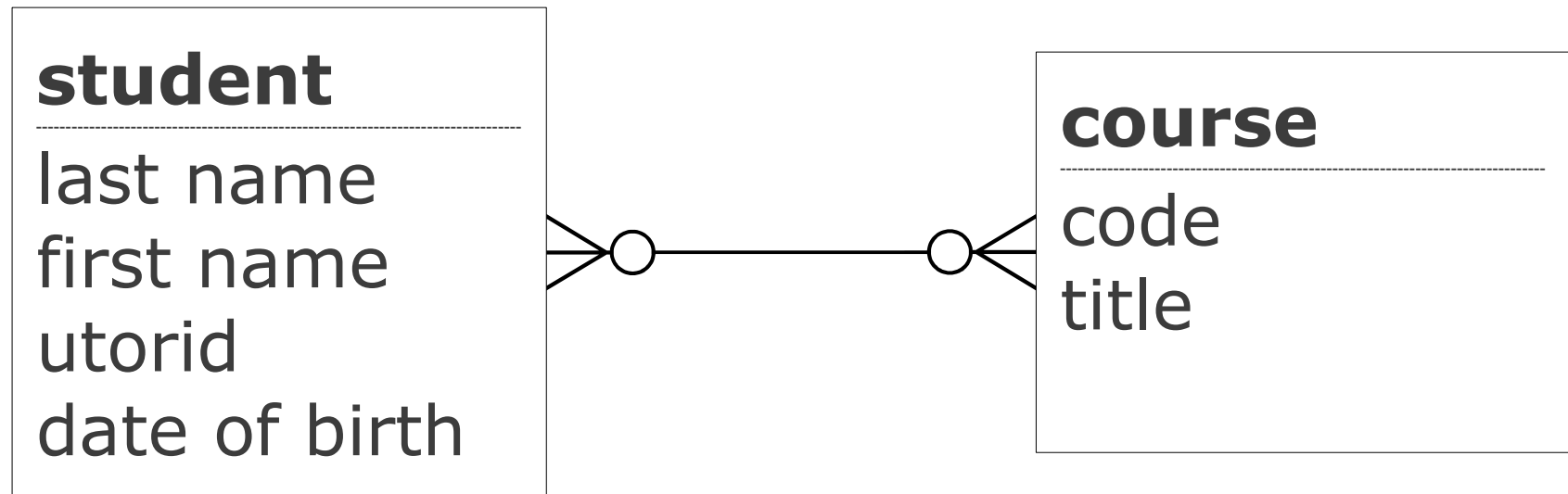
Which relationships are 1:M and
which are M:M?

We! 

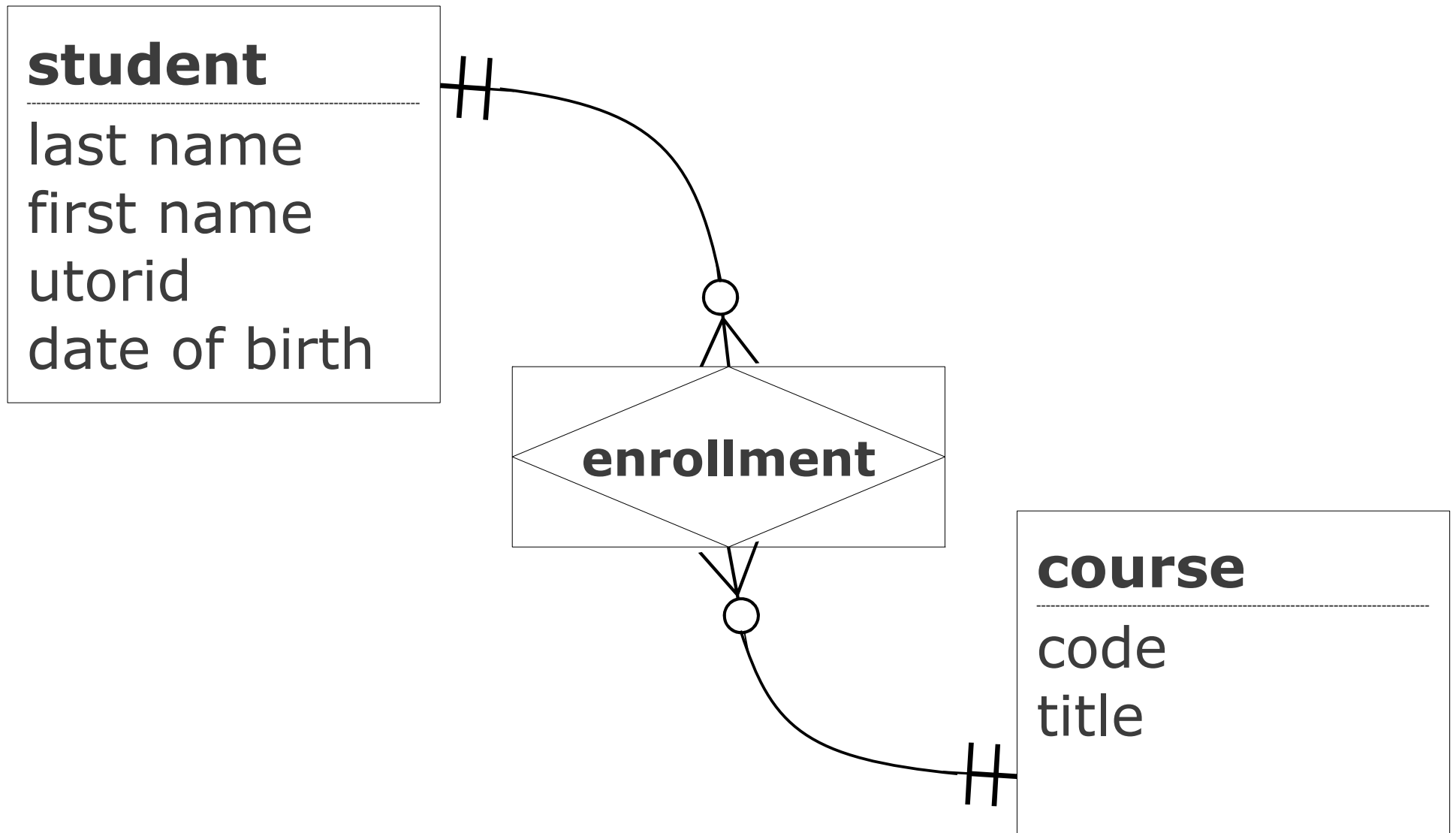
M:M

Because they **cannot**
be represented in a
relational database.

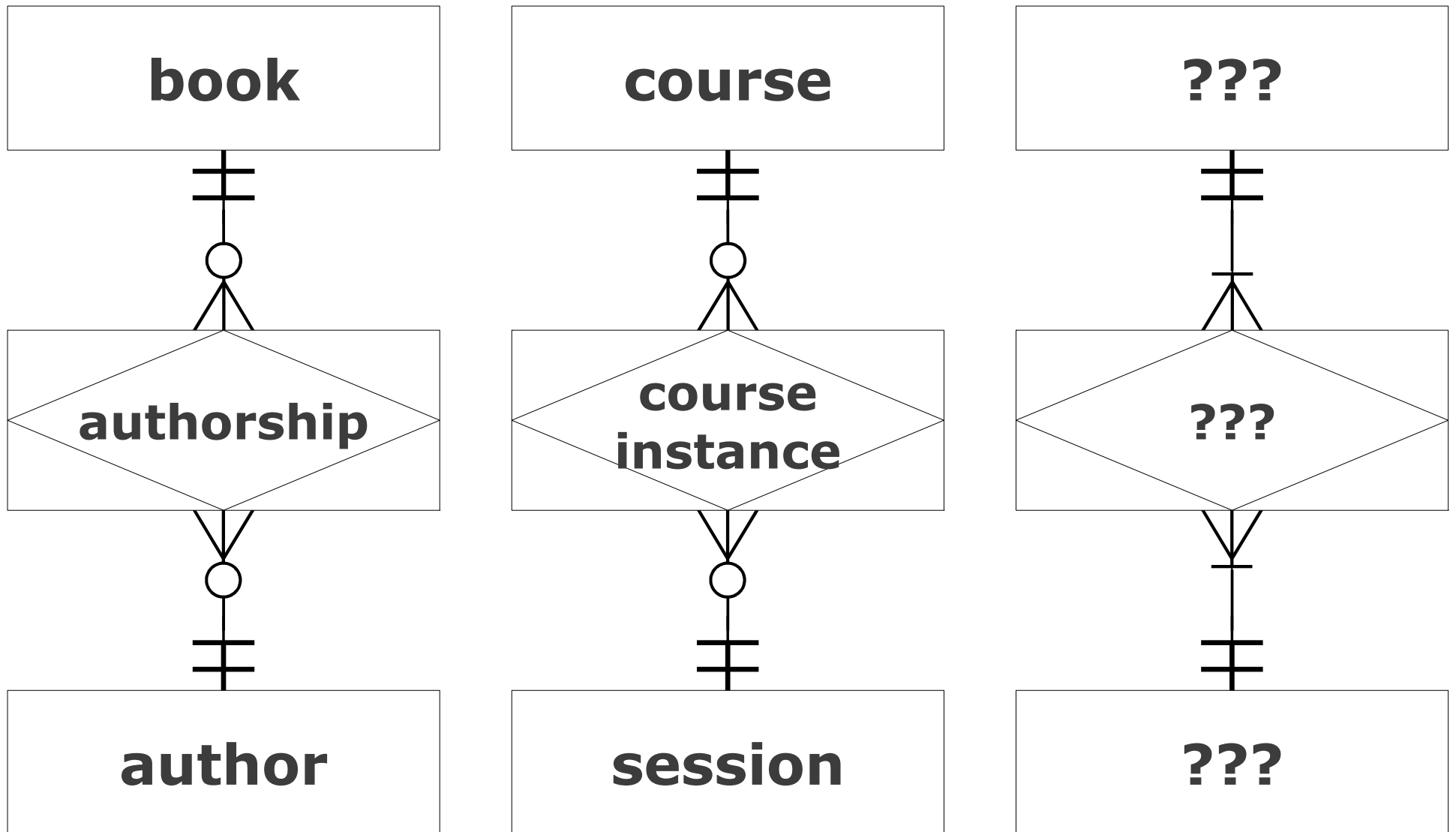
Breaking Up M:M



“Associative Entity”

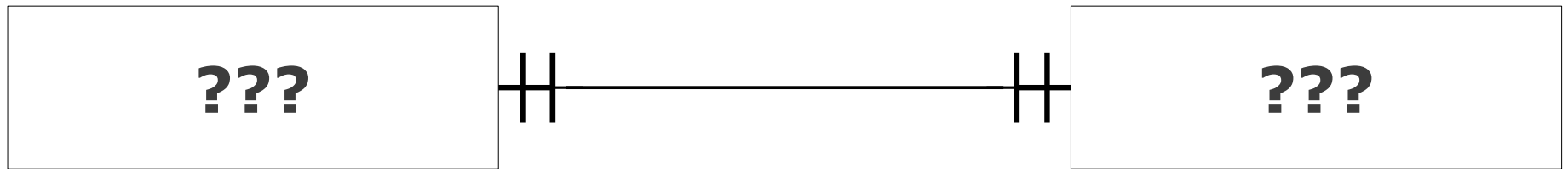


Examples

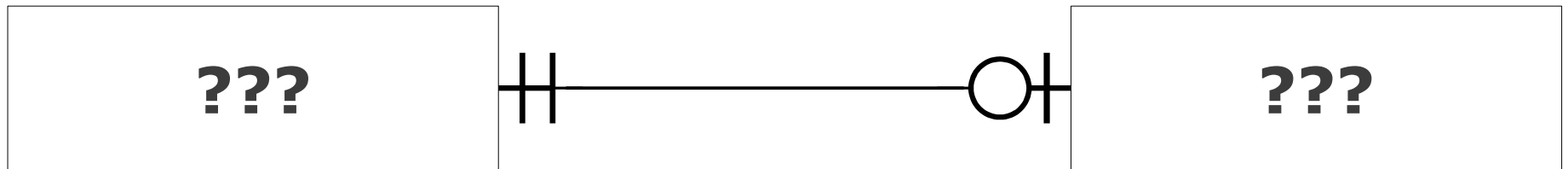


Questions on M:M?

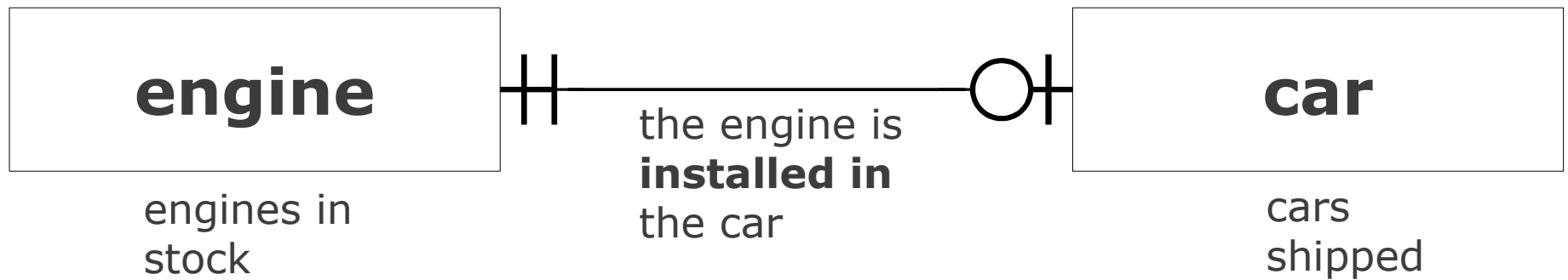
One-to-One



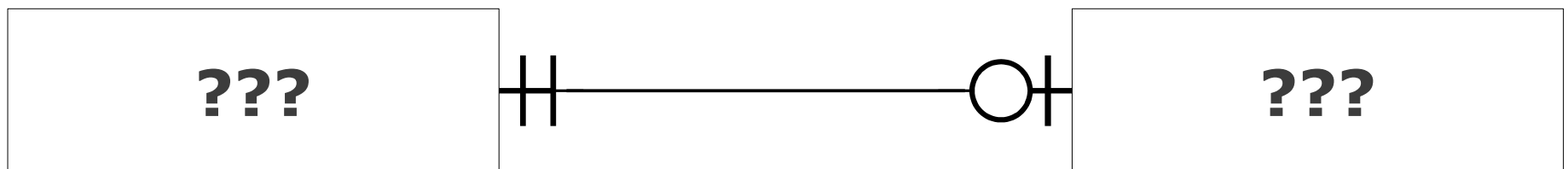
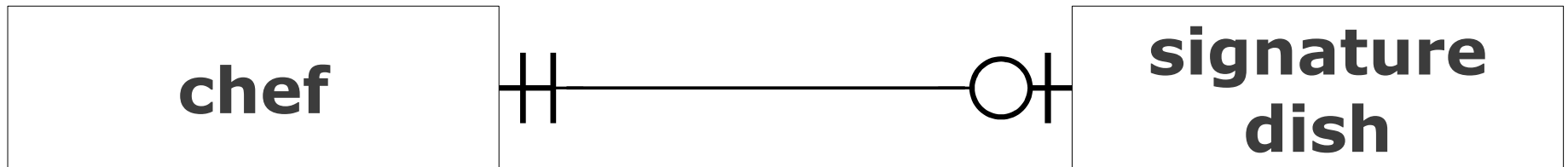
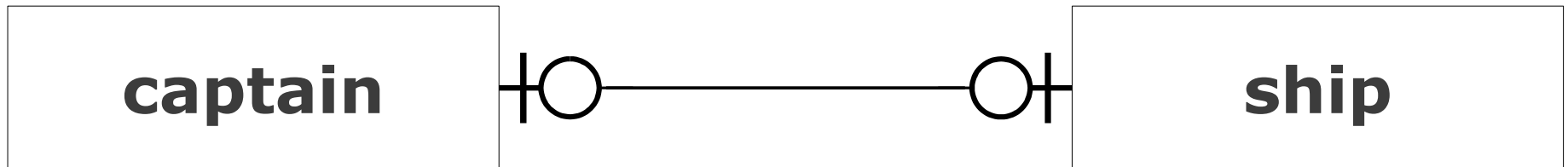
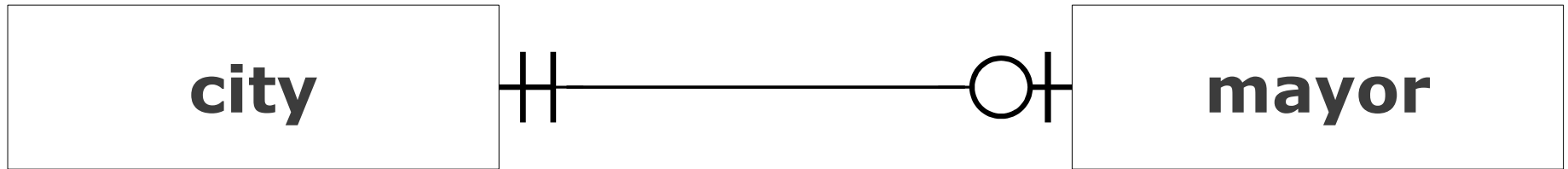
One-to-One



One-to-One



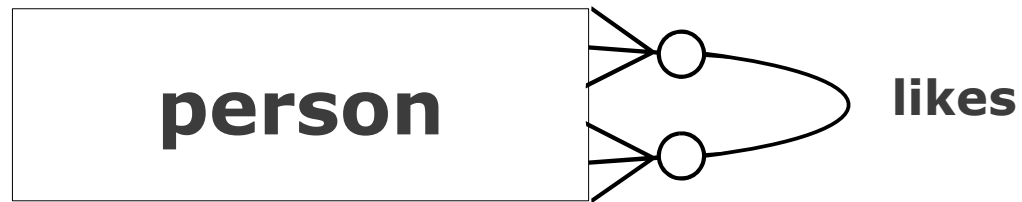
Examples



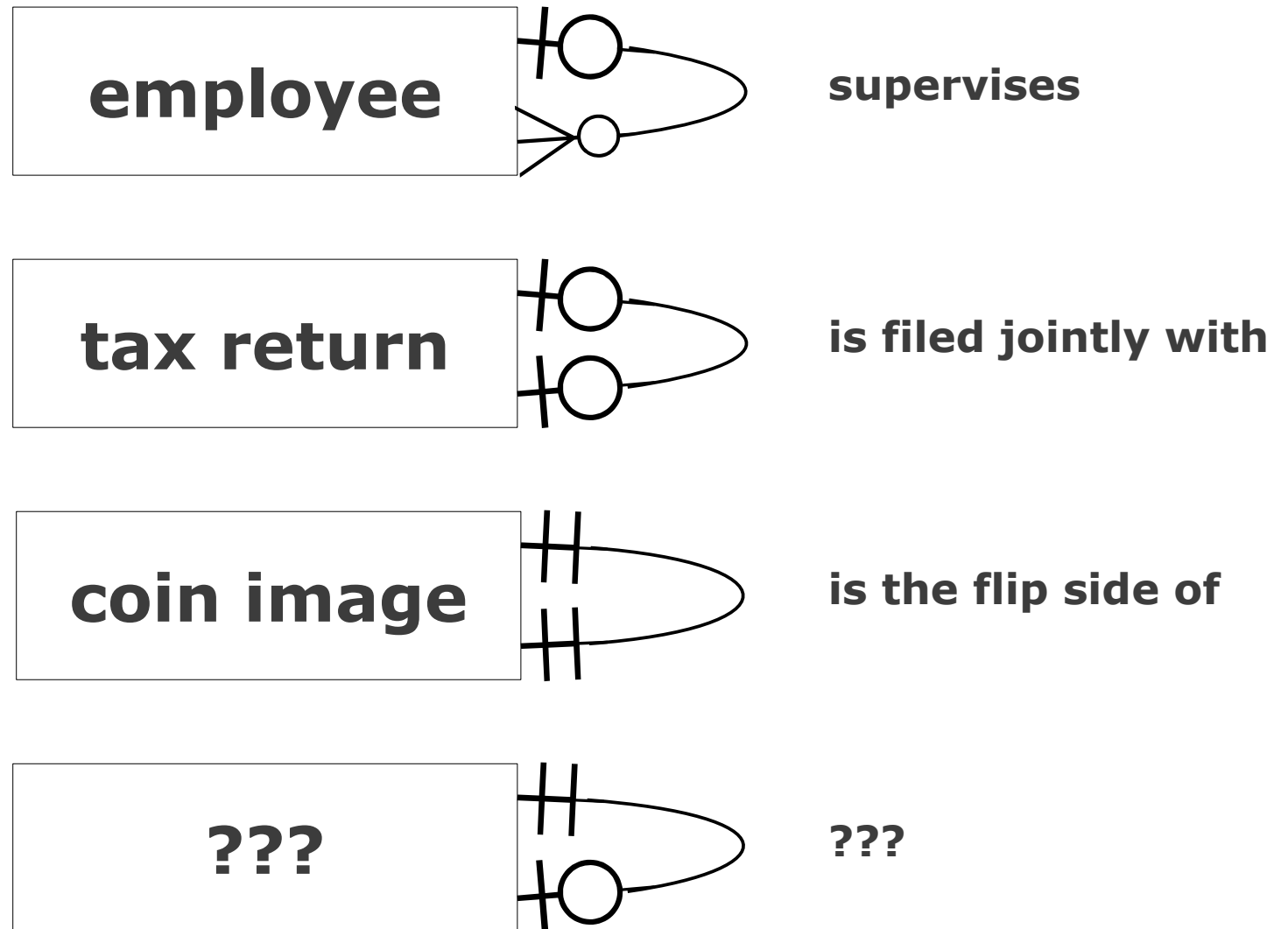
Recursive Relationships



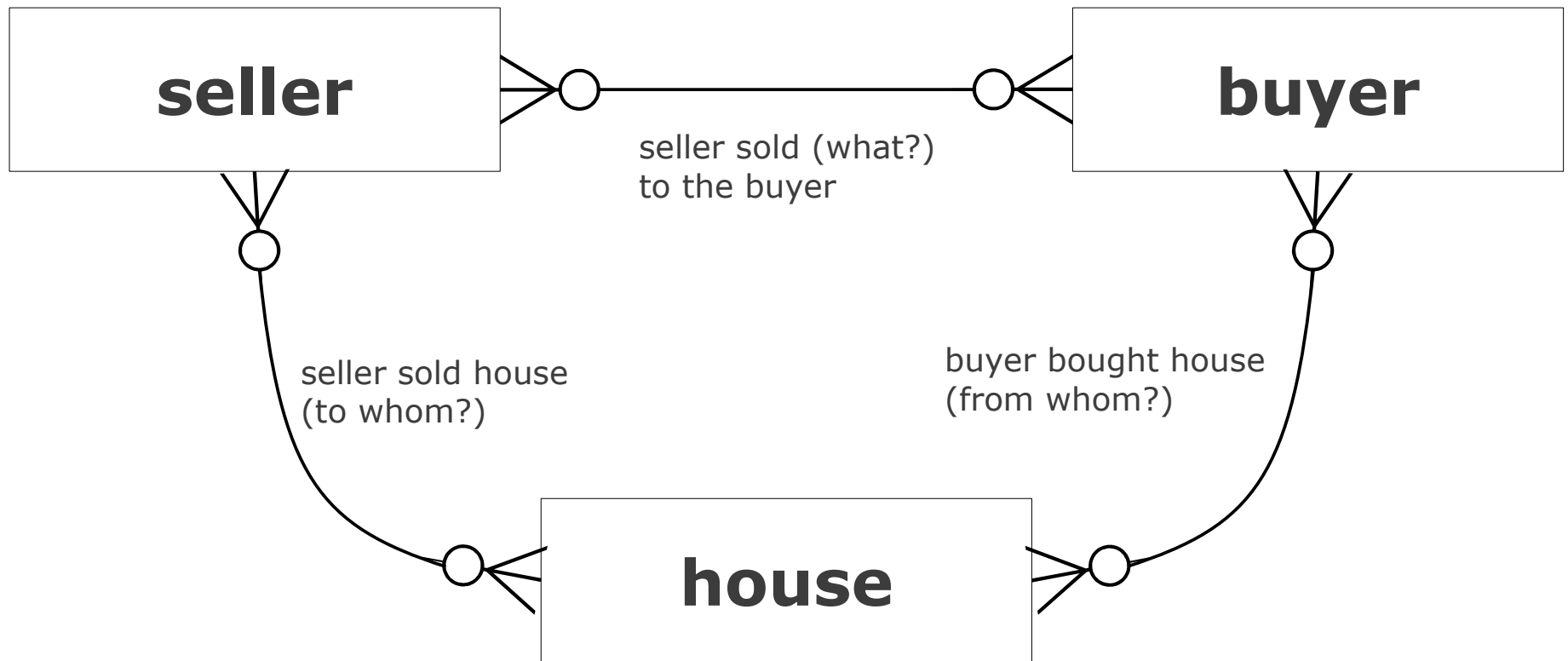
Recursive Relationships



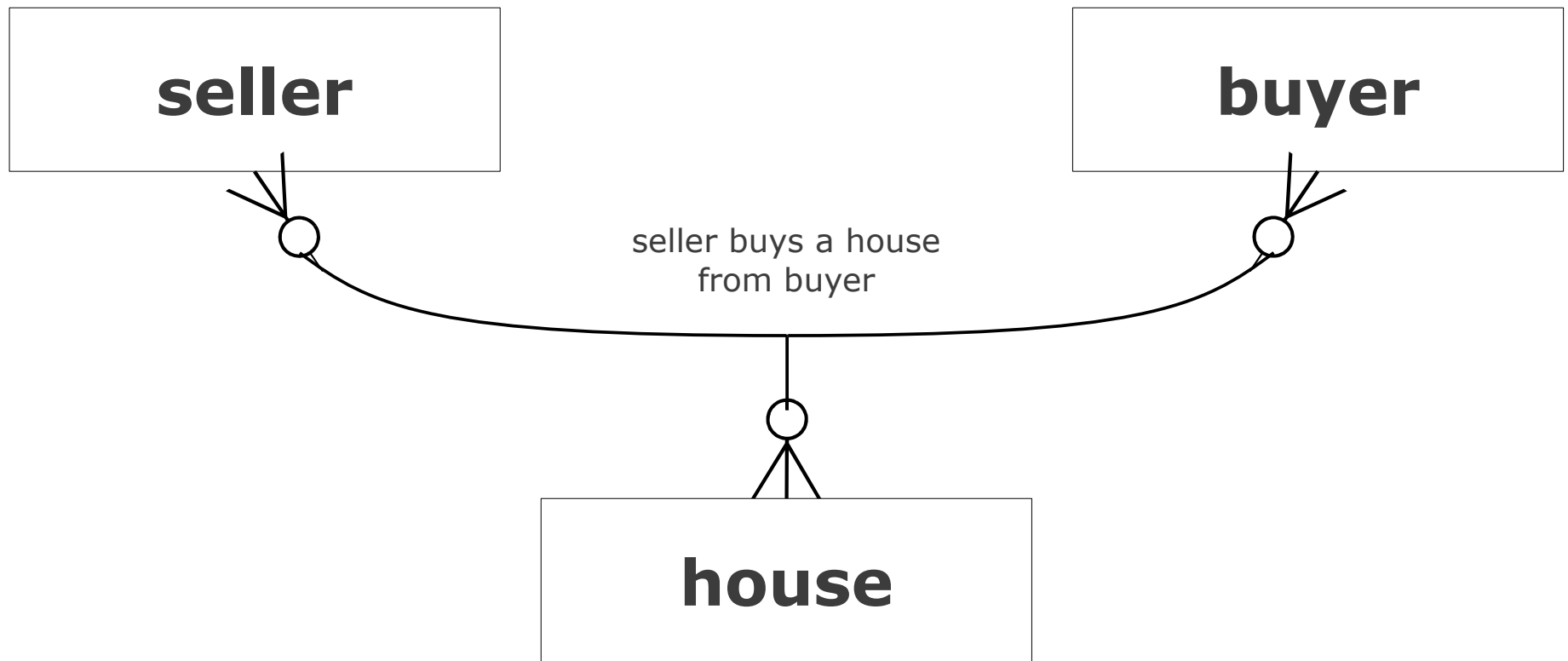
Examples



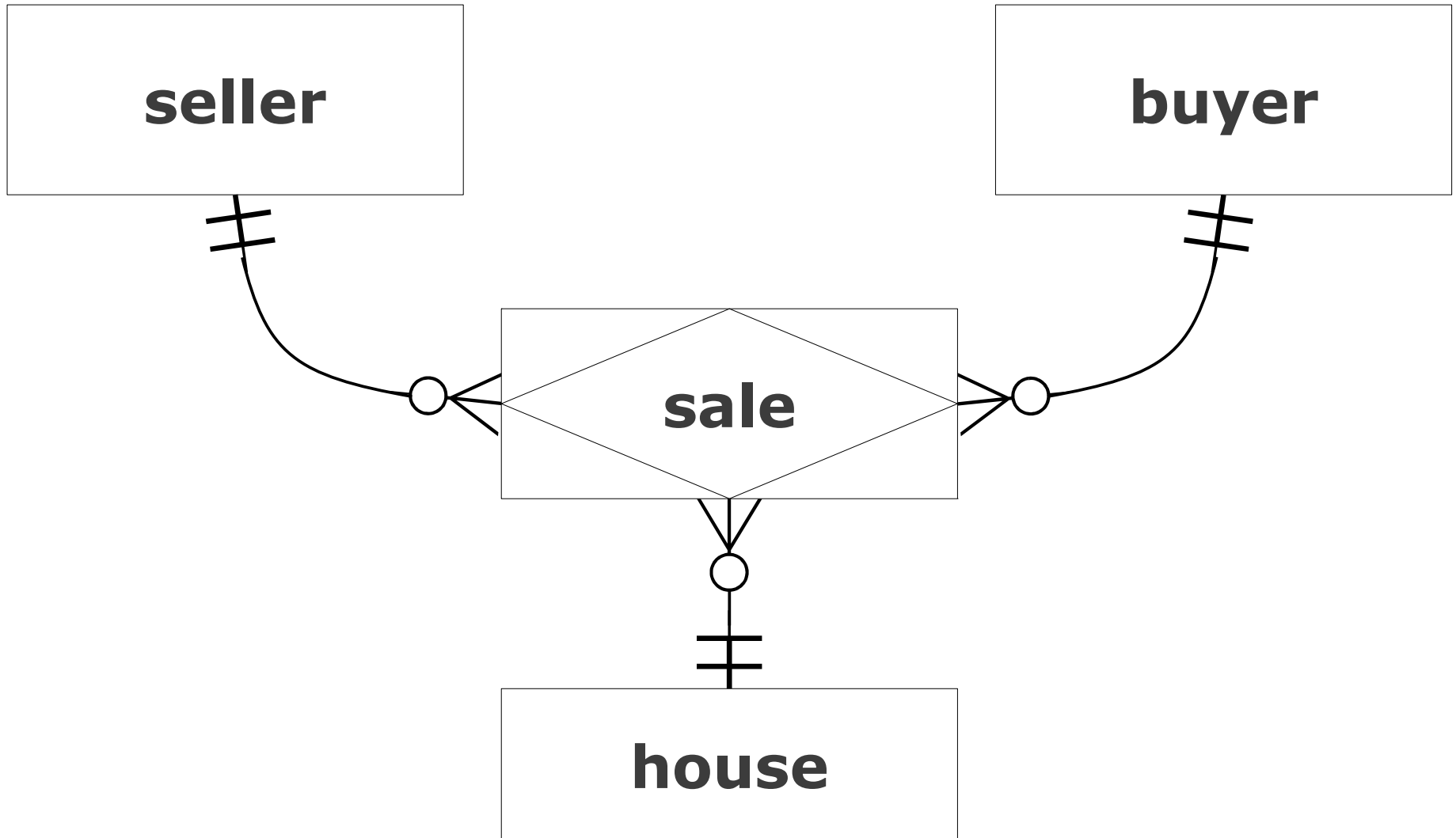
N-nary Relationships



N-nary Relationships



N-nary Relationships

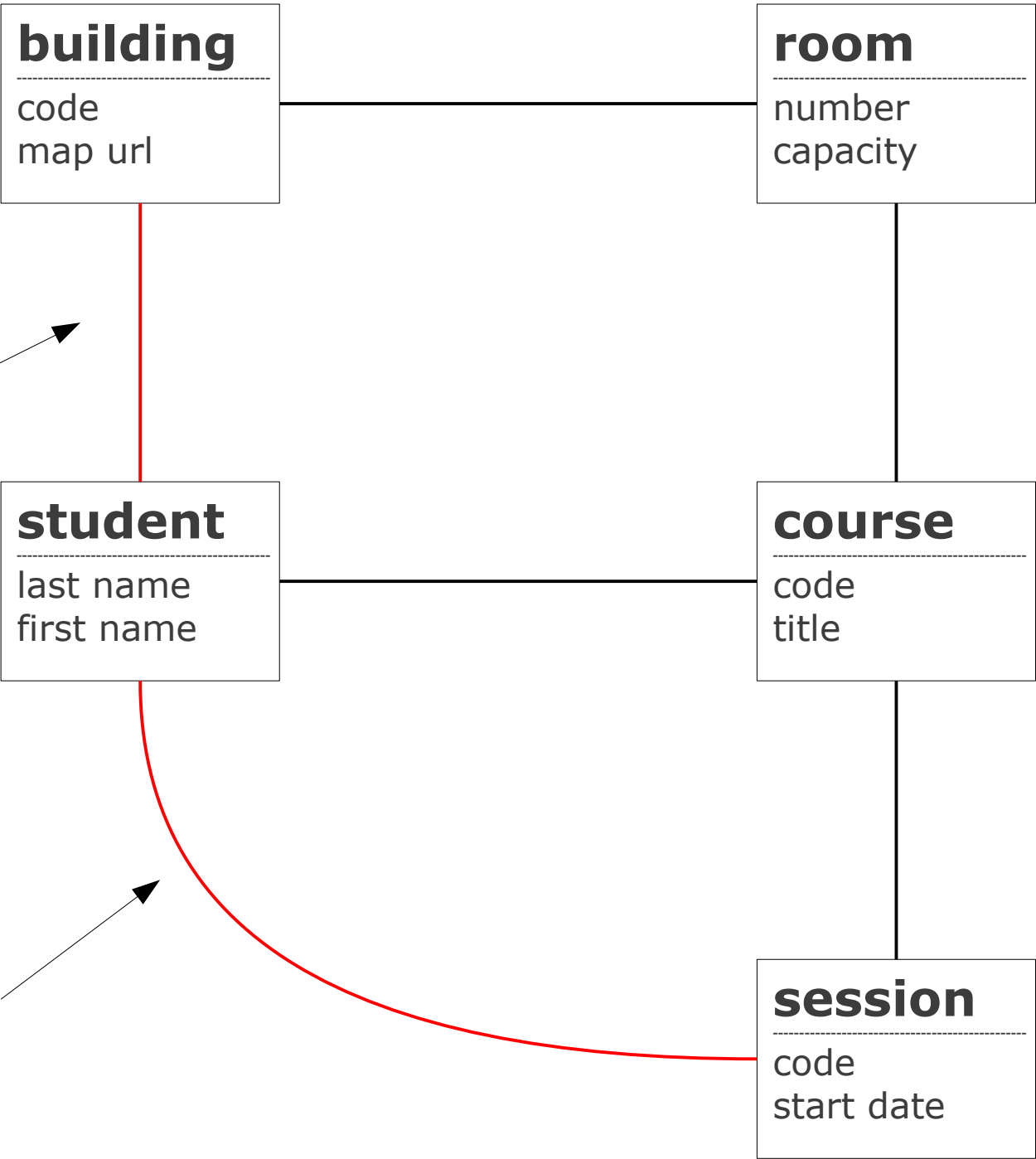


Putting It Together

Options for software:

- OpenOffice Draw
 - Free / open source
 - Available in the lab
 - You can get “Crow’s Foot” templates at <http://www.thinktek.ca/articles/article2.php>
 - Alternatively, do UML notation (“n..m”) by hand
- Microsoft Visio
- Your favorite software

Questions?



building

code
map url

room

number
capacity

student

last name
first name

course

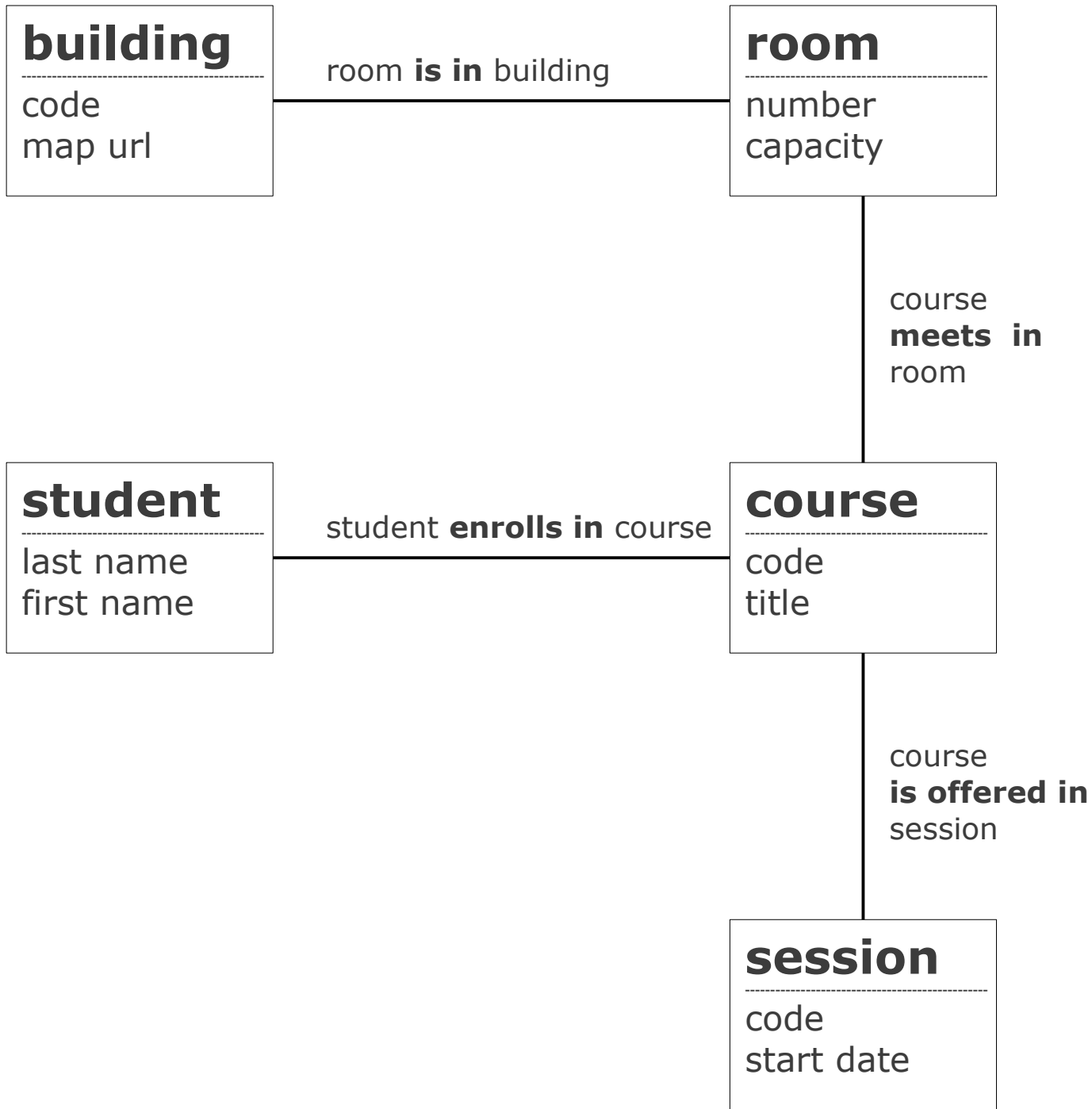
code
title

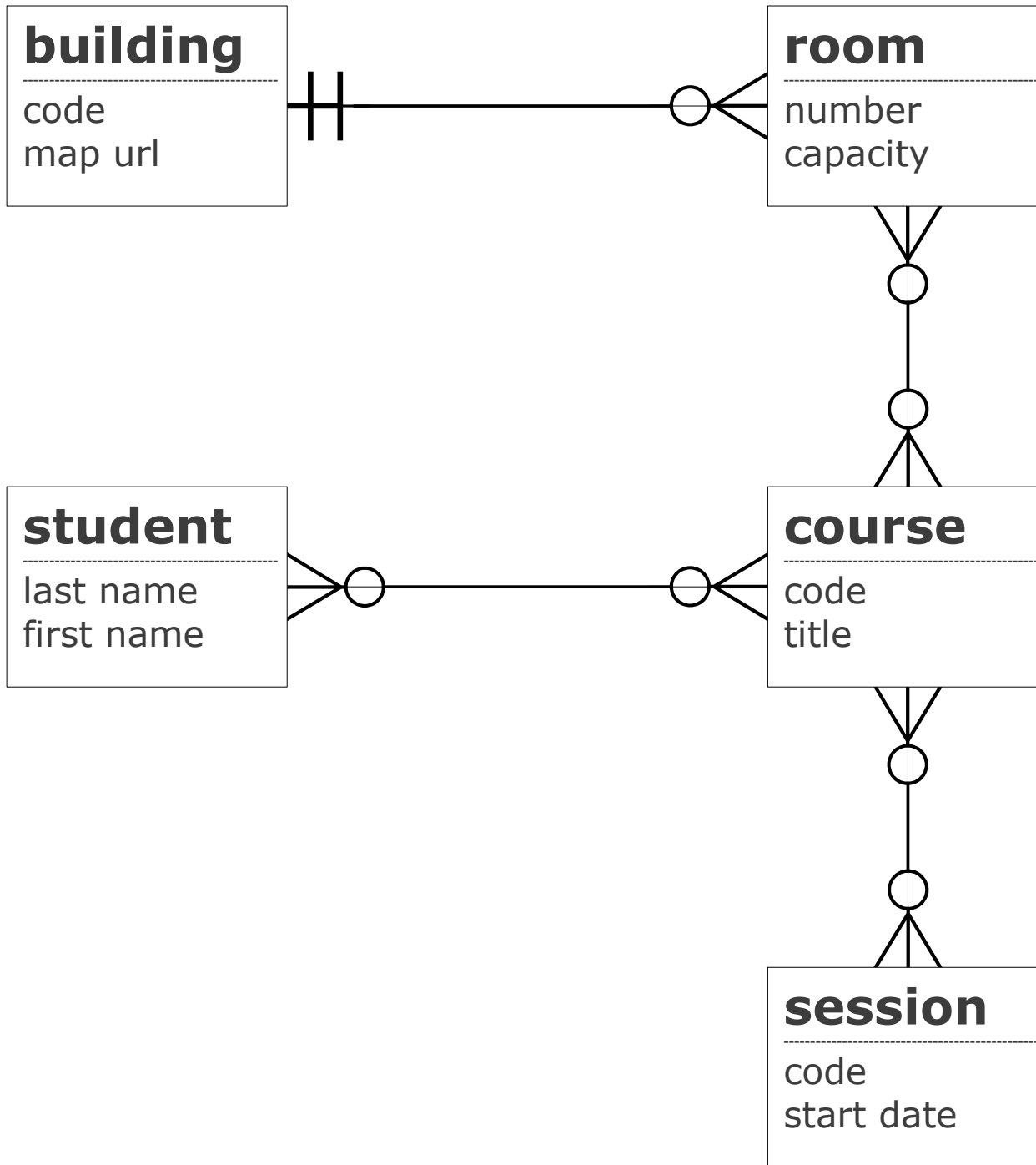
session

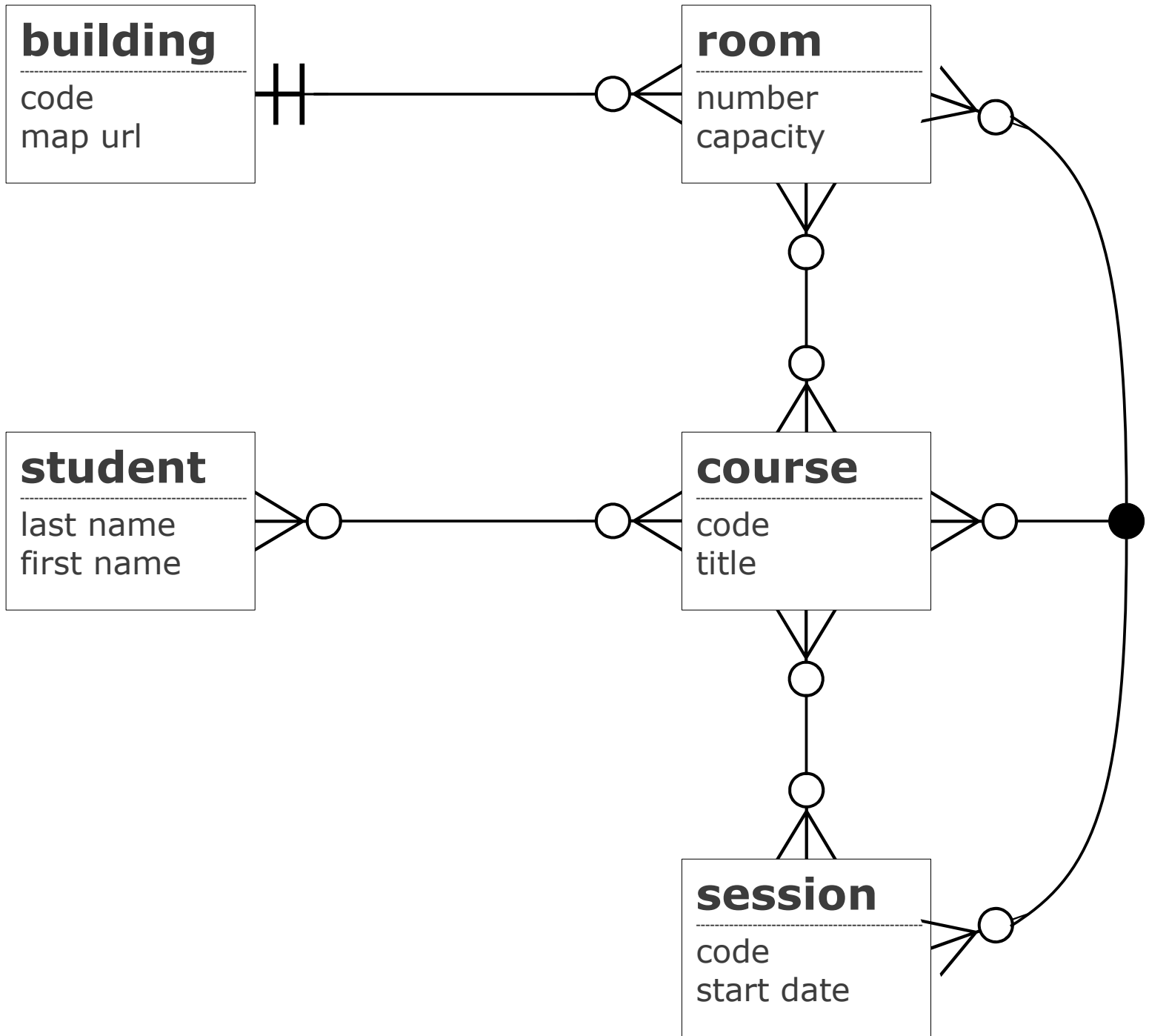
code
start date

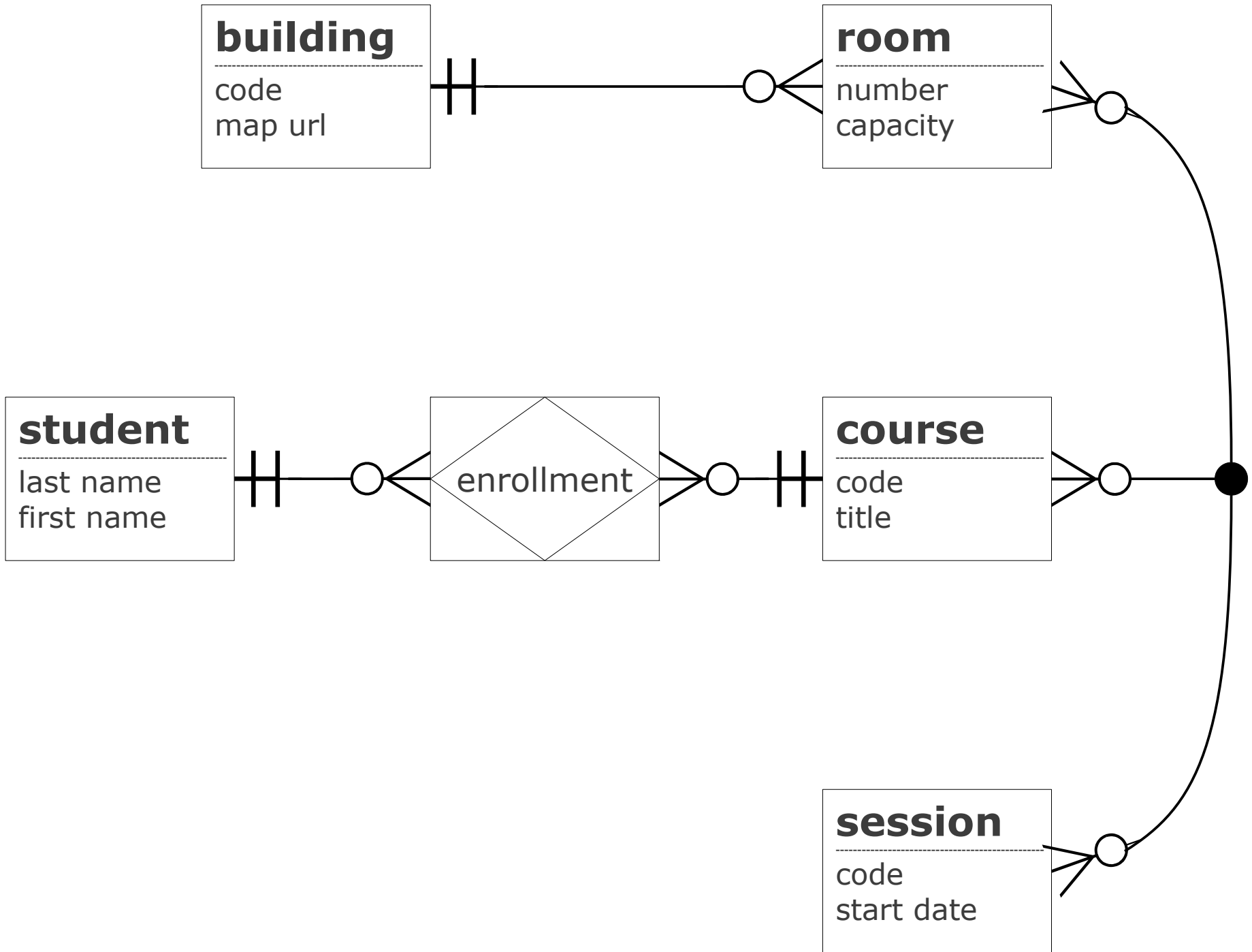
probably
redundant

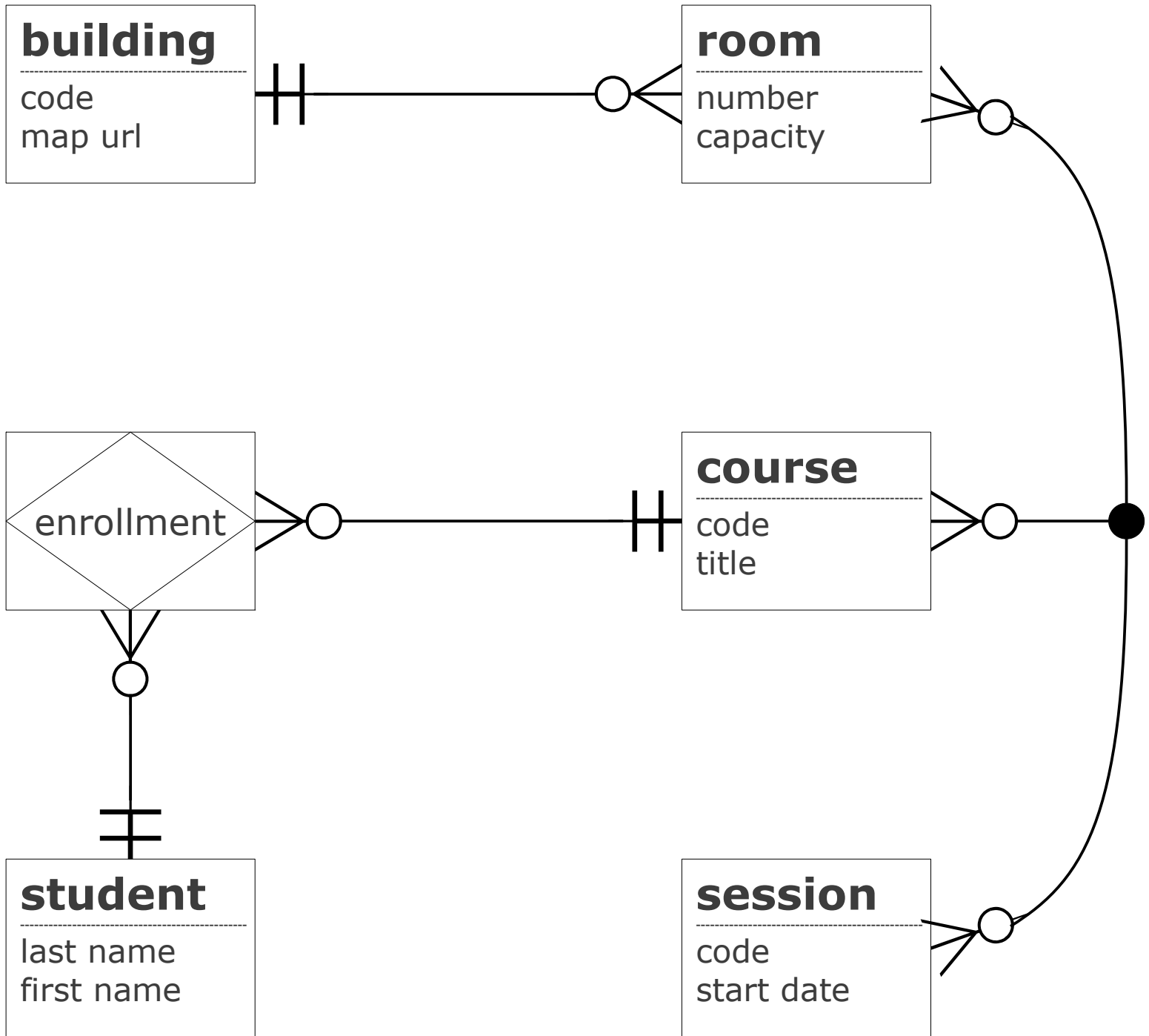
might be
redundant

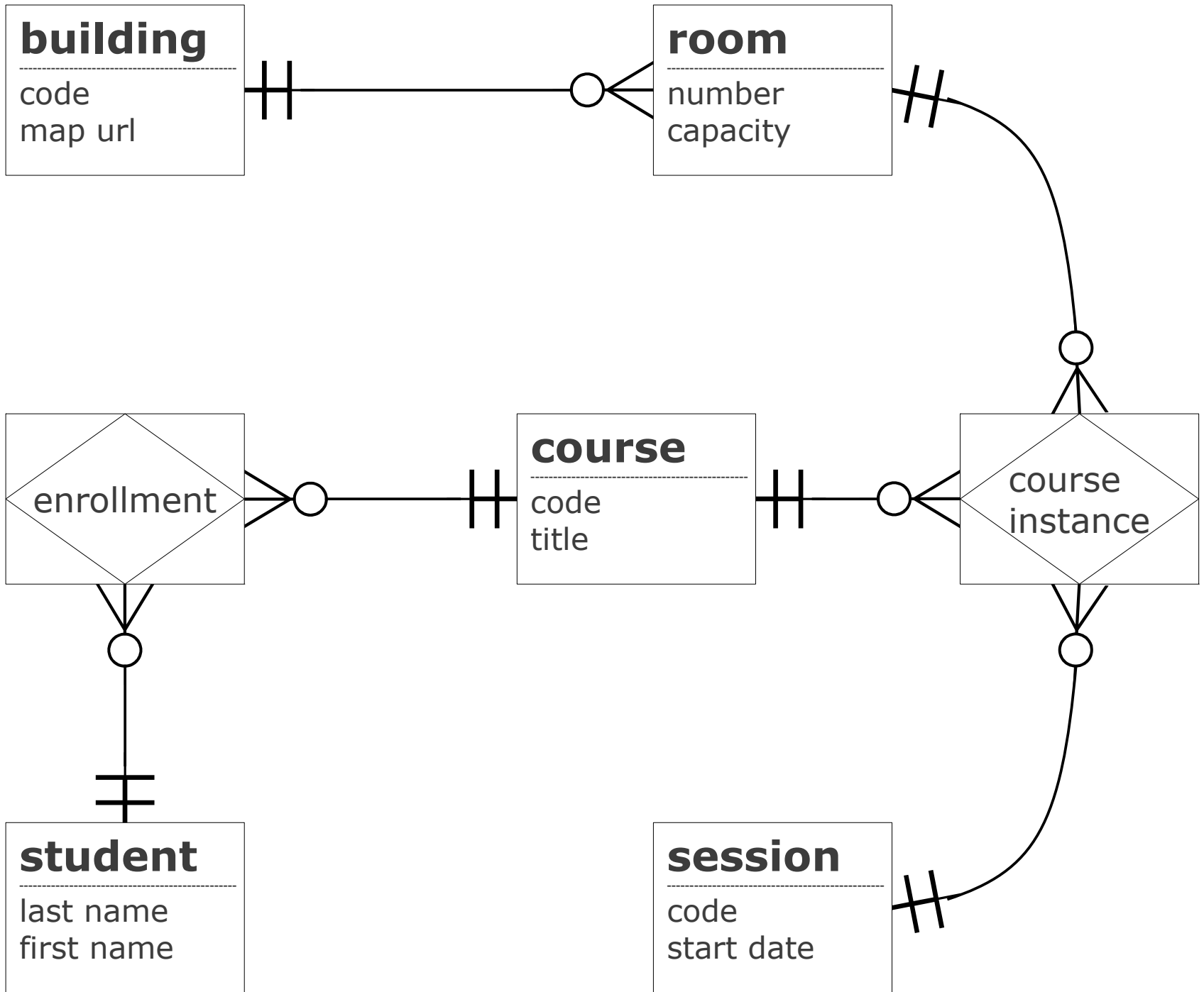


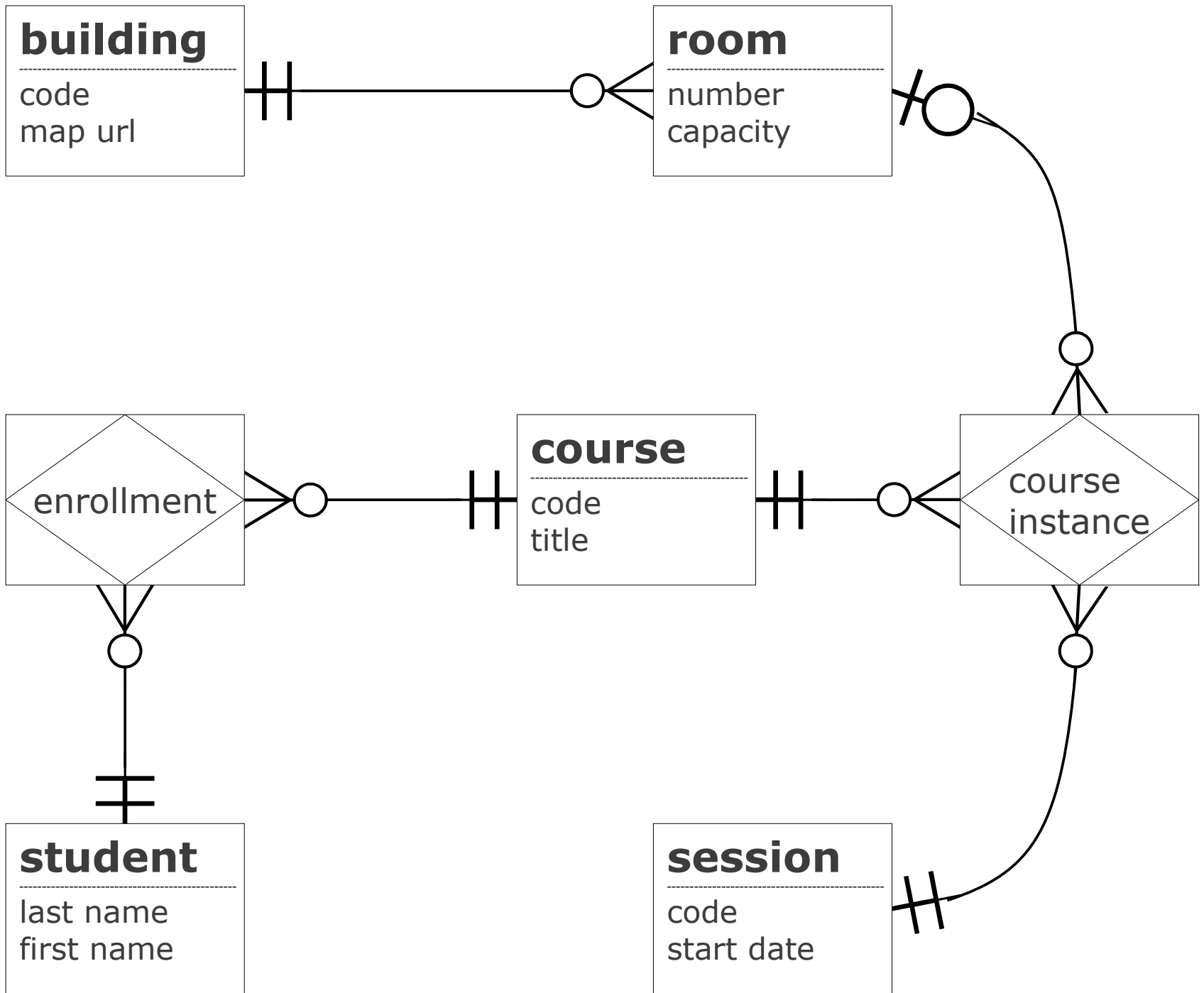


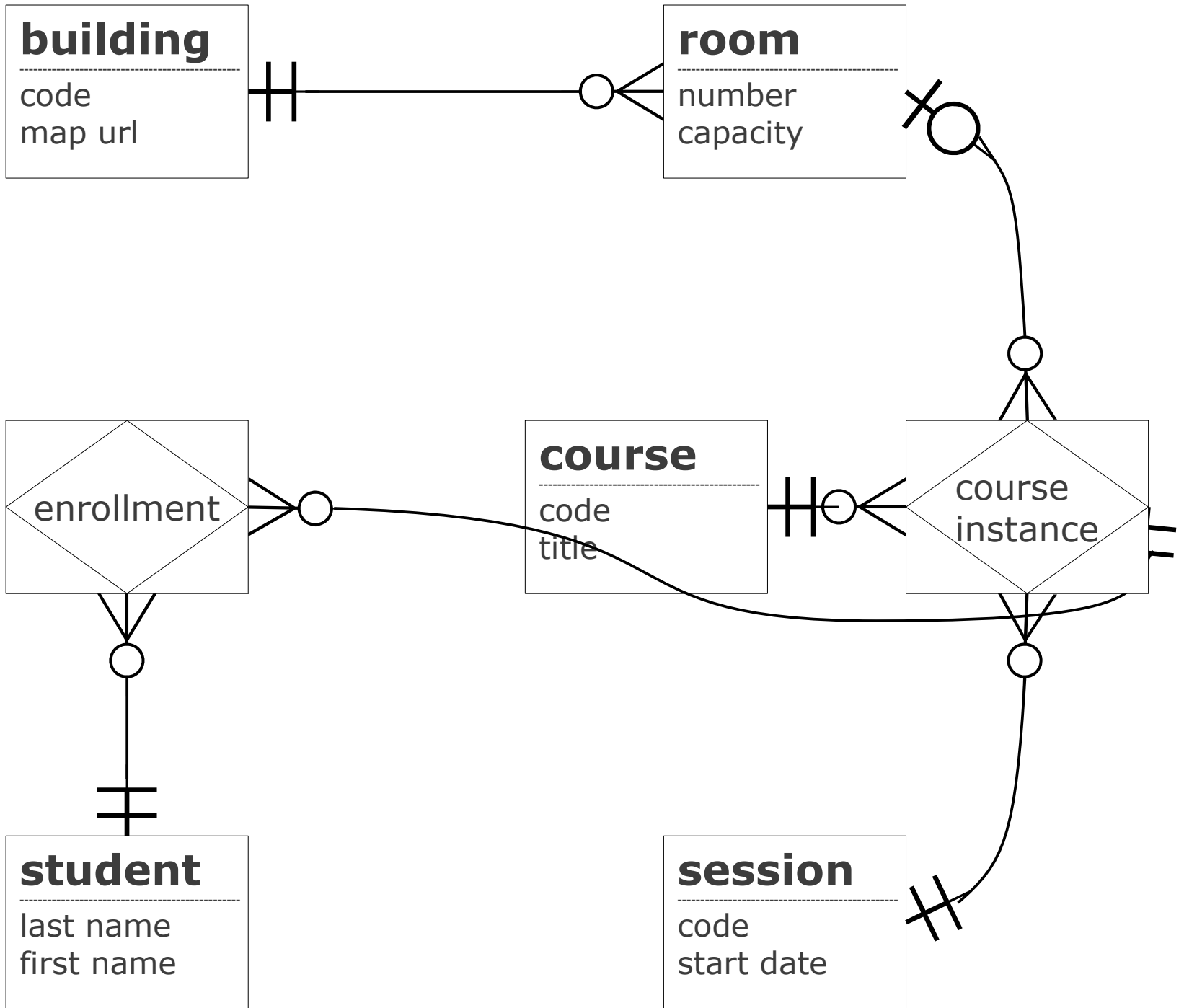


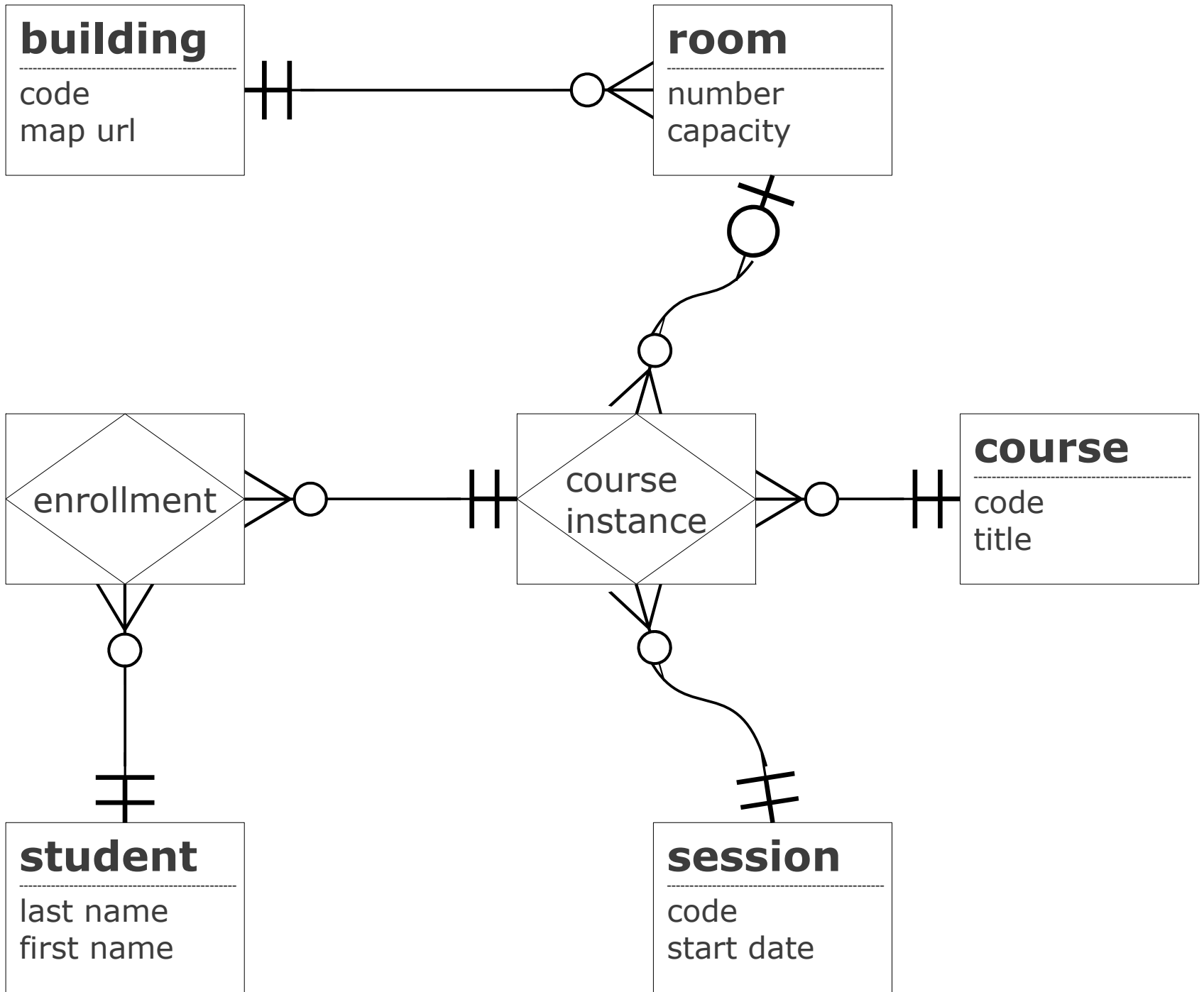


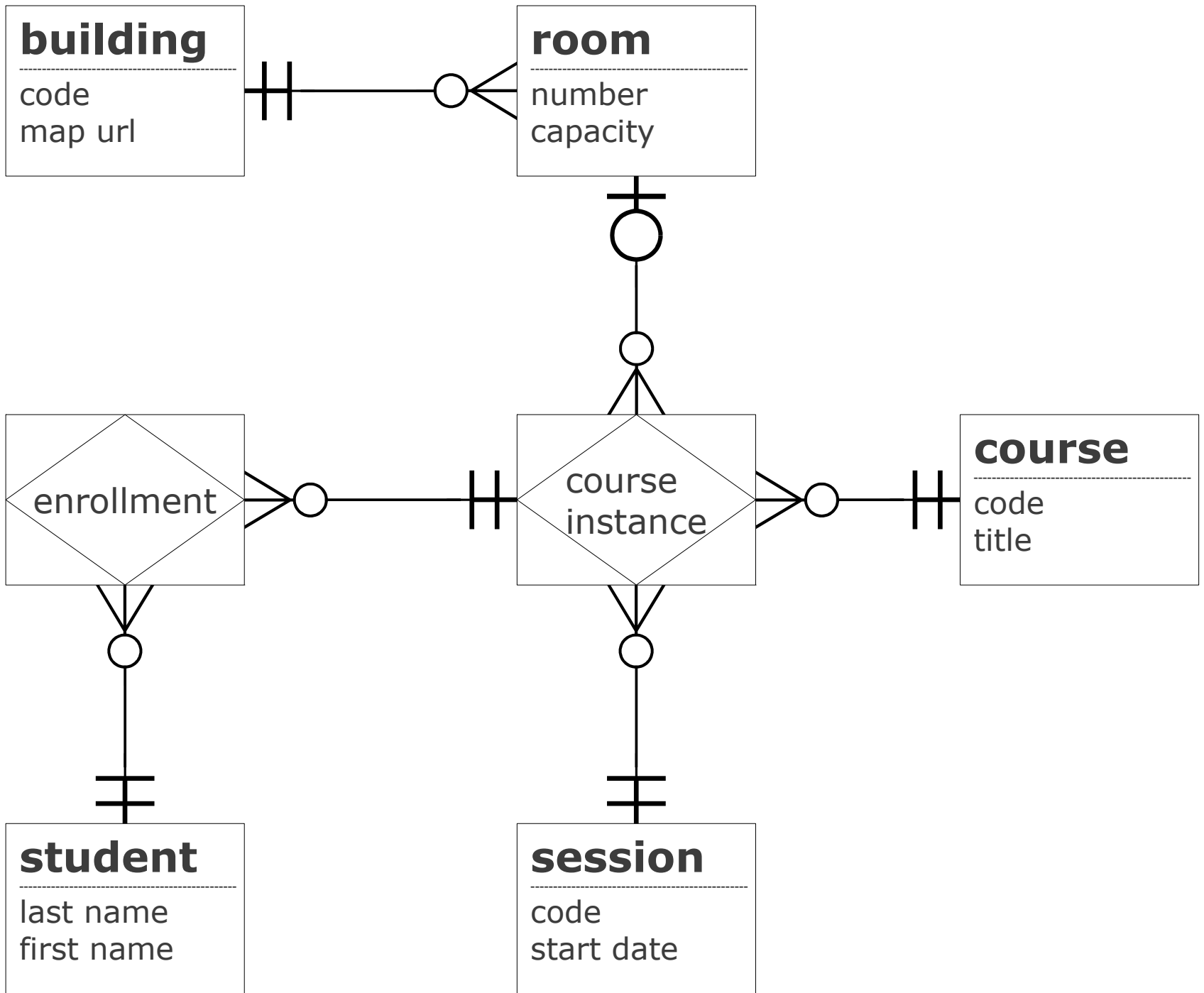


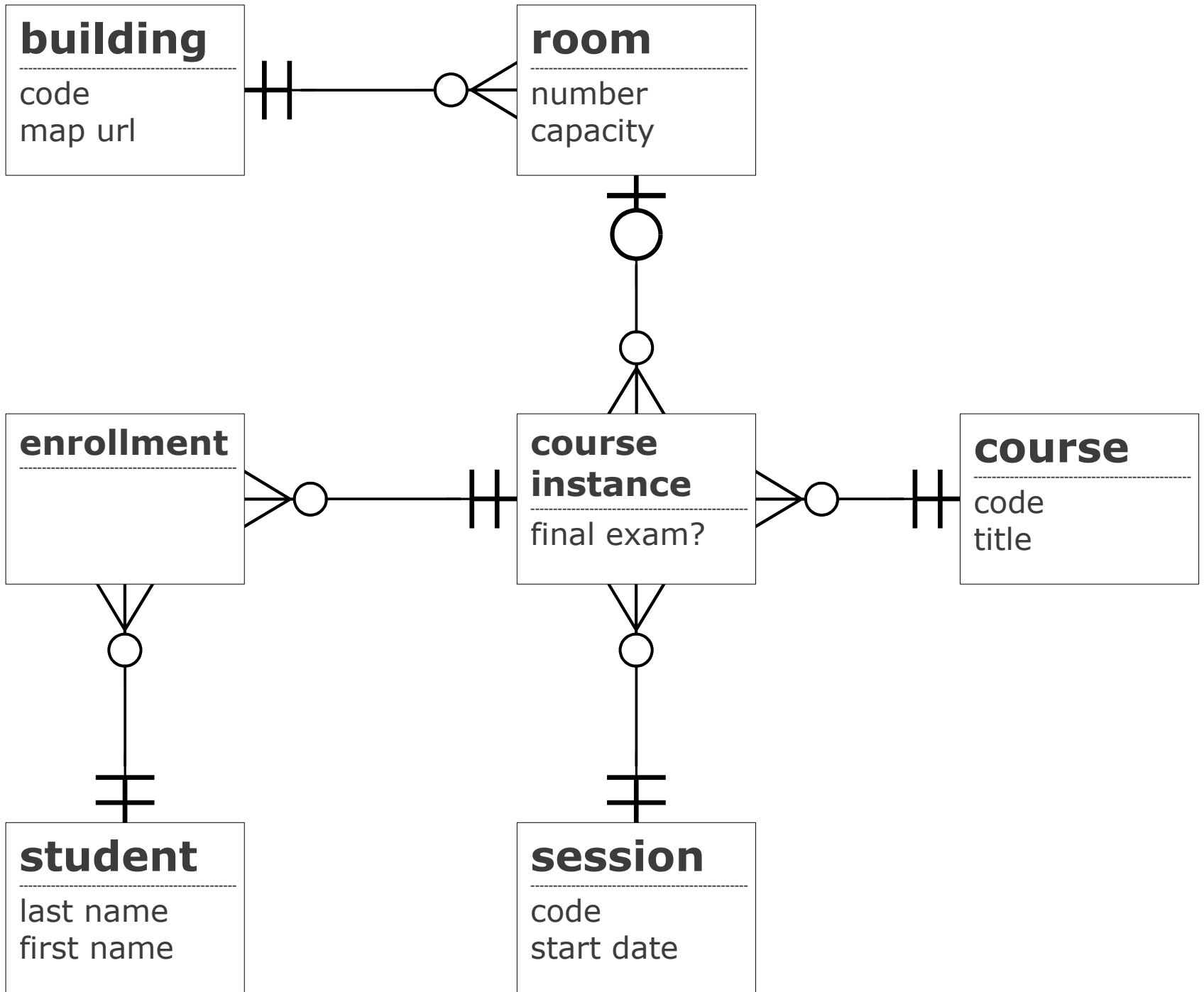


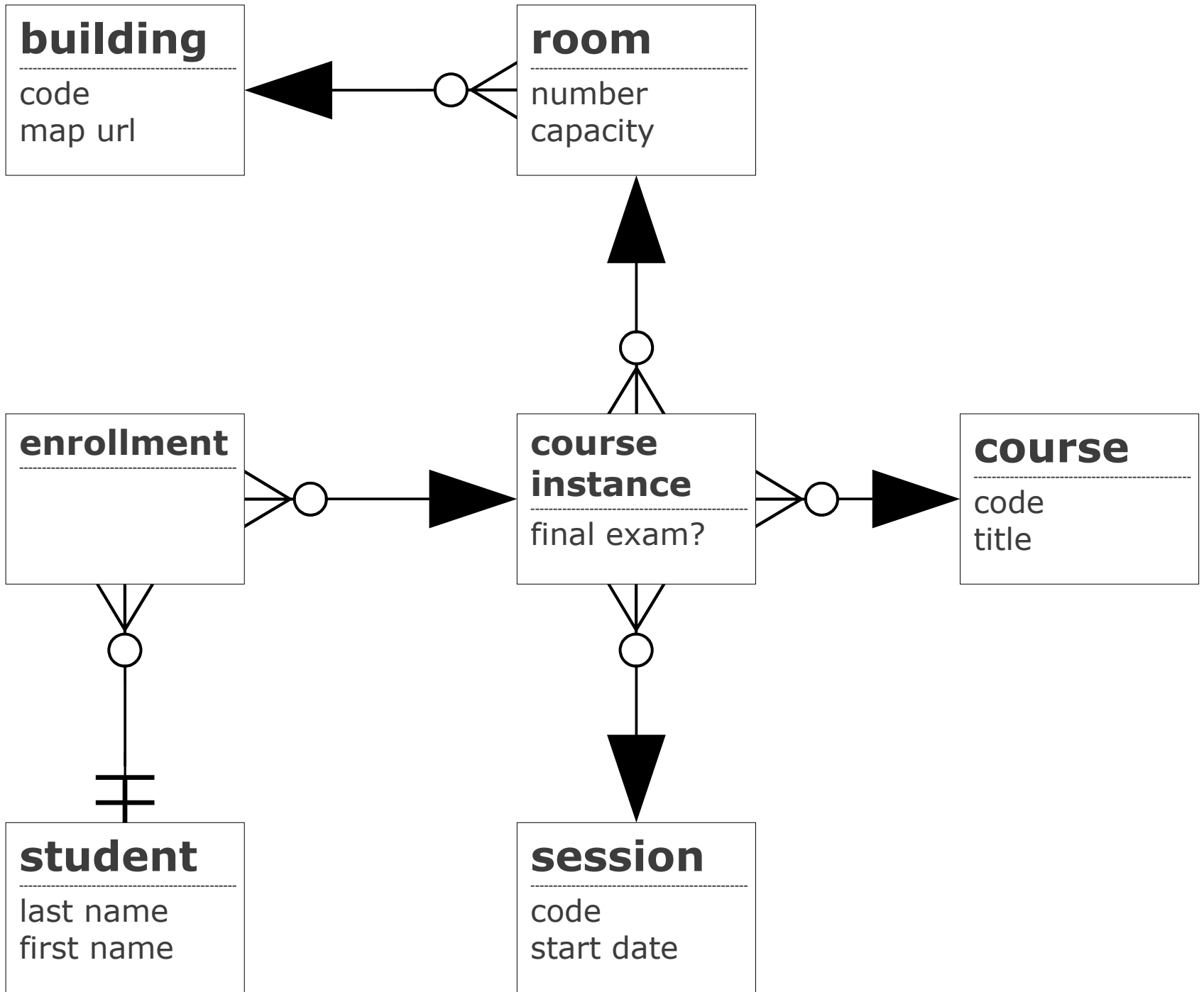












Questions?

