ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Informatik 2

Übungblatt 11

Relations

What is a relation?

- Relational data model: tables (relations)
- **Relation** *R* defined as subset of cartesian product
  $R \subseteq D_1 \times ... \times D_n$
  with *n* domains
- An element of *R* is called **tuple**
- Relations are also called **tables**
  - Columns are called **attributes**
  - Columns have to be named uniquely
  - Rows of a table correspond to **instances** of relations
- **Relation schemas** provided with following pattern:
  `phonebook: {[Name: string, Adresse: string, Tel: integer]}`
- **Key**: minimal set of attributes that uniquely identify tuples

From ER to relational schema

What does the ER model contain?

A) Entity types

B) Relationship types

both of which are mapped to **relations** in the relational model

A) Relational represenation of entity types

- Attributes from ER model
- Key underlined
- No generalisation

From ER to relational

B) Relational representation of relationships

1. A relation for each relationship

$$R : \{[\underbrace{A_{11}, \ldots, A_{1k_1}}_{\text{Schlüssel von } E_1}, \ldots, \underbrace{A_{n1}, \ldots, A_{nk_n}}_{\text{Schlüssel von } E_n}, \underbrace{A_1^R, \ldots, A_{k_R}^R}_{\text{Attribute von } R}]\}$$

- Keys of all entities (foreign keys)
- Attributes of the relationship
- Potentially necessary to rename if name clashes
- Careful with weak entities

2. Determine keys

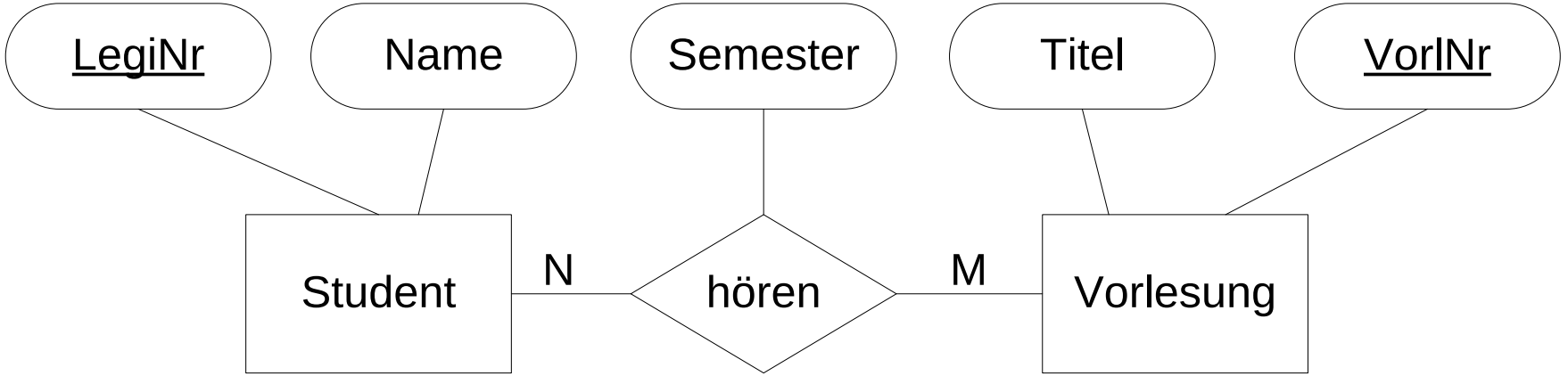
- with regards to functionalities (1:N, N:M etc.)

3. Refinement of the schema

- merge relations with the same keys (and only such relations!)

From ER to relational

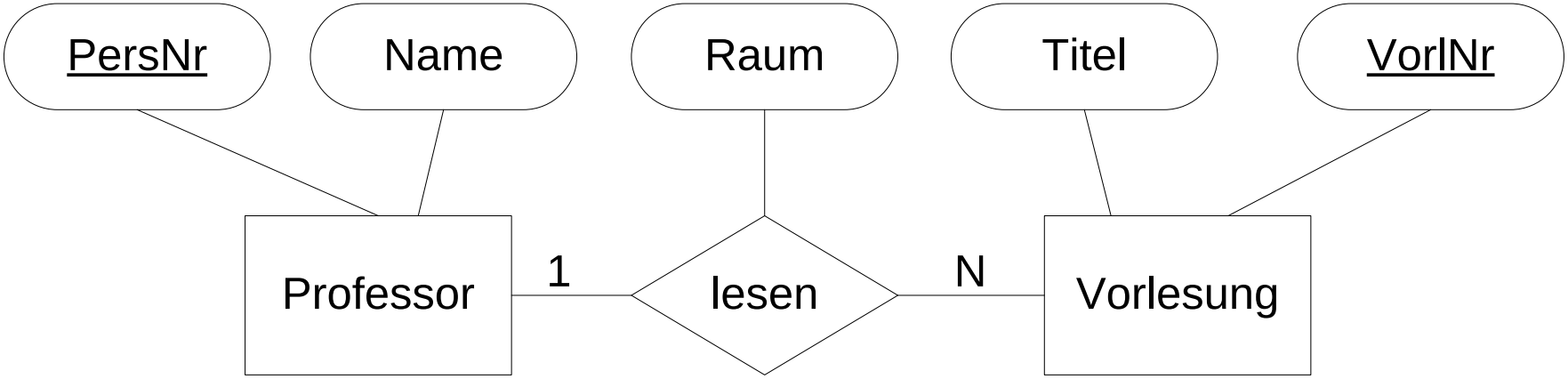
Example (N:M)



- **Student** {[LegiNr, Name]}
- **Vorlesung** {[Titel, VorlNr]}
- **hören** {[LegiNr, VorlNr, Semester]}

From ER to relational

Beispiel (N:1)



- **Professor** {[PersNr, Name]}
- **Vorlesung** {[Titel, VorlNr]}
- **lesen** {[PersNr, VorlNr, Raum]}

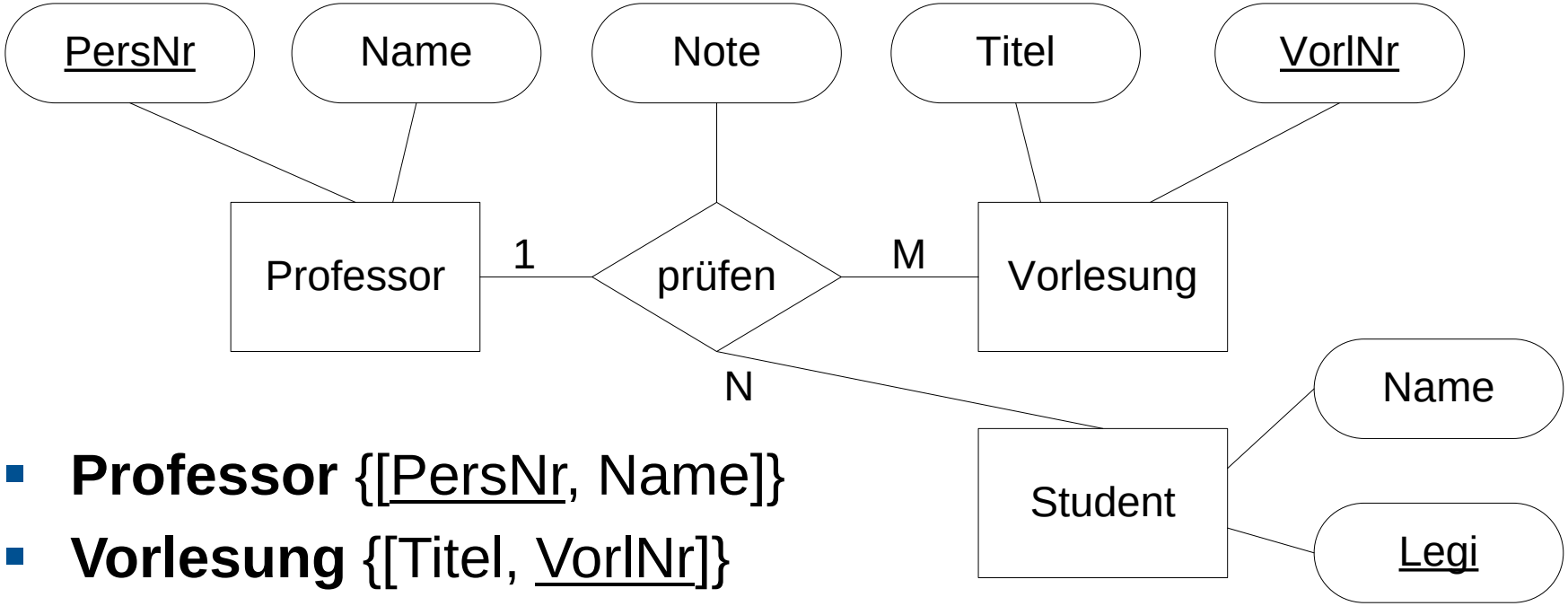
} **Vorlesung** {[Titel, VorlNr, Raum, gelesenVon]}

Functional dependency

`lesen: Vorlesungen -> Professoren`

From ER to relational

Example (ternary relation)



- **Professor** {[PersNr, Name]}
- **Vorlesung** {[Titel, VorlNr]}
- **Student** {[Legi, Name]}
- **prüfen** {[PersNr, VorlNr, Legi, Note]}

```
prüfen: Student x Vorlesung -> Professor
```

Relations

Tasks today:

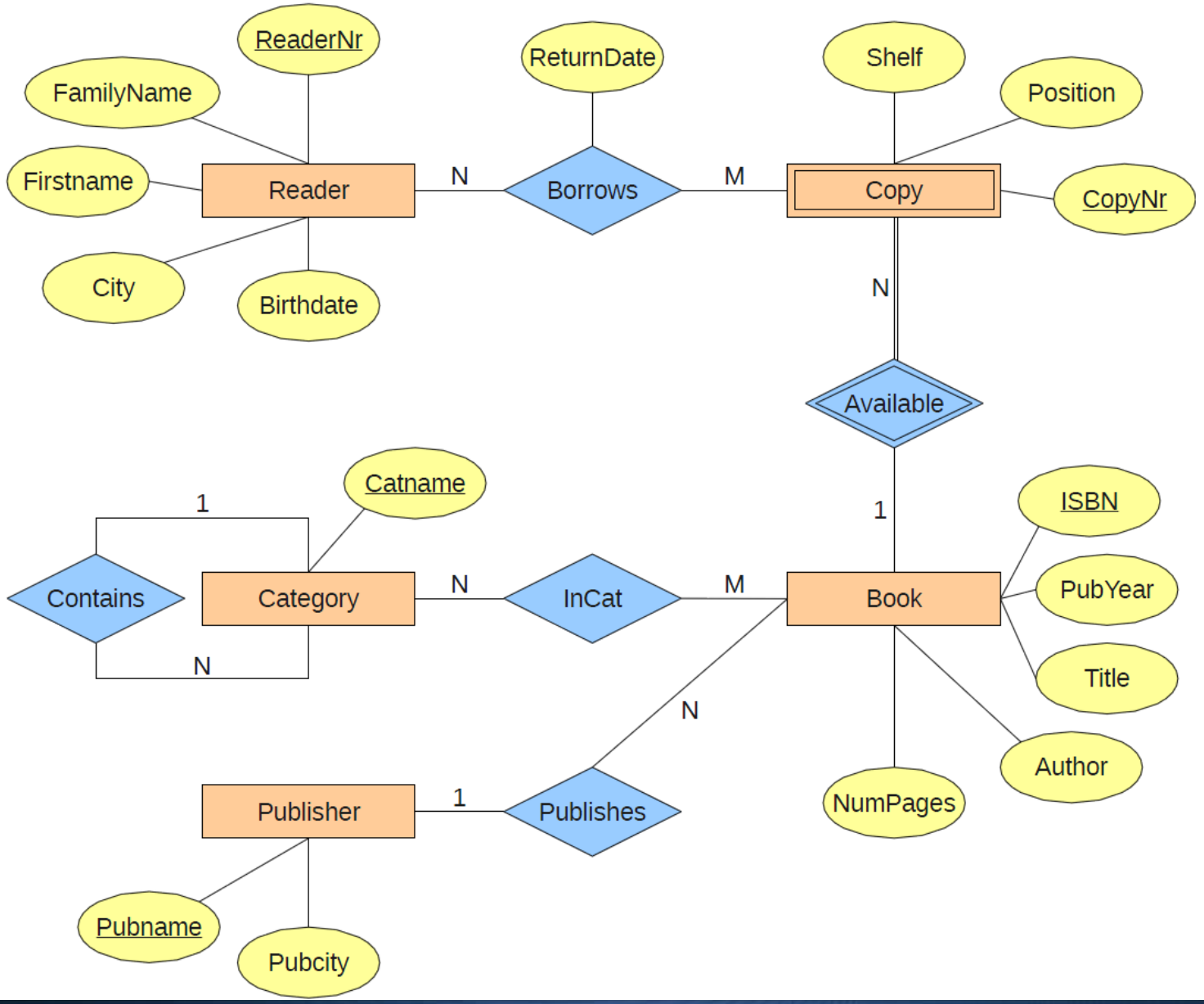
- Given: Entity Relationship Diagramm
- wanted: Relational schema

Important for exam

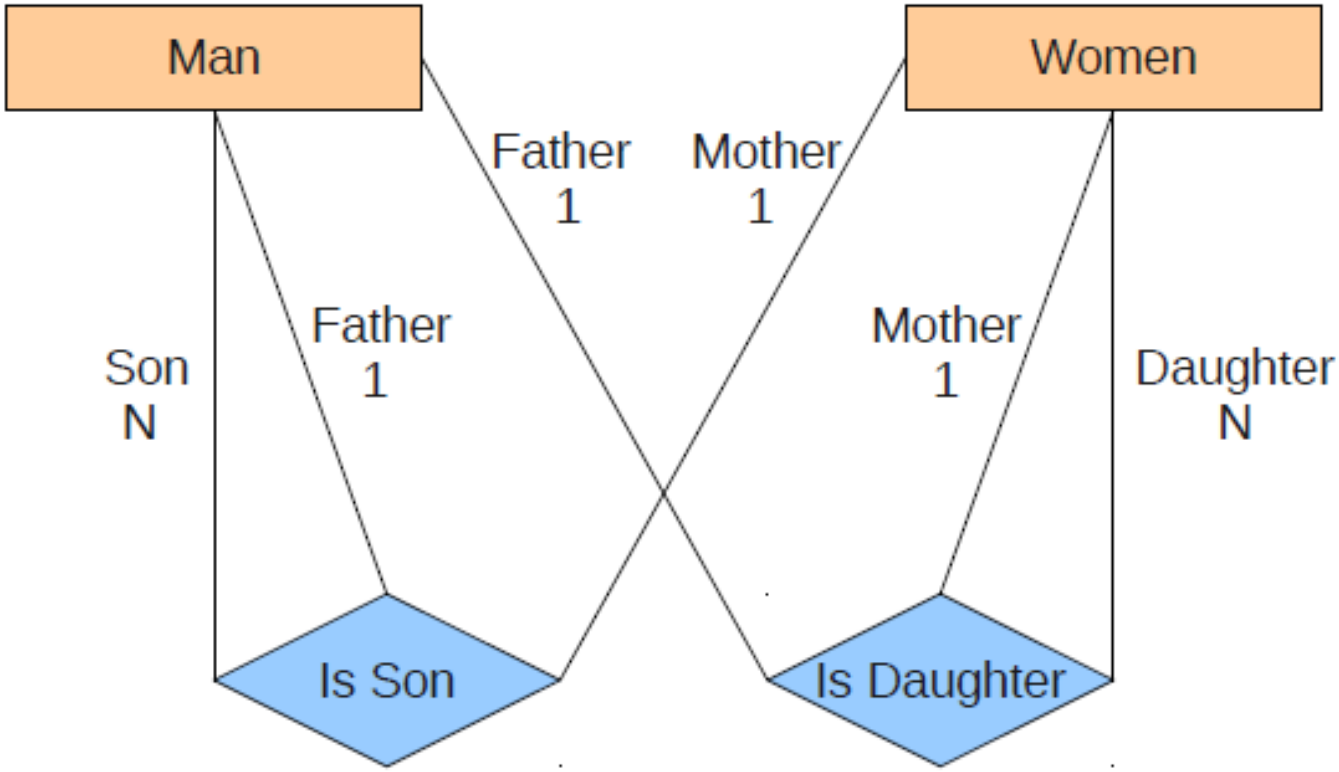
- given ER diagram -> create relational schema
- set keys and attributes correctly

This week's exercises

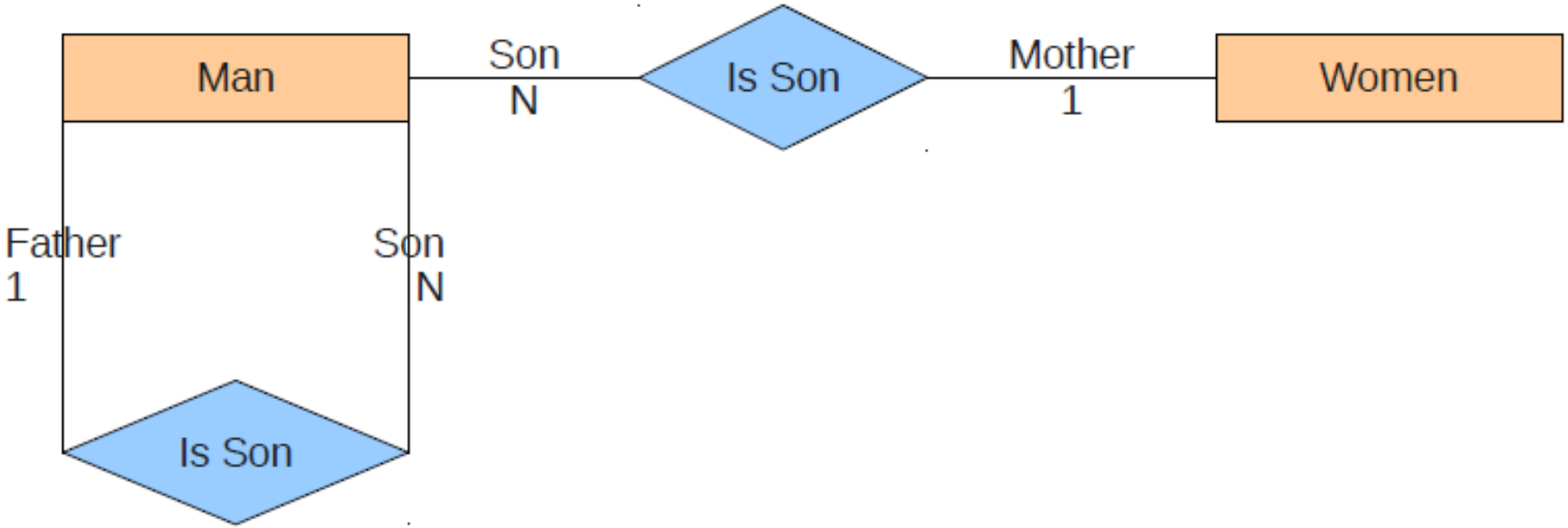
Assignment 11.1.1



Assignment 11.1.2: Abstammung

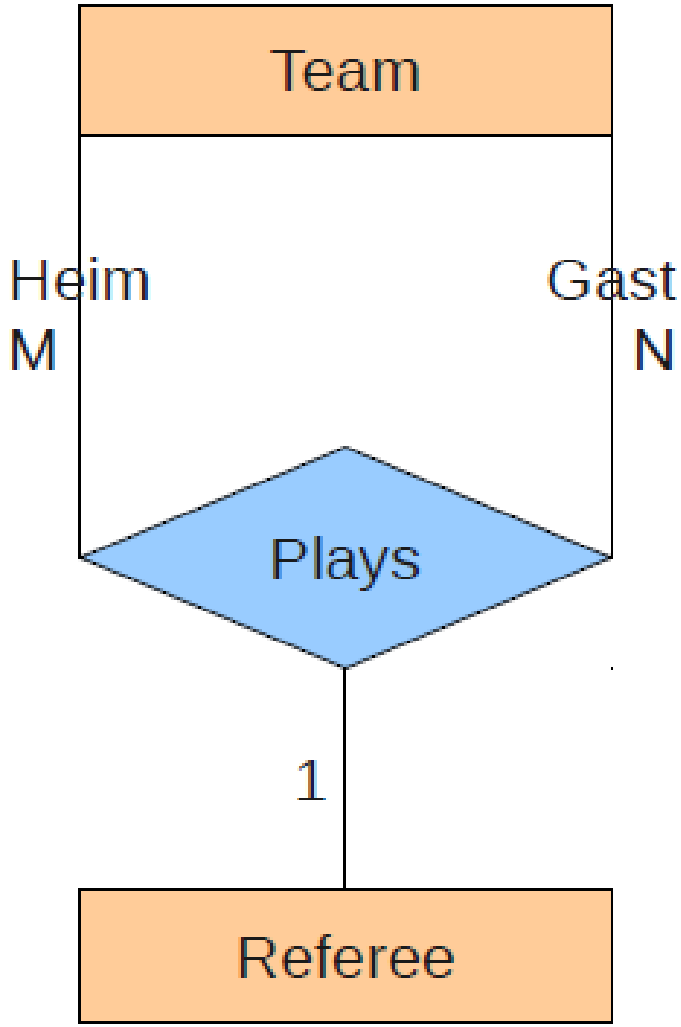


Assignment 11.1.2: Abstammung

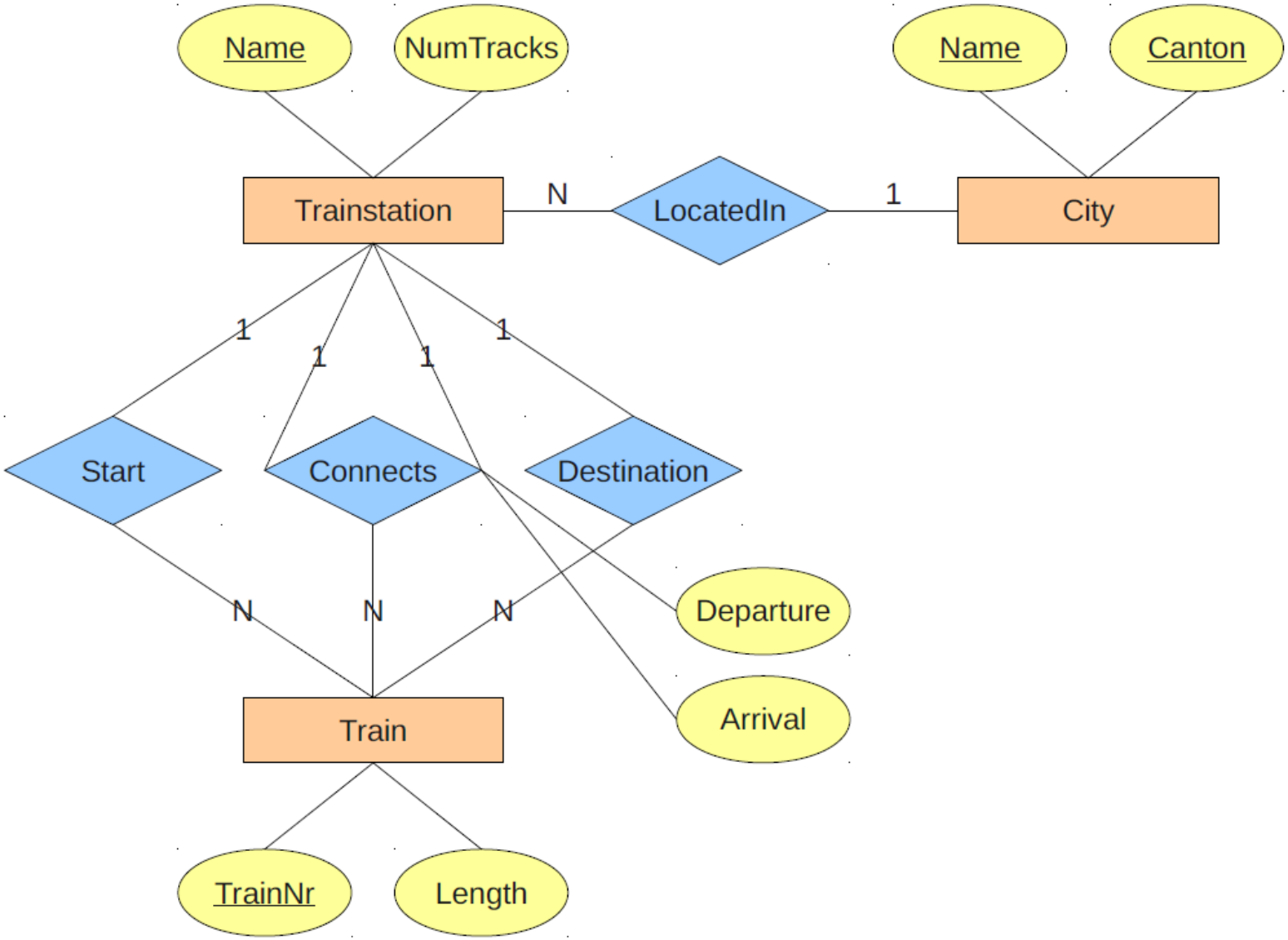


Analog für „**ist Tochter**“

Assignment 11.1.3: Fussball



Assignment 11.1.4: Züge



The relational Algebra

- σ Selection
- π Projection
- x cartesian product
- ⋈ Join
- ρ Renaming

Assignment 11.2 & 11.3: Relational algebra

Schema

- **Reader** (RDNR, Surname, Firstname, City, Birthdate)
- **Book** (ISBN, Title, Author, NoPages, PubYear, PublisherName)
- **Publisher** (PublisherName, PublisherCity)
- **Category** (CategoryName, BelongsTo)
- **Copy** (ISBN, CopyNumber, Shelf, Position)
- **Loan** (ReaderNr, ISBN, Copy, ReturnDate)
- **BookCategory** (ISBN, CategoryName)

Assignment 11.2 & 11.3: Relational Algebra

Queries

a) Surname of readers in Zürich?

b) Which books (Author, Title) have been released by publishers in Zürich, Bern or New York?

c) Which Books (author, title) have been borrowed by Lemmi Schmoker?

d) Which books of category "Alps" do not belong to category "Switzerland"?

e) Which readers (Surname, Firstname) have borrowed books that had been published in their home city?

f) Which readers have borrowed at least one book that has also be borrowed by Lemmi Schmoker?

Assignment 11.4: SQL Updates

Queries

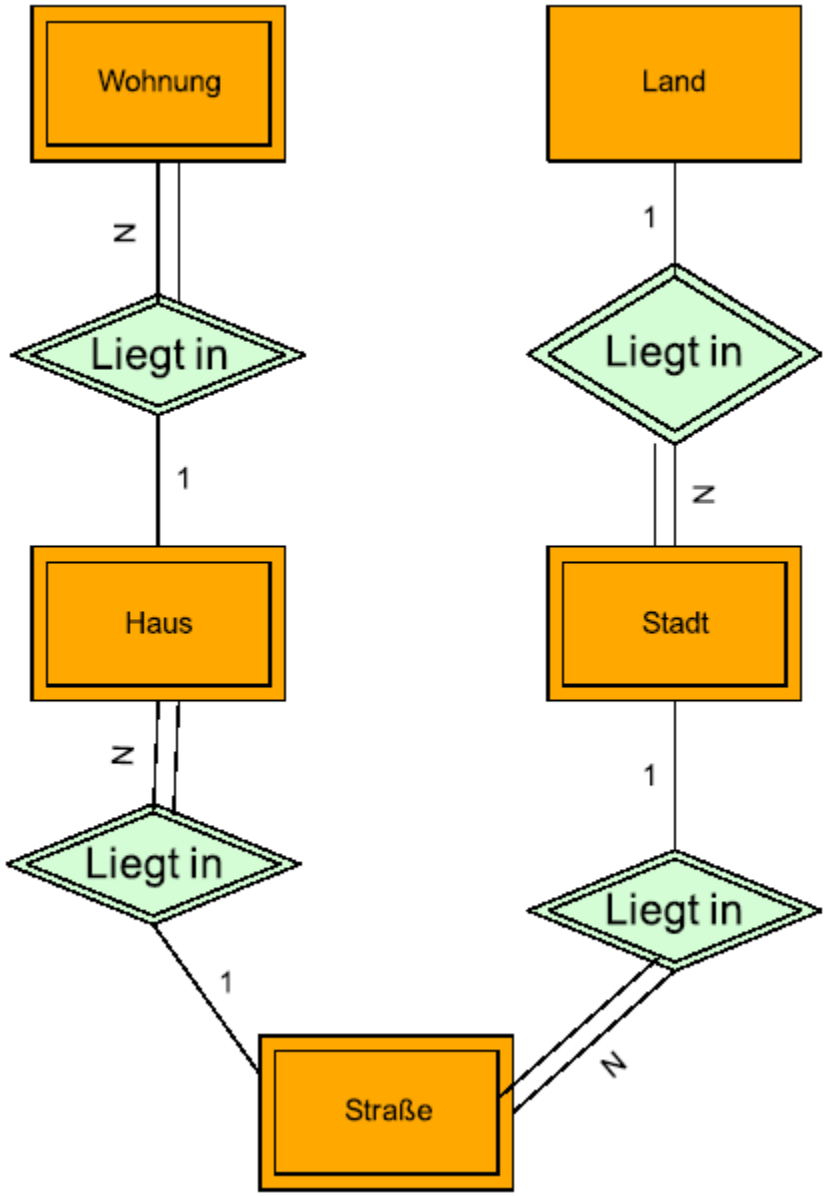
a) **Insert a new nation with the name "Switzerland".**

b) **Delete all orders with a total price less than 100**

c) **Change the order status of a an order with order key 4 from "O" to "F"**

Solutions Ex Sheet 10

Aufgabe 1a


Wohnung
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Haus
Stadt
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1
Liegt in
Liegt in
1
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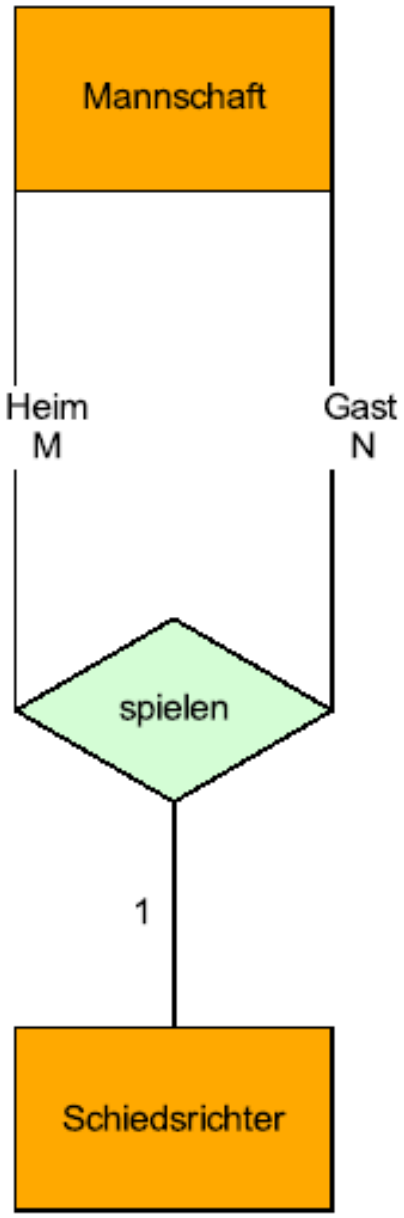
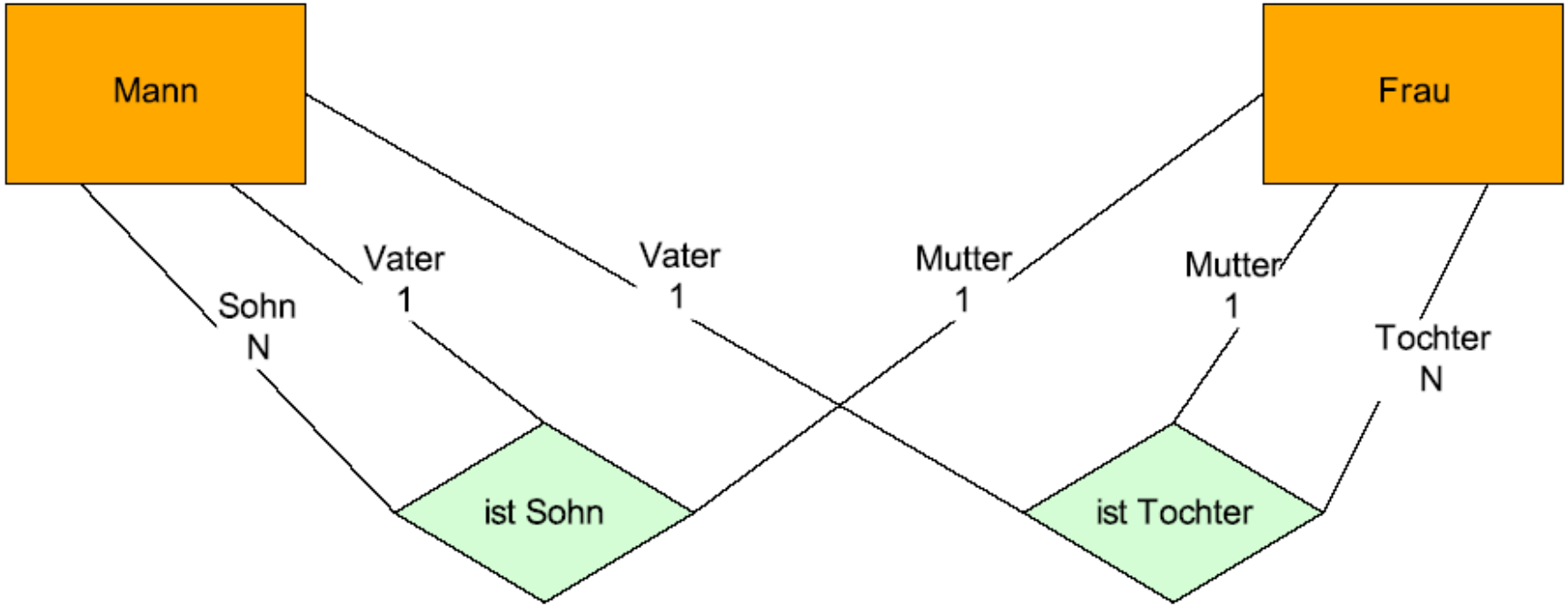
Straße

Aufgabe 1b



Aufgabe 1c


Mann
Frau
Vater
1
Vater
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Mutter
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Mutter
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Sohn
N
Tochter
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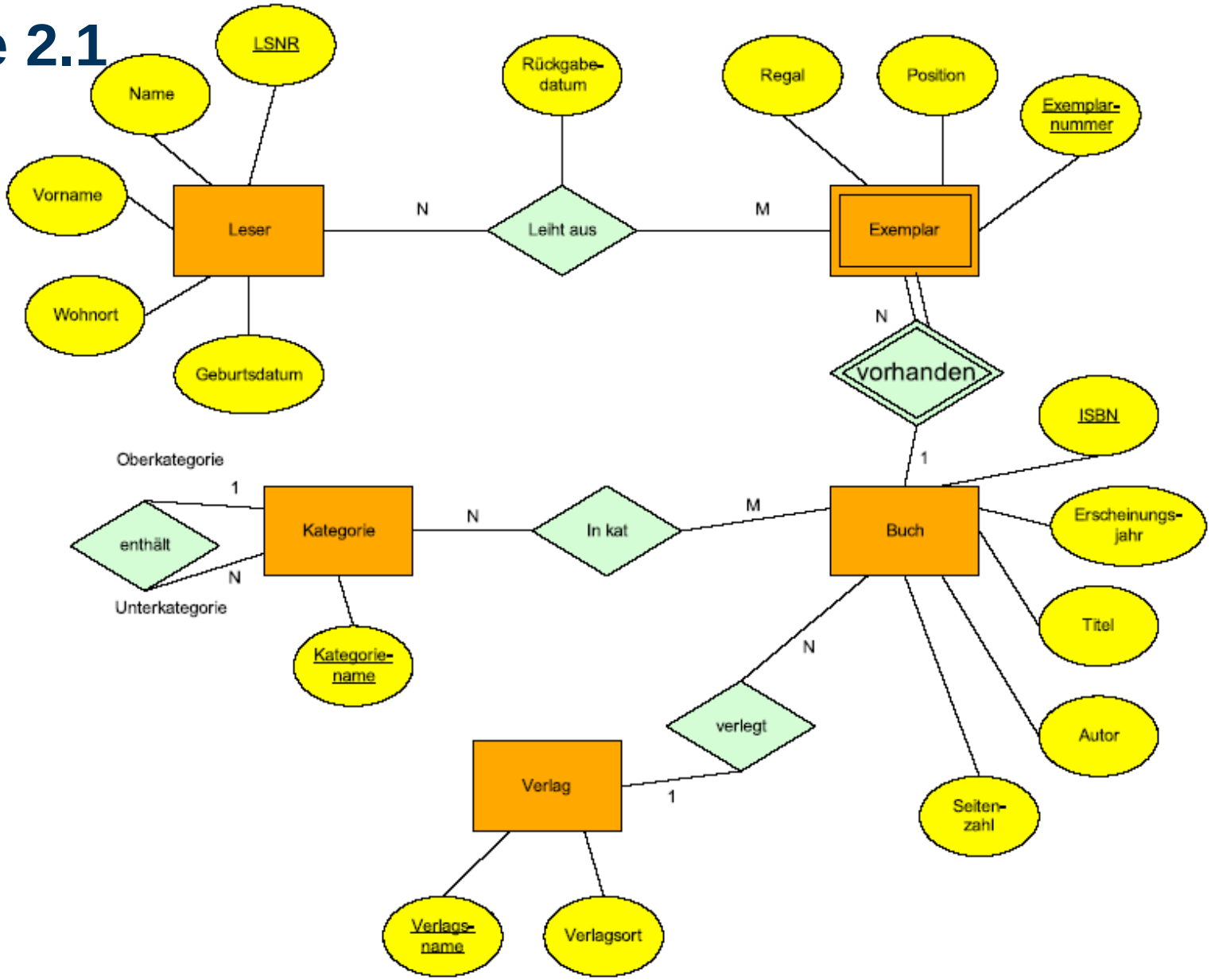
ist Sohn
ist Tochter

Aufgabe 2.1

Schema

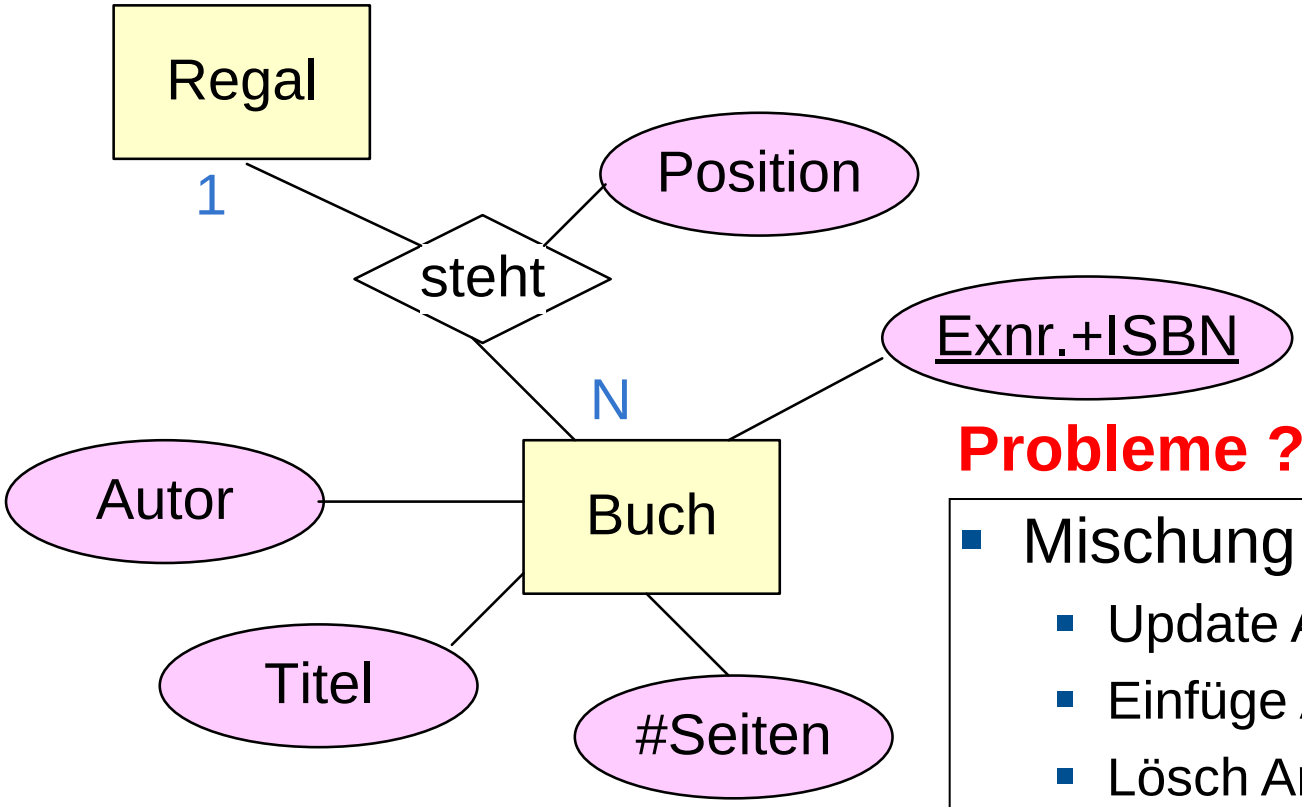


Aufgabe 2.2

Bibliotheksverwaltung (falsche Lösung)

- Mehrere Exemplare desselben Buchs in Bibliothek

Vorgeschlagenes Schema:



Probleme ?

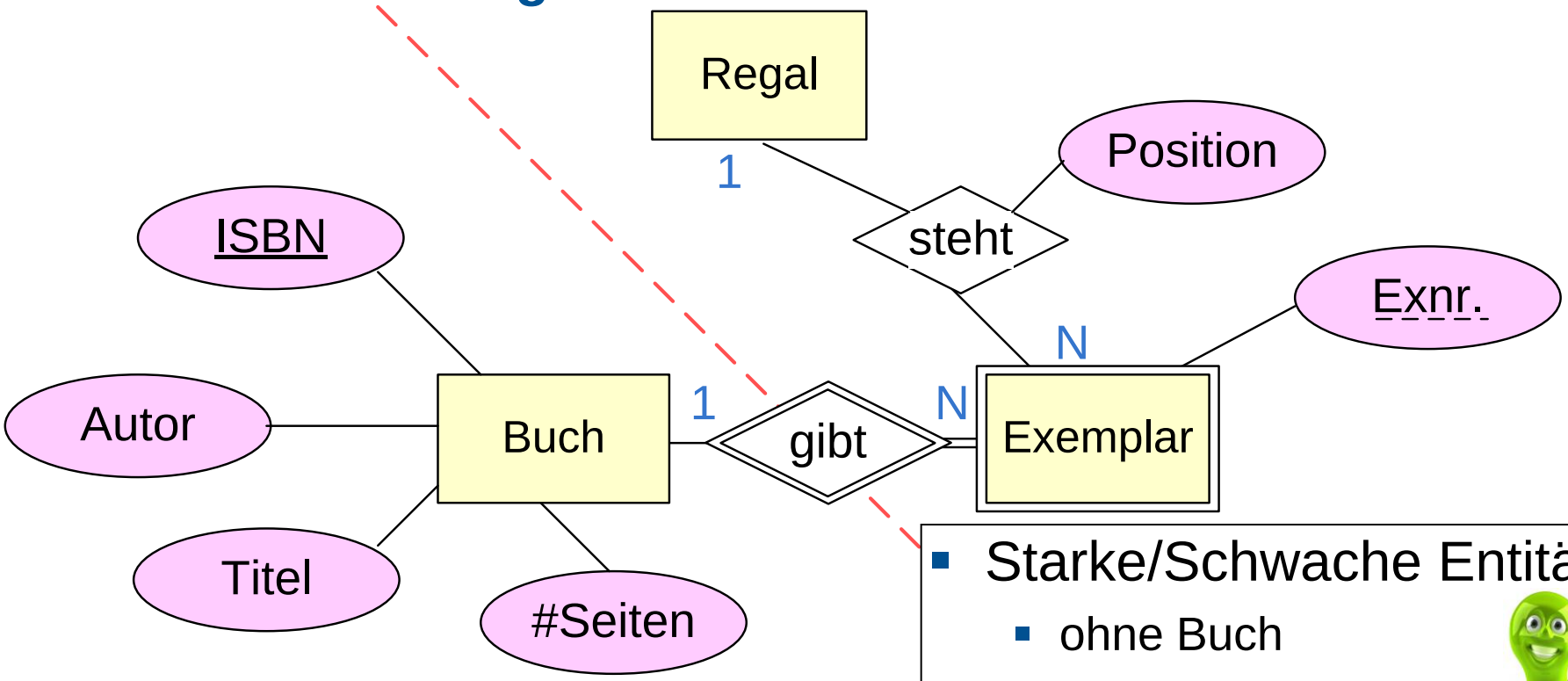
- Mischung von Konzepten
  - Update Anmomalie
  - Einfüge Anomalie
  - Lösch Anomalie

Aufgabe 2.2

Bibliotheksverwaltung (richtige Lösung)

- Separater Entitytyp für jedes „Konzept“

Verbesserte Lösung:



- Starke/Schwache Entität
  - ohne Buch kein Exemplar

Aufgabe 2.2

Warum hat jede Relation mindestens einen Schlüssel?

- Im relationalen Modell müssen alle Einträge unterschiedlich sein
- Brauche daher minimale Menge von Attributen, die Einträge unterscheidbar machen
- Verwende minimale Teilmenge als Primary Key

Aufgabe 2.2

ISBN	***TITEL***	***AUTOR***	***SEITEN ZAHL***	***ERSCHEI-NUNGS-JAHR***	***VERLAGS-NAME***	***VERLAGS-ORT***
12345	Datenbank-systeme	Kemper	504	1999	Oldenbourg	München
78912	Datenbanken im Unternehmen	Pernul	650	2003	Oldenbourg	München

Probleme ?

- Mischung von Konzepten
  - Unnötiger Speicherverbrauch
  - Update Anmomalie
  - Einfüge Anomalie
  - Lösch Anomalie