Database Management Systems

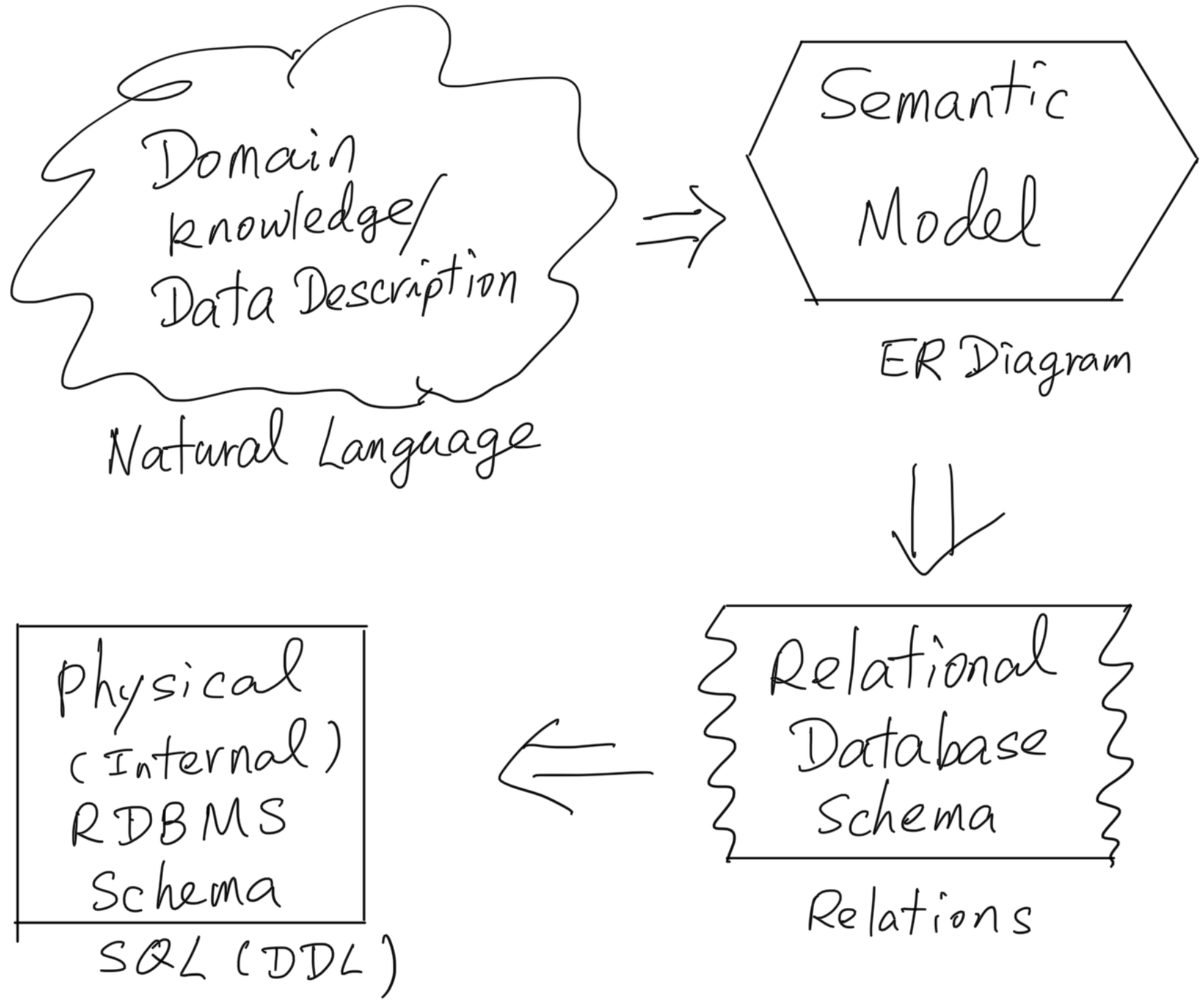
ER Modelling

Semantic Modeling

- Why not using relational schema directly?
    - Relational model has only one concept — relation
    - real world situation usually have several
- Real World Ideas (description in natural languages)
  → High-Level Design (semantic models)
  → Conceptual Relational Database Schema (relations)
  → Physical Schema in a Relational DBMS (SQL DDL statements to actually create tables)

- Candidates:
    - Entity-Relationship (ER) Model or ER diagram
    - UML (Unified Modelling Language)

Semantic Modeling



The ER Model

- ER modelling is one of the most widely used semantic modelling approaches.

- The visualization of ER modelling is ER diagram.

- There are three principle element types:

  - Entity sets

  - Properties (or attributes)

  - Relationship sets

Description

- A hypothetical corporation (similar to Costco) operates a chain of membership-only warehouse stores. The corporation would like to collect and store data to support mainly its (vastly simplified) daily activities related to product purchasing and returning.

- The corporation has a list of the stores. Each store has a unique ID, an address and a publicly accessible phone number.

- Each customer must open a membership account in one of the stores first. For simplicity's sake, we ignore the possibility that several authorized customers can share one membership and decide that one membership account represents one customer. Each membership account is assigned a unique account number across the corporation. Each account stores the customer's name, contact information, account opening date and the last renewal date.

- To support transactions, a list of the product data should be collected and stored. Each product has a unique barcode, a short product name, a slightly longer description of the product, and a price. Again, for simplicity's sake, let's ignore the tax data associated with the products.

- Customers can purchase multiple products in one transaction. We assume that each product can only appear at most once in a transaction. Because it happens physically in a store, each purchase transaction is assigned with a unique transaction ID within the store where the transaction happens. The date/time when the transaction happens should also be recorded, along with an employee's number to indicate who assists this transaction. It is also important for the corporation to keep track which customer made each purchase transaction.

- Customers can return purchased products in any store. Each return transaction is assigned a unique transaction ID within the store. The date/time when the return transaction happens should be recorded, along with an employee's number to indicate who assisted this transaction. The return transactions also need to record which product purchased in which transaction was returned.

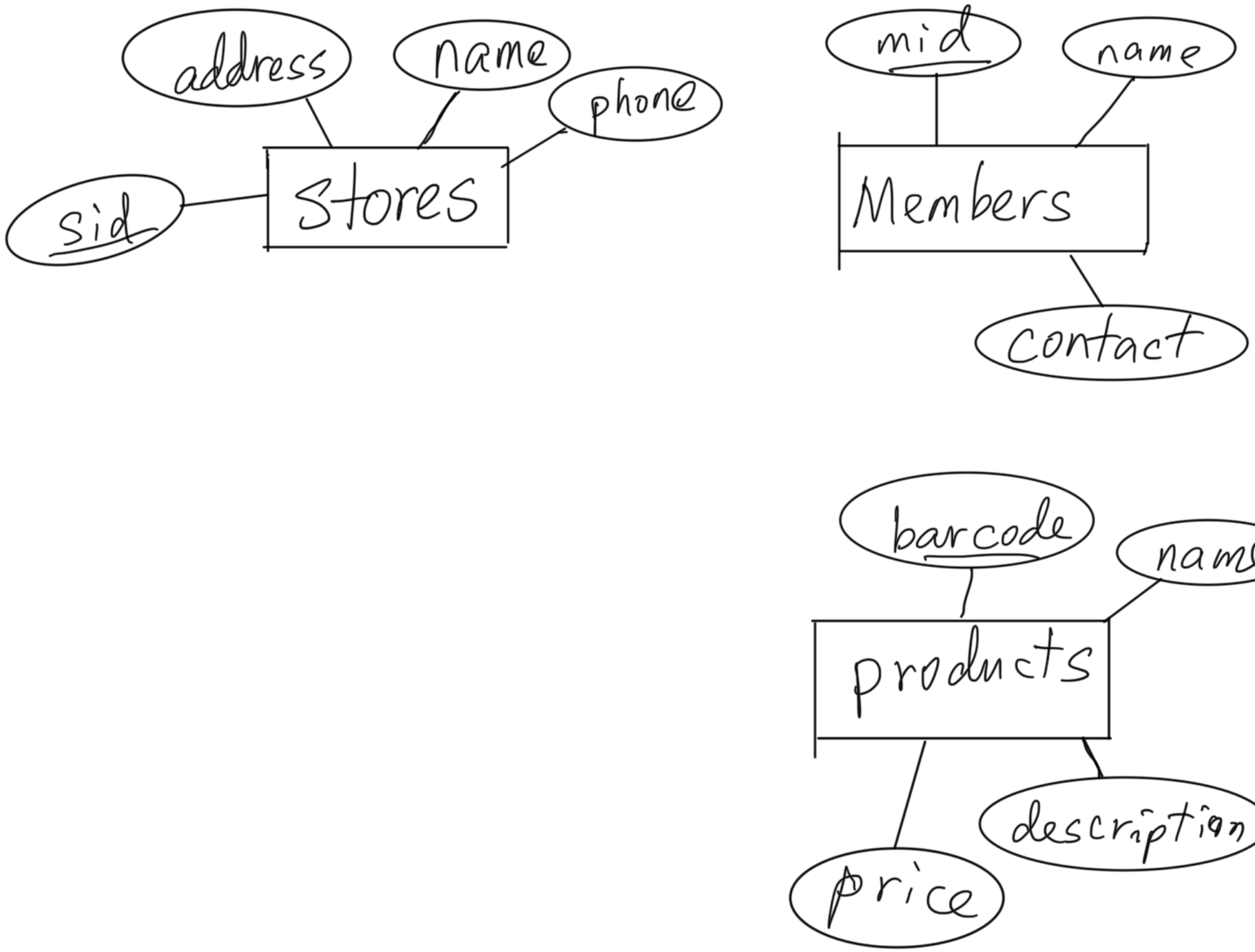
Entity Sets

- Strong (regular) entity sets
- Weak entity sets
- Existence dependencies: weak (subordinate) entity's existence dependents on dominant entity
- a weak entity set must have a Many-to- one relationship set to a regular entity set

Attributes

- describes entity sets (adjectives) and/or relationship sets (adverbs)
- Special attributes:
  - identifier of a strong entity set: a special set of attributes selected by designer to uniquely identify the entities in the entity set
  - discriminator of a weak entity set: a set of attributes that distinguish subordinate entities in a weak entity set, for a particular dominant entity
- Typically the identifier of a weak entity set consists discriminator of the weak entity set and the identifier of the entity set for dominating entities

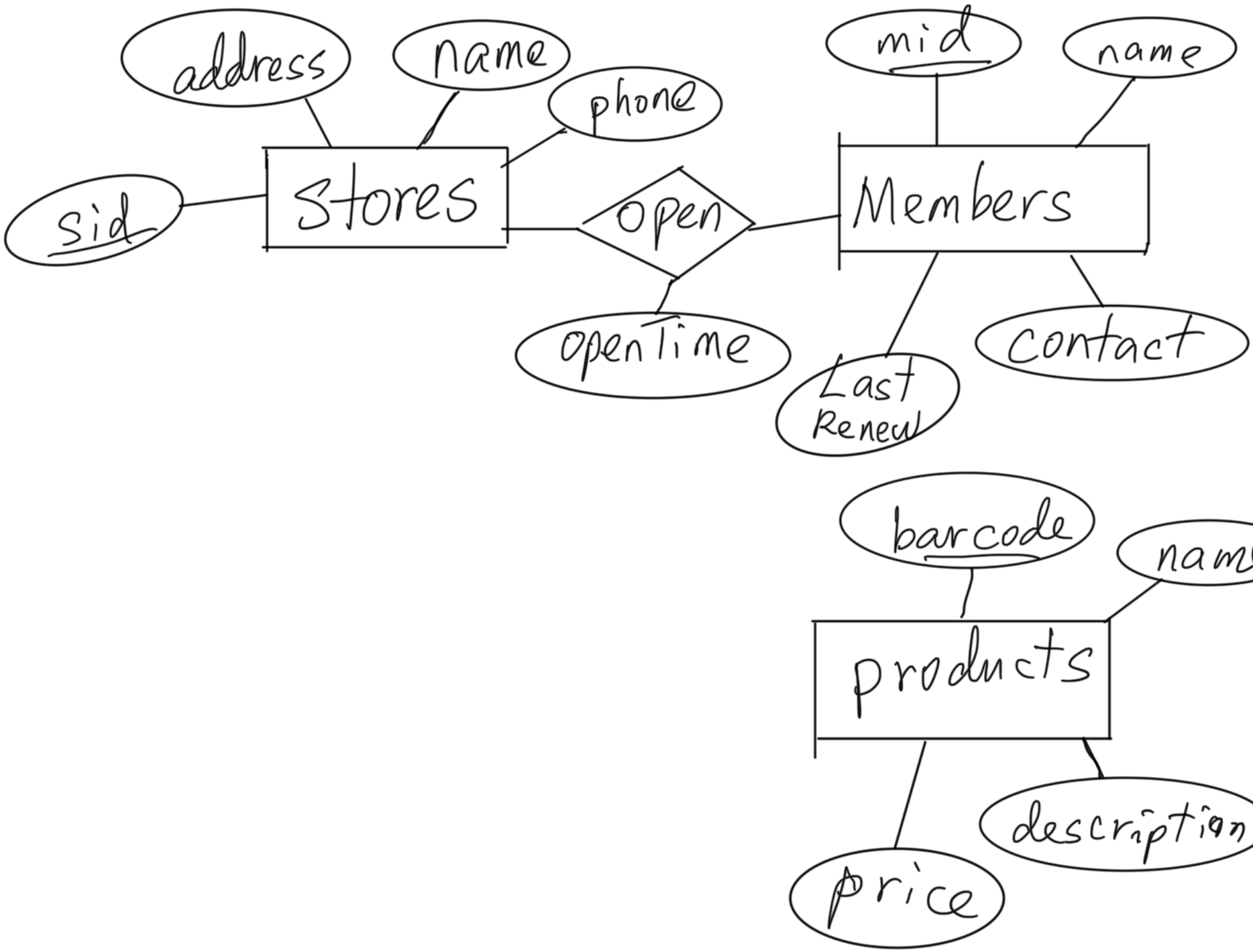
Entity Sets


address
name
phone
sid
stores
mid
name
Members
contact
barcode
name
products
description
price

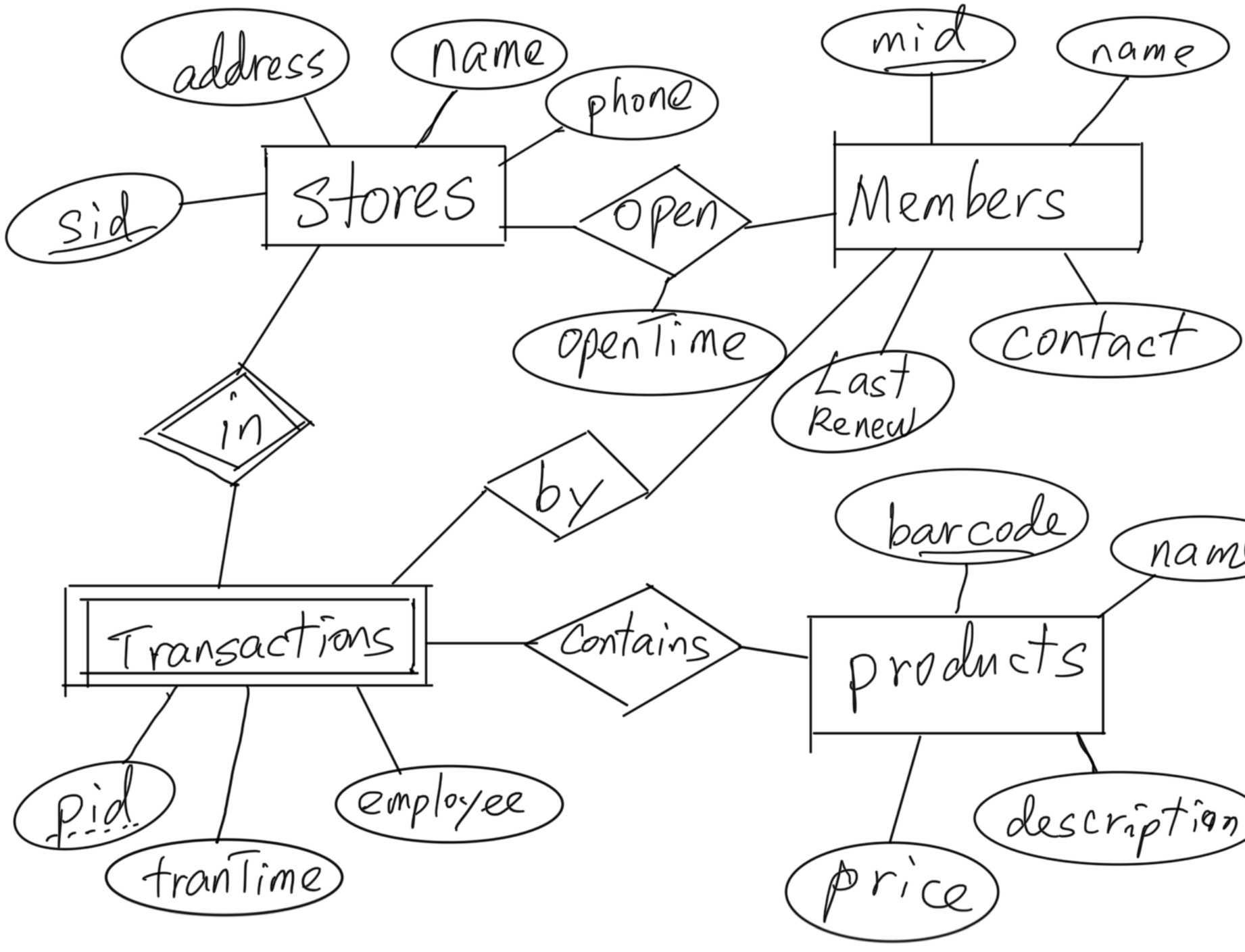
Relationship Sets

- Usually they are binary ones.
- roles in relationships — if a relationship involves two entities from the same entity set, different role names are given to these two entities
- Types of the relationship set according to the cardinality of the relationship set
    - one-to-one
    - many-to-one
    - many-to-many
- General cardinality constraints can be applied to relationship sets in ER diagram
- multiway relationship sets are usually converted to multiple binary ones using aggregation

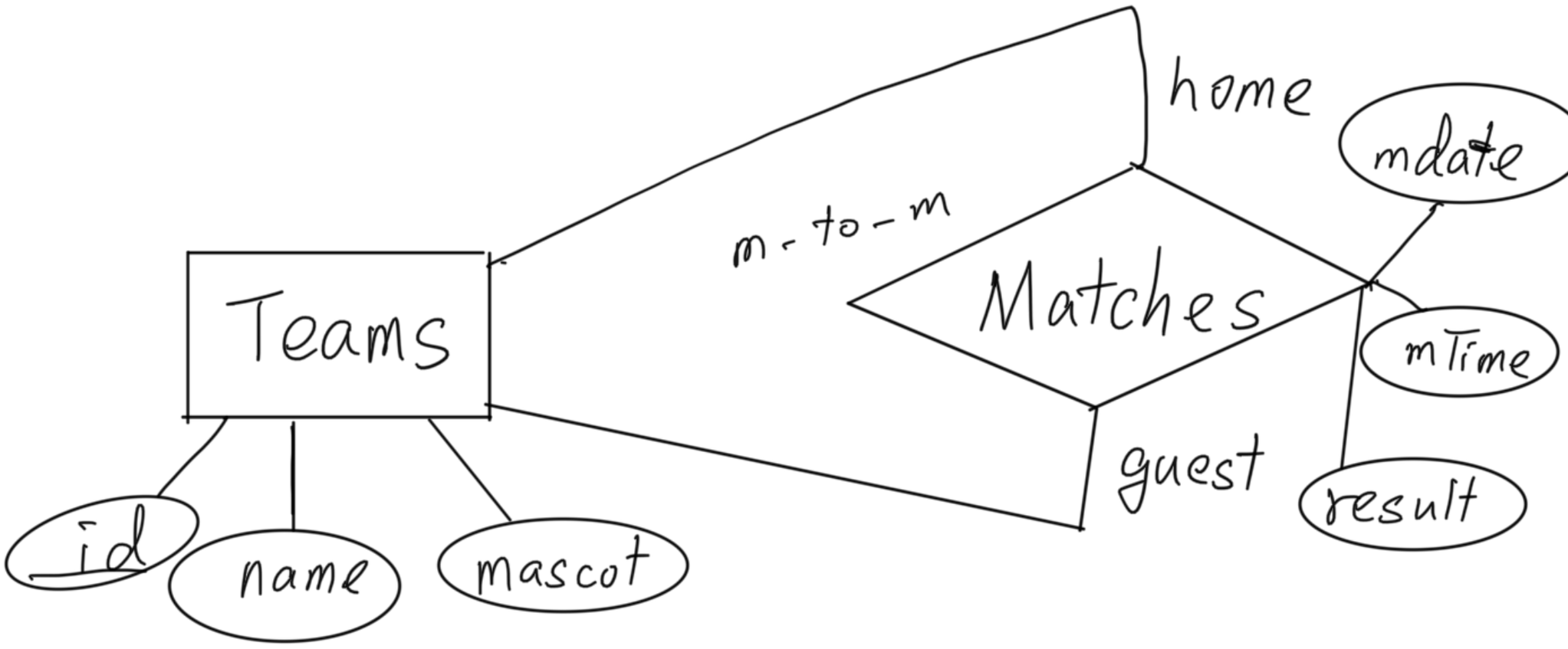
Relationship Sets



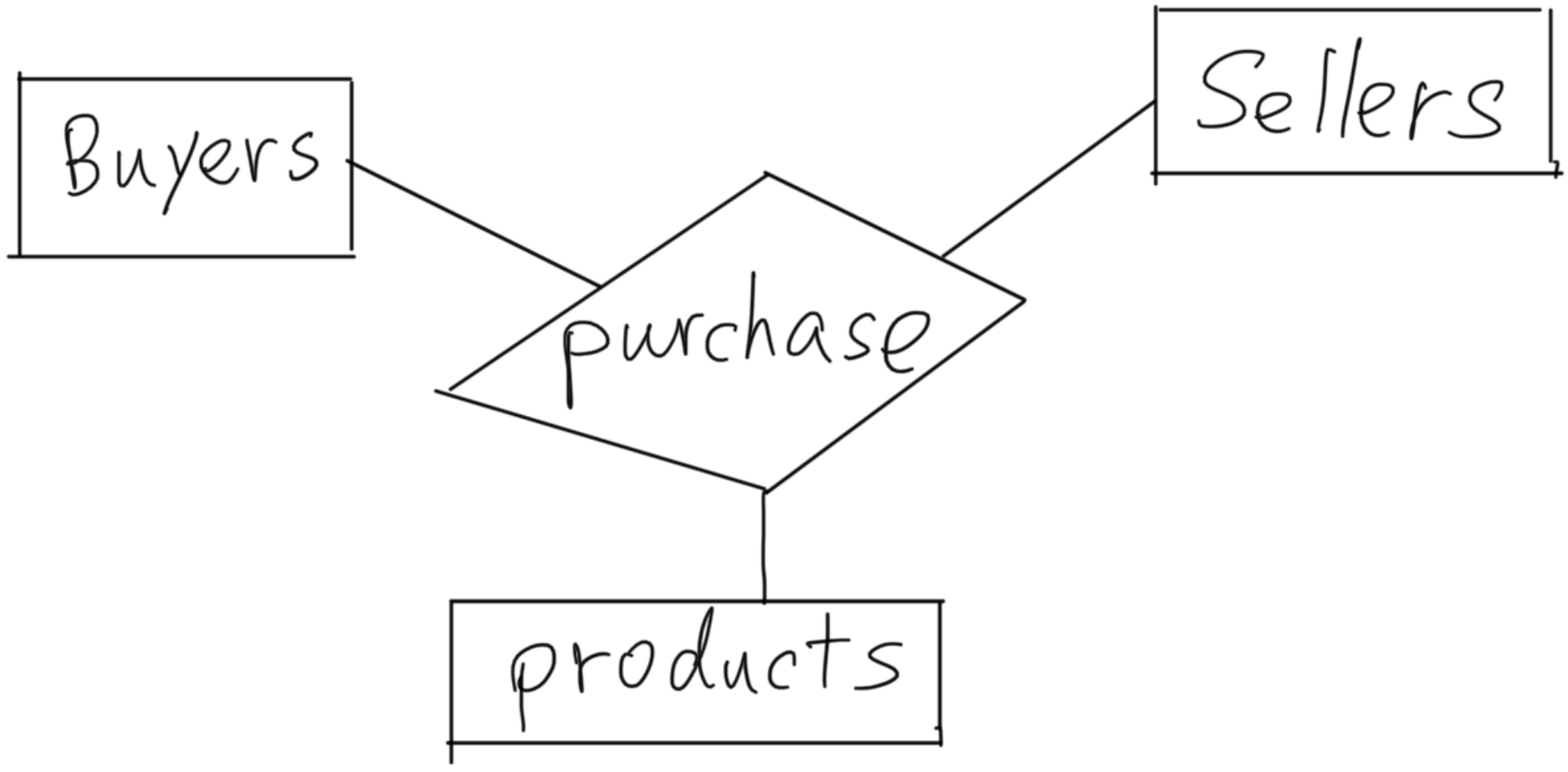
Weak Entity Sets



Roles In Relationships



Multi-way Relationship Sets



Design Principles

- Be faithful to the specifications of the application.
- Avoid Redundancy, say everything once only.
- Choose the right relationships.
- Pick the right elements.
- If something can’t be modelled exactly, it is preferable to be under-constrained rather than over-constrained.