Appendix D: Alternative Notations for ER-Diagrams

Elmasri/Navathe:

- Appendix A, “Alternative Diagrammatic Notations”

I have also used the following sources:

- Rauh/Stickel: Konzeptuelle Datenmodellierung (in German), Teubner, 1997.
- Kemper/Eickler: Datenbanksysteme (in German), Ch. 2, Oldenbourg, 1997.
- Teorey: Database Modeling & Design, Morgan Kaufmann, 1994.
- Barker: CASE*Method, Entity Relationship Modelling, Oracle/Addison-Wesley, 1990.

Overview

General Remarks

- Variants of the ER-model differ in:
  - The selection of modeling constructs which the specific version of the ER-model supports.

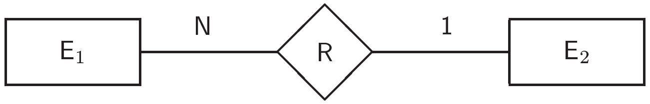
    E.g. only binary relationships, no structured attributes.
  - The notation used for these constructs.
  - The possibility to model also behaviour: Methods/Operations supported by objects/entities.
- Which variant to use might be prescibed by company policies or the available CASE tools.
- If you know data modeling in one notation well, it will be very easy to adapt to other notations.

Overview

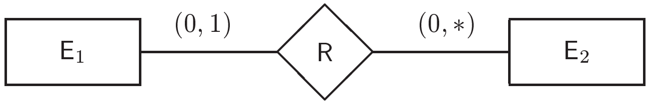
Cardinalities (1)

- The textbook mainly uses the “M:N” notation for the maximum cardinalities.

  The new edition also explains (min,max)-cardinalities.
- Many to One Relationships: N entities of type E_1 are related to a single entity of type E_2.



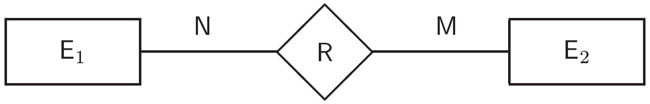
- Equivalent (min,max)-cardinalities ($(0,*)$ on “1” side):



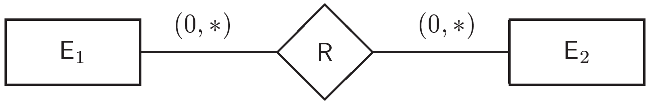
Cardinalities (2)

- “N:M” relationship: No restrictions. Many E_1 entities can be related to the same E_2 entity, many E_2 entities can be related to the same E_1 entity.

  E.g. “enrolled in” between students and courses.

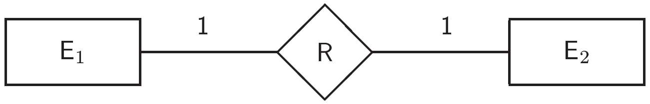


- Equivalent (min,max)-cardinalities:

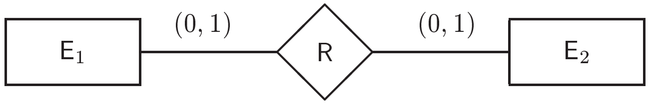


Cardinalities (3)

- “1:1” relationship: Each E_1 entity can be related to at most one E_2 entity, each E_2 entity can be related to at most E_1 entity. E.g. “married with” between men and women.



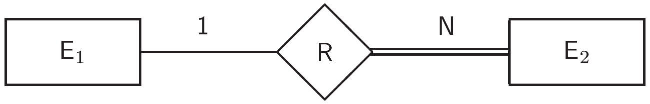
- Equivalent (min,max)-cardinalities:



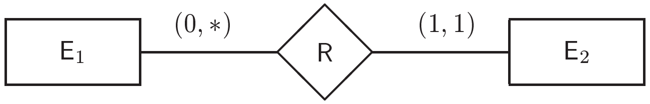
Cardinalities (4)

- Minimum cardinalities are represented by a single or double connecting line.
- Optional participation (minimum cardinality 0): single line. Total participation (minimum cardinality 1): double line.

  Mandatory participation means the same as total.



- Equivalent (min,max)-cardinalities:

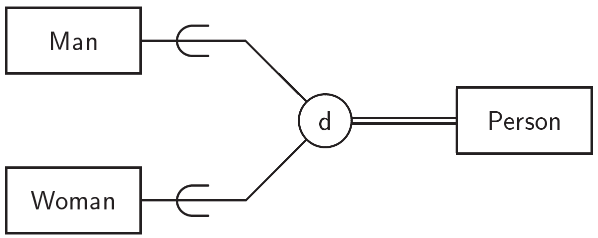


Specialization (1)

- When it comes to specialization, nearly no two authors use the same notation.
- Elmasri/Navathe connect the subtype and the supertype by a line and write a “$\subset$” sign across the line in the right direction.
- If there are multiple subtypes, they use a circle and write “d” (disjoint) or “o” (overlapping) into it.
- If this circle is connected by a double line to the supertype, the partition is total. Otherwise, it is partial.

Specialization (2)

- Of course, one would normally show the superclass (“Person”) above the subclasses (“Man” and “Woman”), but my text-processing system has difficulties with turning characters like “$\subset$” in different angles:



Overview

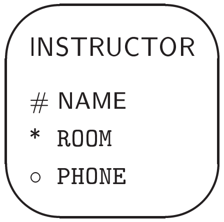
1. General Remarks
2. Notation used in Elmasri/Navathe
3. Notation used in Oracle Designer

ER-Constructs in Oracle Designer

- Binary relationships (no ternary etc.), also recursive ones.
- The most important cardinalities.
  0 and 1 as minimum, 1 and $*$ as maximum, one exclusion.
- No relationship attributes.
- Optional attributes, but no multivalued/structured ones.
- Domains for attributes, constraints on attribute values.
- Only disjoint and total specialization, each type can be specialized only in one way, no multiple inheritance.
- Weak entities (using a relationship to identify entities).
- New: mutually exclusive and non-transferable relationships.

Entity Types and Attributes (1)

- The Oracle tool uses a "softbox" for entity types.
- Attribute names are written into this box:



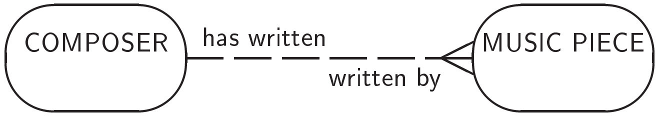
- Oracle Designer allows to customize what is displayed, and it is especially possible not to show attributes.
  In order to get an overview over a large diagram, it might be better not to show the attributes.

Entity Types and Attributes (2)

- Attributes which are mandatory (not null) are marked with *, optional attributes with ○.
- Primary Key attributes are marked with #.
  Attributes marked with # together form the primary key.
  Key attributes are automatically mandatory, no * is needed.
- In earlier versions, one could mention an example entity (e.g. "Stefan Brass") in the entity type box.
  This was shown at the bottom of the box.
- More information is stored about entities which is not graphically displayed.
  By double clicking on an entity you reach a dialog box in which you can read and change these entity properties.

Relationships

- Only binary relationships are allowed. Relationships are marked by lines between the entity boxes (no diamond).
- Relationships have two names (seen from each of the ends): "from name" and "to name" (role names for the entities).
  Just as a relationship between people, relationships are "both way", and this is reflected in the two names.

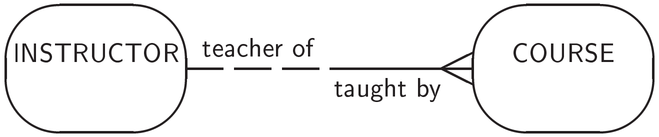


- You can use the same names for different relationships.
  Only between the same two entities there cannot be two relationships which agree in both, two and from name.

Notation for Cardinalities (1)

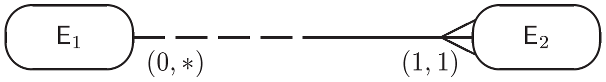
- One to many (One instructor teaches many courses):

- Oracle Designer uses the "Crowsfoot-Notation":



- This notation is very illustrative: One instructor can teach many courses. There are instructors without courses.

Notation for Cardinalities (2)



- Maximal cardinality for E_1:
  - $*$: Crowsfoot on the side of E_2.
  - 1: Simple line on the side of E_2.
- Minimal cardinality of for E_1:
  - 0 (optional): Dashed line on the side of E_1.
  - 1 (mandatory): Solid line on the side of E_1.

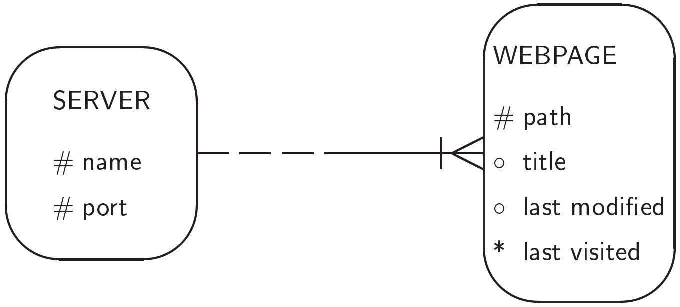
Notation for Cardinalities (3)

- If the role names of the relationship (“teacher of”, “taught by”) are chosen rigorously, natural language sentences which explain the cardinalities can be automatically generated.
- “Each (and every) INSTRUCTOR may be teacher of one or more COURSES.”

  Note that the Oracle Designer knows the plural for of every entity type. “may be” indicates optional participation. Phrases in parentheses only emphasize, but don’t change the meaning. They can be left out.
- “Each (and every) COURSE must be taught by one and only one INSTRUCTOR (ever)”.

Weak Entity Types

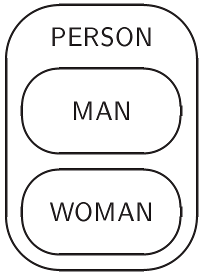
- If a relationship contributes to the identification, there is a bar across the connecting line:



A web page (e.g. `http://www.sis.pitt.edu:80/~sbrass/db/`) is identified by the server and the path on the server.

Specialization

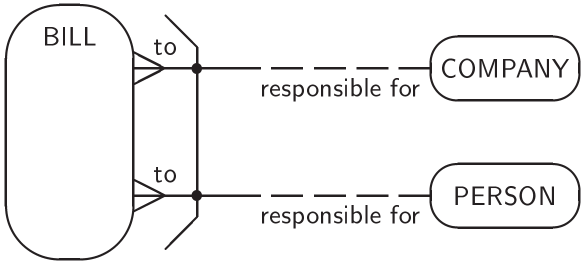
- Specialization is represented by writing the softbox of the subtype into that of the supertype:



- Such specializations must be partitions: The subtypes must be non-overlapping and total.

Mutually Exclusive Relationships

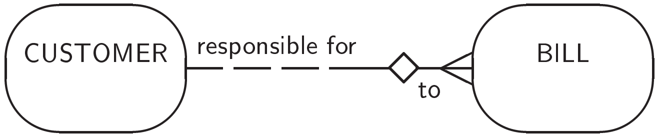
- You can specify that two relationships are mutually exclusive:



- I.e. a bill is either to a person or to a company, but not to both.

Non-Transferable Relationships

- You can mark a relationship as non-transferable:



- With this construct, a bill cannot be disconnected from a customer and connected to another customer.
- I.e. the foreign key attribute (customer number in bill) is non-updatable.

  Oracle Designer allows the “non-transferable” sign also on the other side of the relationship. Semantics unclear (?).