

# Entity-Relationship (ER) Modelling

With Thanks to

<http://www.inf.unibz.it/~franconi/teaching/2000/ct481/er-modelling/> - many examples are taken from this link.

!!! The link views ER Modelling from a database-viewpoint however !!!

# Terminology

**Mind maps:** Developed to support brainstorming, explorative creative activity (Tree Structures)

**Concept maps:** Developed to enhance meaningful learning (named graphs)

**Conceptual models:** „view of world in our minds“ – often not descriptive (what is) but normative (how e.g., a business process should be)

**Data models:** Structure for data within an information system

**Knowledge model:** Structure of knowledge within an information system (knowledge representation)

**ER models:** Developed to facilitate data(base) modelling (~named graphs with additional pre-defined properties for relationships)

# We do: Data and Knowledge Modelling

And today: ER modelling (which could be used for both purposes) to show what kinds of things one typically wants to express when modelling data and knowledge.

## An Example...

Every department within our company is in only one division. Each division has more than one department in it. We don't have an upper limit on the number of departments that a division can have. For example, the *New Business Development*---the one managed by Mackenzie---and *Higher Education* departments are both in the *Marketing* division.

# What are the items of interest?

Every **department** within our company is in only one **division**. Each division has more than one department in it. We don't have an upper limit on the number of departments that a division can have. For example, the *New Business Development*---the one **managed by Mackenzie**---and *Higher Education* departments are both in the *Marketing* division.

- Departments, e.g., New Business Development, Higher Education
- Divisions, e.g., Marketing
- Managers, e.g., Mackenzie
- Employees? (!!! Interpretation !!!), e.g., Mackenzie

# Entities vs. Entity Types

What is the difference?

- Entity: A concrete (often real-world) item
- Entity Type: A set of entities; collects entities of the same „type“ in the sense of having the same characteristics.

What is the analogy in object-oriented programming?

What is the analogy in databases?

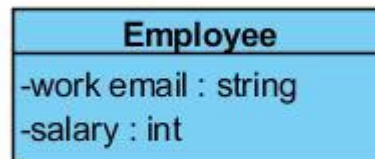
Are we looking for relationships between entities or entity types?

# Attributes

An attribute is a descriptor whose values are associated with individual entities of a specific type

What are interesting attributes of the entity type “Employee”?

Visual Paradigm for UML Community Edition (not for c

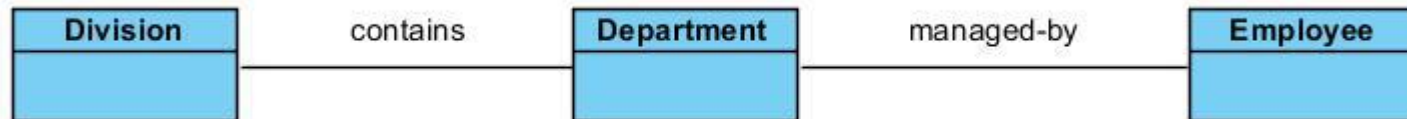


# What are the relationships between entity types?

A relationship is an association between entity types.

- How would you name the relationship between
  - „Division“ and „Department“?
  - „Department“ and „Employee“?

Visual Paradigm for UML Community Edition [not for commercial use]

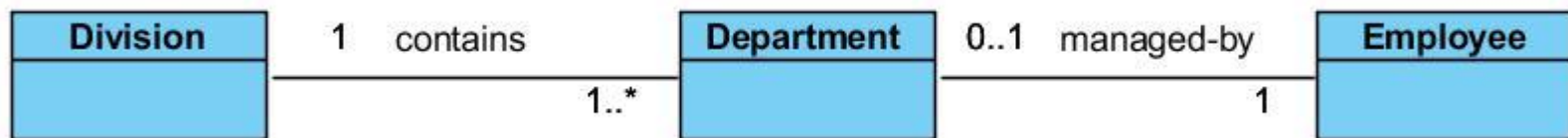




# How many must or can there be?

- How many departments **must** a division contain? (min)
- How many departments **can** a division contain? (max)
- How many employees **must** be managing a department? (min)
- How many employees **can** be managing a department? (max)
- ... and in the other direction?

Visual Paradigm for UML Community Edition [not for commercial use]



# How many must or can there be?

## Cardinalities (can):

- 1 Division contains many Departments
- 1 Department is managed by at most 1 employee
- An employee can work in multiple projects, and in each project, multiple employees can work

Makes a stmt about the maximum number!

# How many must or can there be?

## Existence (must):

- 1 Division contains at least one Department, and 1 Department belongs to at least 1 Division (exactly if you look at both cardinality and existence)
- 1 Department is managed by exactly 1 Employee (mandatory), but not every Employee manages a division (optional)

Makes a stmt about the minimum number!

# Type Hierarchies

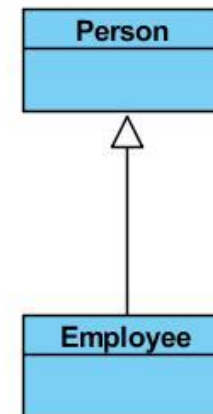
An entity subtype is a collection of entities of the same type as the entity supertype, but with

- additional relationships
- additional attributes
  
- What is an additional
  - Relationship
  - Attribute

for „Employee“ in a company compared to „Person“?

- Why would a company need the concept „Person“?

Visual Paradigm for UML Community E

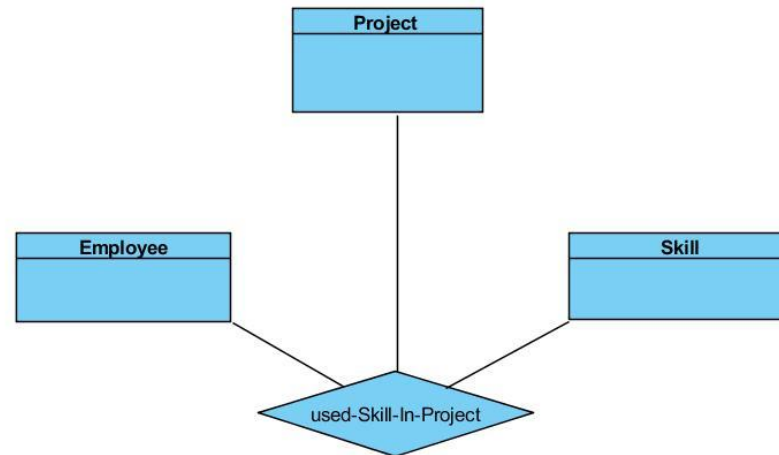


# Ternary (and higher order) relationships

Relationships can involve more than two entities.

What is an example of that?

Visual Paradigm for UML Community Edition [not for commercial use]



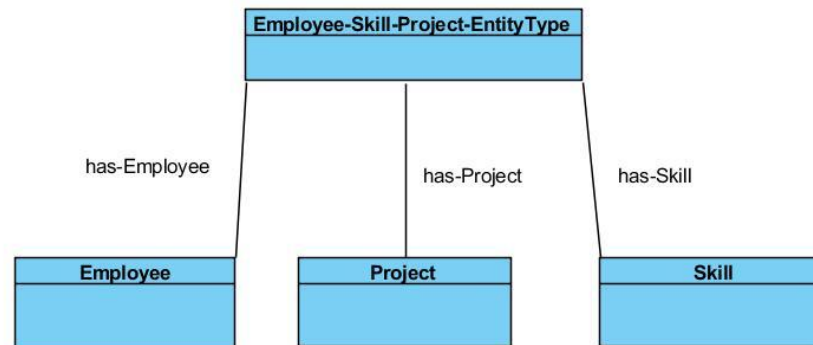
# Ternary (and higher order) relationships

Can you replace the ternary relationship with two binary relationships? **NO**

- Employee X used Skill Y.
- Skill Y was used in Project Z.
- Instead of: „Employee X used Skill Y in Project Z.“

How could you get rid of ternary relationships?

Visual Paradigm for UML Community Edition [not for commercial use]



## Additional concepts...

- Aggregation (vs Type Hierarchy)
  - Wheels are part of a Car, Arms and Legs are Part of the Human Body etc.
- Type hierarchy: Disjoint vs. Overlapping
  - Person X can be an employee and a customer, but cannot be an employee and a former employee.
- Recursive relationships
  - Employees have supervisors; these are also employees

# Exercise 1

1. Identify relevant entities and entity types in the example (next slide).
2. Identify relevant relationships.
3. Draw **and** verbalise the single statements.
4. For each Relationship: What is the cardinality and existence?
5. Take at least one entity type and identify interesting attributes.



# Exercise 1 - Example

Every institute at the Graz University of Technology belongs to one department (Fakultät). Each department has one dean, who is also professor at one institute within the department. Each institute belongs to exactly one department, but departments consist of more than one institute.

One particular institute is the knowledge technologies institute, in the department of computer science, whose dean is Franz, who in turn is professor at the Institute for Software Technology.

## Exercise 2

1. Which relationship exists between the following pairs of entity types: „subtype“ (specialisation) or aggregation?
  - Company – One-Person-Enterprise
  - City - District
  - Family – Person
  - University – Educational Institution
2. Given a \*.csv-file with the following data – what ER model would you create?

Jahr	Monat	Herkunftsland	Naechtigungen
2012	1	Arabische Länder in Asien	74
2012	1	Australien	188
2012	1	Baden- Württemberg	1158
2012	1	Bayern	2699
2012	1	Belgien	180
...	...	...	...

<http://data.graz.gv.at/daten/package/touristen-in-graz> - Daten f. 2012

# ER Models...

... are good for

- Representing real objects, types of objects and their relationship
- Representing concepts and their relationship
- A first-cut model on the way to a (relational) database, or semantic model in e.g., RDF(S), OWL

... are less good at

- Representing processes