

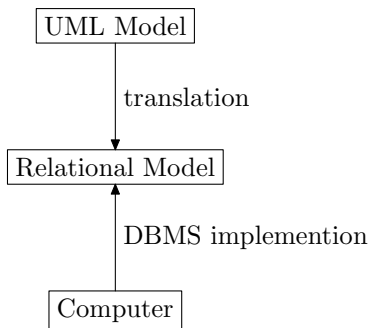
Lecture 9: Modelling and Translation

How to design a database

- What is a model?
- Why model?
- What is UML?
- Decisions
- Translation

See Elmasri and Navathe, Chapters 3 and 4, but especially 12.

Where are we now?



This weeks lectures and next weeks lab session are about the top box and the arrow coming out of it.

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 - which is cheaper, faster, easier, possible

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Meteorological Model

a mathematical structure and/or computer program

- resembles the weather and its progress
- runs faster than reality
- enables weather prediction

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- we create a database schema from the model
- therefore the database resembles the world

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(eg, the UML diagram of the labs database)
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- Maintenance: modify model then retranslate

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- The goal is now for modelling to replace programming as the main software development activity.
(Model Driven Development or Engineering or Architecture)
- We are only interested in the most basic diagram types, the **class diagram** [E&N §3.8] and **object diagram**

External Resources on UML

The course web page contains a couple of UML related links.

Brief overview of UML

<http://www.ibm.com/developerworks/rational/library/>

A little more detail and advice on UML Class diagrams

<http://www.agilemodeling.com/artifacts/classDiagram>
(controversy alert!)

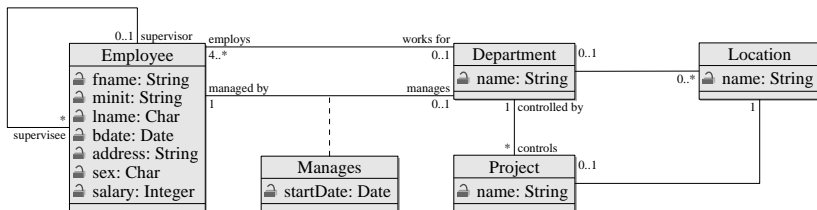
The current official definition of UML

<http://www.omg.org/spec/UML/2.1.2/Superstructure/PD>

Lab Scenario in UML

The database we used in the first lab is adapted from [E&N Figure 5.5, 5.6]. It is shown as a UML class diagram in [E&N Figure 3.16]. Here is an adapted (and corrected) version to match our lab material.

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- UML is probably too big and complicated for its own good, but we will only use a tiny subset that is mostly equivalent to Entity-Relationship diagrams and models.
- However, other parts of UML are useful in database design work. For example, Use-Cases for high level requirements, and Sequence Diagrams for modelling system interactions.
- I am biased, but I think the UML diagrams look much simpler and are easier to understand!

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However, it is a defined language, you can not just make up some notation and say “this means . . .”

It is also prudent to use the smallest part of the language you can. Less to learn, less to translate.

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- the top compartment contains the class name
- the middle compartment contains the attributes
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it is possible to create domain-like custom types
- the bottom compartment contains operations, but we will not use it

UML Elements - Associations

The lines joining classes are associations. The lines with a diamond at one end are called aggregations. These are also, perhaps incorrectly, considered to be a kind of association.

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 - For example, an Employee can **work for** a Department.
 - Note the order: class, far end, other class. ER diagrams do it backwards!

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 - In our example, each Employee can be employed by from 0 to 1 Departments. Each Department can employ from 4 to any number of Employees.
- Following ER terminology, we often talk about many-one and many-many associations

Association Classes

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- In our example, the `startDate` does not belong to the `Employee`, nor the `Department`, but to the management relationship between the two.
- They can be “factored out” by replacing them with a normal class and 2 associations.

and many many more

Some other things you might see in UML Class diagrams.

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- generalisation (like inheritance in object oriented programming)
- qualified associations

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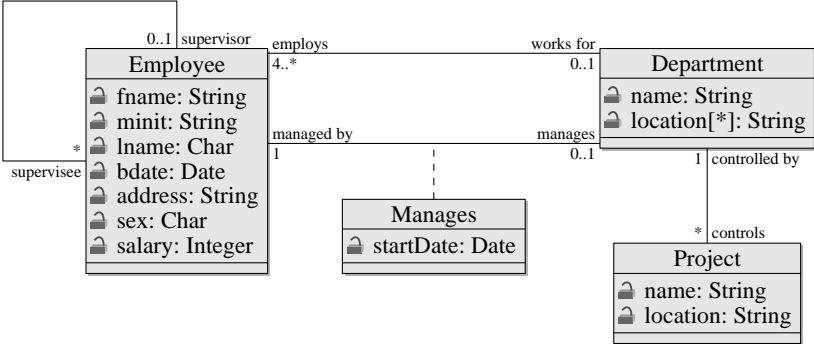
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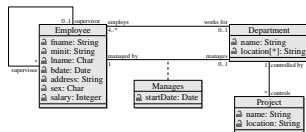
It's because we are trying to convert our ideas into a fixed system of metaconcepts (object, event, entity, relationship, ..).

There can be many ways to do it, no obvious criteria for making a choice. The ideas sometimes just don't fit!

Decisions Decisions

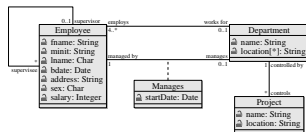


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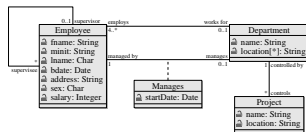
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- A revision of the example model, location is now an Attribute, not a Class
- Multiple valued attributes used (a UML feature considered harmful by some!)
- Choices like this can be controversial (and therefore time consuming)

Exercise

Modify the class model replacing the association class with an ordinary class and 2 associations.

Hint: take care with multiplicities.

Translation (Outline)

- For each class, create a relation schema with
 - ① a relation attribute for each class attribute
 - ② specify the primary key, as indicated in the diagram
- For each many-many association, create a relation schema with a foreign key for each association end
- For each many-one association, add a foreign key to the class at the many end

Exercise

Translate the modified UML class diagram from the previous exercise.

Note places where you must make a choice: what detail should be added to the procedure to make it fully automatic?