

Conceptual modelling: UML revisited

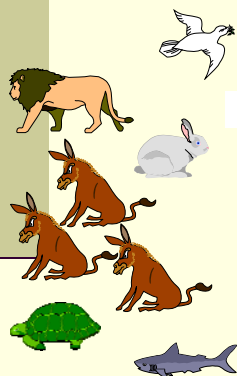
From reality to system
Conceptual modeling
Modelling patterns

2018-09-10

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Building the “right” system

Universe of Discourse



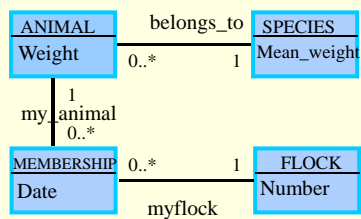
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Conceptual Model (CM)



Use of CM



Contract



System



Education,
Reverse Engineering

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Models – true?, false?, good?, problematic?

Model: A structure-map of some part of reality?

Example of a model: - a MAP



Models simplify

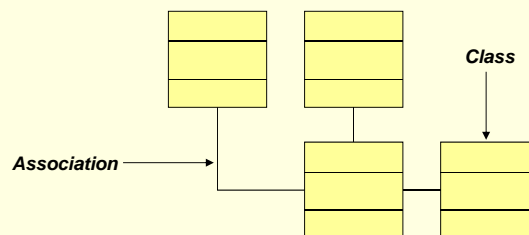
Models distorts - Greenland, Africa

Models focuses and highlights - topographically, politically etc. etc.

Modelling languages: Complex languages with many symbols VS simpler languages that are, perhaps?, easier to understand and validate for domain-knowledgeable stakeholders who know the domain but not the modeling-language.

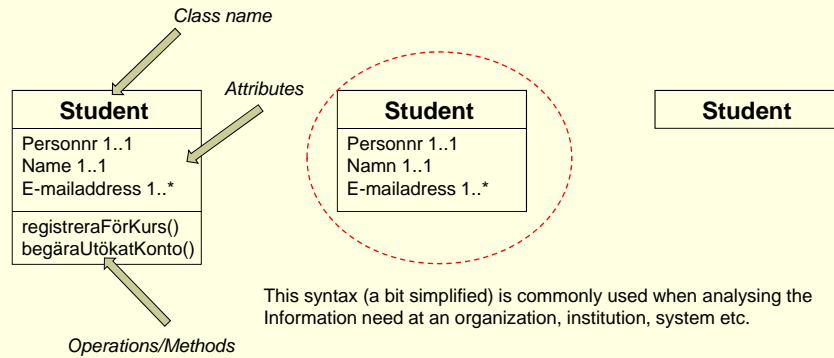
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UML klassdiagram revisited



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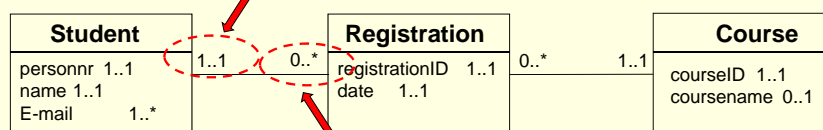
Classes – variations in syntax



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Multiplicities – minimum..maximum

A role: how a Registration views the relationship toward a Student!



Another role: how a Student views the relationship towards a Registration.

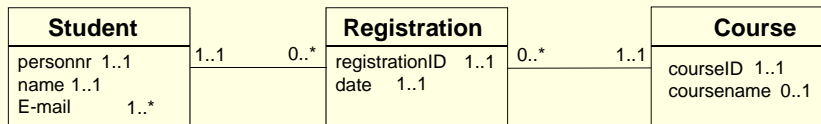
Multiplicities (or cardinalities) for an **attribute** or a **role in an association** shows how many objects the association can/must refer to or how many valued the attribut can or must have.

Values for multiplicities:

- The minumum value is given first
- The maximum value last
- Two full stop separate minimum and maximum values: **Min.. Max**

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Multiplicity – common combinations



1..1 At least 1 and at most one

Example: A student has one and only one value on `personnr`.

1..* At least 1 and possibly many

Example: A student always have an e-mail address but can possibly have very many.

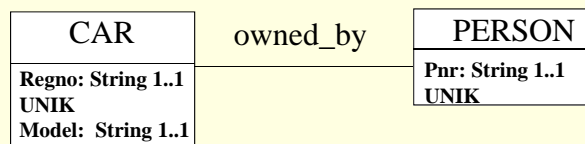
0..* Not necessarily any but possibly many. Example: A student may not be registered at any course but can be registered at many courses.

0..1 Not necessarily any but at most one

Exempel: A course need not have a course name and can have at most one

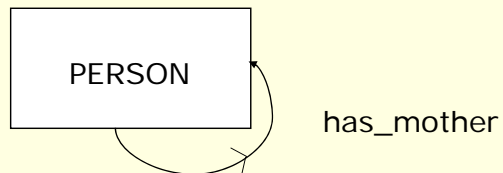
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Multiplicities – rules in the system vs 'common sense'



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Multiplicities – an other exercise

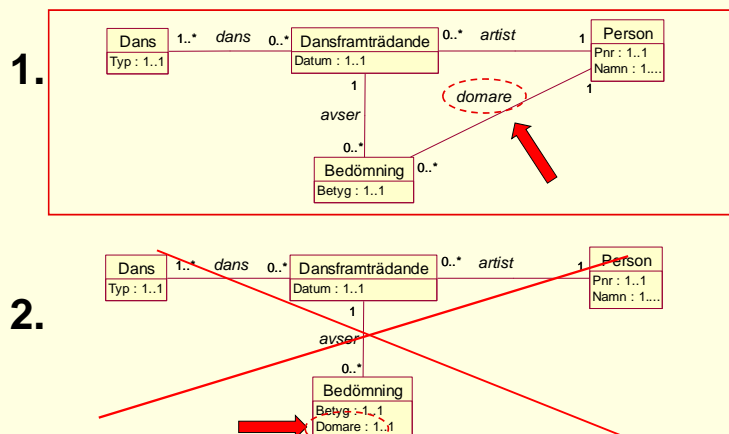


What multiplicities hold for the association 'has_mother' ?

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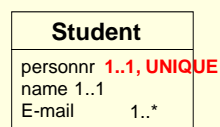
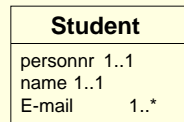
Classes are related via associations– NOT via attributes!

Compare the following two UML-diagram:



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Multiplicities for ATTRIBUTES in UML – What identifies a class?



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So how do we start to model...?

- In a real situation users are interviewed, manuals read, legacy systems studied, organizations analyzed etc....
- Sometimes we only have access to textual descriptions of the system-to-be-modelled
- How to analyze large walls of text? Verbs, nouns, adjectives? Modelling patterns, so called data-abstractions, rules of thumb, etc...

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Same word – different concepts (homonyms)

- How is the word "book" used in the sentences below?
 - Jules Verne wrote many books, one of which has the title 'The Children of Captain Grant'
 - The library in Vällingby has many books
 - If 'The Children of Captain Grant' was printed in A4-format the number of pages in a printed copy will be 100.
 - The shopkeeper in a bookstore in Jönköping sold many books.

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The same concept – different words/terms (synonyms)

- Fire – Let go
- Labour giver – Labour buyer
- Student – Pupil?

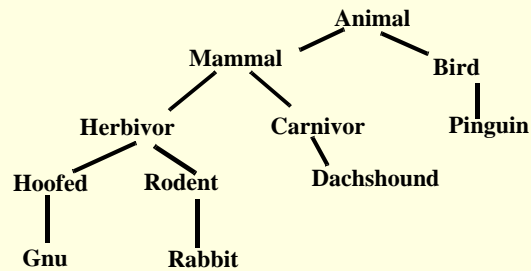
Do synonyms always mean the same? For instance across organisational or institutional borders?

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Modelling patterns – Analysis patterns

- Data abstractions

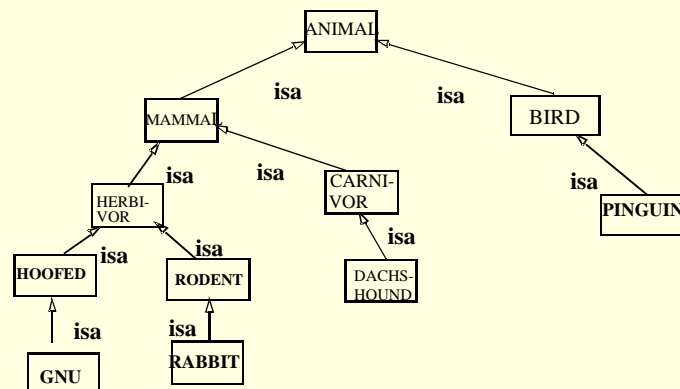
Whatever reality one wish to model there will be hierarchical structures. This means we have to catch these structures in our model of the same reality.



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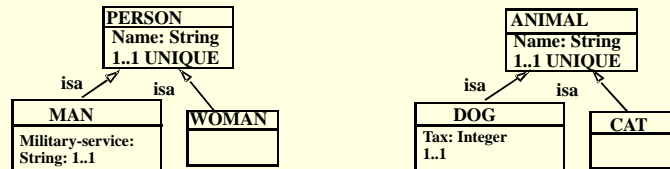
Inheritance/Generalization/Specialization

Class schema with so called 'isa'-associations:



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Inheritance/Generalization/Specialization



MAN and WOMAN are mutually exclusive and exhaustive wrt PERSON.

CAT and DOG are mutually exclusive but NOT exhaustive wrt PERSON.

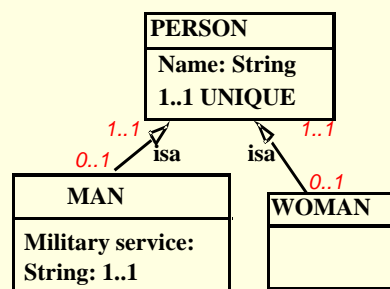
An inheritance hierarchy consists of super and sub-types. The sub-type is a subset of the supertype. If the sub-types cover the entire super-type the subtypes are said to be exhaustive with respect to the super-type. If one and the same instance cannot be part of more than one sub-type the sub-types are said to be mutually exclusive.

Partial attribute = an attribute with minimum value = 0

Total attribute = an attribute with minimum value > 0

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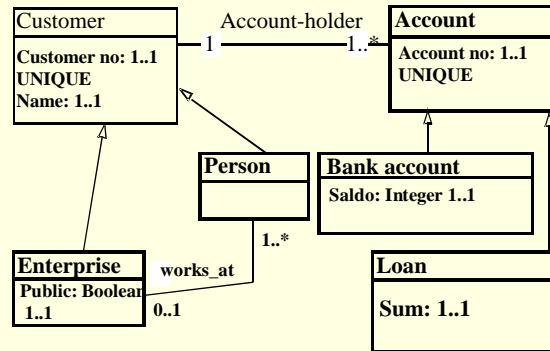
Inheritance/Generalization/Specialization



What are the multiplicities for an *isa*-relation?

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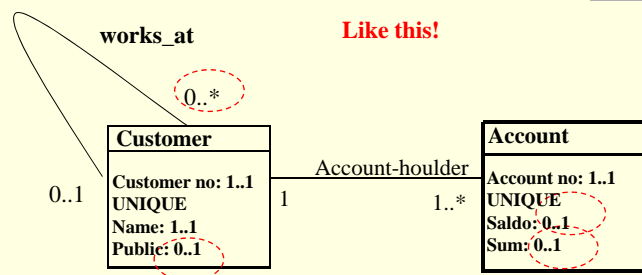
Inheritance cont.



What would the schema look like if isa-relations were not used?

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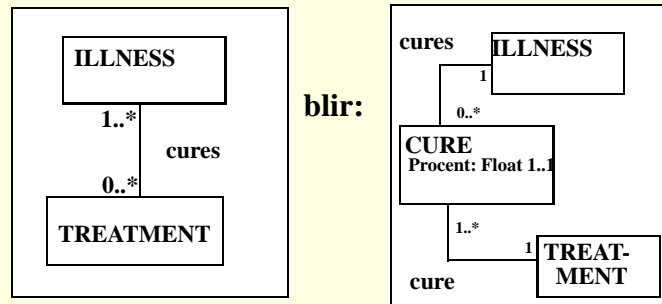
Inheritance continued



Better? Worse? What are the advantages and disadvantages of using generalization/specialization?

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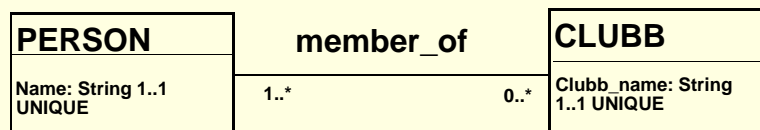
Reification



The association “cures” is M:M. If we want to store information about the relation “cures” it must be reified, i.e. made into a class. Other M:M-associations may be left as they are at the modelling level but will be turned into tables in a DBMS!

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Excercise reification



Extend the conceptual schema above so that it can represent that a certain person entered a certain clubb a certain date!

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Template-copy

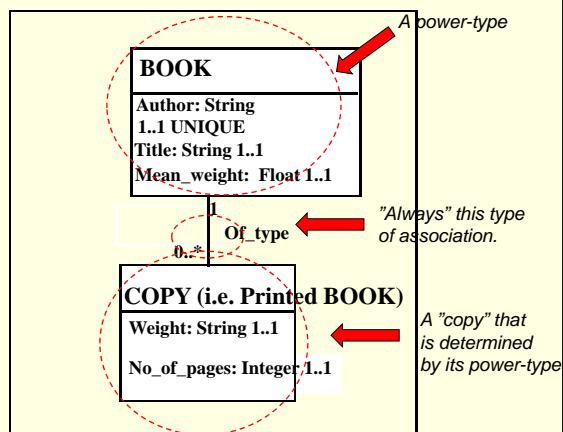
- How is the word "bok" used in the sentences below?
 - Jules Verne skrev många böcker, en heter 'Kapten Grants barn'
 - Biblioteket i Vällingby har många böcker
 - Om 'Kapten Grants barn' trycks i A4-format blir antalet sidor i en tryckt bok 100 och den väger 150 gram.
 - Bokhandlaren i Jönköping sålde många böcker

BOOK
Author 1..1
Title 1..1
Weight 0..1
No_of_pages 0..1
Mean-weight 0..1

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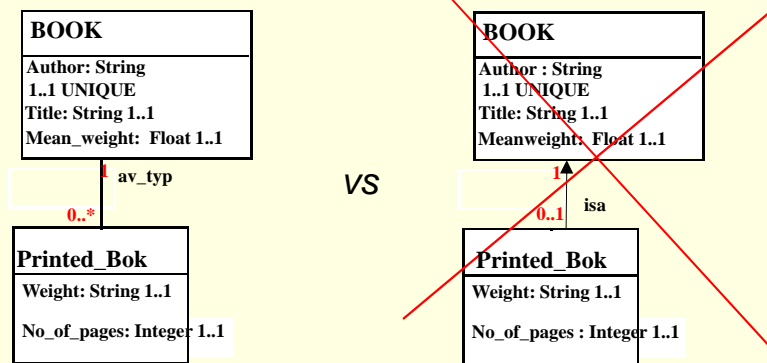
Template-Copy structures (power types, "category classes")

Certain objects may be seen as templates for other objects - copies.
 A template describes the general features of the copy - the copy may contain other features.
 Templates (power types) often model abstract phenomena while copies more often model concrete ditto.
 BOOK is a typical example of a template, the book as a piece of art. The BOOK has a title, an author etc. The individual copies are the physical printed copies of the book. A copy has attributes of its own such as weight, number of pages etc.
 OBS, a COPY is NOT 'isa' a BOOK! Template-copy relationships are not 'isa'-relationships.



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Template-Copy structures (power types, "category-classes") compared to inheritance:



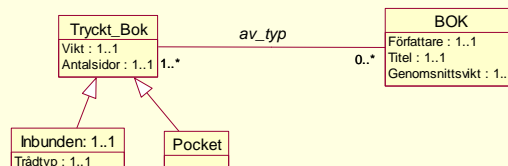
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Multiplicity as measure of model quality?

Rule of thumb: All attributes in a class should be total (= min value 1)

A large number of partial attributes (i.e. attributes with mininum value = 0) means that not all instances of the class has a value on said attributes, which **may** mean that **several** different phenomena are modelled in **one and the same class**. This may be remedied by using inheritance (when there is several subsets of one and the same phenomenon) or via power types (when the same phenomenon exists on different levels of abstraction).

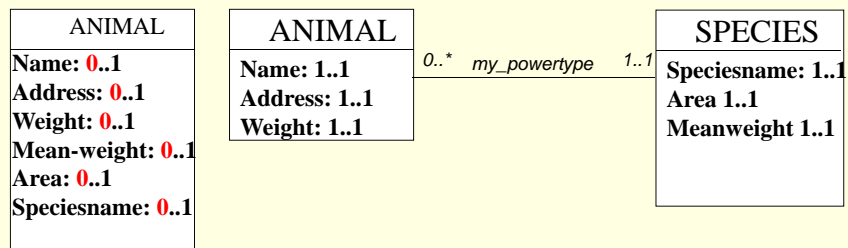
Author 1..1
Title 1..1
Weight 0..1
No_of_pages 0..1
Mean-weight 0..1
Binding: 0..1



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Power-types – yet another example

Rule of thumb: All attributes in a class should be total (= min value 1)



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Summary: modelling mechanisms

- Classification – from domain phenomenon to classes including attributes and associations
- Generalization/Specialization/Inheritance
- Reification
- Power-type – copy categorizations
- More? Yes!

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