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Conceptual modelling

Erik Perjons

Questions to answer

- What is a concept?
- What is a conceptual model?
- Why do we create conceptual models?
- What is classification and generalization?

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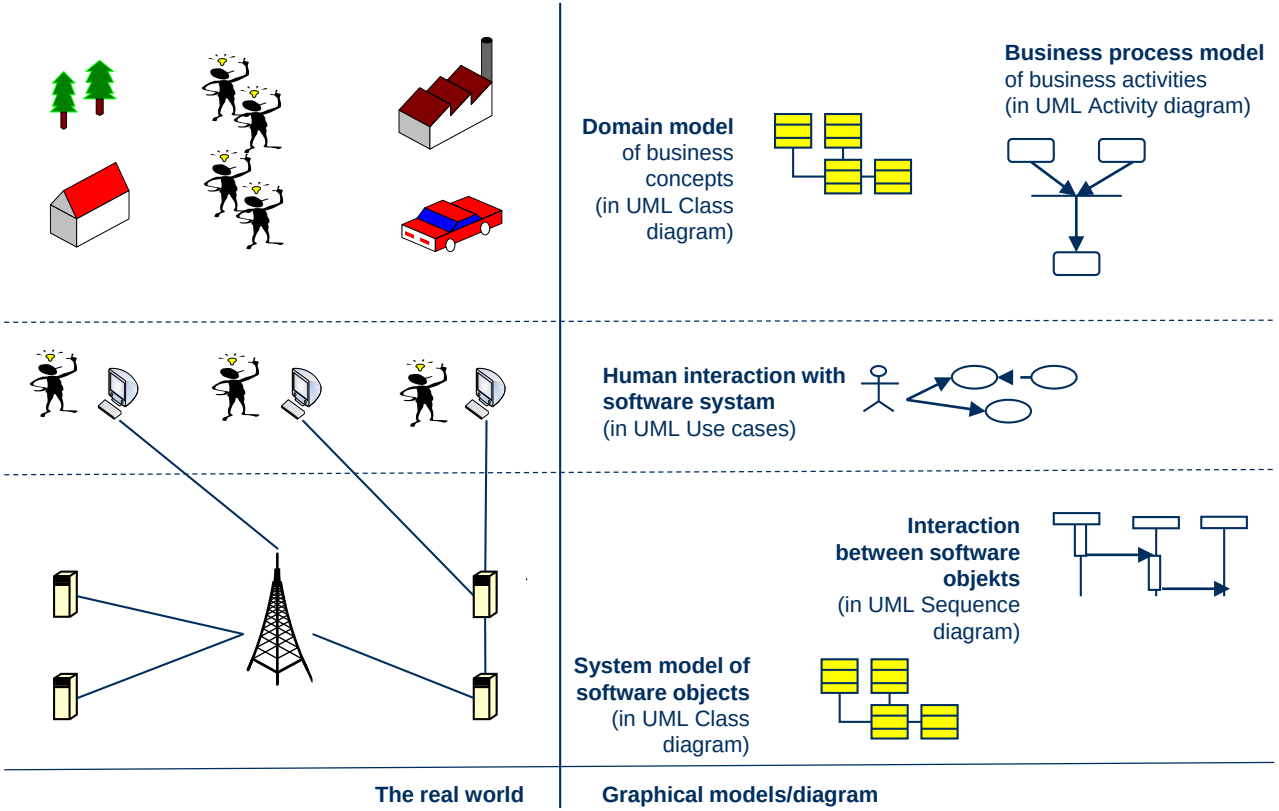
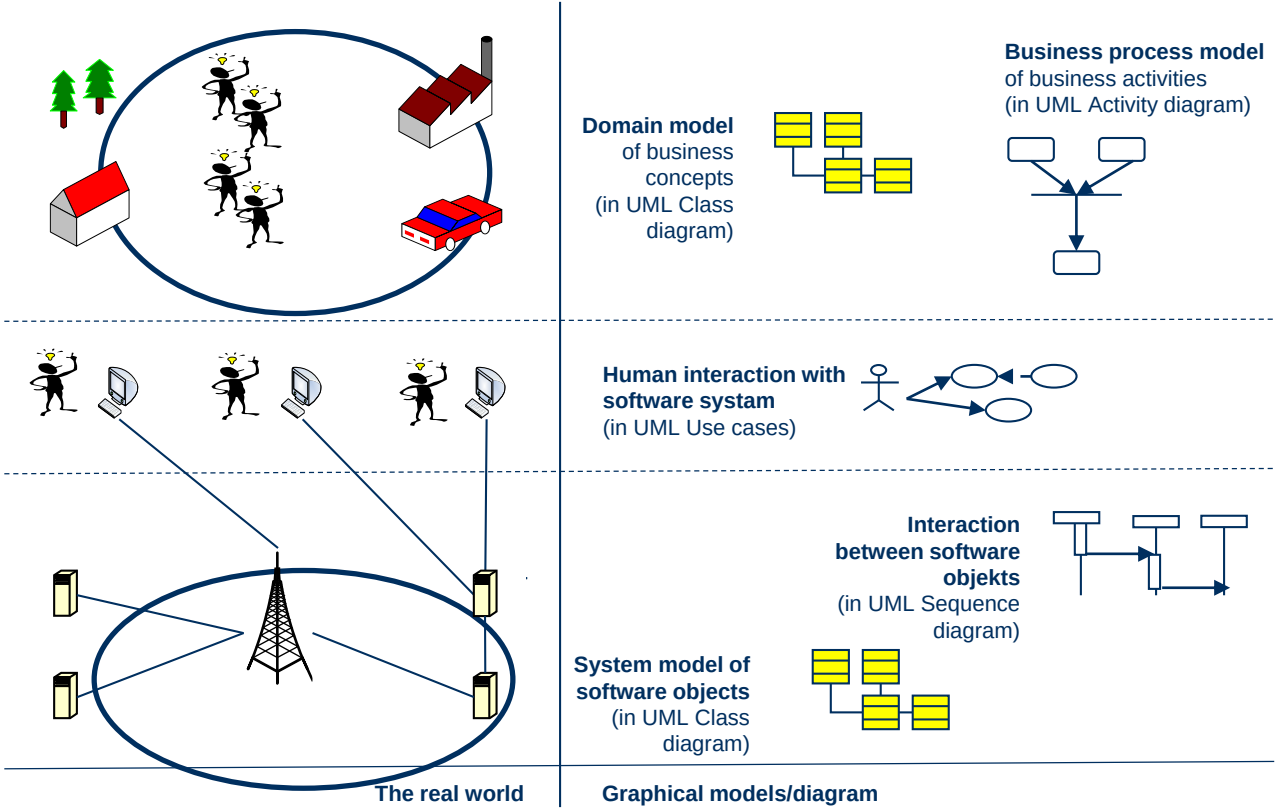
Concepts and Models

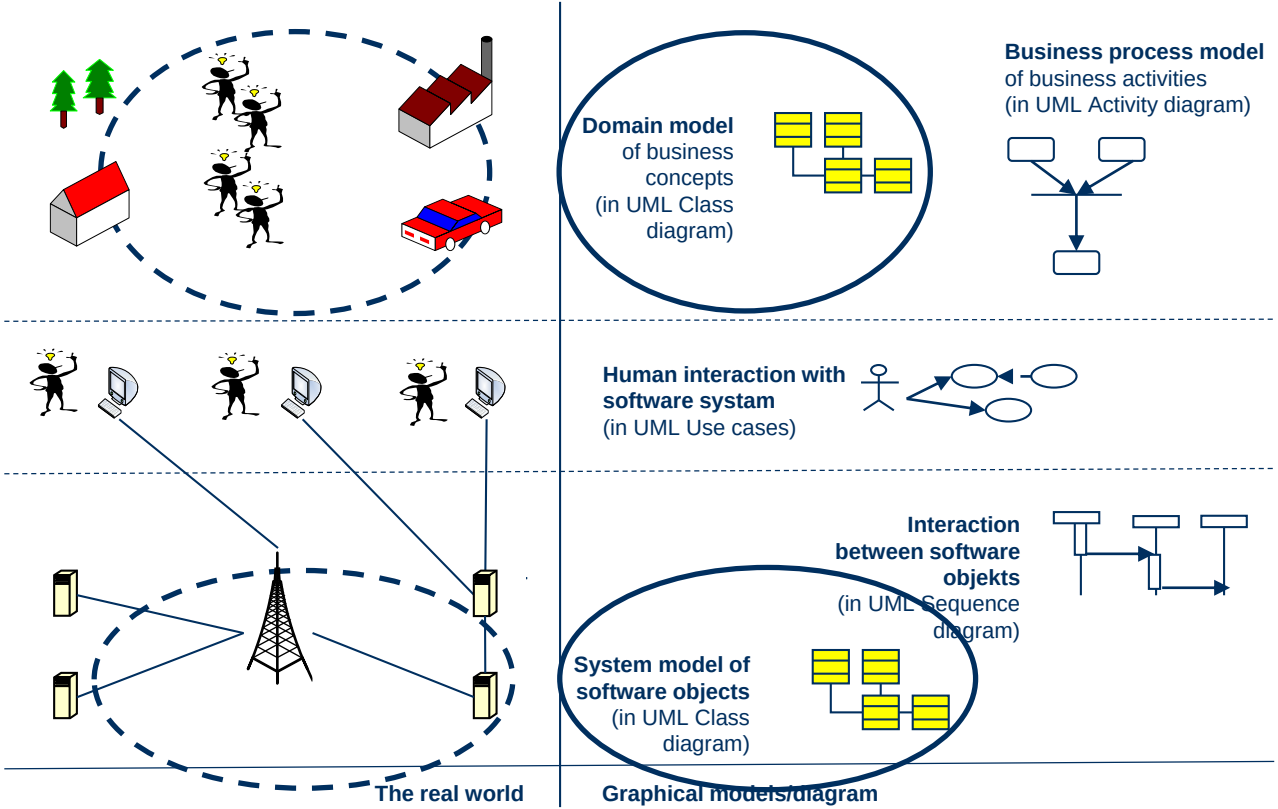
Real World and Models



Concepts (in Real World)



Conceptual Models



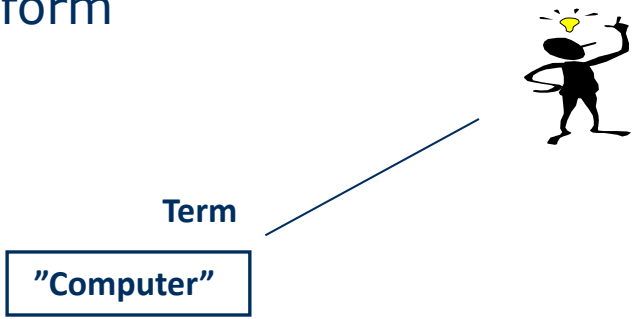
Concepts (in the Real World)

Concept

- A concept is how we think about things or what we mean. A concept can be seen as thought unit or a mental view.

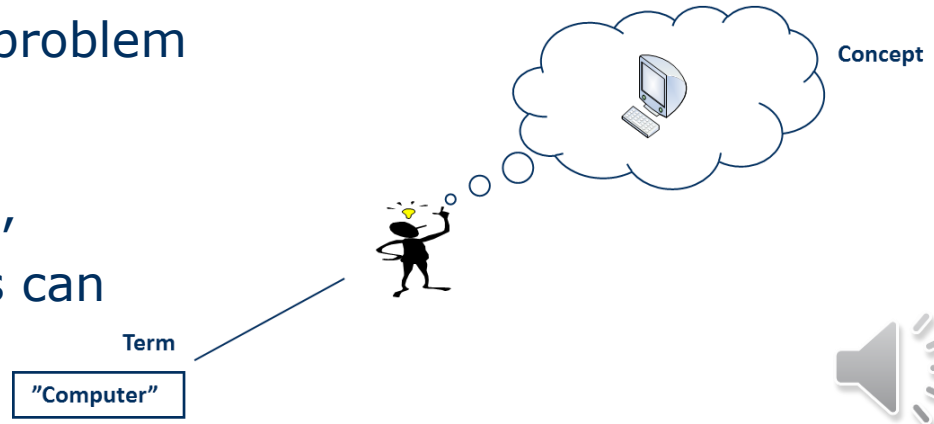
Term

- A term is a representation of a concept
- A term can be seen as a sign for the concept, for example, in form of a word, a group of words (phrase), or symbol



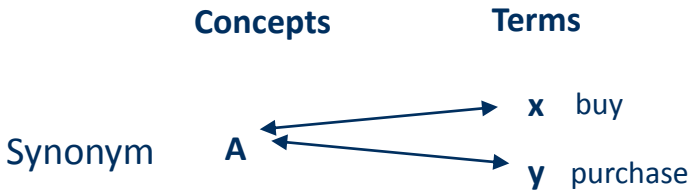
The Relation between Concept and Term

- In order to express a concept, a term is needed
- If the relationship between the term and the concept is ambiguous, interpretation problem can emerge.
- The existence of synonyms, polysemes, and homonyms can cause such problems



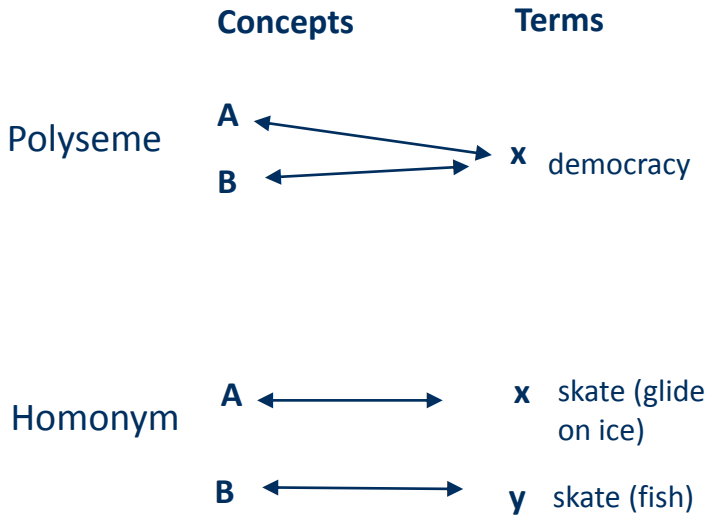
Synonym

- Synonym - is a term that means the same as another term in the same language (such as ”buy” and ”purchase”, ”big” and ”large”)



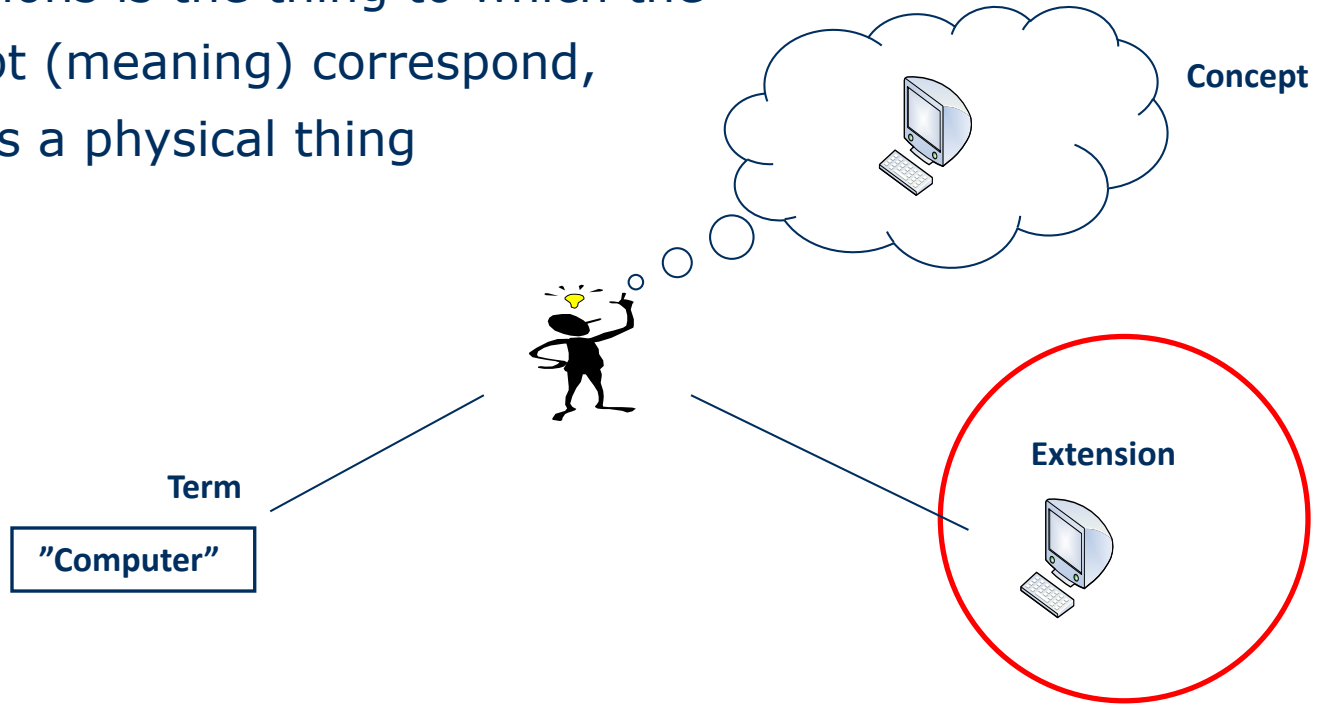
Polyseme and Homonym

- Polyseme – is a term that have different but related meanings (”democracy” – different meaning in different economic systems, ”service-oriented development”)
- Homonym – is two terms with the same spelling or sound and have different meanings



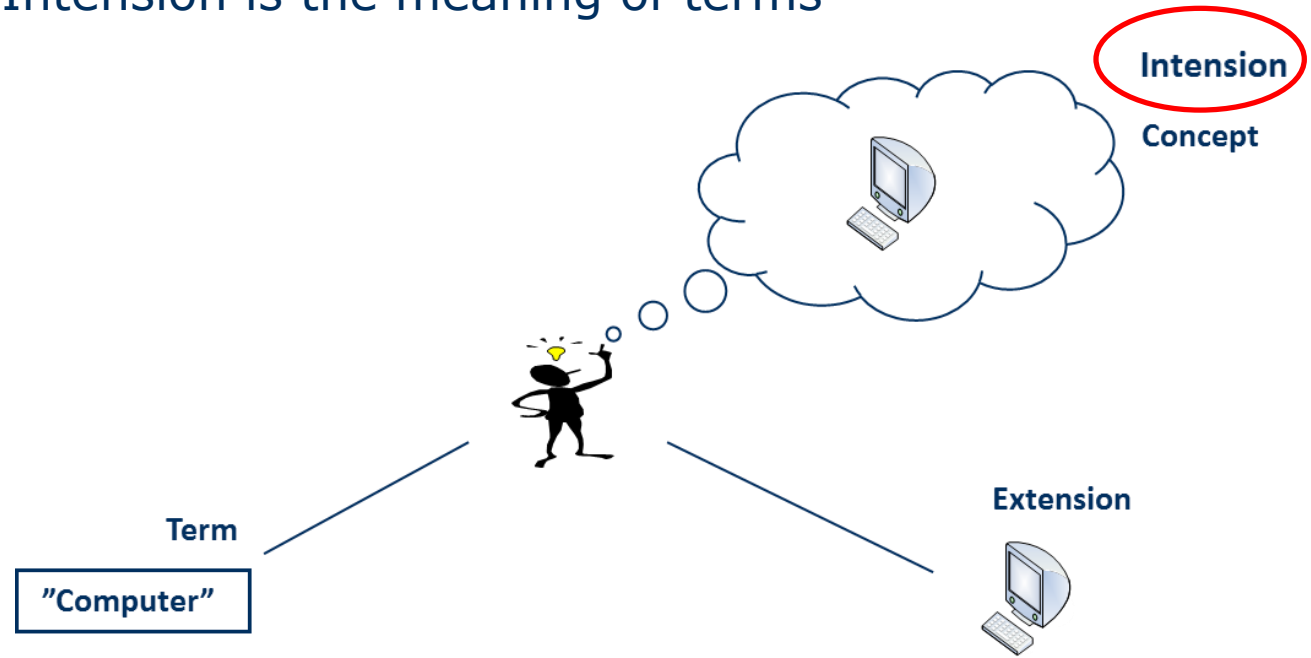
Extension

- Extensions is the thing to which the concept (meaning) correspond, such as a physical thing



Intension

- Intension is the meaning of terms

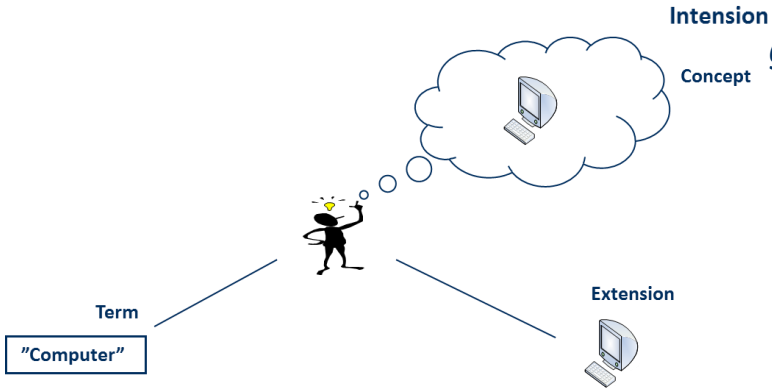


Definitions

- A **definition** is a statement of the meaning of a term
- Use definitions to limit possible interpretations of a term
- Definitions can be extensional or intensional

Intensional Definitions

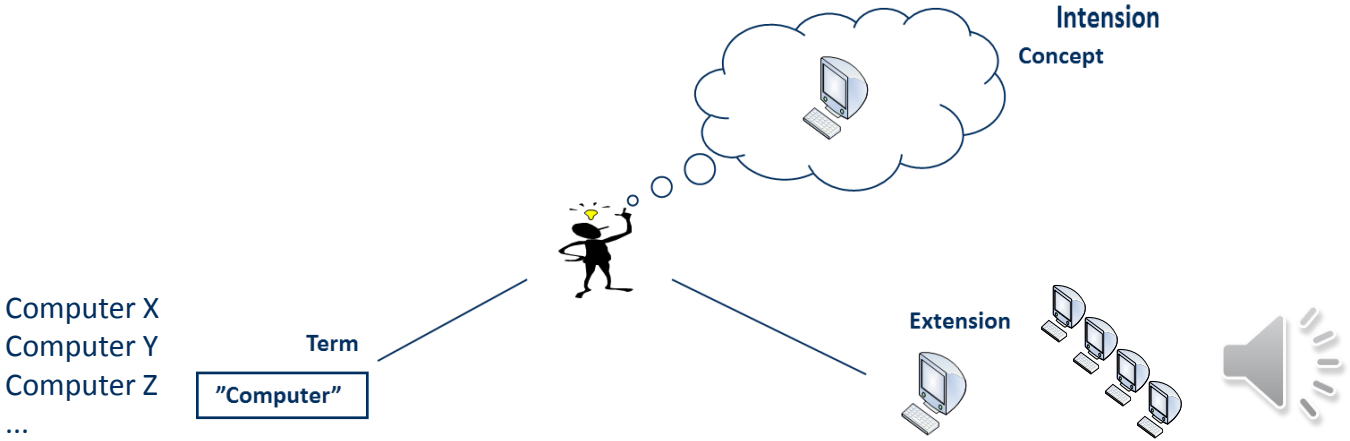
- Intensional definition – specifies the characteristics of the concept that a term represent. For example, a *"barchelor"* is a *man that is unmarried,* and a *"computer"* is ....



*"A **computer** is a general-purpose device that can be programmed to carry out a set of arithmetic or logical operations automatically".*

Extensional Definitions

- Extensional definition – lists every thing in the extension that falls under the definition. For example, if the term to define is ”computer” you need to list all computers, or the term is ”barchelor” you need to list all unmarried men in the world



Guidlines for definitions

- **Use intensional definitions** and not extensional definitions if possible
- Start the intensional definition by using the expression **”X is …”** or **”X means …”** where X is replaced by the term to be defined and the ”…” is the definition (*barchelor* is *a man that is unmarried)*
- Use the genus-differentia method when defining a term using an intensional definition

Genus-differentia method

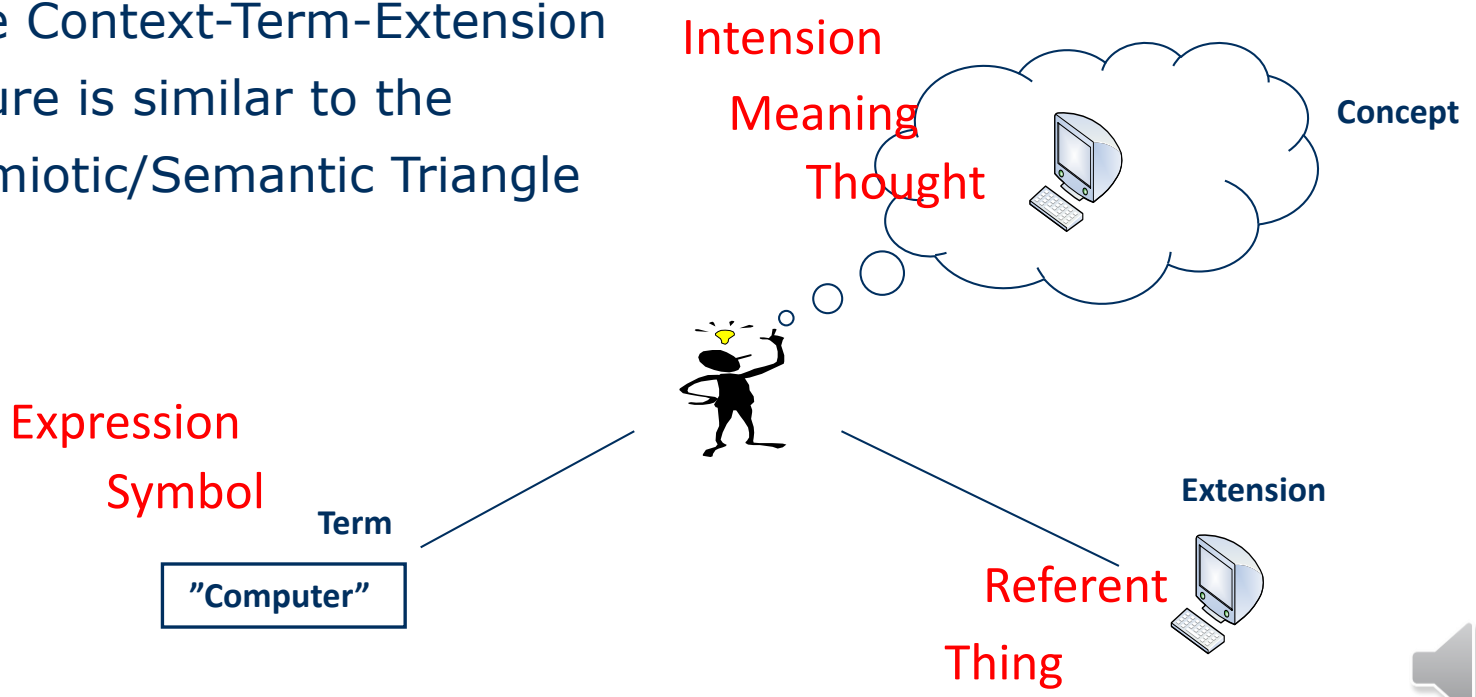
- Exempel: A witness is a person that tesify under oath at a trial
- The genus-differentia method means that a term is defined by using both:

  1) the category (called genus) to which the *item* is suppose belongs to (such as person), and

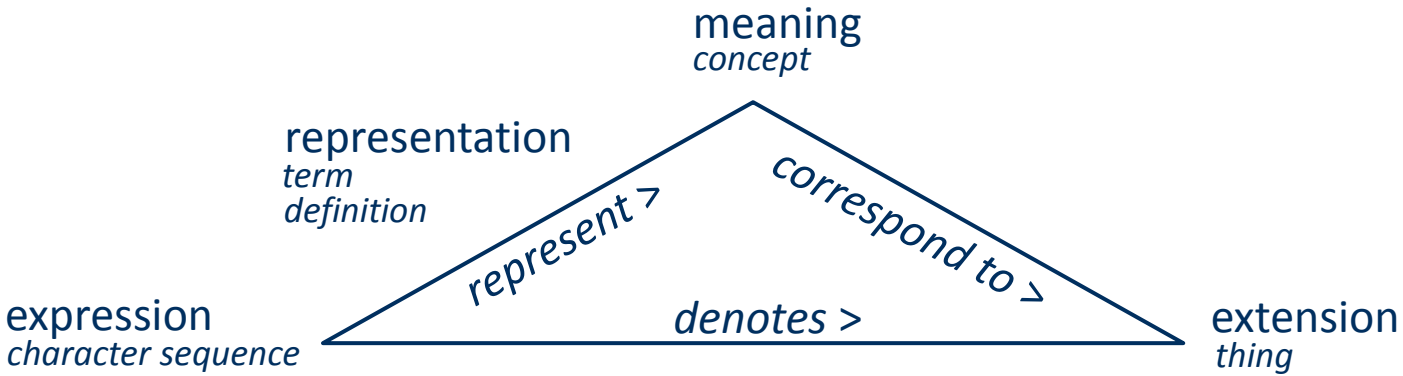
  2) the characteristica that separate the *item* from other *items* in the same category (called differentia)

Concept-Term-Extension

- The Context-Term-Extension figure is similar to the Semiotic/Semantic Triangle



SBVR

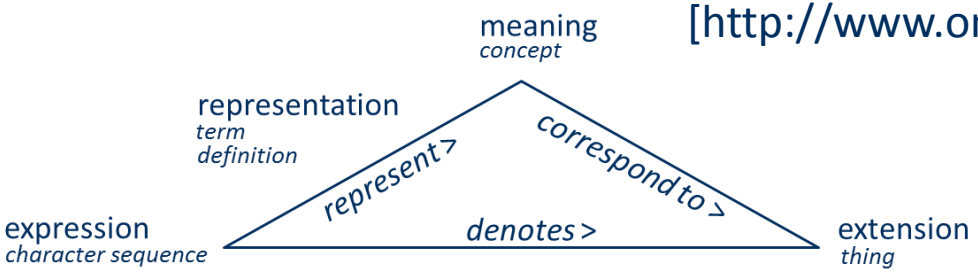


[http://www.omg.org/spec/SBVR/] [Note, SBVR is somewhat simplified and changed by me]

SBVR

Extension	Meaning	Representation	Expression
The actual drivers of motor vehicles	Concept ”driver” – how we think about drivers, what characterizes them	The term driver which relate the concept ”driver” to the character sequence ”driver”	The character sequence ”driver”
		Definition of the concept ”driver” as ”operator of a motor vehicles”	The character sequence ”operator of a motor vehicles”

[http://www.omg.org/spec/SBVR/]



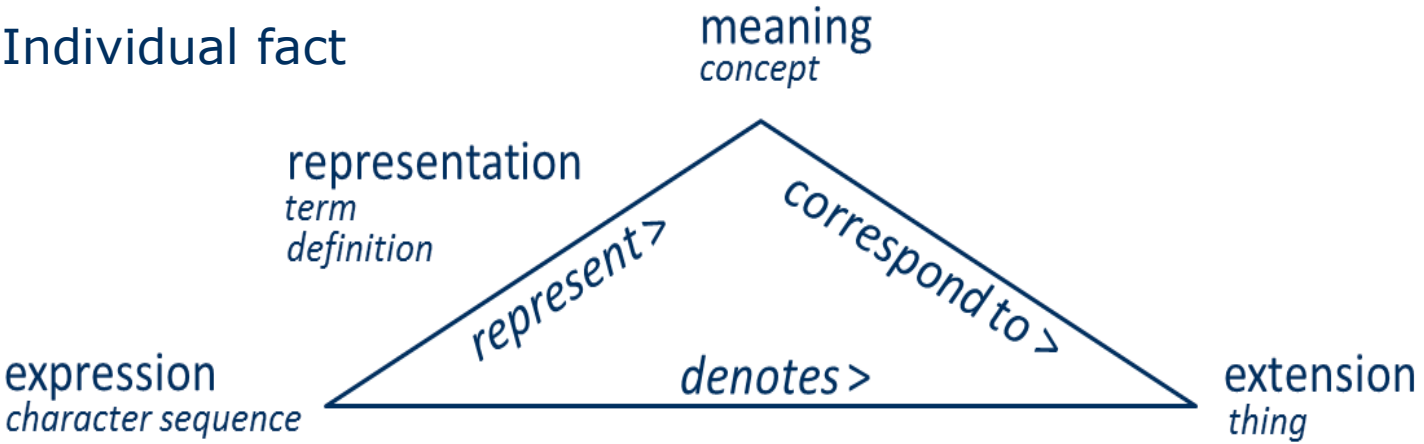
SBVR

- *Semantics of Business Vocabulary and Rules (*SBVR) is a OMG specification (i.e. standard) supporting documention of the semantics of business vocabularies and business rules
- SBVR also support exchange of such business vocabularies and business rules between organization and IT systems

[http://www.omg.org/spec/SBVR/]

SBVR

- Individual concept
- General concept
- Verb concept
- Individual fact

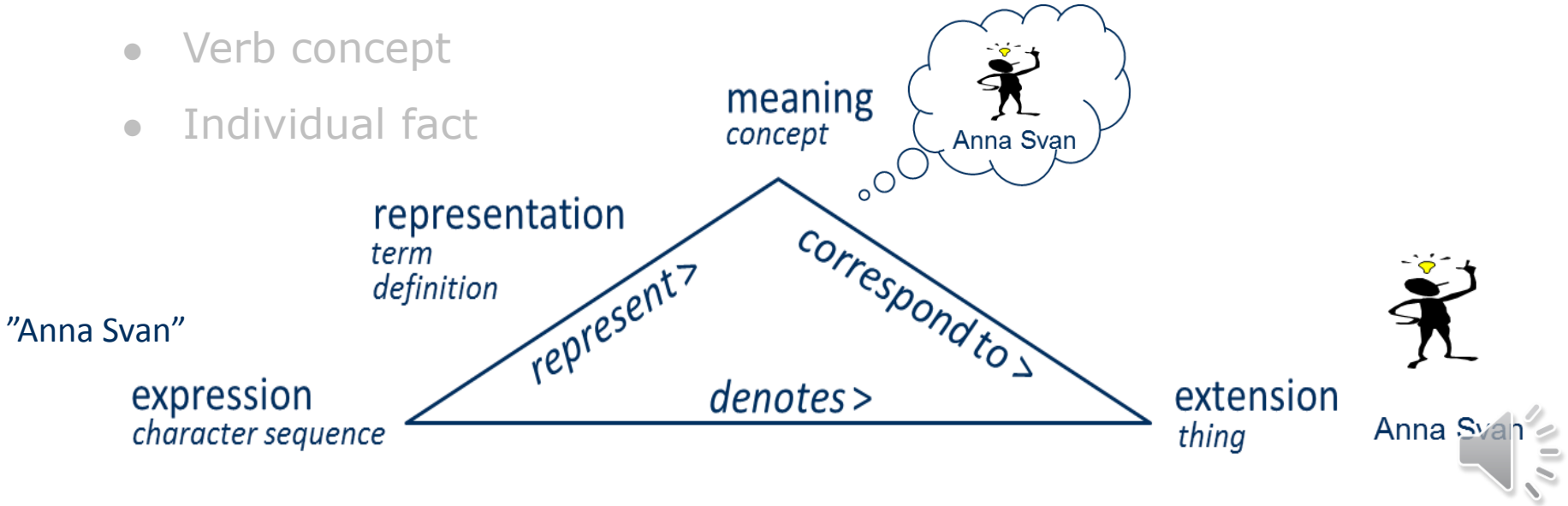


[Haarst (2013): SBVR made easy]

SBVR

- **Individual concept**
- General concept
- Verb concept
- Individual fact

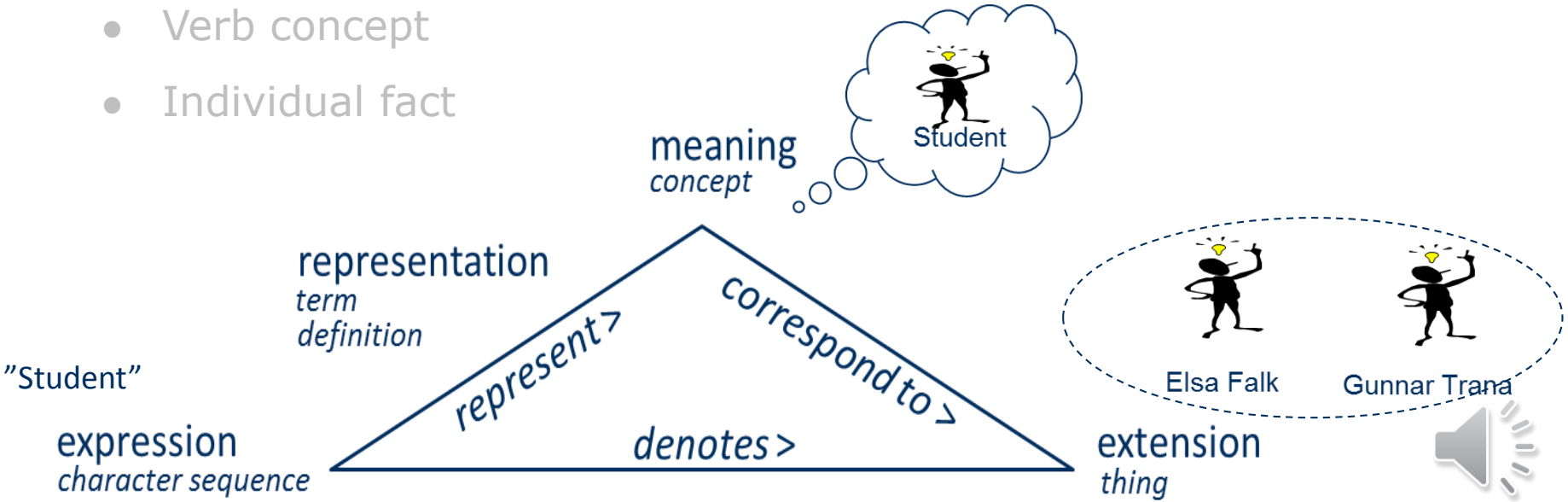
- An **individual (noun) concept** – correspond to one specific thing, that is, **one instance** in the extension (the real world)



SBVR

- Individual concept
- **General concept**
- Verb concept
- Individual fact

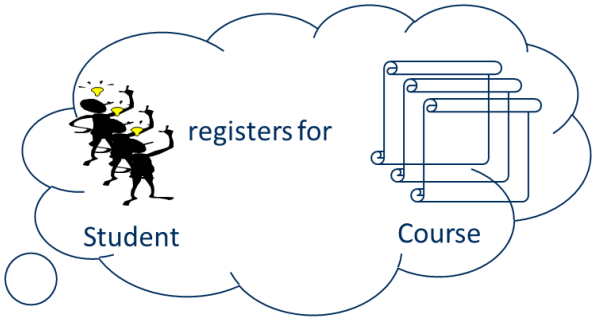
- A **general (noun) concept** – correspond to two or more actual things that are grouped**,** that is, correspond to a **group of instances** in the extension (the real world)
- This ”procedure” can be called **classification**

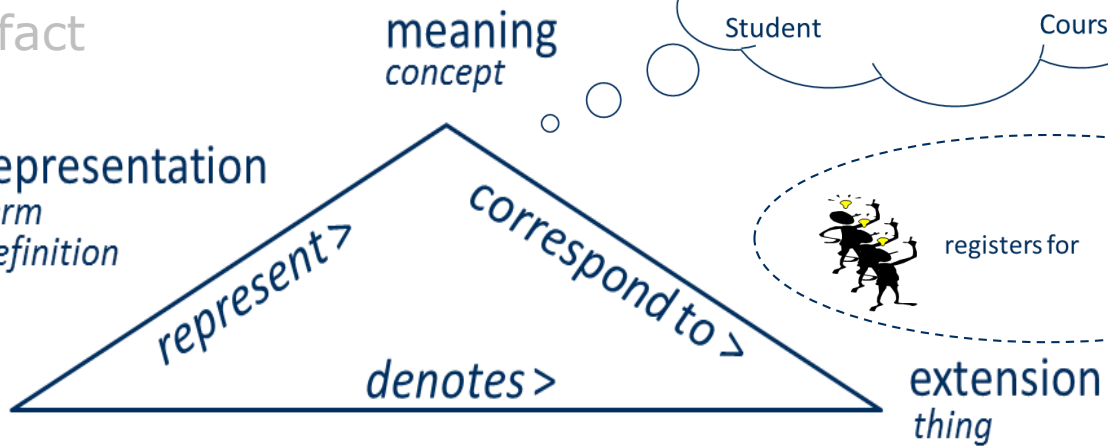


SBVR

- Individual concept
- General concept
- **Verb concept**
- Individual fact

- Things get involved in relationships with other things
- A **verb concept** is the whole **structure of a relationship and the related <u>general</u> concepts**



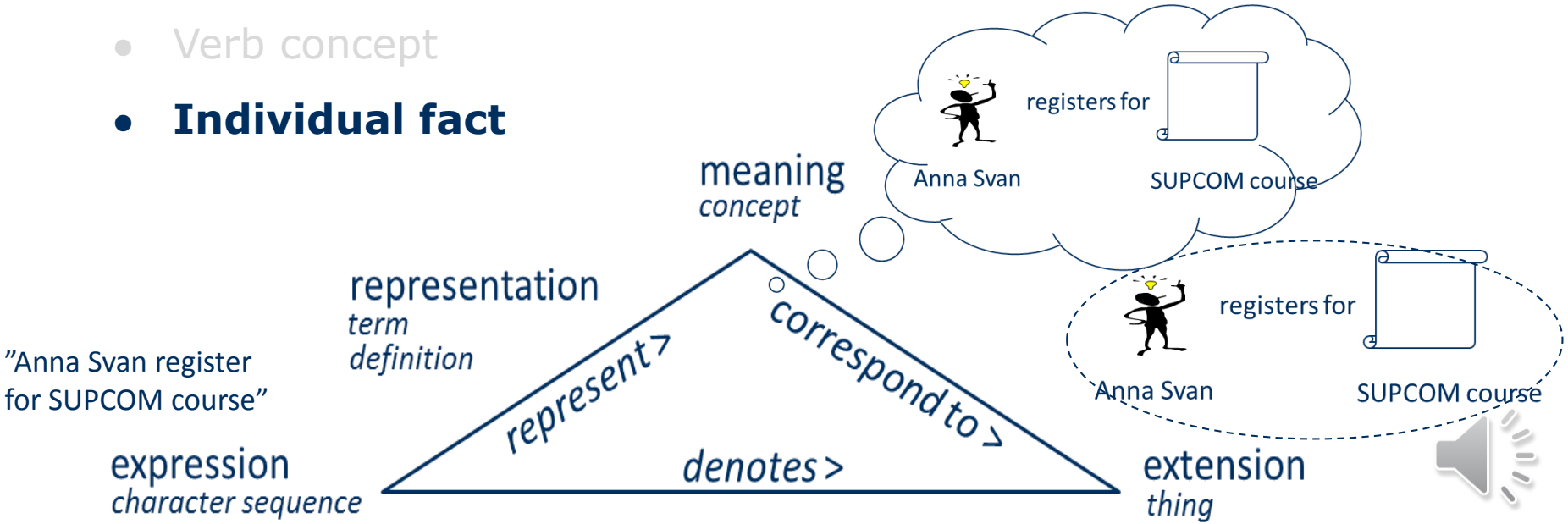


”Student registers for course”

SBVR

- Individual concept
- General concept
- Verb concept
- **Individual fact**

- **Individual facts** is the **whole structure of a relationship and the related individual (and not general) concepts**
- Individual fact is something that may be found to occure in the extension (real world) or not (actual/not actual; true/false)



Conceptual Models

Modelling Instances

Real World

Model World

Elsa Falk

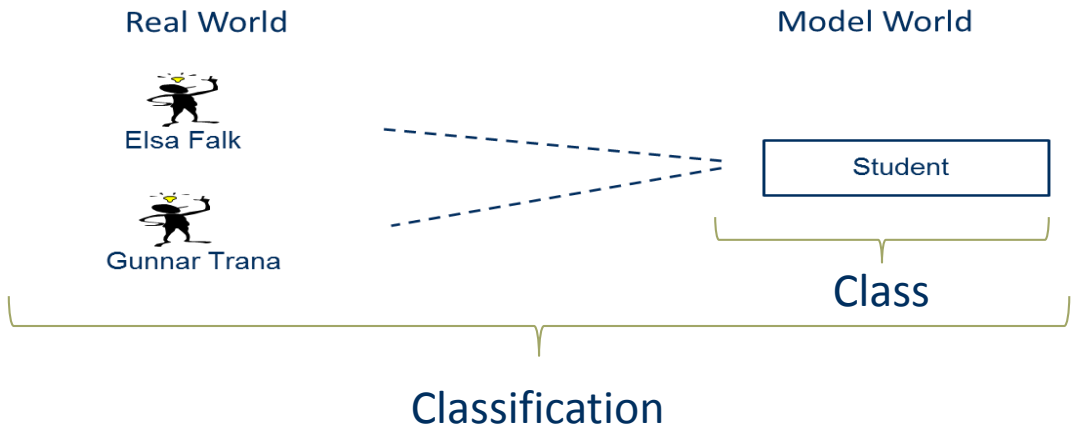
Elsa Falk

Gunnar Trana

Gunnar Trana

Modelling a Group of Instances

- Modelling a **group of instances into a class** is called **classification**
- Classification means (in practice) that properties that are common are highlighted and properties that differs between the instances are disregared (for example, gender, hair colour, etc)



Modelling Attributes of Class

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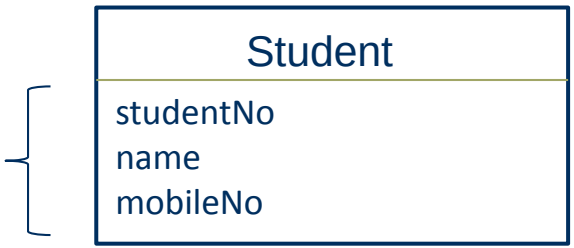
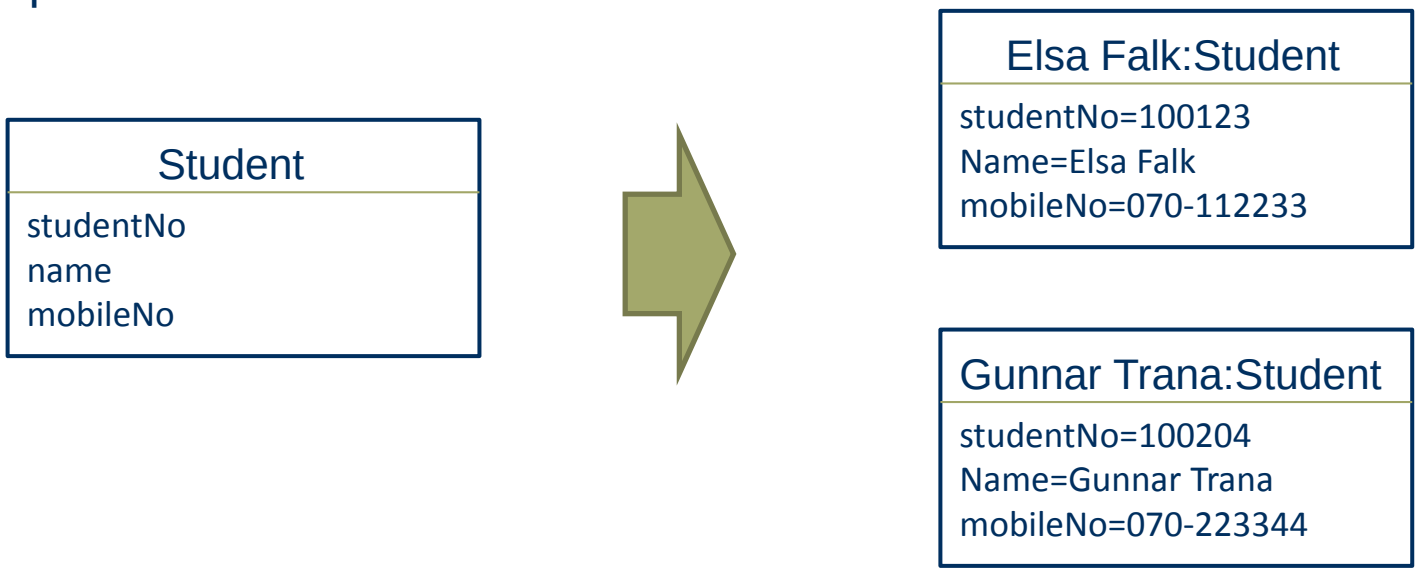
Properties
/Characteristics
/Attibute

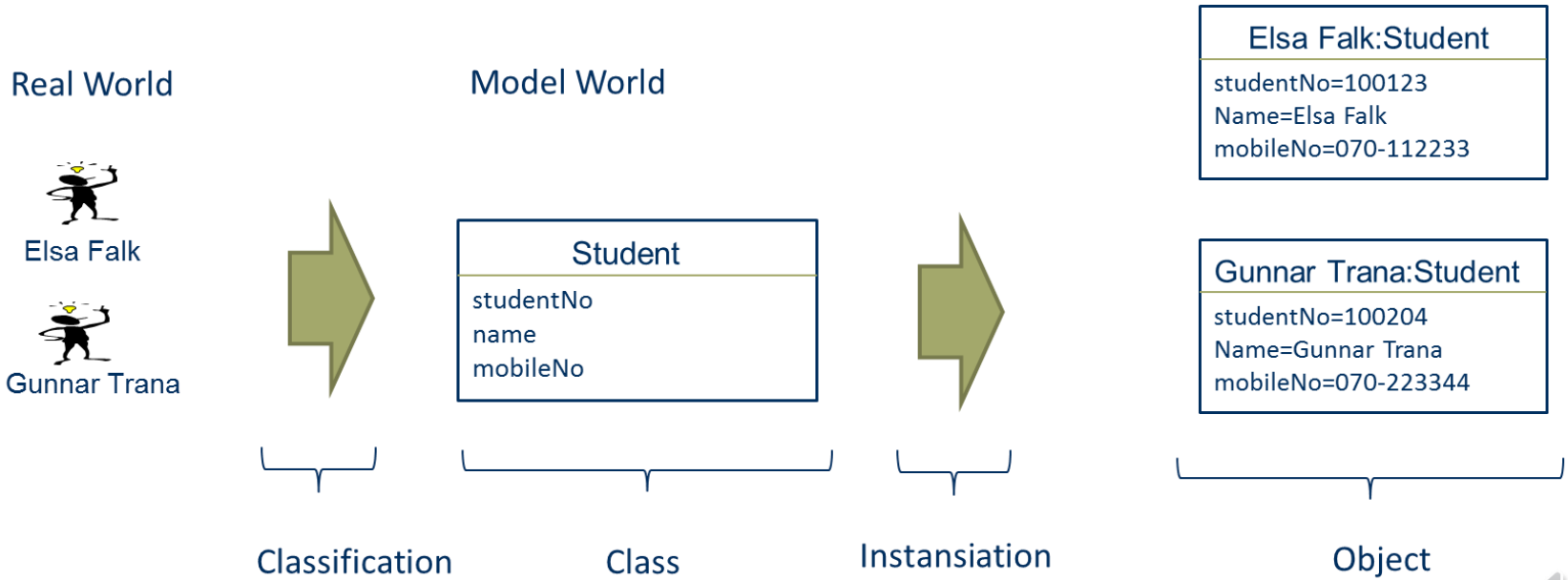


Creating Objects from the Class

- The class can be **used as a template** for **creating model instances** – often called **objects**. This ”procedure” can be called **instantiation**



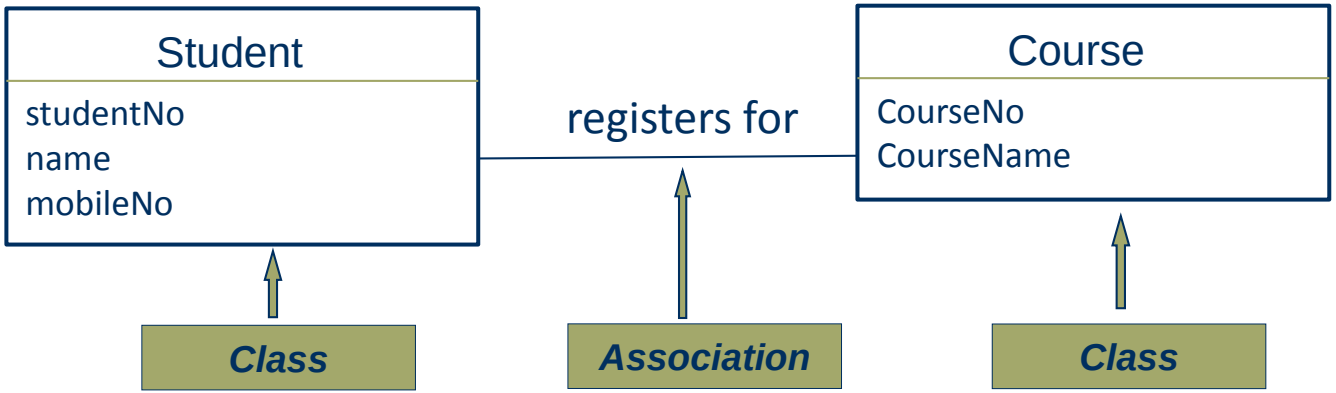
Modelling Class and Objects



Class and Association Structure

- Relationships between classes are also modelled, creating a diagram/model (compare SBVR's verb concepts)
- Relationsships between classes are called associations in UML
- The diagram/model can be seen as a "class and association structure"

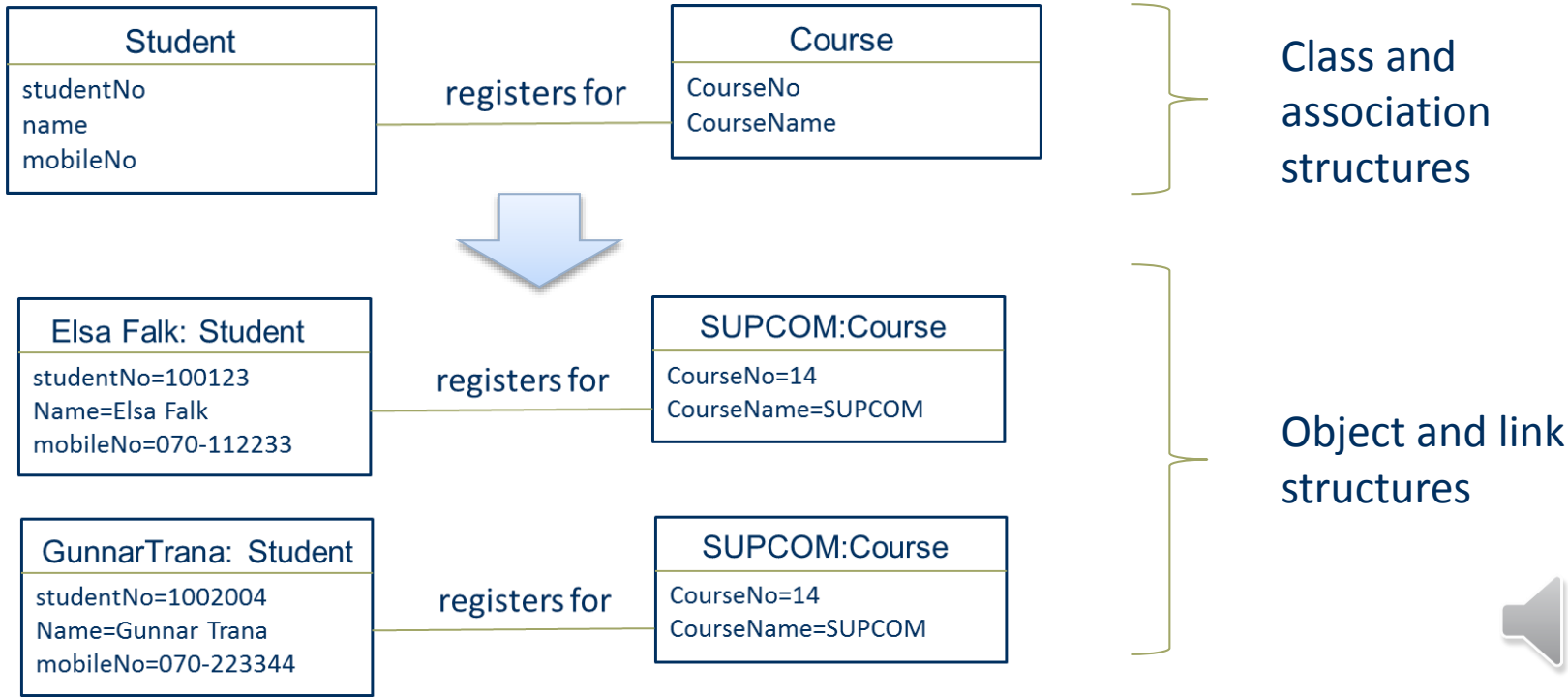
Class and Association Structure



Class and Association Structure

- A class and association structure can be seen an **information structure**, constraining what objects and links are possible to create/instansiate

Creating Object and Link structures

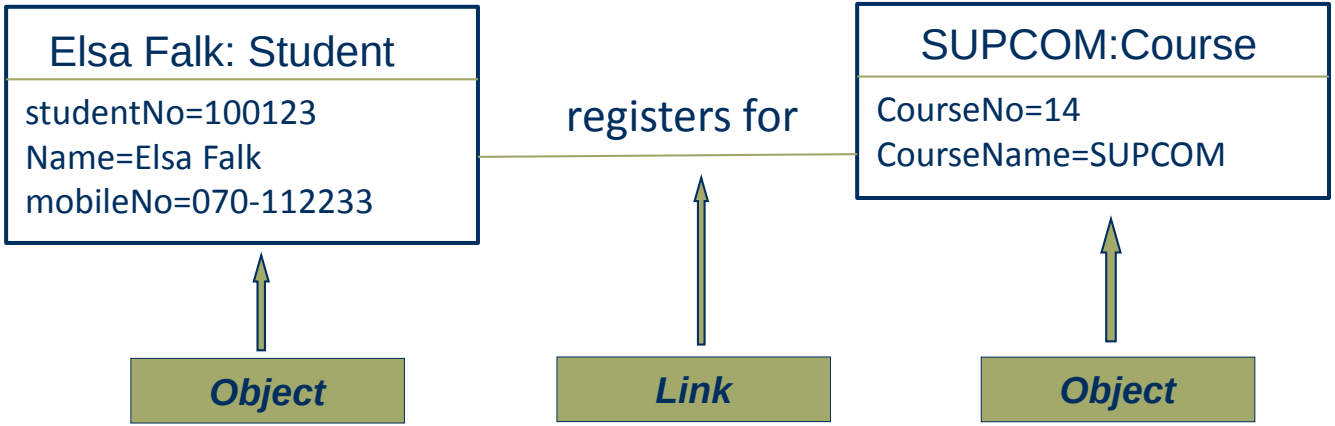


Object and Link structures

- Object and link structures (compare SBVR's individual facts) are usually not modelled, but could be:

Object and Link structures

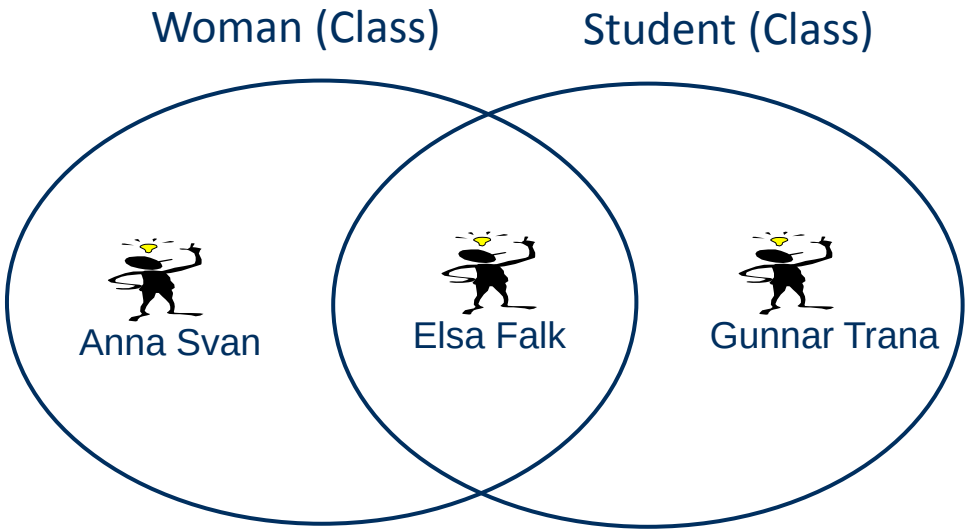
- Object and link structures (compare SBVR's individual facts) are usually not modelled, but could be:



Classification and Generalization

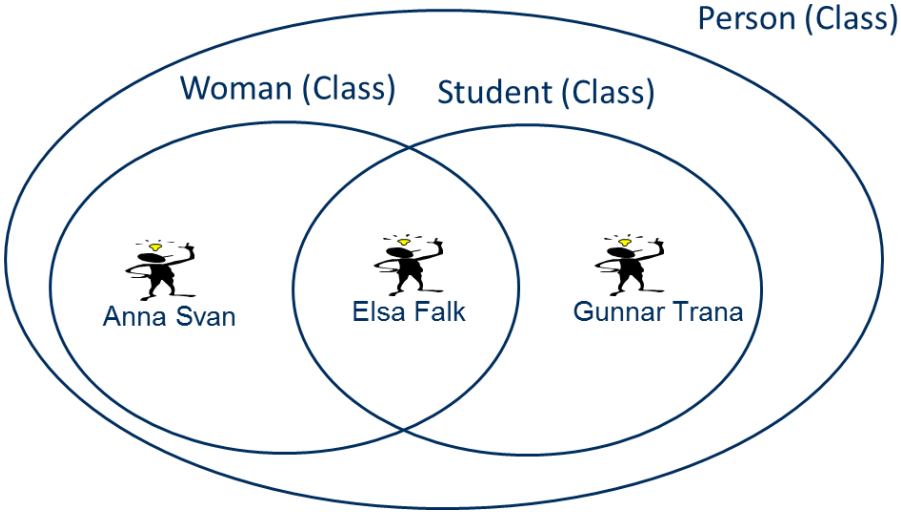
Back to the Real World: Classification

- **Classification** is grouping of instances.
- It means (in practice) that attributes that differs between the instances are disregared (for example, gender, hair colour) and and properties that are in common are highlighted



Generalization

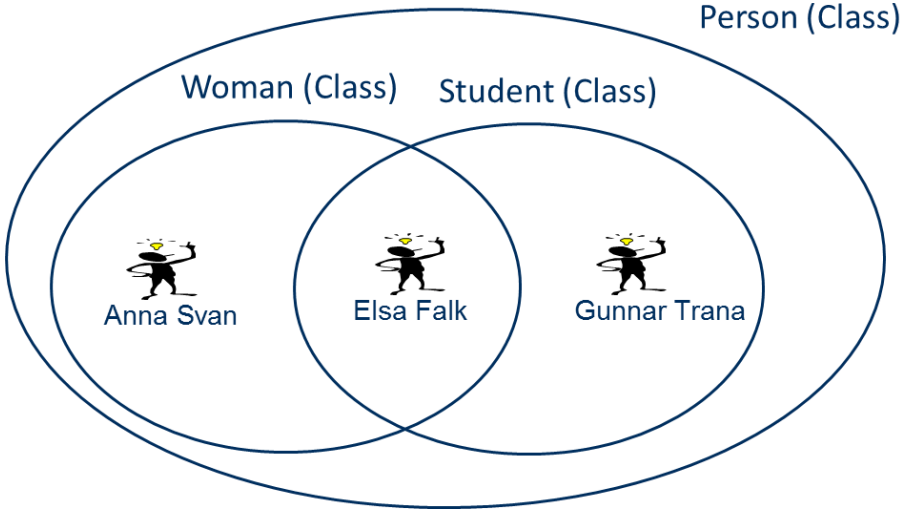
- Generalizering are grouping of classes, where classes totally include others
- The opposite to generalization is specialization



- Person is a generalization of Woman and Student
- Woman and Student are specializations of Person

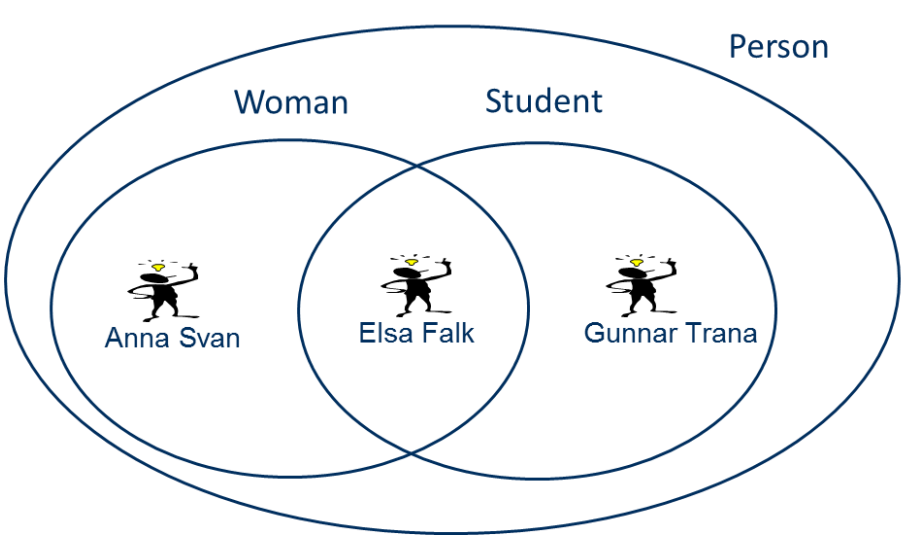
Generalization Test

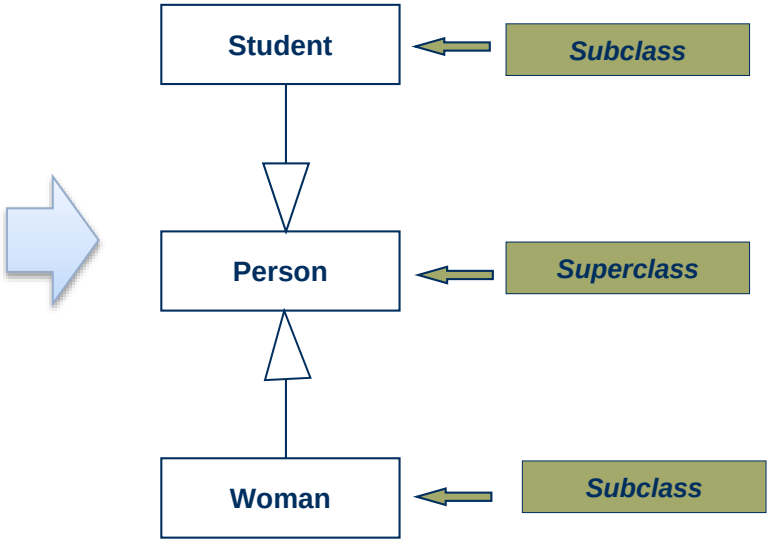
- To test if a relationship between two classes is a generalizering/ specialization relationship: Ask if all instances in a specialized (sub) class are included in the generalized (super) class – if ”yes” it is a generalizering/ specialization relationship



Question: Is Woman a generalization of Student?
Answer: No, there are instances of Student that ar not instances of Woman

Modelling generalization in UML





Real World

The Model World

Why Conceptual Modelling?

- To **specify terms and concepts that are - or should be - used in a organization**. Thereby, support the **development of a common vocabulary,** which will support communication within the organization
- To **specify terms and concepts for an information system** so that the system use the same terms and concepts as the people in the organization, thereby **supporting business and IT alignment**

Why Conceptual Modelling?

- To be used as a **first step as developing a database system or a Java program** (or a programme of some other programming language). The conceptual model can be also be used by model driven development tools to generate part of the database schema or Java code
- To **support integration between departments, organizations, information systems,** by specifying the differences between terms and concepts used

Questions to answer

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- What is a conceptual model?
- Why do we create conceptual models?
- What is classification and generalization?