Modeling I

Class diagrams

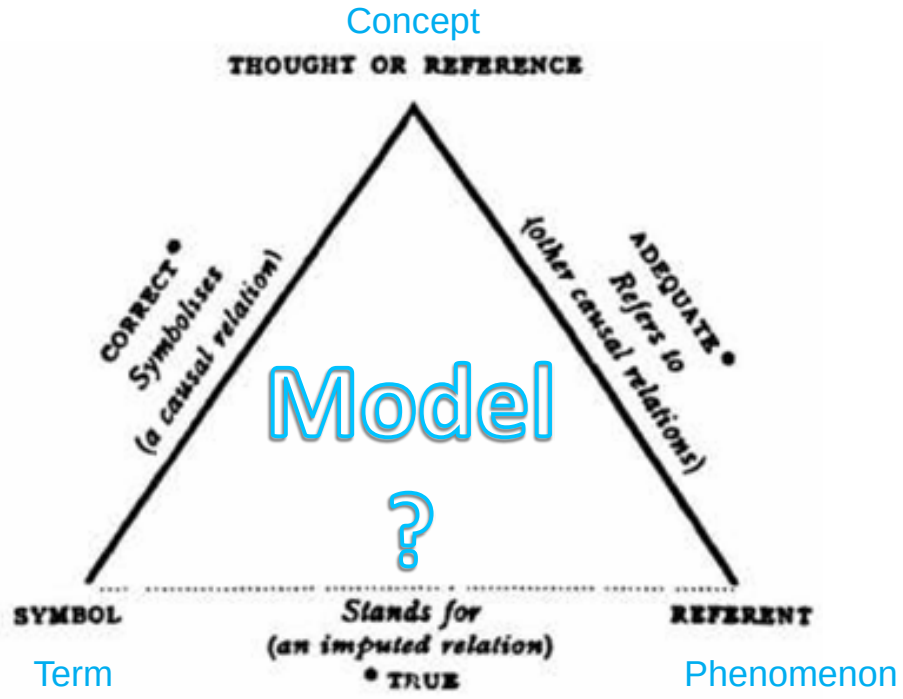
Ketil Stølen

Partly based on slides prepared by Prof. Øystein Haugen, HiØ & SINTEF

Overview of lecture

- Modeling
  - What is it?
  - Why do we do it?
  - Modeling and Programming – sides of the same coin?
- UML Class modelling
- Tooling
  - Papyrus

What's a Model?



Exercise: Explain *class* in the setting of the previous slide

- In which corner does *class* belong?
- What would you put in the two other corners?

Exercise: Explain *threat* in the setting of the previous slide

- In which corner does *threat* belong?
- What would you put in the two other corners?

Artefacts in Informatics

Abstraction

Models **Frameworks** **Patterns** **Algorithms**

Languages

Programming **GPL** **DSL** **Formal** **Visual ....**

Tools

Editors **Compilers** **Verifiers** **Simulators** **Apps ....**

Exercise: How do the other languages you have been thought fit in the previous picture?

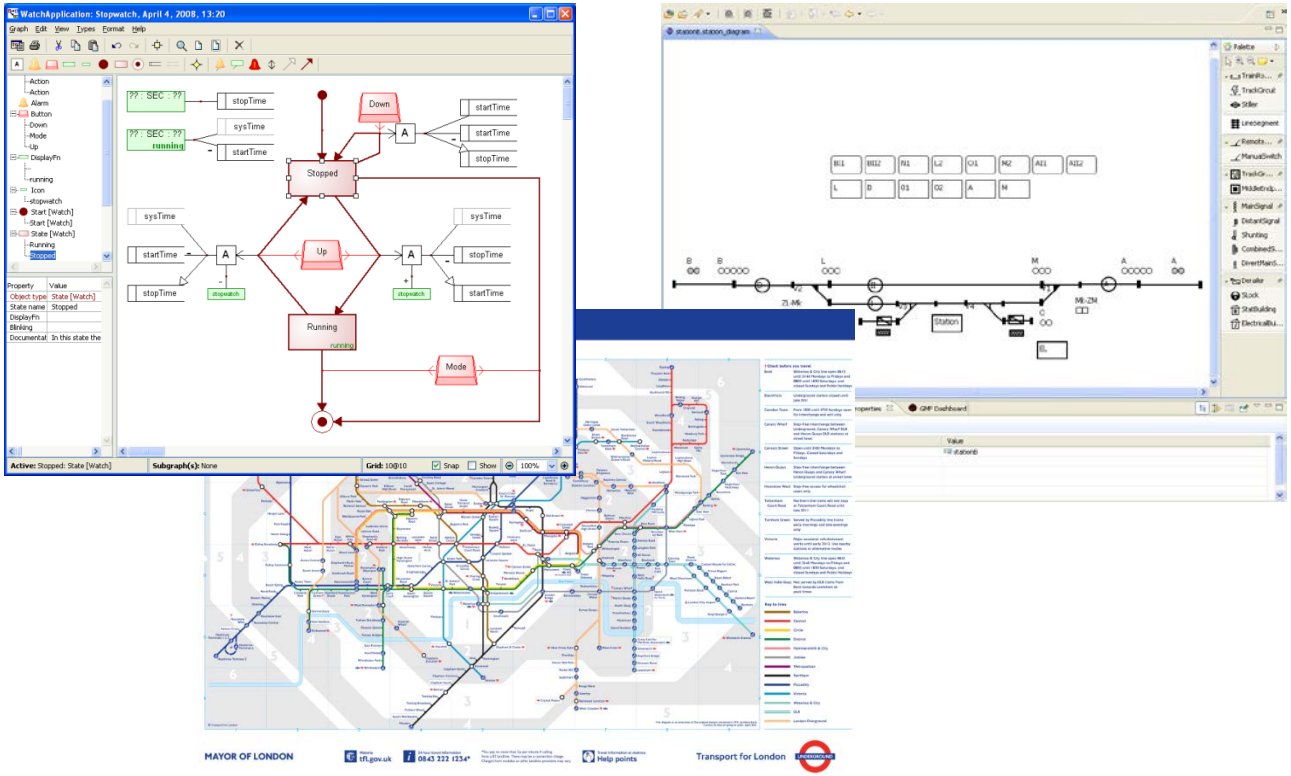
Modeling a system

- A system is a part of the world
  - which we choose to regard as a whole, separated from the rest of the world during some period of consideration, a whole which we choose to consider as containing a collection of components, each characterized by a selected set of associated data items and patterns, and by actions which may involve itself and other components
- Mental systems
  - Systems existing in the human mind, physically materialized as states of the cells of our brains
- Mental and manifest models
  - when a limited set of properties is selected from a system
- These definitions are from K. Nygaard and his DELTA team (in 1977)

What language(s) to use?

- Must have good mechanisms for abstraction
- Must have adequate tooling
- Must scale to "real systems"

Why make a language?



UML Class modelling

- Concepts
- Identity
- Generation
- Meta
- Aggregate

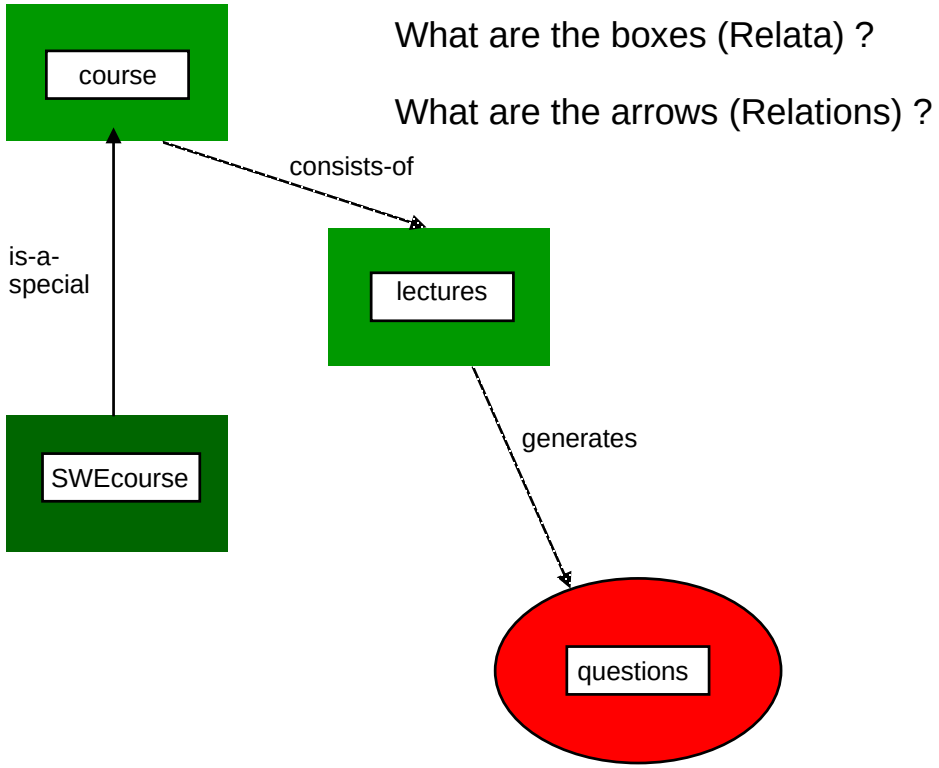
Concepts

Class		Object
Type		Instance
Pattern		Entity
Method		Method call
Function		Function call
Datatype		Variable
	Prototype	
	Clone	

A small story about Courses

- The Software Engineering Course is a special Course
- Courses contain Lectures
- The lectures may generate questions

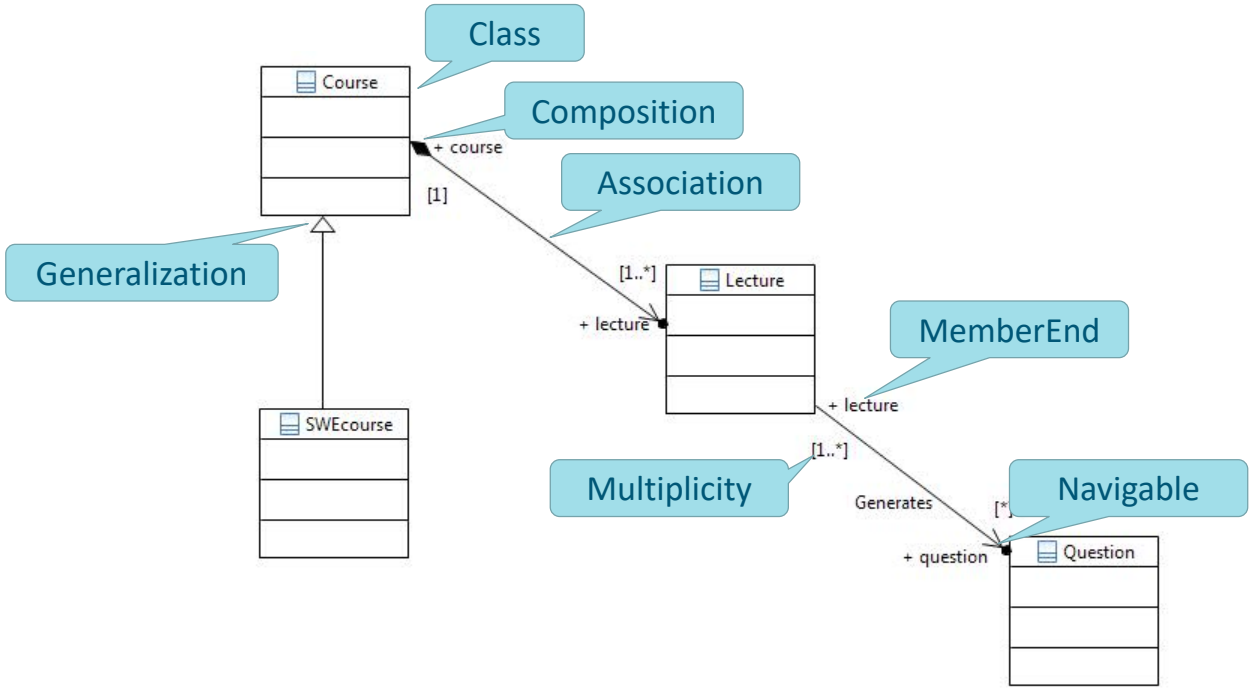
A small Story with Boxes and Arrows



What are the boxes (Relata) ?

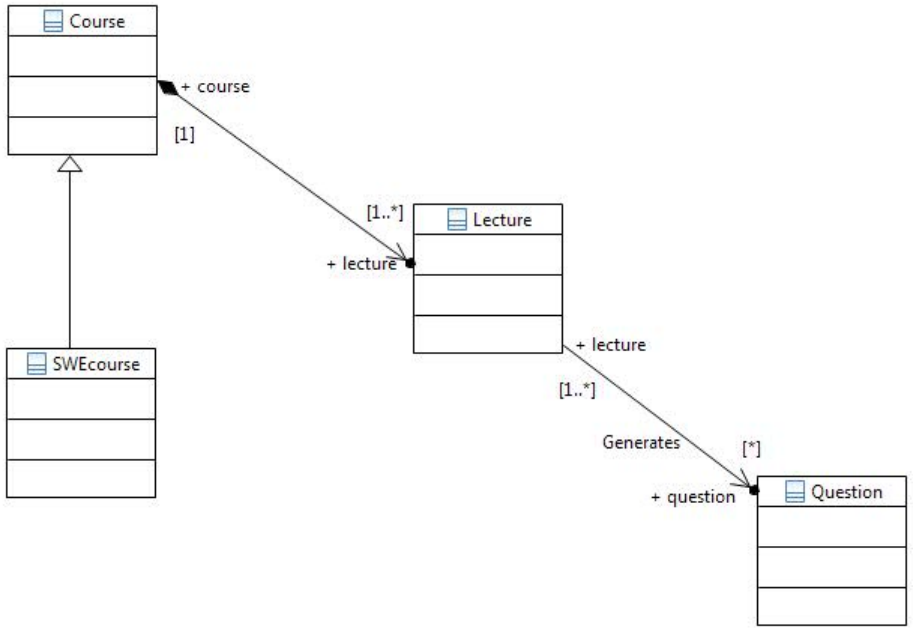
What are the arrows (Relations) ?

A small Story with UML class diagram



Exercise:

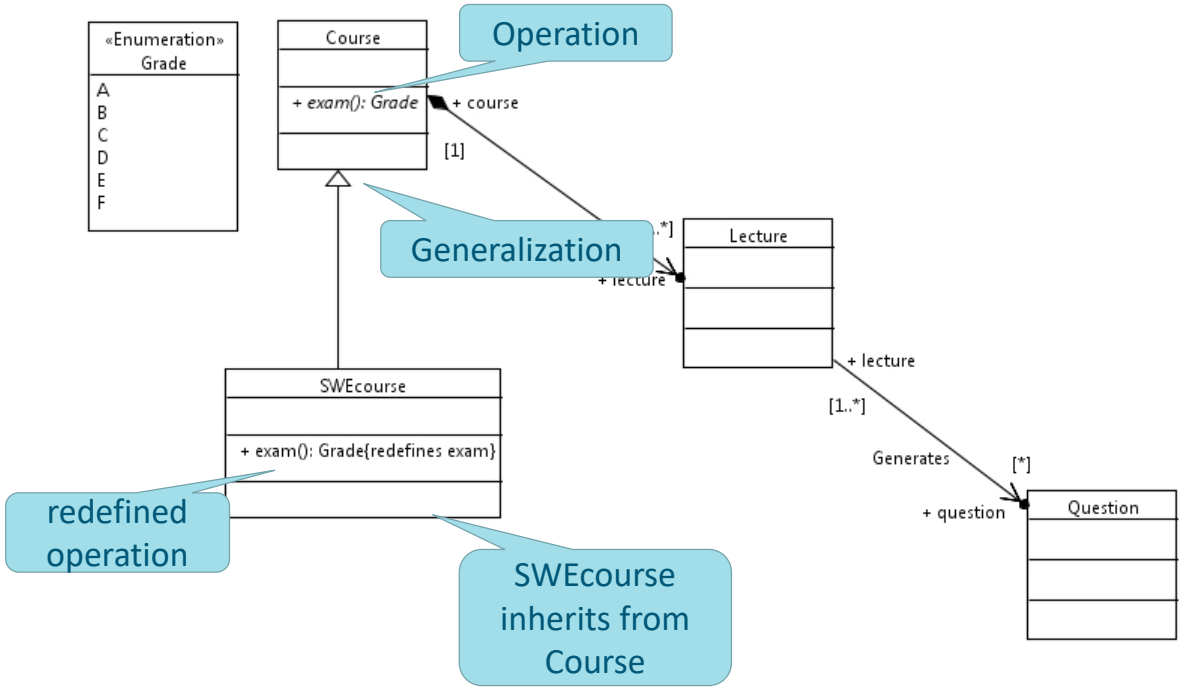
- Can Software Engineering course (SWEcourse) be held without lectures?
- Can there be lectures without questions asked?
- Can the very same lecture be given in two different courses?
- Can the very same question be posed to several lectures?
- If a course is cancelled, will all remaining lectures also be cancelled? (or "terminated")



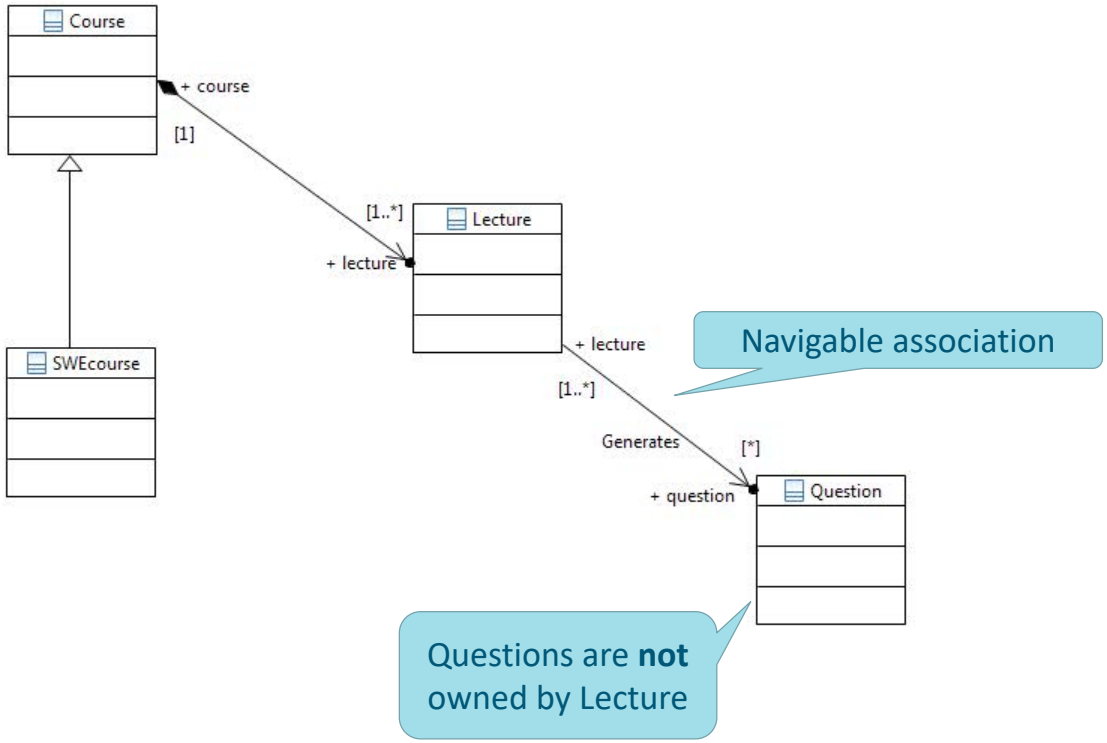
Identity

Identity modifiers:	**Languages:**
Generalization	UML
Subclass	Simula
Derived Classes	C++
Extension	Java
Interface	UML, Java
Parameters	FORTRAN, Pascal, Algol, ...
Overloading	C++, Java
Redefined operations	UML
Virtual procedures	Simula, Smalltalk
Virtual functions	C++
Overriding methods	Java
Pointers to functions	C, C++

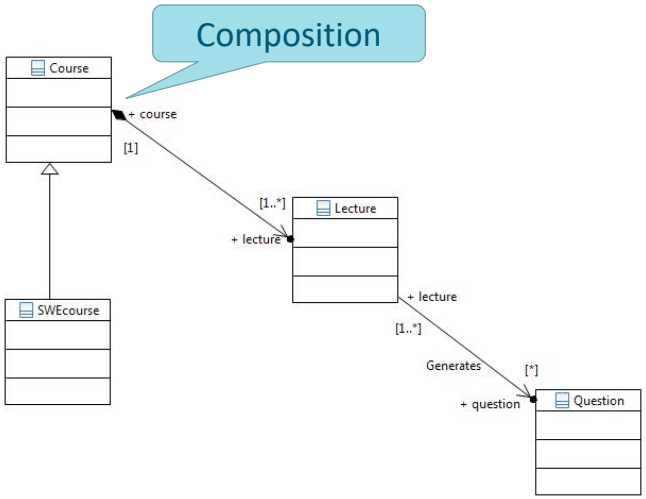
Subclassing or Inheritance



Generation

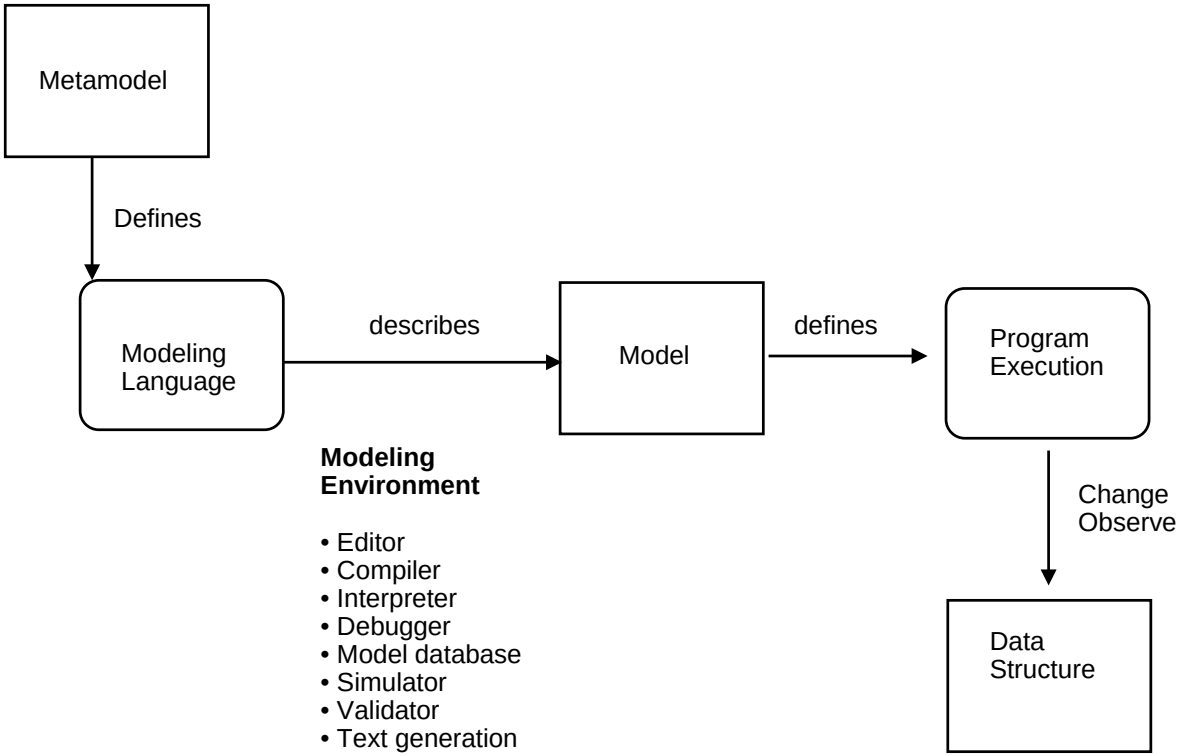

Course
+ course
[1]
[1..*]
Lecture
+ lecture
SWEcourse
+ lecture
[1..*]
Generates
[*]
+ question
Question
Navigable association
Questions are **not** owned by Lecture

Aggregation



Concept aggregate relation

Meta


Metamodel
Defines
Modeling Language
describes
Model
defines
Program Execution
Change Observe
Data Structure
Modeling Environment
• Editor
• Compiler
• Interpreter
• Debugger
• Model database
• Simulator
• Validator
• Text generation

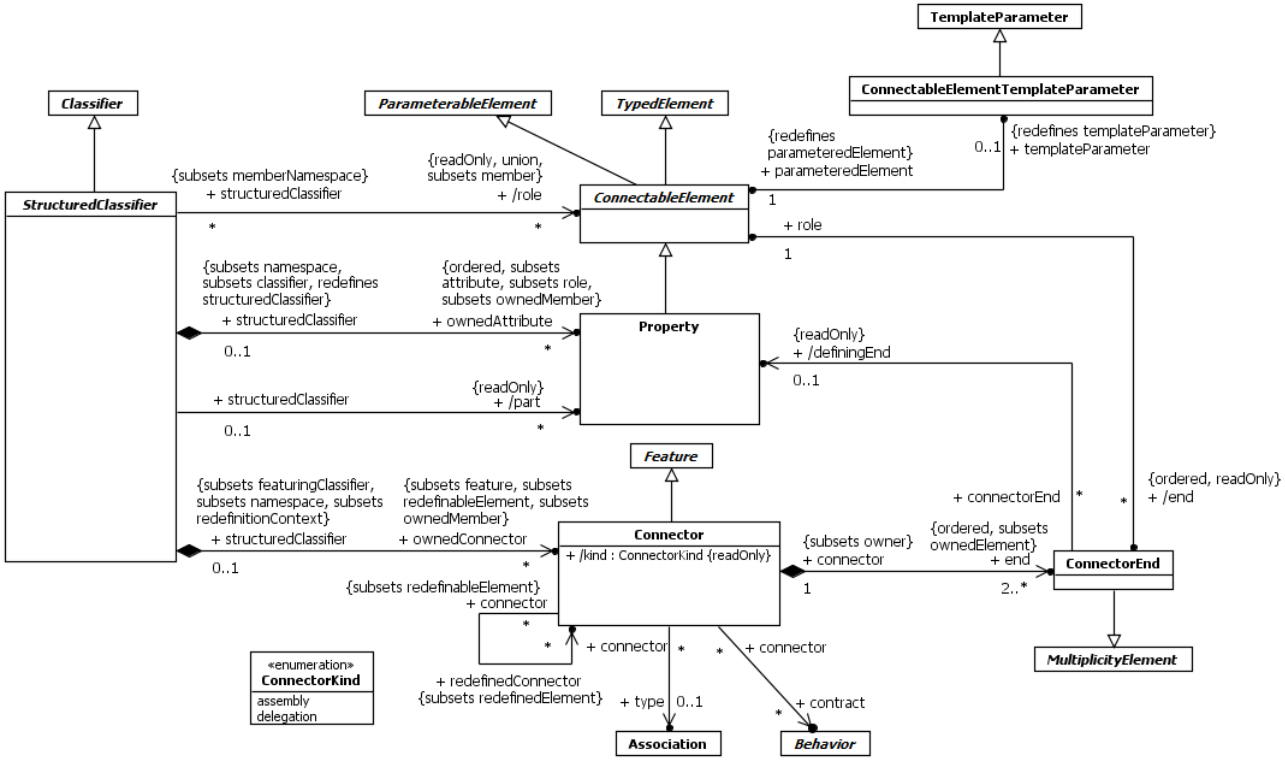
Exercise: Explain the previous slide wrt the language *English*

- What is the meta-model?
- What is the modeling-language?
- What is a model?
- What is program execution?
- What is the data structure?

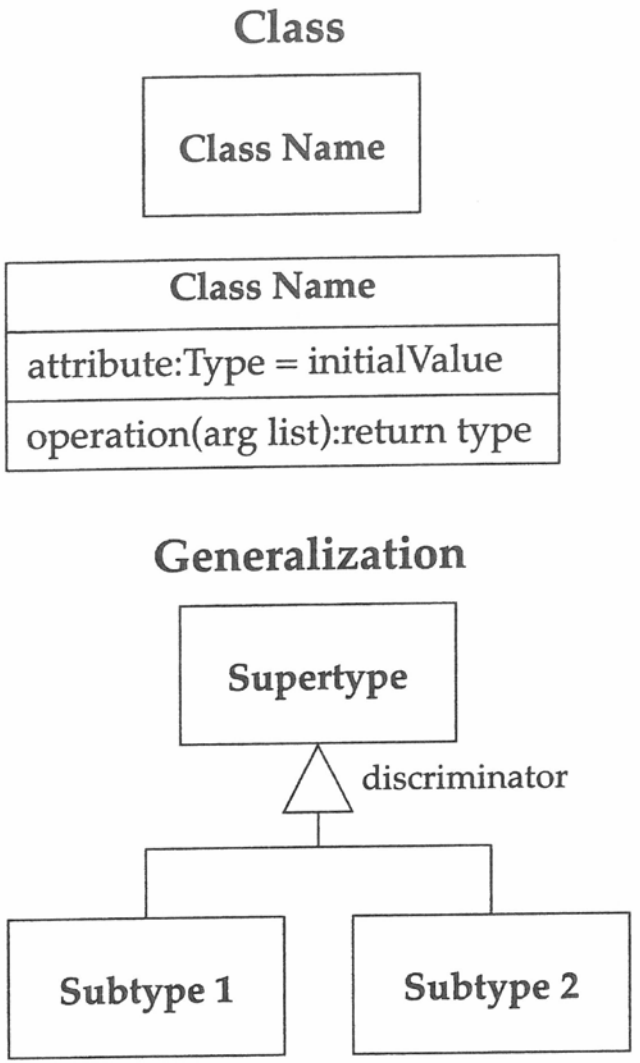
The 4-level meta hierarchy

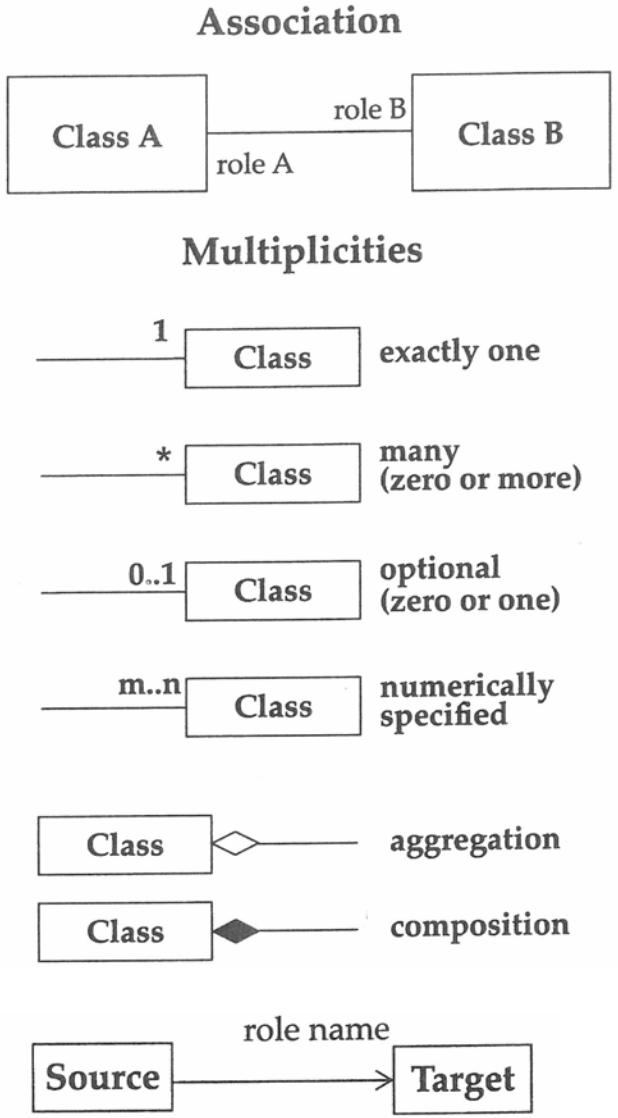
Lev	UML model	Language	Programming	Language
M3	MOF metamodel	MOF	Grammar of BNF	BNF?
M2	UML metamodel	MOF	Grammar of Java	BNF
M1	UML user model	UML	Java user program	Java
M0	Execution of user model		Execution of java program	

A piece of the UML Metamodel

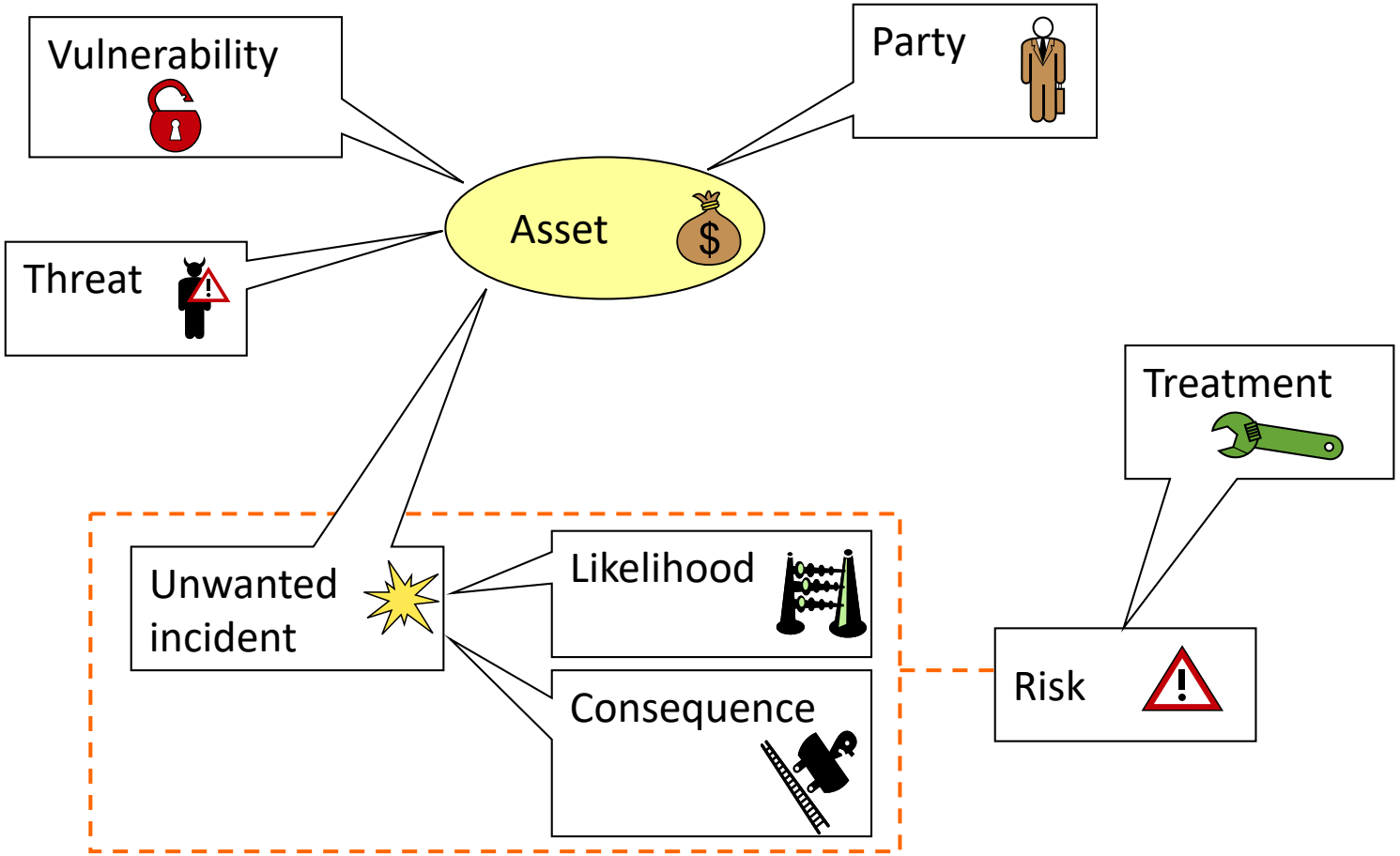


Class Diagram Summary





Exercise: Represent the drawing below in UML



Modeling tool used for the UML part of this course

You may use the tool of your preference

Some alternatives:

- https://www.eclipse.org/papyrus/ (powerful but involves a lot to install and use)
- https //www.draw.io app (light weight)