Metamodeling

- Why metamodels?
- Models and Metamodels
- Examples of metamodels
Questions

- How can we tell if our specification is correct, syntactically and semantically, wrt. the particular notation being used?
- How do we define the syntax and semantics of a notation?
- How do we compare the expressive power of different notations?
- How do we extend a notation in a consistent manner?
What is meta-modeling?

- Generally, the analysis, construction and development of the frames, rules, constraints, models and theories applicable and useful for the modeling in a predefined class of problems.

- In computer science and related disciplines, the construction of a collection of "concepts" (things, terms, etc.) within a certain domain.

- A model is an abstraction of phenomena in the real world, and a metamodel is yet another abstraction, highlighting properties of the model itself.

- A model should conform to its metamodel like a program conforms to the grammar of the programming language in which it is written.

“A valid metamodel is an ontology, but not all ontology are modeled explicitly as metamodels” [Söderström2002].
Review: Instances and Classes

Instances: tokens, specific things
Classes: collections of instances
Review: Instances and Classes

Instances: tokens, specific things
Classes: collections of instances

Why?
Models and Metamodels

Specific models: tokens, specific things, and relationships
Generic models: collections of instances, and relationships
Metamodels: ontology, …and epistemology, of generic models

Lawrence Chung
Models and Metamodels

Specific models: tokens, specific things, and relationships
Generic models: collections of instances, and relationships
Metamodels: ontology, …and epistemology, of generic models
Models and Metamodules

Specific models: tokens, specific things, and relationships
Generic models: collections of instances, and relationships
Metamodells: ontology, and epistemology, of generic models

Why?
Models, Metamodels & Metaclasses

![Diagram showing relationships between entities and classes.]

Lawrence Chung
Key standards that make up the MDA suite of standards include Unified Modeling Language (UML); Meta-Object Facility (MOF); XML Meta-Data Interchange (XMI); and Common Warehouse Meta-model (CWM).
OMG Four Layer Metadata Architecture

[Cooper and Chung]

Meta-metamodelling
- abstract language
- specific paradigm (e.g., OO)
- application independent

Metamodelling
- abstract language
- specific paradigm (e.g., OO)
- application specific (process or notation modeling, etc.)

Modeling
- concrete language
- specific paradigm (e.g., OO)
- specific model
- describes the data needed

Information
- applied in “real world”
- specific paradigm (e.g., OO)
- specific project

Metamodelling Architecture

Examples

www.site.uottawa.ca/ftp/pub/courses/Winter/seg3310/coursenotes/Lecture7-8-Metamodelling.ppt

- M3 Metametamodel
  - Meta Object Facility (MOF)
  - Example: UML metamodel, e.g., Class, Interface, Attribute

- M2 Metamodel
  - Your own UML model
  - e.g., Car

- M1 Model
  - The actual objects that I model
  - e.g., the car with license plate XX-31-NN

- M0 User objects
  - Project X: UML Models
  - Project X: Artifacts

Figure 1 OMG 4-layer architecture

Lawrence Chung
UML Metamodel Diagrams

UML Meta Model

Metaclasses used in class, package, component and deployment diagrams

www.site.uottawa.ca/ftp/pub/courses/Winter/seg3310/coursenotes/Lecture7-8-Metamodelling.ppt
Mapping of UML Models to Metamodel Elements (Example)
KAOS Metamodel [See module on requirements elicitation]
Goals & Scenarios


**Requirements chunk model**

- Requirement Chunk
  - Reference
- AND
- OR
- Goal
- Scenario

Revised by

**Goal structure**

- Goal
  - Verb
  - Parameter
  - 1+ Way
  - 1+ Beneficiary
  - Target
  - Direction
  - Way
  - Means
  - Manner
  - Source
  - Destination

- ‘Take (the receipt)Obj (from the printer)So’;
- ‘Read (the validity date of card)Obj (in the card chip)So’;
- ‘Display (the error message)Obj (to the customer)Dest’;
- ‘Improve (our services)Obj (by providing (cash)Obj (to our bank customers)Dest (from account)So (with a card based ATM)Mea)Man’;
Points to Ponder

- What is the ontology of SADT?
- What is the ontology of RML/Telos?
- What is the metamodel for SADT?
- What is the metamodel for RML/Telos
- How do you extend the UML metamodel to incorporate SADT?
- How do you extend the UML metamodel to accommodate RML/Telos
- How do you extend the UML metamodel to accommodate NFRs?