UML Extension Mechanisms

Advanced Software Engineering
D22 - 2003/04
UNIT 15: UML Extension Mechanisms

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UML Extension Mechanisms

Objectives:
- Introducing UML
- Brief History of UML
- What does UML do
  - Examples
- Benefits of UML
- Limitations of UML
- UML Extension Mechanisms :: A solution to UML limitations
  - Mechanisms include:
    - Constraints
    - Stereotypes
    - Tagged values
  - Examples

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Introducing UML

- UML: Unified Modeling Language
- UML is a standard language to construct and document systems (software or non software systems)
- It is a set of modeling notations
  - Graphical: Shapes to construct diagrams
  - Textual: Syntax that tells how the shapes can be combined.
- It is a modeling technique that combines Object Oriented methods and concepts.
  - Data abstraction :: Flexibility
  - Reuse :: Compatibility :: Extensibility
- UML enhances the analysis and design of software and non software projects by allowing more cohesive relationships between objects.

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History of UML

- Since early 1990s: Many different design models and methodologies. →A de facto standard is needed.
- UML is the outcome in response to a request for a proposal from the **OMG**. (The Object Management Group produces and maintains computer industry specifications and software standards).
- 1994: **Grady Booch** (co-founder of **Rational** Software) and **James Rumbaugh** working together in a modeling technique.
- 1995: **Ivar Jacobson** joins them – **The Three Amigos**.
- 1996: UML is born.
- January 1997: UML 1.0 is published and proposed to the OMG.
- November 1997: OMG adopts **UML** as the standard for Object Oriented modeling.
- Current version: UML 1.5
- UML 2.0 nearing completion.

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What does UML do I

- UML helps visualise, and document models of systems or processes, including their structure and design, in a way that meets the requirements specifications.
- Helps stakeholders understand what the system will be and what are the possible options available.
- It is language and platform independent.
- UML assembles the important aspects of a system while omitting the rest - abstraction mechanism - mapping of elements onto a Model.
- Models are applicable to most domains:
  - Software :: Building, plumbing… :: Electrical, Mechanical Engineering…
  - Business processes :: Telecoms, Networks…

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What does UML do II

- UML allows developers to quickly assemble programs from existing components and operations.
- It defines a wide set of concepts and diagrams to communicate information effectively. These are applicable to most domains.

Display the boundary of a system	Illustrate the boundary of a system	Represent the static structure of a system	Model the behaviour of a system	Reveal the physical implementation architecture	Extend your functionality
Use Case Diagrams	*Collaboration Diagrams*	*Class Diagrams*	*State Transition Diagrams*	*Component Diagrams*	*Stereotypes*
	Sequence Diagrams			*Deployment Diagrams*	*Packages*

[Source: Rational Corporation]

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What does UML do III - Examples

Use case diagram example

Deployment diagram example

[Source: MS Visio 2003 example library]

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What does UML do IV - Examples

Class Diagrams

State Transition Diagrams

[Source: www.raba.com/~jcstaff/oodev/presents/uml/intro_uml/]

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Benefits of UML

- UML supports the entire software project lifecycle.
- Enhances the quality of software and non software systems.
- Graphical representations of a design translate into actual source code (e.g Rational Rose → Java, C++, Ada)
- It decreases costs of development and maintenance.
- Helps risk management and team productivity.
- It is supported by many vendors.
- Promotes component based development.
- Supports distributed processing systems modeling for modern and complex applications.
- UML technology allows reverse engineering (e.g MS Visio will reverse C++, VB and J++ code into Class Diagrams)

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Limitations of UML

- UML brings a set of notations and concepts that meet the needs of typical software modeling projects but some users have found UML unable to express their modeling needs. (non software systems)

- Flexibility should be added to construct and document more heterogeneous and complex systems.

- UML lacks features that would allow to attach non-semantic information to models.

- Component models and architectural frameworks (JavaBeans, CORBA Component Model and COM+ cannot be modeled easily with UML.

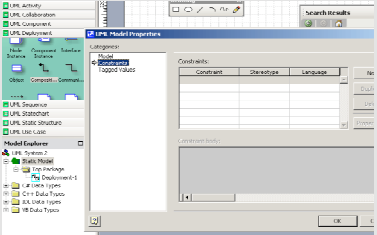ComputerScience   10

UML Extension Mechanisms I

- Limitations are removed in UML by three built-in extension mechanisms that enable new kinds of modeling elements to be added.
- These modeling elements can have distinct semantics.
- **User defined** – User edits/adds the properties of a UML model.
- Used to define process-specific or to implementation language-specific extensions.

  - Stereotypes
  - Constraints
  - Tagged Values

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UML Extension Mechanisms II

- UML model → Stereotype
- Stereotypes → May have Tagged Values and Constraints

[Source: MS Visio 2003 example library]

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UML Extension Mechanisms III

Stereotypes

- A Stereotype is a UML model element that is used to classify other UML elements.
- A Stereotype may introduce additional **Values**, additional **Constraints** and a new **Graphical** representation.
- A Stereotype has semantic impact.
- Certain Stereotypes are already defined in UML.
- User defined Stereotypes share attributes and operations of their base classes.
 (See slide 11 – Static Model = base class)

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UML Extension Mechanisms IV

Constraints

- A Constraint is a condition or restriction attached to a Model Element or a collection of Model Elements.
- Some Constraints are predefined in UML others may be user-defined.
- A Constraint has semantic impact.
- Any Constraints attached to a Stereotype, apply to each Model Element that has this Stereotype.
- Constraints are expressed as text within braces ({ }).
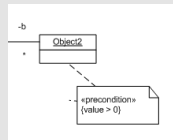
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UML Extension Mechanisms V

Tagged Values

- A Tagged Value is a name-value pair denoting a characteristic of a Model Element or collection.
- It also has semantic impact to the Model.
- Some Tagged Values are predefined in UML but equally to Constraints they can be user defined.
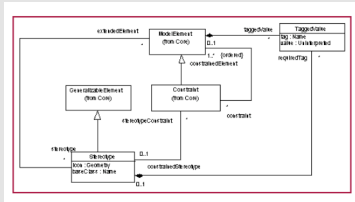- Tagged Values are expressed as text within braces ({Name = Value})
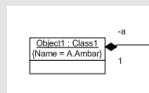
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UML Extension Mechanisms VI

- Constraints or Tagged Values associated with a particular Stereotype are used to extend the semantics of Model Eements.
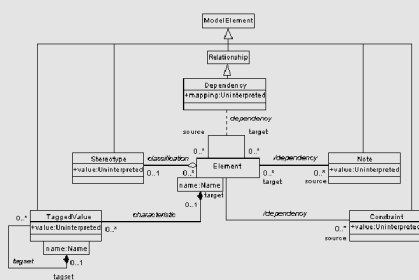

[Source: http://etna.int-evry.fr/COURS/UML/semantics/semant6.html]

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UML Extension Mechanisms VI

[Source: www.uml.crespim.uha.fr/documentation/version1.0/semantics/semantics_ch3.html]

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