UML Extensions

Excerpts from Bran Selic (IBM) tutorial on UML & SysML (2007)

Customizing UML for a Domain

Heavyweight/extension

- Requires adding new concepts (classes) and relationships (associations) to the UML metamodel using MOF
- Example: Adding a Petri-net behavioral formalism to UML

Lightweight/refinement

- Refinements must be formally consistent with base UML semantics and well-formedness rules!
- Specified using the built-in UML extension mechanisms:
  - Profiles
  - Stereotypes
  - Constraints
  - Model libraries

Example: adding a Semaphore concept

Semaphore semantics:

- *A specialized object that limits the number of concurrent accesses in a multithreaded environment. When that limit is reached, subsequent accesses are suspended until one of the accessing threads releases the semaphore, at which point the earliest suspended access is given access.*

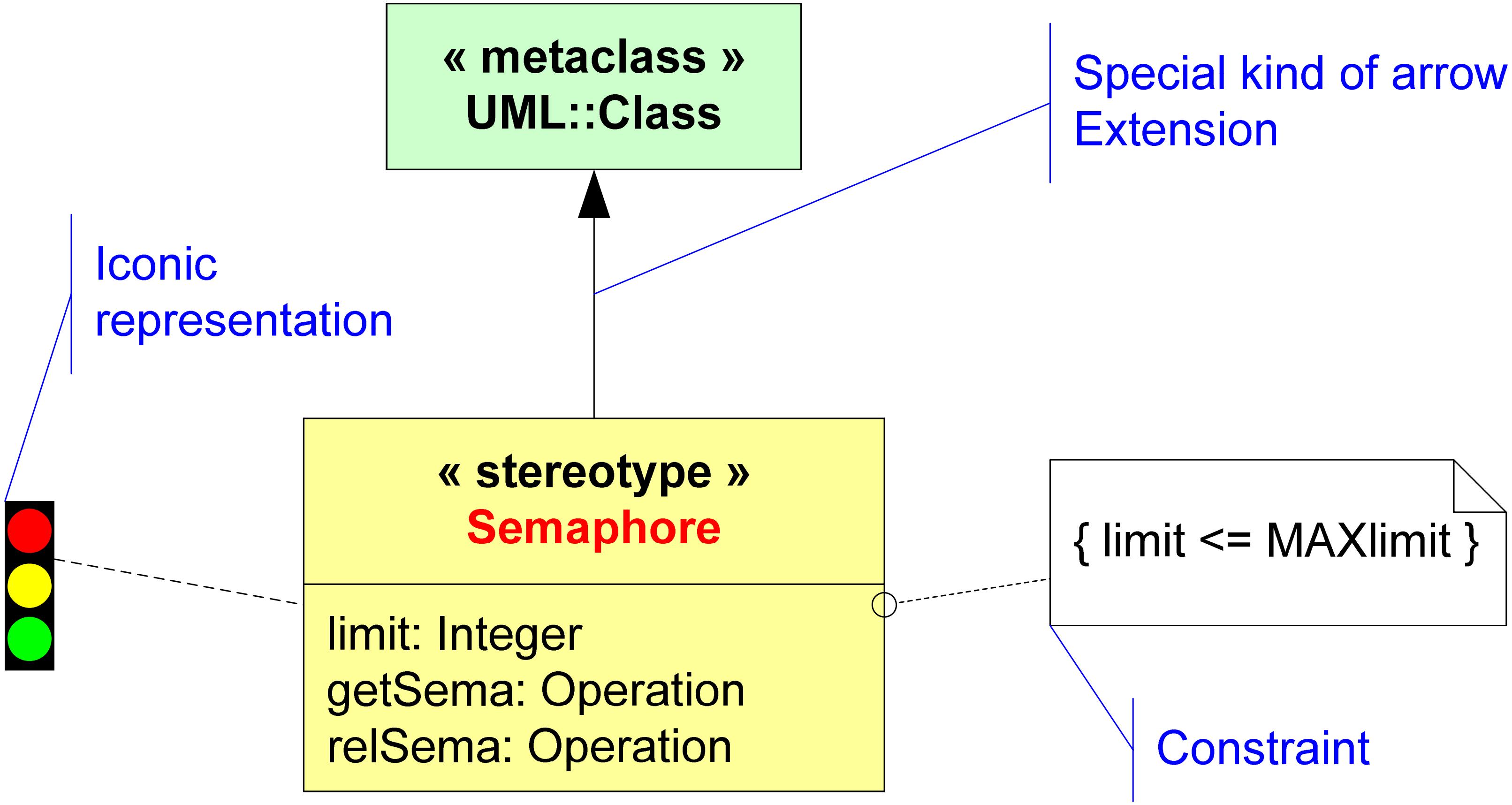
What is required is a special kind of object

- Has all the general characteristics of UML objects
- But includes additional refinements

The Semaphore stereotype

- Refine the UML Class concept by
  - “Associating” semaphore semantics
    - Done informally as part of the stereotype definition
  - Adding constraints that capture semaphore semantics
    - E.g., when the maximum number of concurrent accesses is reached, subsequent access requests are queued in FIFO order
  - Adding characteristic attributes using tags (e.g., concurrency limit)
  - Adding characteristic operations (`getSema()`, `releaseSema ()`)
- Create a new “subclass” of the original metaclass with the above refinements
  - For technical reasons this is done using special mechanisms instead of MOF Generalization

Graphical definition of the stereotype



« metaclass »
UML::Class

Special kind of arrow: Extension

Iconic representation

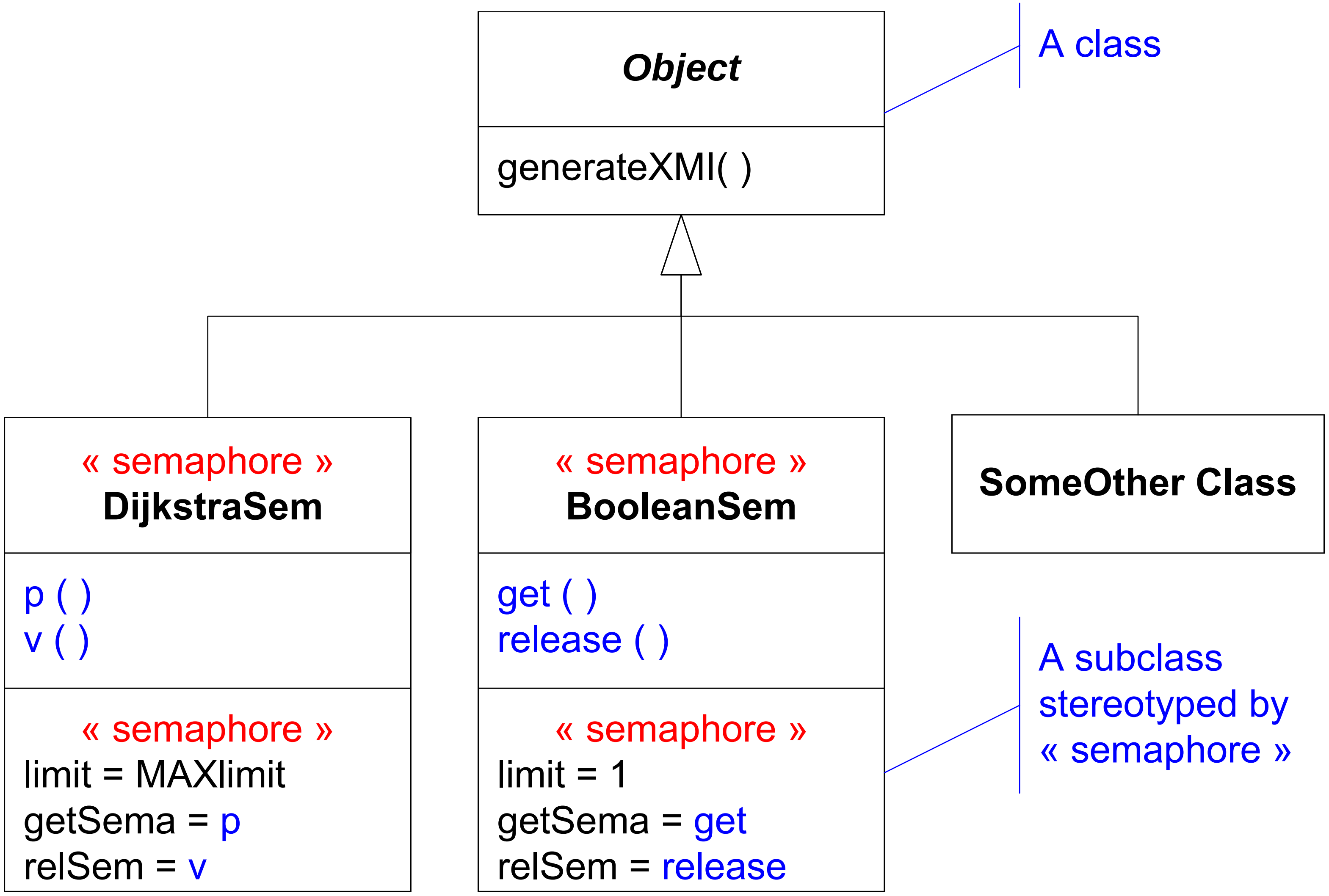
« stereotype »
Semaphore

limit: Integer
getSema: Operation
relSema: Operation

{ limit <= MAXlimit }

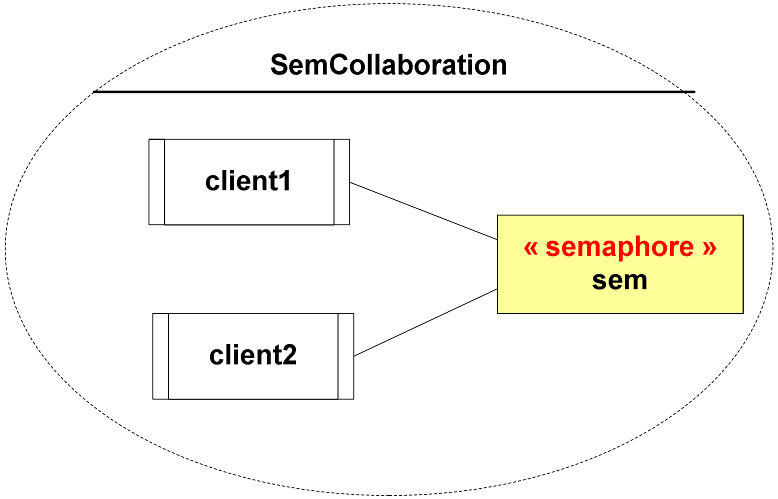
Constraint

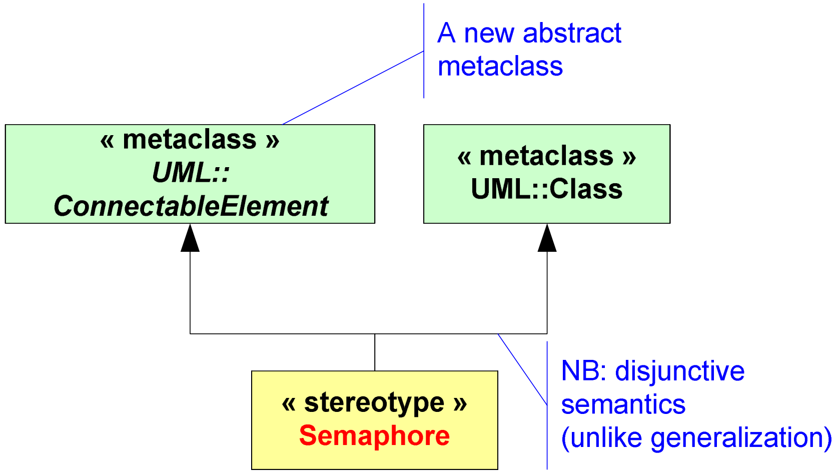
Using the Stereotype



Extending the scope of a stereotype

- It is common to associate a given stereotype with different kinds of metamodel elements





A new abstract metaclass

NB: disjunctive semantics (unlike generalization)

UML profiles

Profile:

- A special kind of package containing stereotypes and model libraries that, in conjunction with the UML metamodel, define a group of domain-specific concepts and relationships
- The profile mechanism is also available in MOF where it can be used for other MOF-based languages

Profiles can be used for two different purposes:

- To define a domain-specific modeling language
- To define a domain-specific viewpoint

Example: The UML profile for Modeling and Analysis of Real-Time Embedded Systems (MARTE)