Adaptive Object-Models

Joseph W. Yoder

University of Illinois

The Refactory, Inc.

yoder@refactory.com

http://www.adaptiveobjectmodel.com

Metadata and Adaptive Object-Models

"Anything you can do, I can do Meta"

Metadata: If something is going to vary in a predictable way, store the *description* of the variation in a database so that it is easy to change....Ralph Johnson

"Meta is Beta"

 Copyright 2001, The Refactory, Inc.

What is meant by Metadata ?

Metadata can be described by saying that if something is going to vary in a predictable way, store the description of the variation in a database so that it is easy to change. In other words, if something is going to change a lot, make it easy to change. The problem is that it can be hard to figure out what changes, and even if you know what changes then it can be hard to figure out how to describe the change in your database. Code is powerful, and it can be hard to make your data as powerful as your code without making it as complicated as your code. But when you are able to figure out how to do it right, metadata can be incredibly powerful, and can decrease your maintenance burden by an order of magnitude, or two. [R. Johnson]

 Copyright 2001, The Refactory, Inc.

General Problem

- Requirements change within applications' domain.
- Business Rules are changing rapidly.
- Applications have to quickly adapt to new business requirements.
- Changing the application is costly, it generally includes code and data-storage.
- There are cycles of: build-compile-release.

 Copyright 2001, The Refactory, Inc.

General Solution

- Create an object design (meta-model) that describes the domain objects which includes attributes, relationships, and business rules as instances rather than classes.
- The domain objects are instantiated through a description given by the user or domain expert.
- Each new requirement is satisfied by creating a new description and a new instantiation.

 Copyright 2001, The Refactory, Inc.

Adaptive Object-Model
(Dynamic Object-Model)

- An ADAPTIVE OBJECT-MODEL is an object model that provides “meta” information about the domain so that it can be changed at runtime
  - explicit object model that it interprets at run-time
  - change the object model, system changes its behavior
- ADAPTIVE OBJECT-MODELS usually arise as domain-specific frameworks
- Business rules can be stored in ADAPTIVE OBJECT-MODELS

 Copyright 2001, The Refactory, Inc.

Architectural Elements of AOM

- Metadata
- TypeObject
- Properties
- Type Square
- Entity-Relationship
- Strategy/RuleObjects
- Interpreters/Builders
- Editors/GUIs

 Copyright 2001, The Refactory, Inc.

Adaptive Object-Model
(Dynamic Object-Model)

- Type-Object
- Properties
- Strategy / Interpreter
- Schema / Descriptor
- Smart Variables
- Builders / Editors

Brian Foote: www.laputan.org

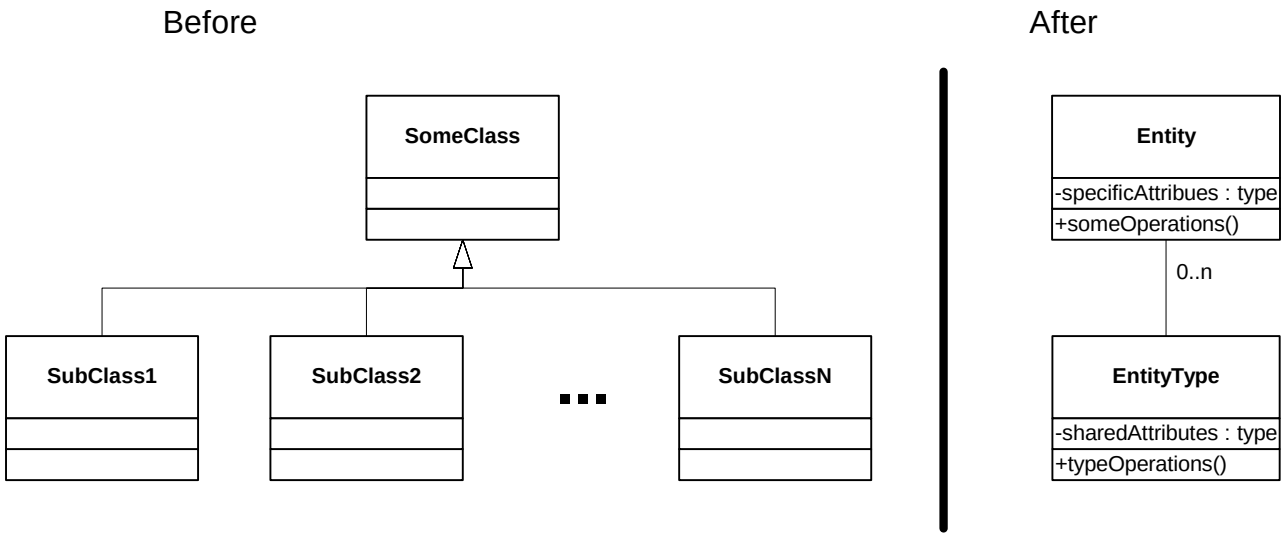
 Copyright 2001, The Refactory, Inc.

Adaptive Object-Model

- When to Build AOMs
  - Need for flexibility
  - High pace of business change
  - Need for experimentation
  - Need to empower user

 Copyright 2001, The Refactory, Inc.

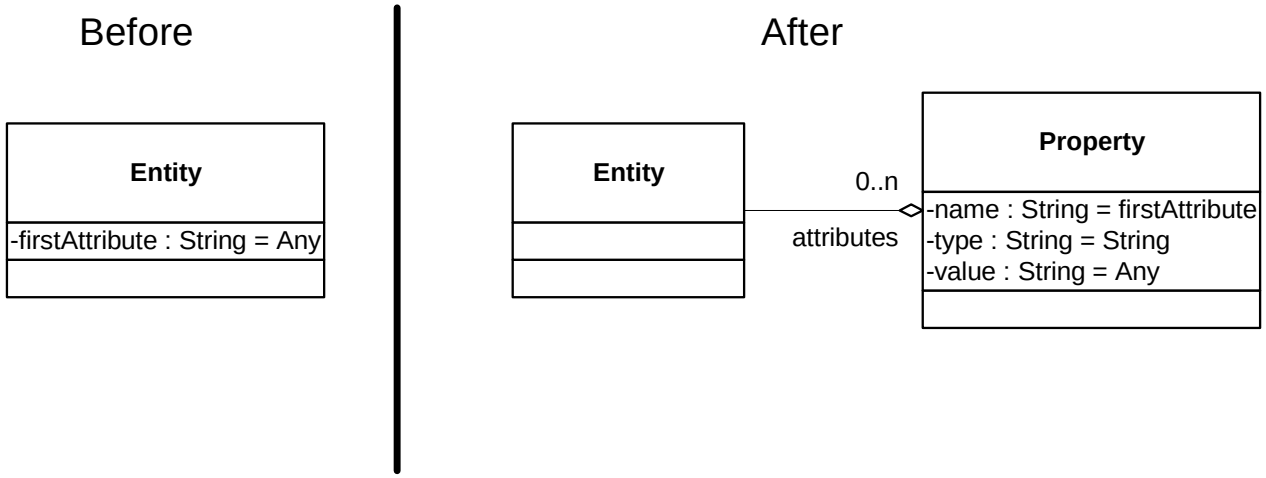
Type-Object



PLoPD3 - Johnson and Woolf

 Copyright 2001, The Refactory, Inc.

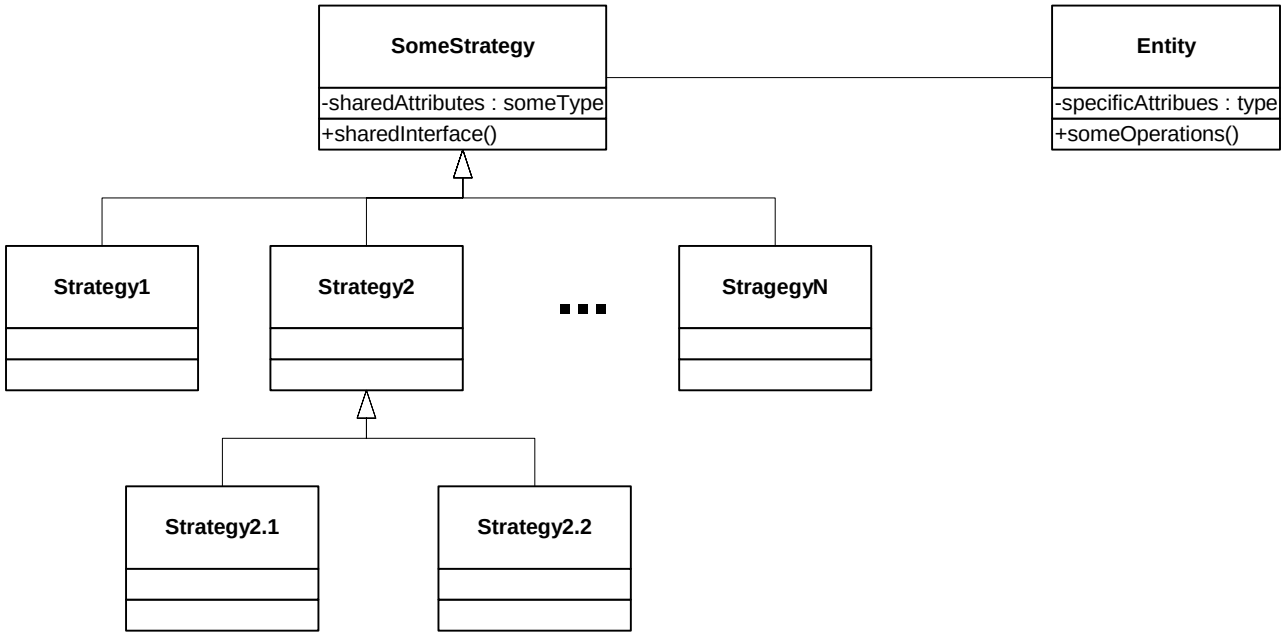
Properties



PLoP98 - Foote and Yoder

 Copyright 2001, The Refactory, Inc.

Strategies

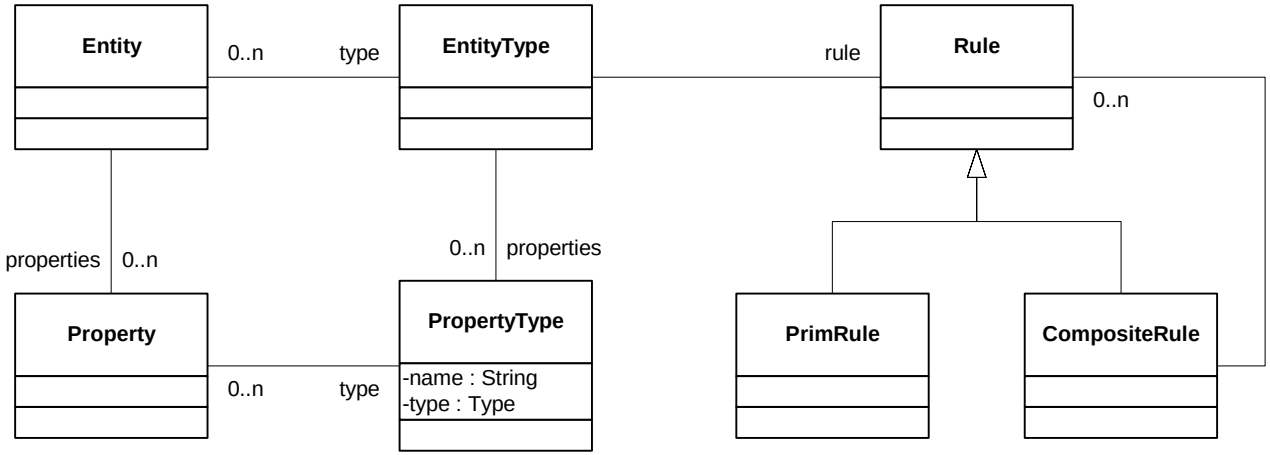


Design Patterns - GOF95

 Copyright 2001, The Refactory, Inc.

Adaptive Object-Model
(Very Common Structure)

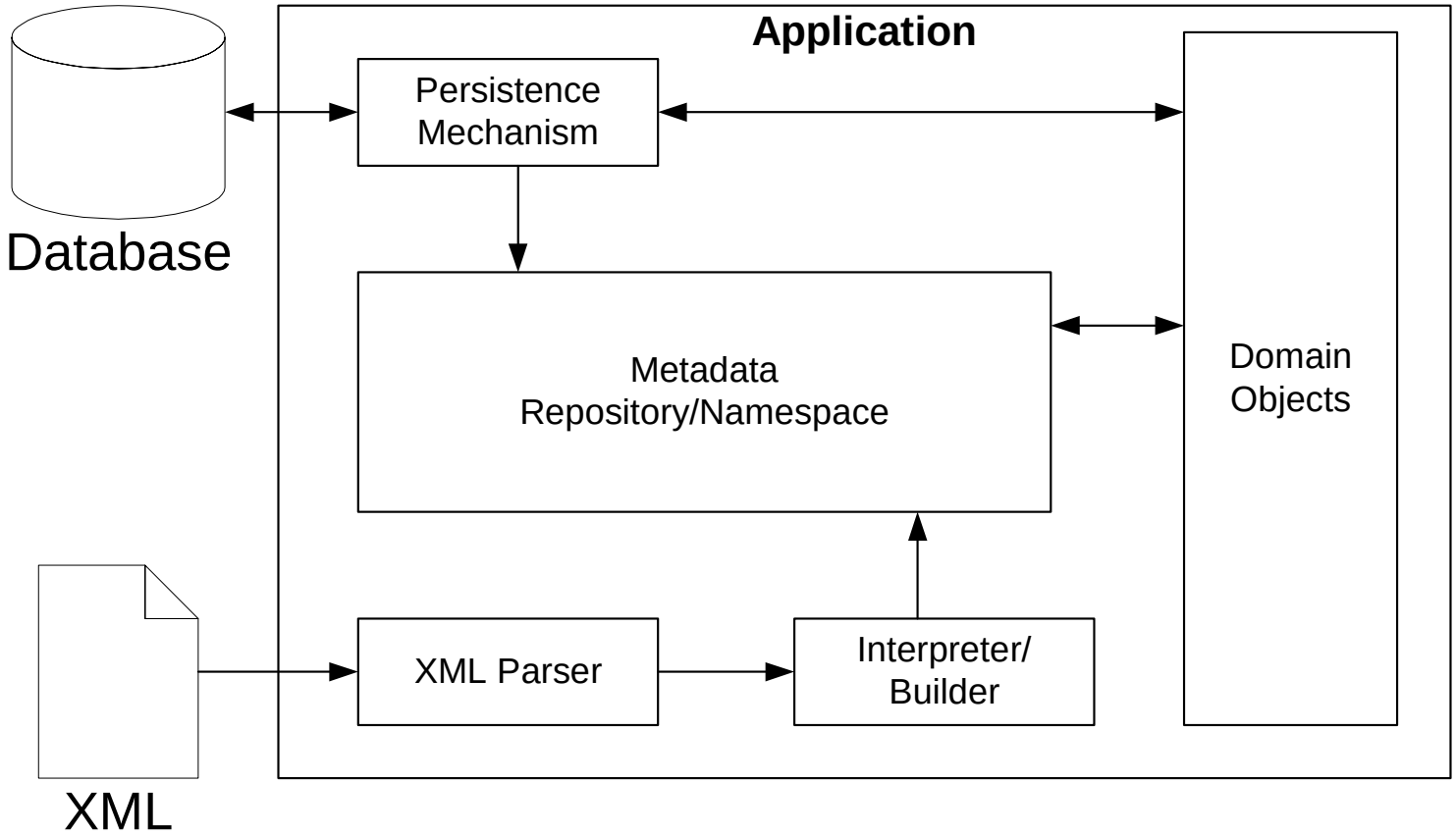
ECOOP & OOPSLA 2001 Yoder, Balaguer, Johnson



Type Square

 Copyright 2001, The Refactory, Inc.

Interpreters / Builders: Solution



 Copyright 2001, The Refactory, Inc.

Medical Observations

Refugee Tracking System

File View Options Help

Clayberg, Zhijiang

Name: Clayberg, Zhijiang

Address: 1234 Anywhere St
Urbana, IL 61801
Champaign County

ID Number	ID Type
A123123123	Alien Number

Phone Number	Phone Type

Volag: Catholic Charities Assigned Site: Frances Nelson Health Visited Site: Frances Nelson Health

Basic Information | Medical | Physical | Imm. & Lab | Class A/B | Hep B & TB | Follow Up | Sponsor

Vitals

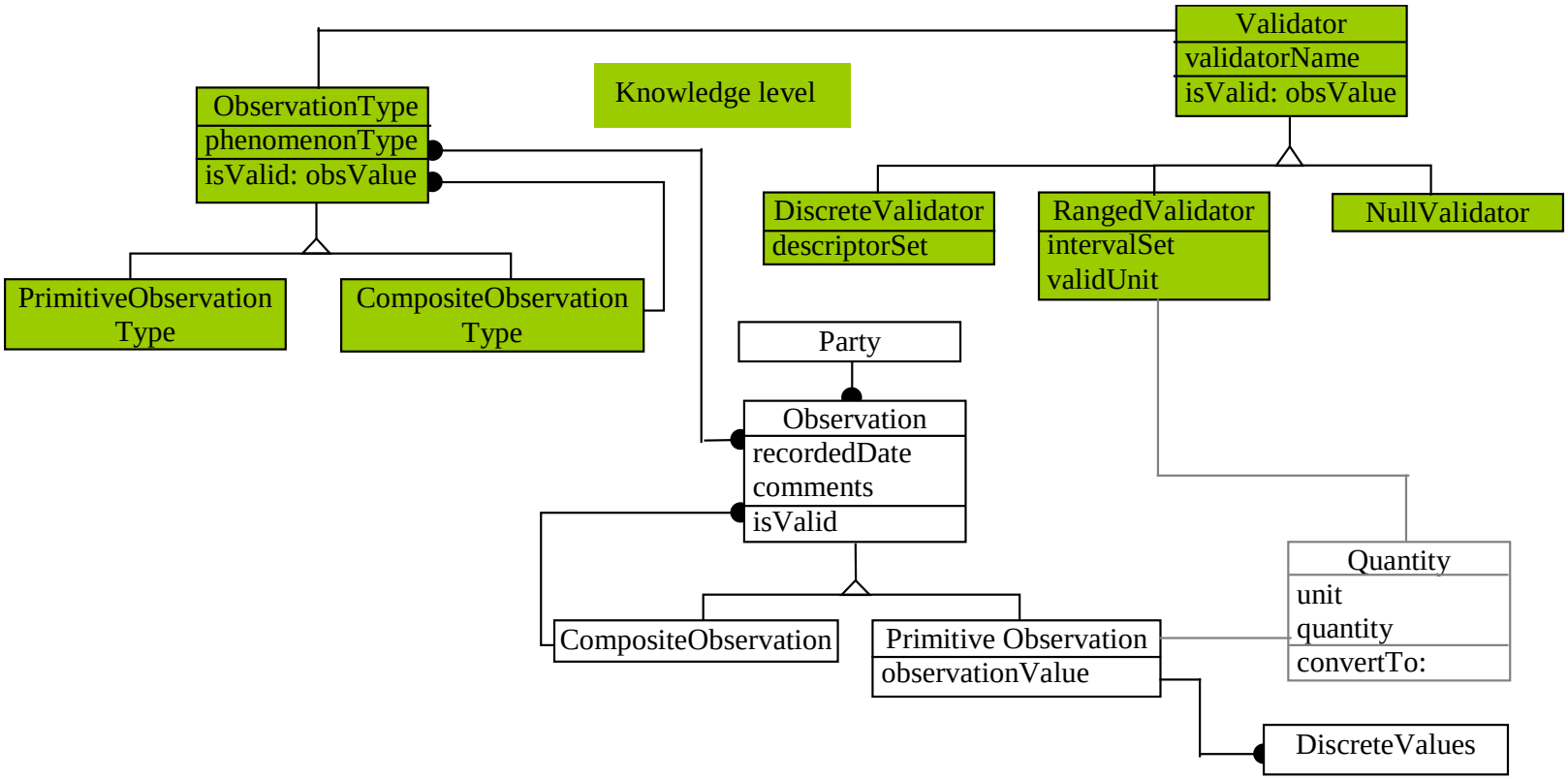
	Blood Pressure (mmHg)	Pulse (beats/s)	Temp (°F)	Height		Weight	
Systolic	120	70	98.6	5	(feet)	185	(lbs)
Diastolic	80			11	(inches)	2	(oz)

Physical

	Nml	Abn	Description		Nml	Abn	Description
HEENT	N	A		Spine	N	A	
Heart	N	A		Skin	N	A	Rash
Lungs	N	A		Neurological	N	A	
Abdomen	N	A		Hansen's Disease	N	A	
Extremities	N	A		STD	N	A	
				Other	N	A	

 Copyright 2001, The Refactory, Inc.

Observation Example



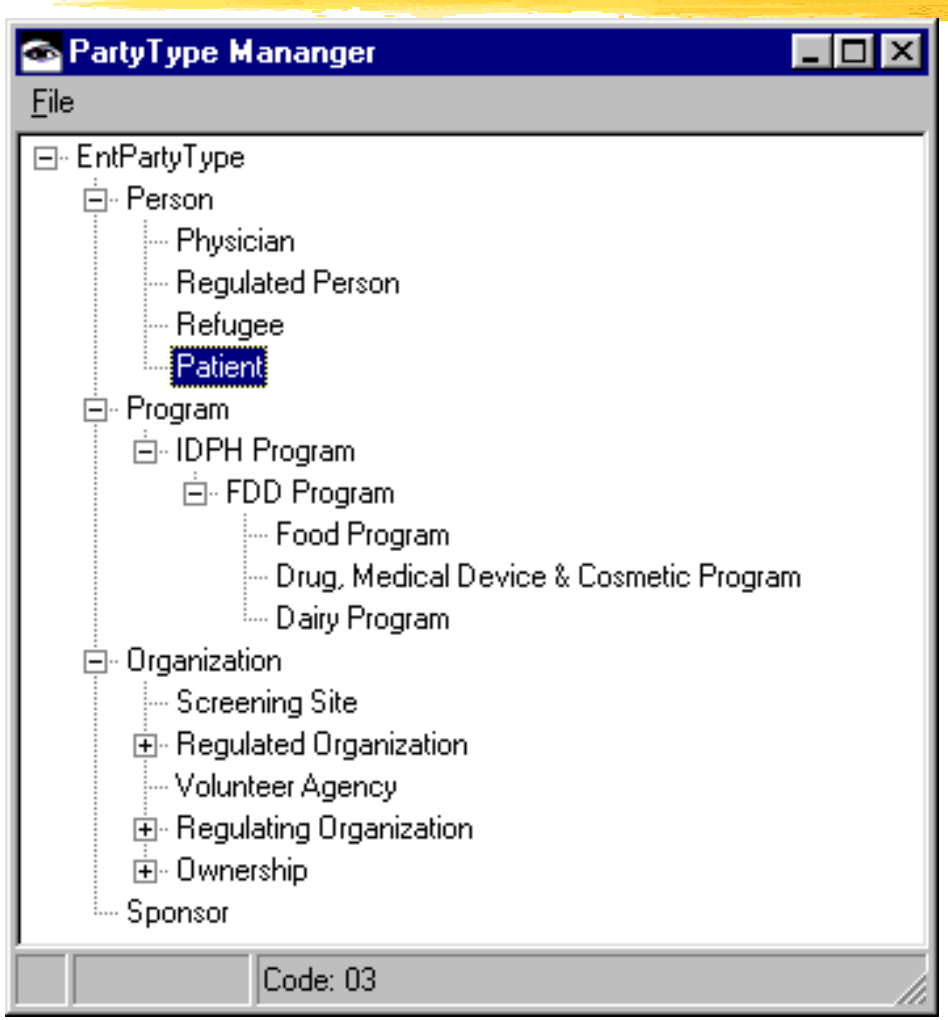
 Copyright 2001, The Refactory, Inc.

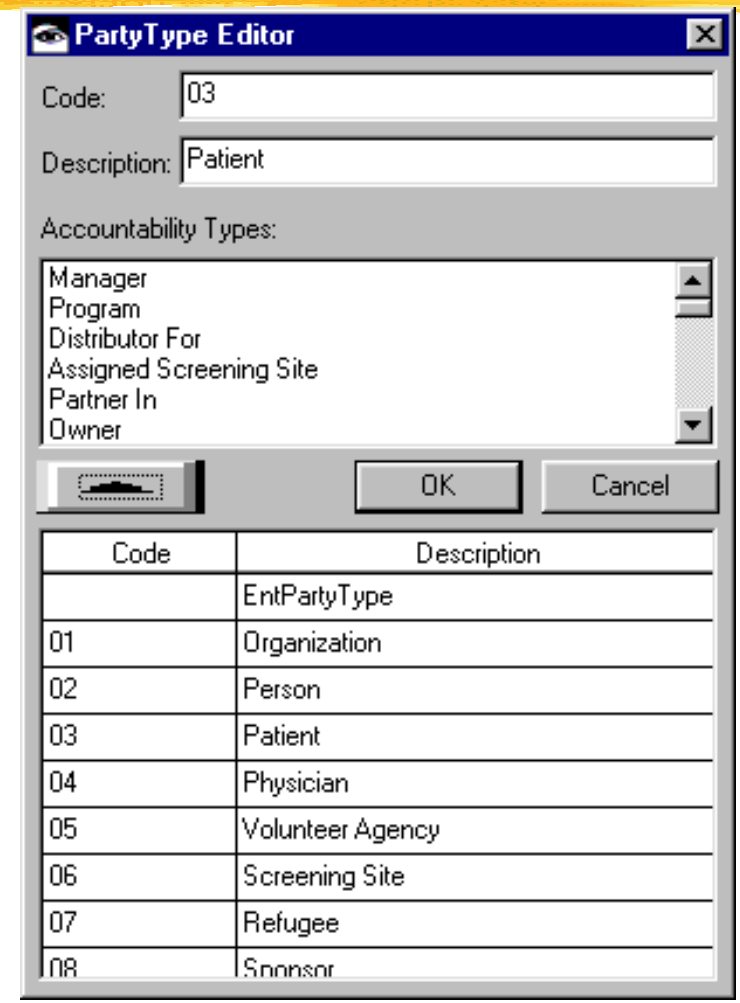
Metamodel and GUI

- The metadata can simplify building user interfaces. Special GUI components can be developed for using the metadata.
- Example: The Observation model includes widgets that display list of values from the DiscreteValidators and also EntryBoxes that use RangeValidator.
- A Mediator and Adaptor layer was developed for managing the interactions between the domain objects and the GUIs.

 Copyright 2001, The Refactory, Inc.

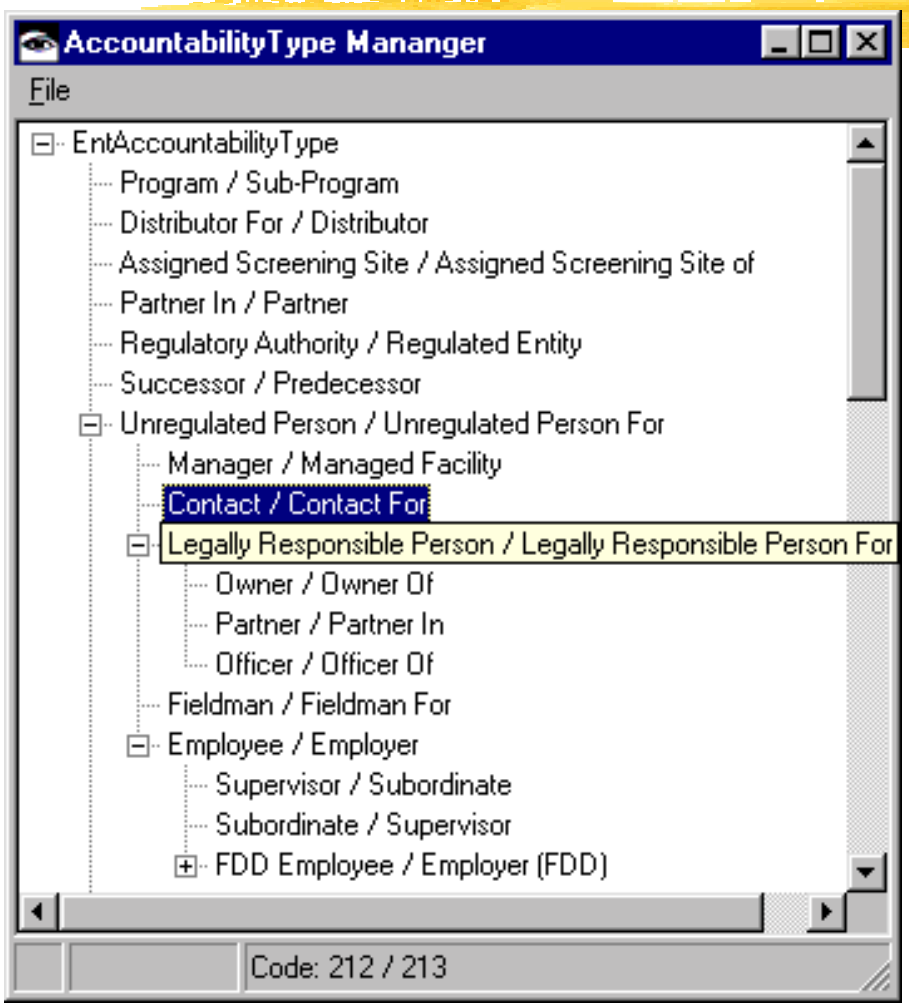
PartyType: Metadata-Editors





 Copyright 2001, The Refactory, Inc.

Accountability: Metadata-Editors



 Copyright 2001, The Refactory, Inc.

Observation: Metadata-Editors

ObservationType Manager

File

Phenomenon	Type	validatorName	validatorType
17-Hydroxyprogester	Composite	DefaultValidator	
17OHPQTY	Primitive	17OHPQTY	Ranged
17OHPRESULT	Primitive	POSNEGBORDER	Discrete
ABDOMEN	Primitive	CONDITIONTYPE	Discrete
ALCOHOLABUSE	Primitive	BOOLEAN	Discrete
ALLERGIES	Primitive	BOOLEAN	Discrete
ANTIHBC	Primitive	BOOLEAN	Discrete
ARTHRITIS	Primitive	BOOLEAN	Discrete
ASTHMA	Primitive	BOOLEAN	Discrete
Biotinidase	Primitive	POSNEG	Discrete
BLOODPRESSURE	Composite	DefaultValidator	
CANCER	Primitive	BOOLEAN	Discrete
CBC	Primitive	CONDITIONTYPE	Discrete
CHANCROID	Primitive	BOOLEAN	Discrete
CHESTXRAYRESULT	Primitive	CONDITIONTYPE	Discrete
CHRONICALCOHOLIS	Primitive	BOOLEAN	Discrete
DIABETES	Primitive	BOOLEAN	Discrete
DIASTOLIC	Primitive	DIASTOLIC	Ranged

All Primitive Composite

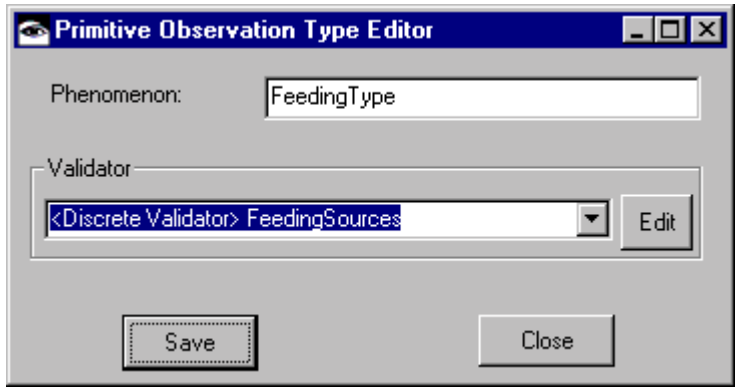
Add ObservationType

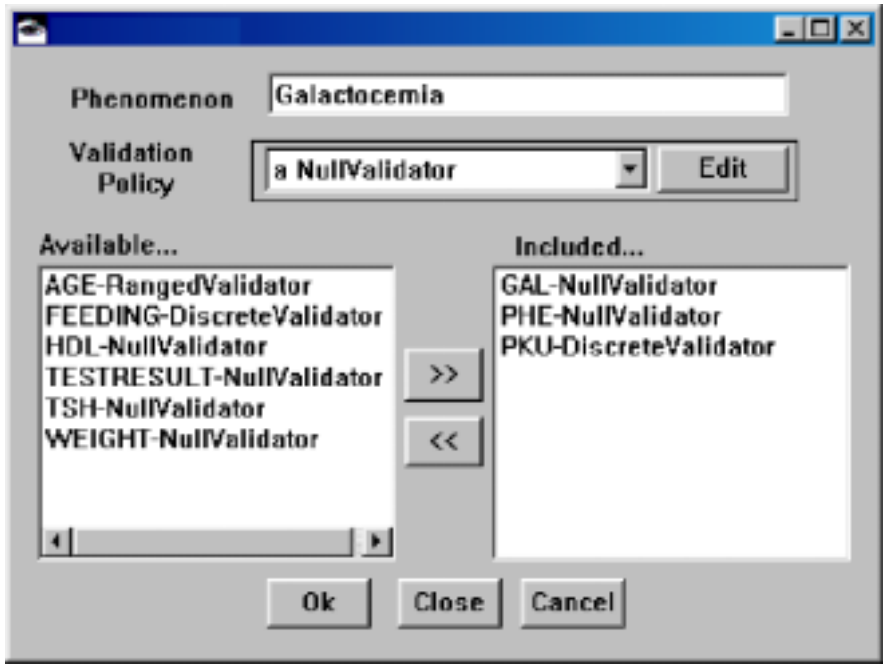
Composite Primitive

Edit Delete

 Copyright 2001, The Refactory, Inc.

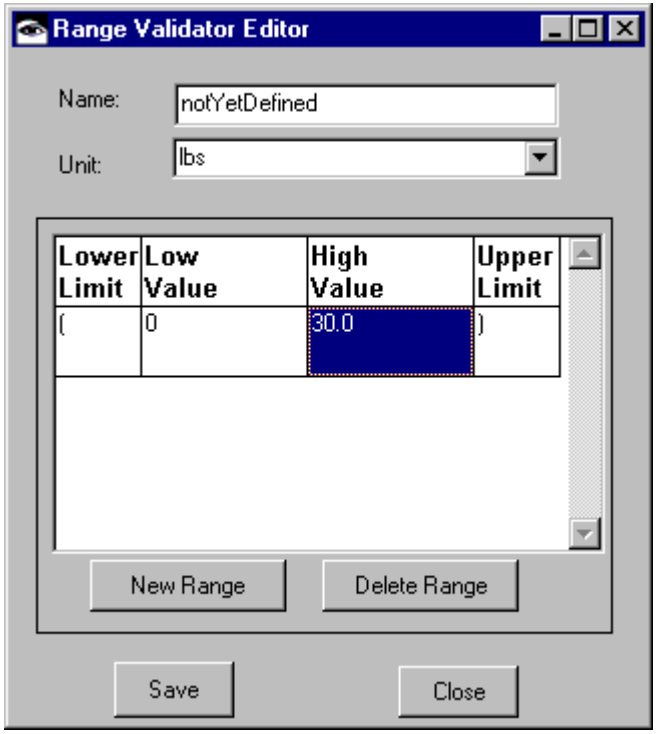
Observation: Metadata-Editors

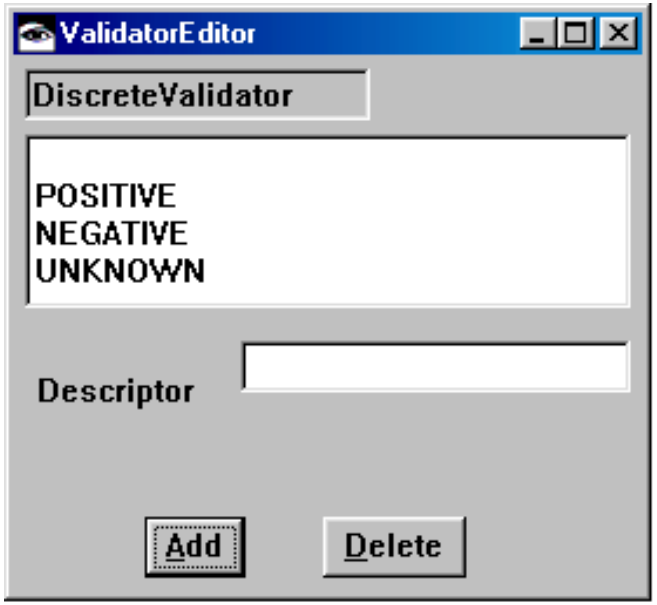




 Copyright 2001, The Refactory, Inc.

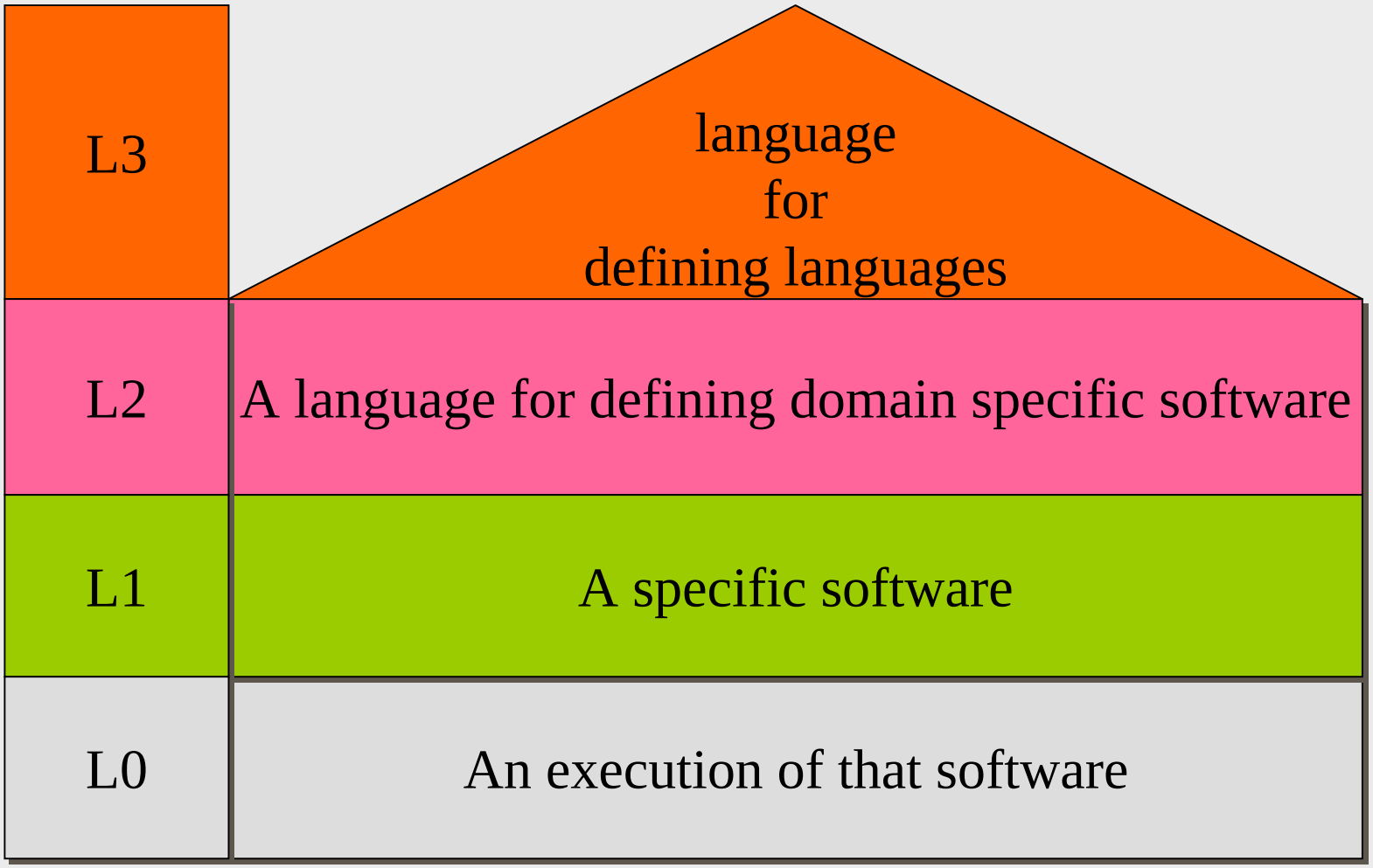
Observation: Metadata-Editors





 Copyright 2001, The Refactory, Inc.

MOF



Dimensions of abstraction in Adaptive Object-Models, Reflection and OMG ’s metamodeling Architecture

Copyright by ECOOP’ 2000 workshop on Adaptive Object-Model. --- http://www.joeyoder.com/Research/metadata/ECOOP2000/description.html

Advantages of AOM

- Systems can more easily be adapted to domain changes.
- Changes do not require recompiling the system.
- Power Users can change the business rules.
- Shorter time-to-market.
- Smaller in terms of classes so can be easier to maintain by experts.

 Copyright 2001, The Refactory, Inc.

Disadvantages of AOM

- Developing AOM is expensive.
  (higher startup costs)
- Can be hard to understand and maintain.
  (user-model and meta-model)
- It requires skilled human resources.
- Can have poor performance.
- It demands having infrastructure for storing, building, interpreting metadata (special support tools, editors, etc).

 Copyright 2001, The Refactory, Inc.

Other Approaches and Technologies

- Black-box Frameworks
- Code Generators
- Metamodeling Techniques
- Table-driven Systems
- Generative Techniques

 Copyright 2001, The Refactory, Inc.

Where to Find More Information

- http://www.adaptiveobjectmodel.com
- http://st-www.cs.uiuc.edu/users/droberts/evolve.html
- http://www.joeyoder.com/papers/patterns
- http://hillside.net
- http://st-www.cs.uiuc.edu/
- http://www.refactory.com
- http://www.metamodel.com

 Copyright 2001, The Refactory, Inc.