## Adaptive Object-Models

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# 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"

#### 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]

## 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.

## **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.

- Here the through a through a description given by the user or domain expert.
- Each new requirement is satisfied by creating a new description and a new instantiation.

## 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-

Business rules can be stored in ADAPTIVE OBJECT-MODELS

# Architectural Elements of AOM

- Metadata
- TypeObject
- Properties
- Type Square

- Entity-Relationship
- Strategy/RuleObjects
- Interpreters/Builders
- Editors/GUIs

#### Adaptive Object-Model (Dynamic Object-Model)

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

Brian Foote: www.laputan.org

## Adaptive Object-Model

#### Hor to Build AOMs

- Need for flexibility
- ☐ High pace of business change
- △ Need for experimentation
- △ Need to empower user

# Type-Object



#### PLoPD3 - Johnson and Woolf

## Properties



#### PLoP98 - Foote and Yoder

## Strategies



#### Design Patterns - GOF95

### Adaptive Object-Model (Very Common Structure)

ECOOP & OOPSLA 2001 Yoder, Balaguer, Johnson



#### Type Square

# Interpreters / Builders: Solution



## Medical Observations

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## **Observation Example**



## Metamodel and GUI

Hereight 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.

## PartyType: Metadata-Editors

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<u>F</u> ile	Code: 03			
∃- EntPartyType	Description: Patient			
🚍 - Person				
- Physician	Accountability Types:			
Regulated Person	Manager			
Refugee	Program Science Scienc			
Patient	Assigned Screening Site			
📮 Program	Partner In			
🖻 IDPH Program	JUwner			
🖻 FDD Program	OK Cancel			
Food Program				
Drug, Medical Device & Cosmetic Program	Lode Description			
Dairy Program				
🚍 Organization	01 Organization			
Screening Site	02 Person			
i Regulated Organization	03 Patient			
Volunteer Agency	04 Physician			
i∃- Regulating Organization	05 Volunteer Agency			
En Ownership	06 Screening Site			
i Sponsor	07 Refugee			
Code: 03	D8 Sponsor			

## Accountability: Metadata-Editors

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🕿 AccountabilityType Mananger 📃 🗖 🔀 💻	🔁 🗠 AccountabilityType Editor
File	Commissioner Type
EntAccountabilityType ▲	Code: 236
Program / Sub-Program     Distributor For / Distributor	Description: Legally Responsible Person
Assigned Screening Site / Assigned Screening Site of Partner In / Partner	Responder Type
Regulatory Authority / Regulated Entity	Code: 237
Successor / Predecessor	Description: Legally Responsible Person For
Manager / Managed Facility     Contact / Contact For	Super Type:
Legally Responsible Person / Legally Responsible Person For	OK Cancel
Owner / Owner Of	Code Description
Partner / Partner In	EntAccountabilityType
Officer / Officer Of	01 Mother
Fieldman / Fieldman For	02 Physician
Encloyee / Employer	03 Sponsor
Supervisor / Subordinate	04 Volunteer Agency
EDD Employee (Employer (EDD)	05 Visited Screening Site
	06 Assigned Screening Site
	07 Child
Code: 212 / 213	08 Patient

## **Observation:** Metadata-Editors



File				
Phenomenon	Туре	validatorName	validatorType 🔺	
17-Hydroxyprogester	Composite	DefaultValidator		
170HPQTY	Primiti∨e	170HPQTY	Ranged	
170HPRESULT	Primiti∨e	POSNEGBORDER	Discrete	
ABDOMEN	Primiti∨e	CONDITIONTYPE	Discrete	
ALCOHOLABUSE	Primiti∨e	BOOLEAN	Discrete	
ALLERGIES	Primiti∨e	BOOLEAN	Discrete	
ANTIHBC	Primiti∨e	BOOLEAN	Discrete	
ARTHRITIS	Primiti∨e	BOOLEAN	Discrete	
ASTHMA	Primiti∨e	BOOLEAN	Discrete	
Biotinidase	Primiti∨e	POSNEG	Discrete	
BLOODPRESSURE	Composite	DefaultValidator		
CANCER	Primitive	BOOLEAN	Discrete	
CBC	Primiti∨e	CONDITIONTYPE	Discrete	
CHANCROID	Primitive	BOOLEAN	Discrete	
CHESTXRAYRESULT	Primitive	CONDITIONTYPE	Discrete	
CHRONICALCOHOLIS	Primiti∨e	BOOLEAN	Discrete	
DIABETES	Primitive	BOOLEAN	Discrete	
DIASTOLIC	Primiti∨e	DIASTOLIC	Ranged 🗸	
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## **Observation:** Metadata-Editors

Phenomenon Galactocemia   Validation a NullValidator   Policy a NullValidator   Policy a NullValidator   Adge-RangedValidator Edit   AGE-RangedValidator GAL-NullValidator   FEEDING-DiscreteValidator PHE-NullValidator   HDL-NullValidator >>   TSH-NullValidator >>   TSH-NullValidator <   WEIGHT-NullValidator <   I >   Ok Close   Cancel

## **Observation:** Metadata-Editors

🗠 Range Validator Editor	ValidatorE ditor
Name: notYetDefined	DiscreteValidator
Unit: Ibs	POSITIVE
LowerLow High Upper A	UNKNOWN
	Descriptor
New Range Delete Range	<u>A</u> dd <u>D</u> elete
Save Close	

# 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.

## Disadvantages of AOM

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

# Other Approaches and Technologies

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

# 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