Generating Domain-Specific Visual Language Editors from High-level Tool Specifications

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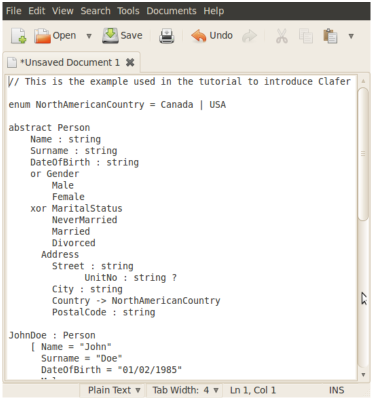
Why domain-specific languages?

- The language is expressed in a higher abstraction, very close to the idioms and vocabulary of the domain
- Easier learning curve for domain experts
- Declarative and self documenting
- High level optimizations
- High quality and portable code
- Productivity and maintainability

Why not domain-specific languages?

- Design issues including syntax/notation, semantics, and scope
- Less flexible than general-purpose languages
- Cost of implementing the language
- Cost of maintaining the language

Textual vs visual



```
// This is the example used in the tutorial to introduce Clafer

enum NorthAmericanCountry = Canada | USA

abstract Person
    Name : string
    Surname : string
    DateOfBirth : string
    or Gender
        Male
        Female
    xor MaritalStatus
        NeverMarried
        Married
        Divorced
      Address
        Street : string
              UnitNo : string ?
        City : string
        Country -> NorthAmericanCountry
        PostalCode : string

JohnDoe : Person
    [ Name = "John"
      Surname = "Doe"
      DateOfBirth = "01/02/1985"
```

Figure: Clafer model

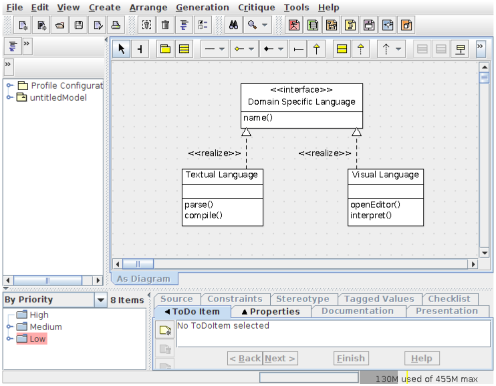
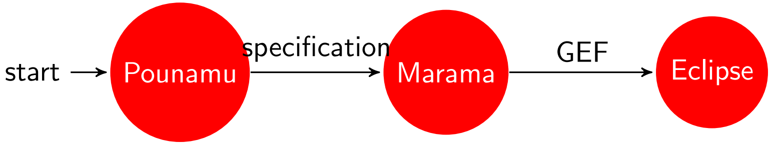


Figure: UML diagram

Marama

- A tool for creating modeling tools
- Implemented as an Eclipse plugin
- Frontend: Pounamu
- Backend: Eclipses Graphical Editing Framework (GEF)



Marama

Pounamu	• Usable by non-experts and non-programmers • Low quality GUI for generated tool • Difficult to integrate with other tools
GEF	• Generates commercial quality GUI • Easy to integrate with other Eclipse frameworks • Requires expert Eclipse developers

How to use Marama

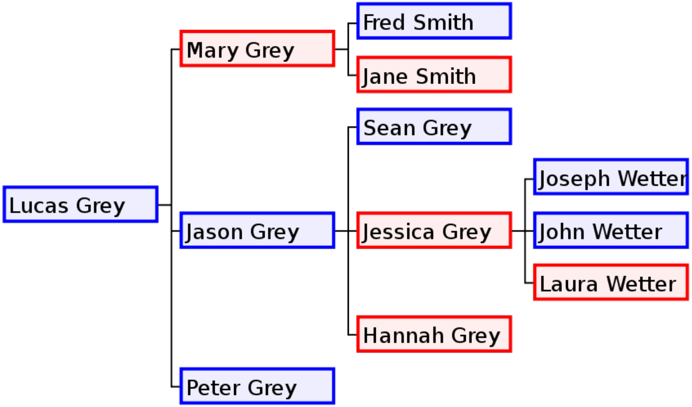
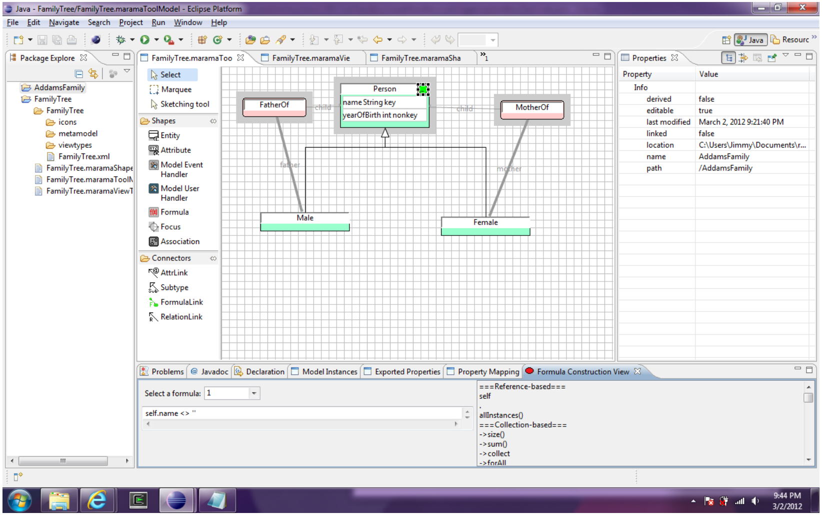


Figure: A family tree by Josef Sbl cz and Mysid

Meta-model



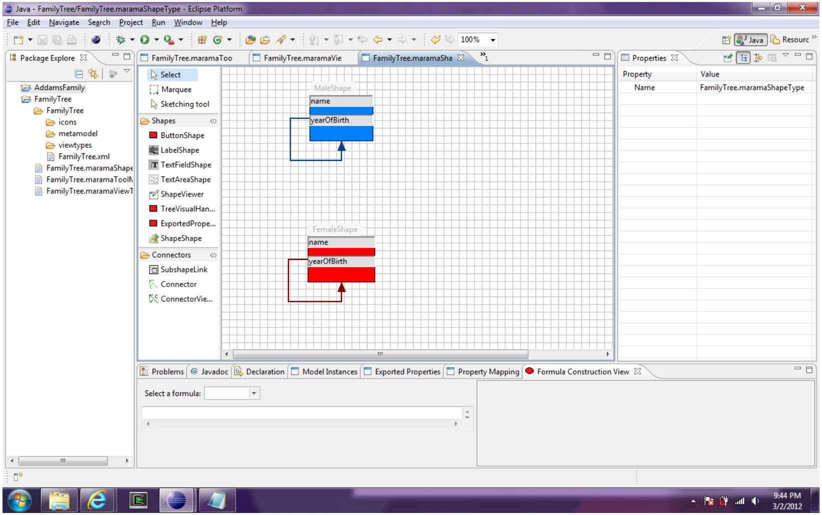
Property	Value
Info	
derived	false
editable	true
last modified	March 2, 2012 9:21:40 PM
linked	false
location	C:\Users\Jimmy\Documents\r...
name	AddamsFamily
path	/AddamsFamily

Select a formula: 1

```
self.name <> ''
```

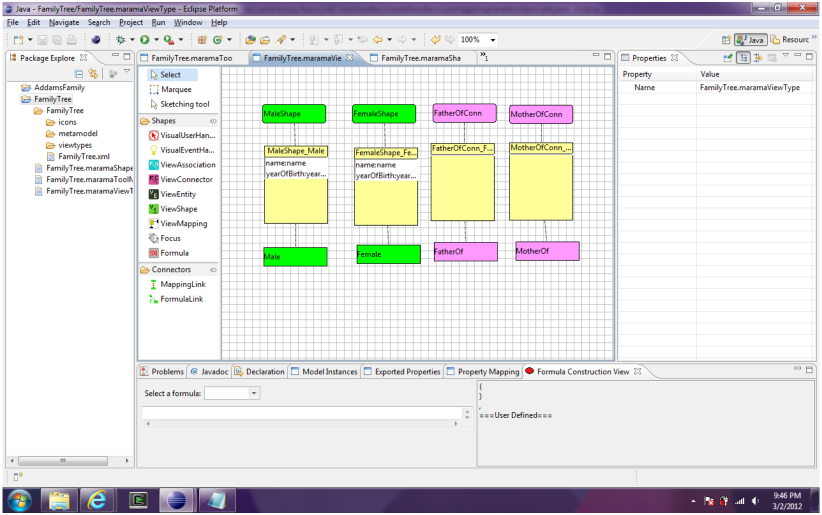
```
===Reference-based===
self
.
allInstances()
===Collection-based===
->size()
->sum()
->collect
->forAll
```

Notation

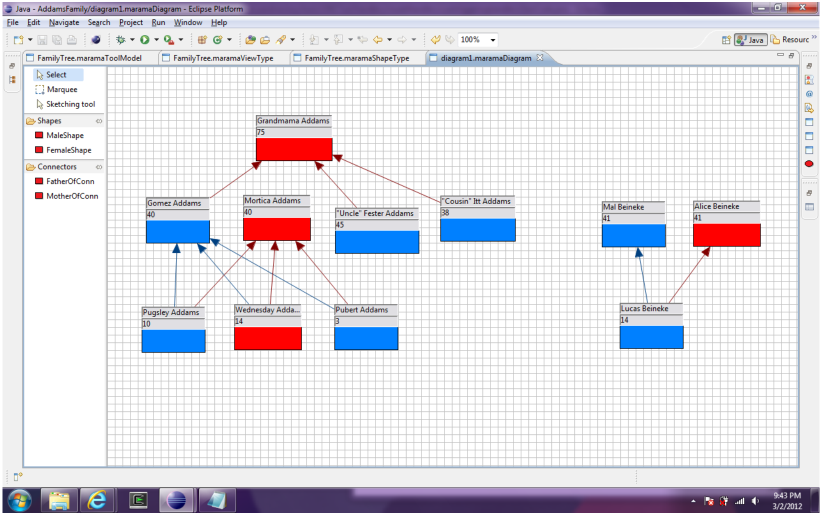


Property	Value
Name	FamilyTree.maramaShapeType

View


Java - FamilyTree/FamilyTree.maramaViewType - Eclipse Platform
File Edit Navigate Search Project Run Window Help
Package Explore
AddamsFamily
FamilyTree
FamilyTree
icons
metamodel
viewtypes
FamilyTree.xml
FamilyTree.maramaShape
FamilyTree.maramaToolN
FamilyTree.maramaViewT
FamilyTree.maramaToo
FamilyTree.maramaVie
FamilyTree.maramaSha
Select
Marquee
Sketching tool
Shapes
VisualUserHan...
VisualEventHa...
ViewAssociation
ViewConnector
ViewEntity
ViewShape
ViewMapping
Focus
Formula
Connectors
MappingLink
FormulaLink
MaleShape
FemaleShape
FatherOfConn
MotherOfConn
MaleShape_Male
name:name
yearOfBirth:year...
FemaleShape_Fe...
name:name
yearOfBirth:year...
FatherOfConn_F...
MotherOfConn_...
Male
Female
FatherOf
MotherOf
Properties
Property
Value
Name
FamilyTree.maramaViewType
Problems
Javadoc
Declaration
Model Instances
Exported Properties
Property Mapping
Formula Construction View
Select a formula:
===User Defined===
9:46 PM
3/2/2012

Editor



Java - AddamsFamily/diagram1.maramaDiagram - Eclipse Platform
File Edit Navigate Search Project Run Window Help
100%
Java
Resourc
FamilyTree.maramaToolModel
FamilyTree.maramaViewType
FamilyTree.maramaShapeType
diagram1.maramaDiagram
Select
Marquee
Sketching tool
Shapes
MaleShape
FemaleShape
Connectors
FatherOfConn
MotherOfConn
Grandmama Addams
75
Gomez Addams
40
Mortica Addams
40
"Uncle" Fester Addams
45
"Cousin" Itt Addams
38
Mal Beineke
41
Alice Beineke
41
Pugsley Addams
10
Wednesday Adda...
14
Pubert Addams
3
Lucas Beineke
14
9:43 PM
3/2/2012

Yet another modeling tool

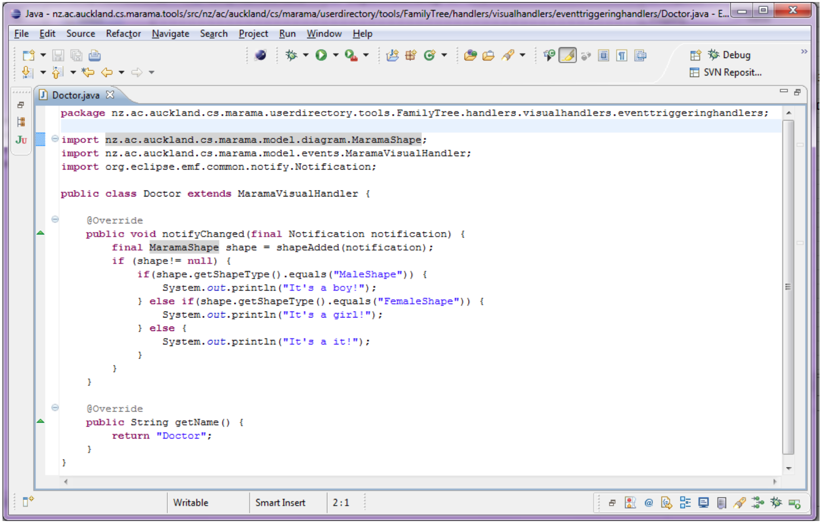
Competitors	Pounamu, MVC, Unidraw, COAST, HotDoc, GEF, Meta-MOOSE, JViews, Escalante, Tcl/Tk, Suite, Amulet, Vampire, DiaGen, VisPro, JComposer, PROGRES, DSLTools, KOGGE, MetaEdit+, MOOT, GME, MetaEnv, IPSEN, GMF, Merlin
Marama	Multi-view, live, rapid development, high level, flexible integration, expressive visual language.

Multi-view

Key requirements for domain-specific visual language tools that we and others have identified include having an underlying model shared by all diagrams with a well-defined meta-model

Model	The University of Waterloo
View 1	Enrollment office views a submodel containing every students
View 2	Professor views a submodel containing students enrolled in his/her classes and but the name is the only readable attribute

Event handling


Java - nz.ac.auckland.cs.marama.tools/src/nz/ac/auckland/cs/marama/userdirectory/tools/FamilyTree/handlers/visualhandlers/eventtriggeringhandlers/Doctor.java - E...
File Edit Source Refactor Navigate Search Project Run Window Help
Debug
SVN Reposit...
Doctor.java
Writable
Smart Insert
2 : 1

```java
package nz.ac.auckland.cs.marama.userdirectory.tools.FamilyTree.handlers.visualhandlers.eventtriggeringhandlers;

import nz.ac.auckland.cs.marama.model.diagram.MaramaShape;
import nz.ac.auckland.cs.marama.model.events.MaramaVisualHandler;
import org.eclipse.emf.common.notify.Notification;

public class Doctor extends MaramaVisualHandler {

    @Override
    public void notifyChanged(final Notification notification) {
        final MaramaShape shape = shapeAdded(notification);
        if (shape!= null) {
            if(shape.getShapeType().equals("MaleShape")) {
                System.out.println("It's a boy!");
            } else if(shape.getShapeType().equals("FemaleShape")) {
                System.out.println("It's a girl!");
            } else {
                System.out.println("It's a it!");
            }
        }
    }

    @Override
    public String getName() {
        return "Doctor";
    }
}
```

Uses of event handling

- Express constraints where Marama is not expressive enough
- Code generation
- Native Pounamu event handlers are supported via adapters and sandboxing.

Future work

- Generalizing visual framework for specifying event based systems
- Integration with Visual Studio

Question 1

Rather than writing process descriptions in a textual scripting language like BPEL4WS, most users would prefer to graphically specify the web services and their composition to form a new business process.

- When is a textual language preferable?
- When is a graphical language preferable?

Question 2

How useful is a modeling tool without code generation?

Question 3

Why is Marama not widely used?