http://prog.vub.ac.be/moves

Supporting Functional Software Variability with Concept-Centric Coding (C3)

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BENEVOL 2007 - PRECISE - Namur

December 13-14, 2007

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The ability of a software system or artefact
to be *efficiently* extended, changed, customised or configured
for use in a *particular context*

[Svahnberg et al. 2005]

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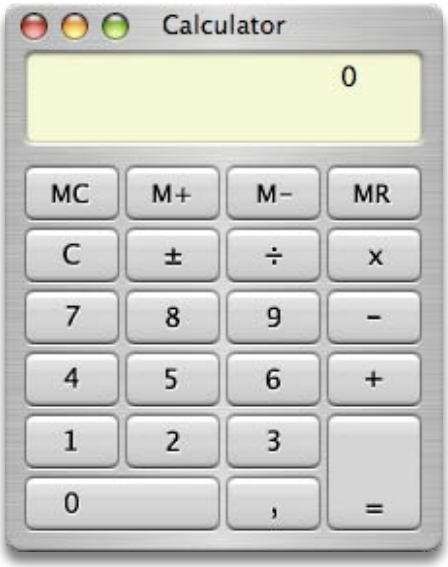
⇨ For a programmer the essential question is:
How to write flexible software (efficiently)?

- Software Product-Lines, Frameworks, DSLs, Programming Language Support, ...

A Variability Example...



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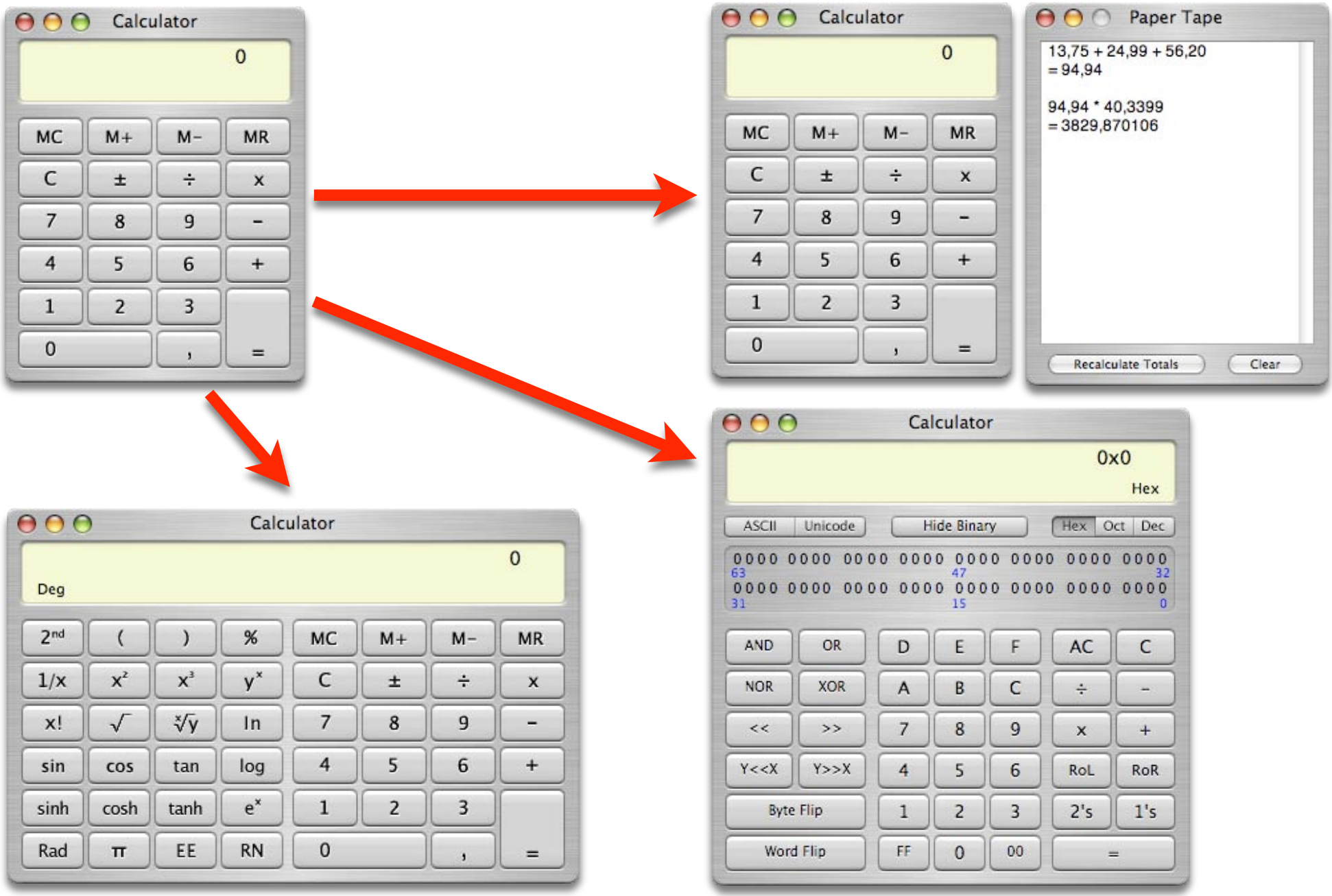

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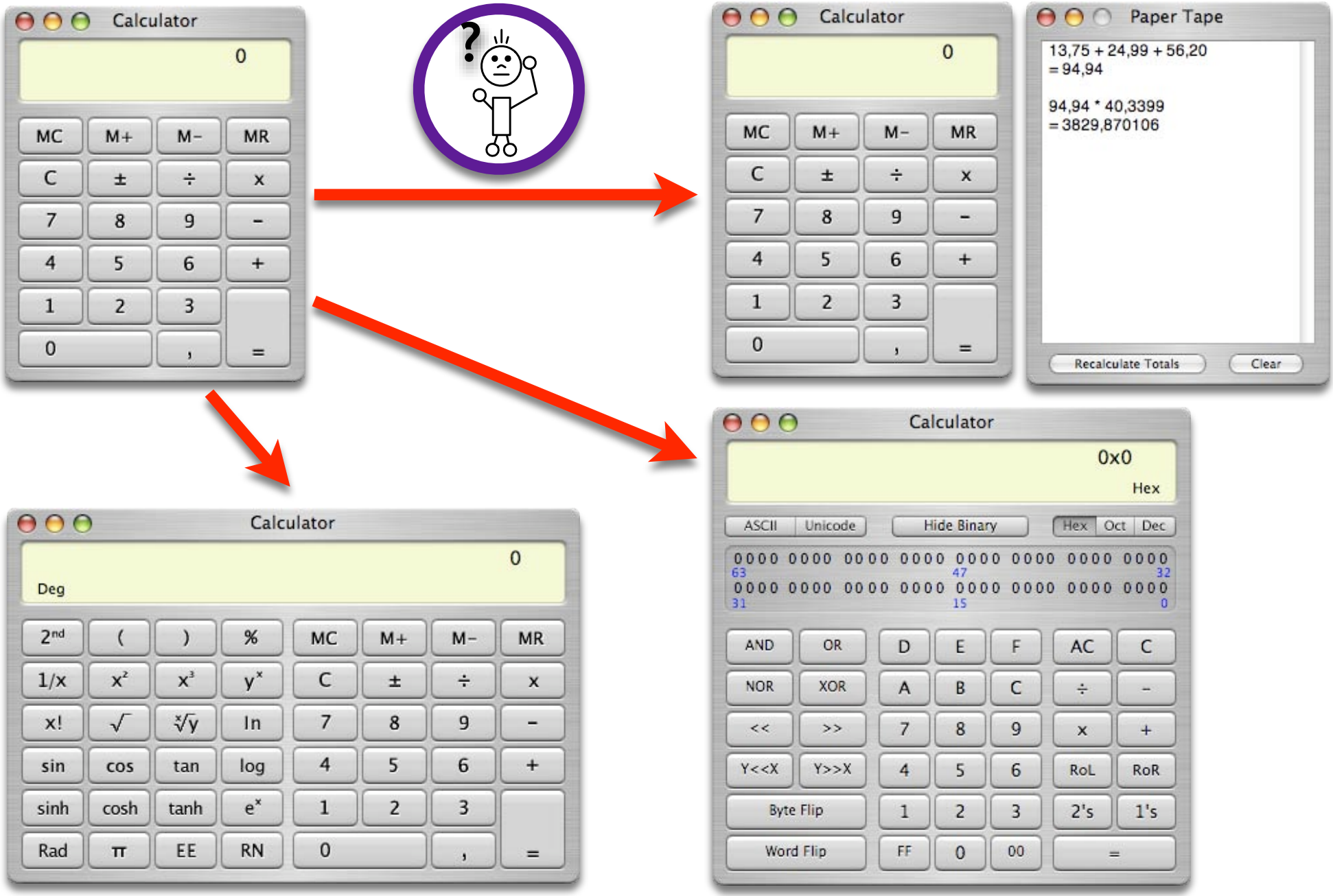
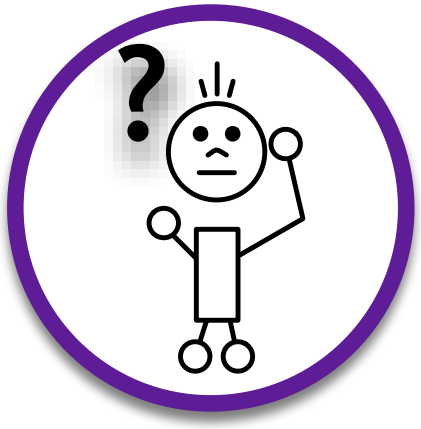


Per Perspective - Many Dimensions



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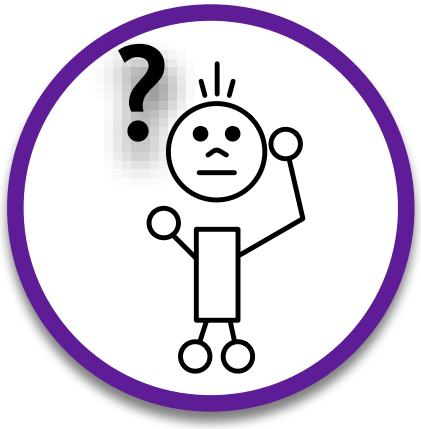
What should vary?

- Functionality (data, behavior, control flow), ...
- User Interface (context, user, task)
- Platform (hardware, OS, infrastructure), ...



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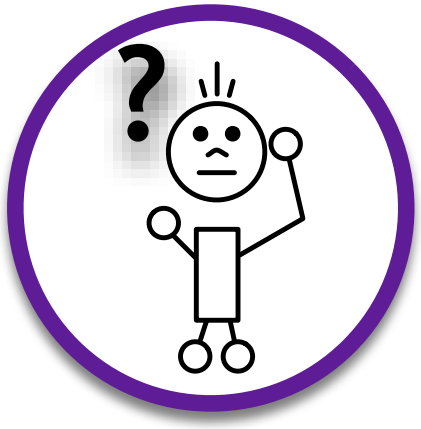
- Compile-time (precompiler, aspect weaving)
- Runtime (reflection), ...



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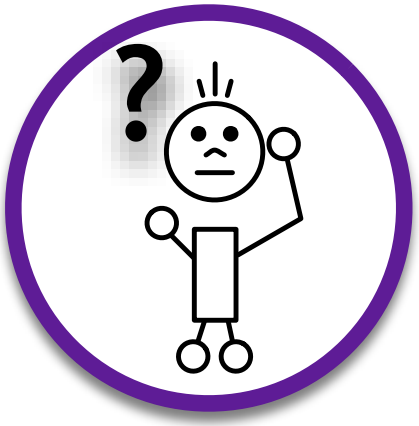
Who should make it vary?

- Developer (configuration files, macro's)
- Domain expert (DSL, Meta-CASE tools)
- End-user (Preferences dialog), ...

...



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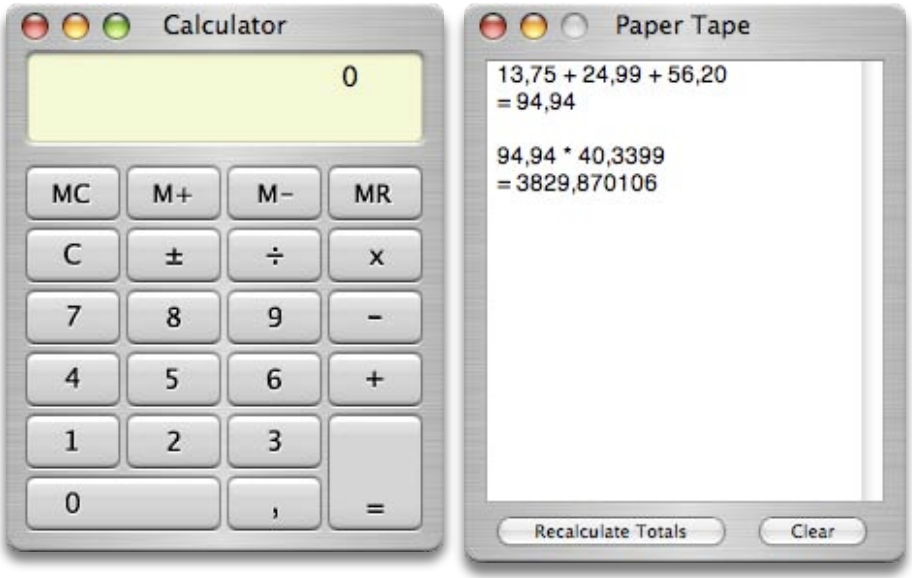

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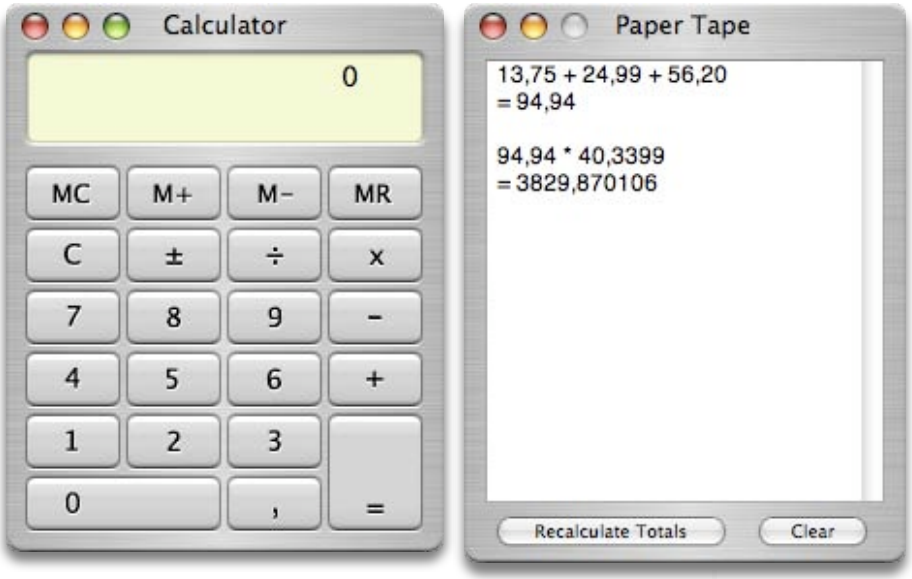

What?
When?
Who?
...

And how to do so Efficiently?

‘Efficiently’ = ‘Clean’ + ‘Easy’ + ‘Digestible’ …

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Lightweight Programmer Techniques

- Use of standard OO techniques
  - e.g. inheritance, polymorphism, delegation, meta programming
- Use of design patterns
  - e.g. Abstract Factory, Strategy, ...
- Use of analysis patterns
  - e.g. Party, Portfolio, Quantity, Observation, ...

And how to do so Efficiently?

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>> Programmer sets up own "meta" infrastructure
>> Generic code results in implicit domain knowledge
>> Connection of domain knowledge and code is lost

C3-CoBro in a Nutshell

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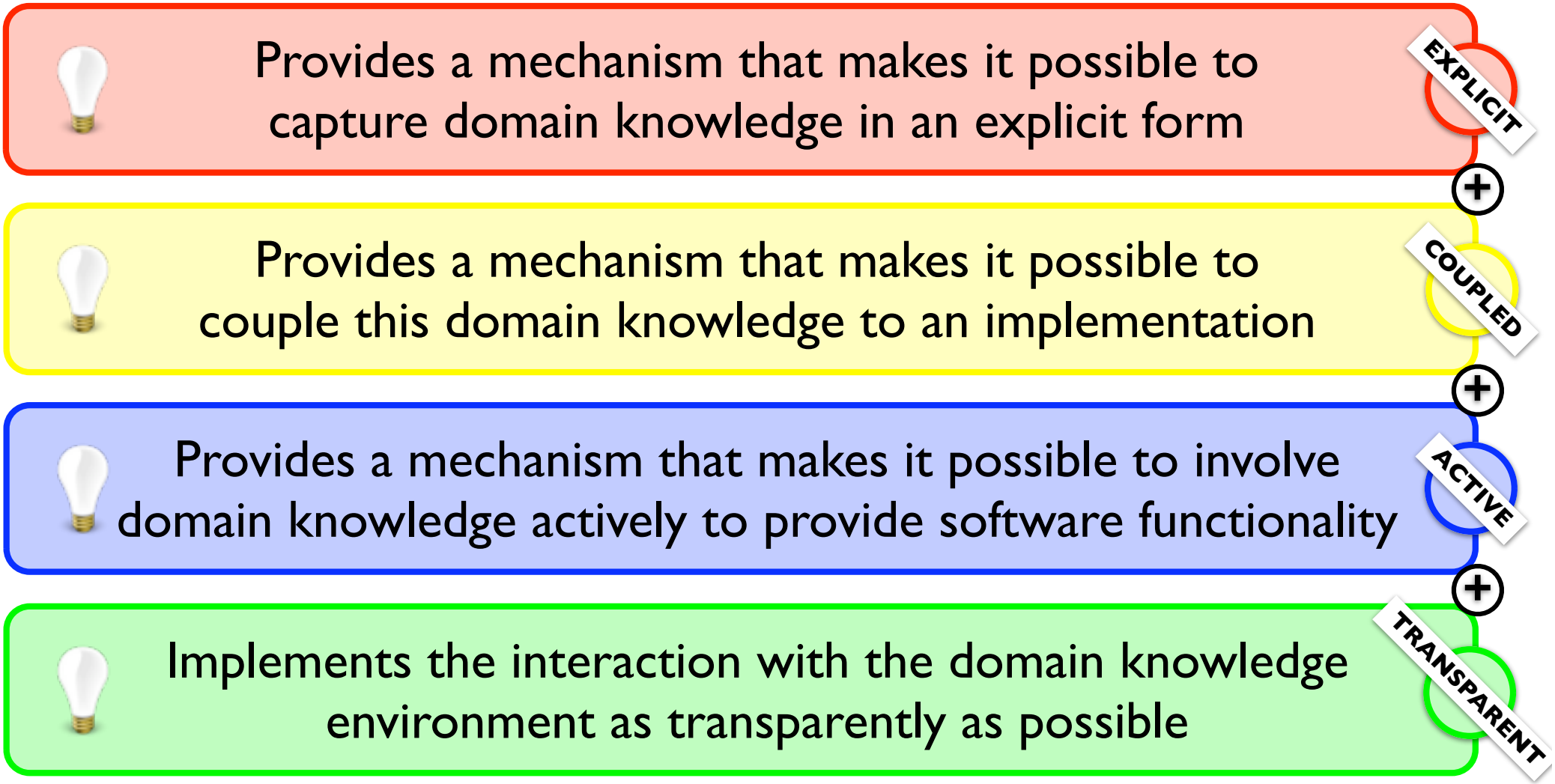
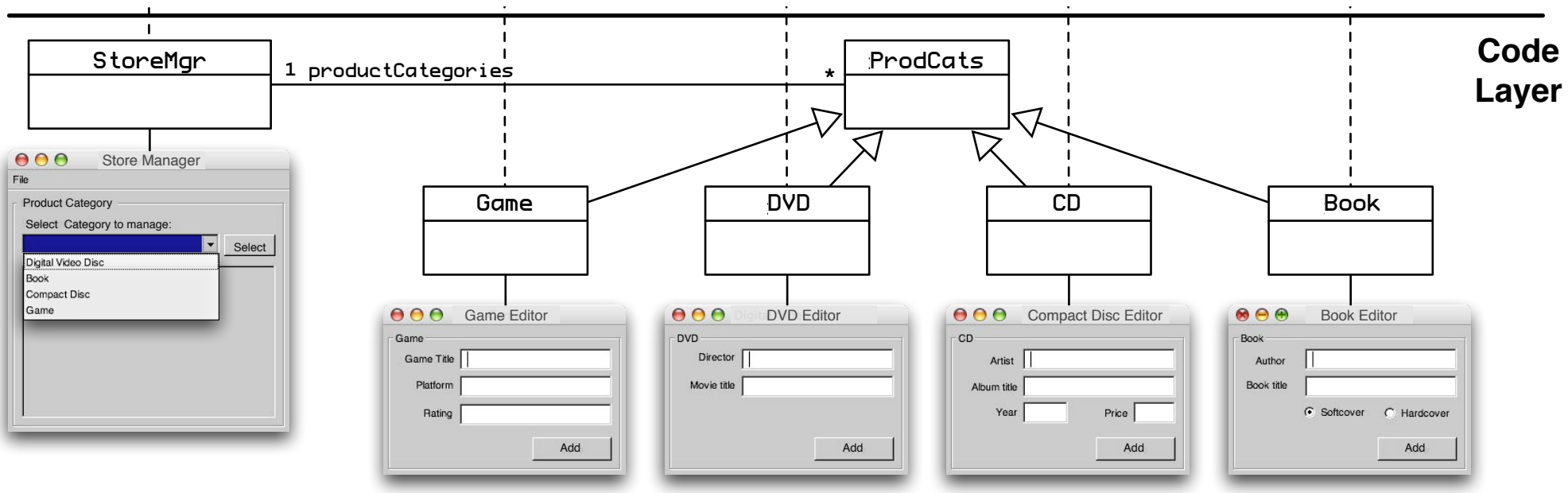


Active Domain Meta Layer



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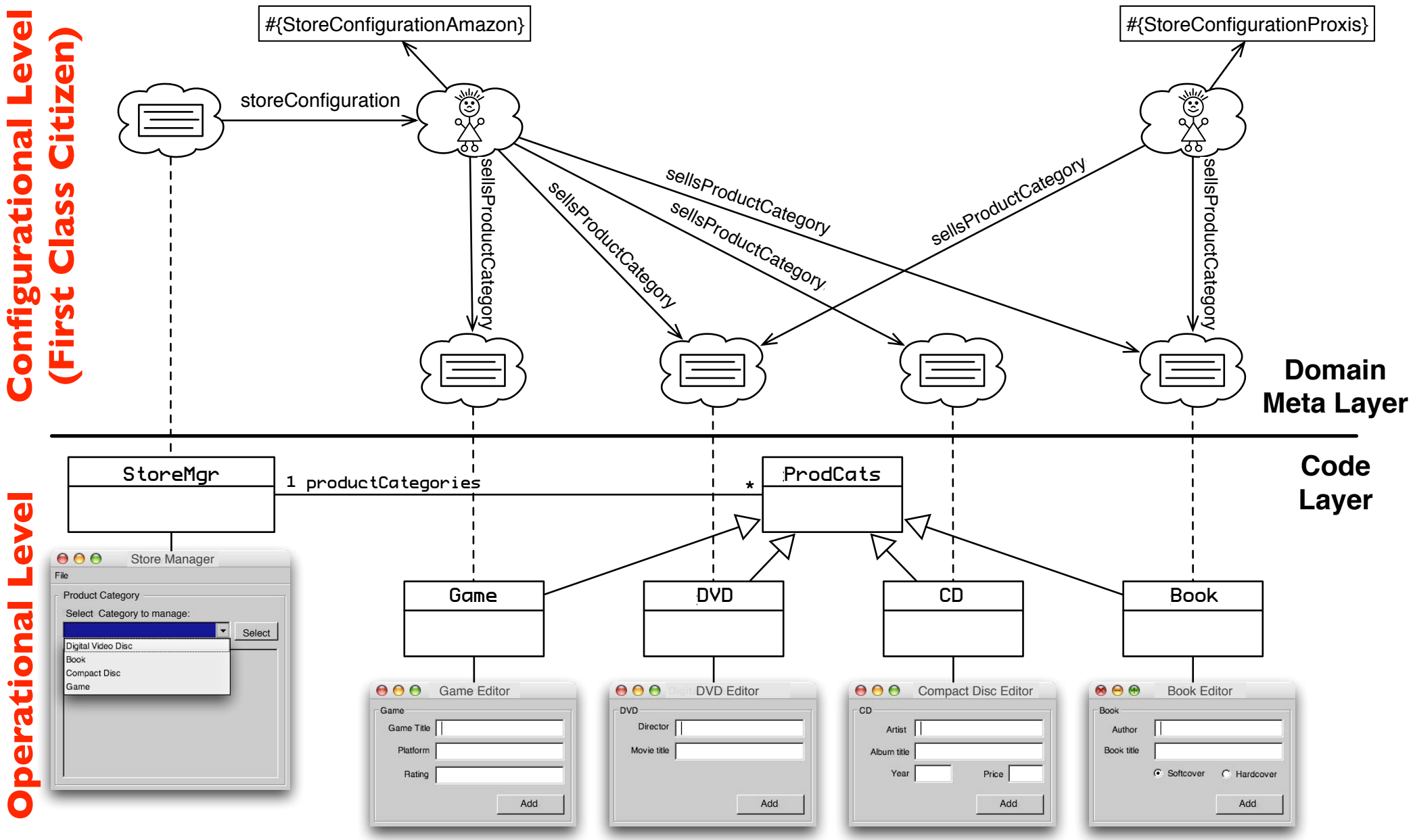

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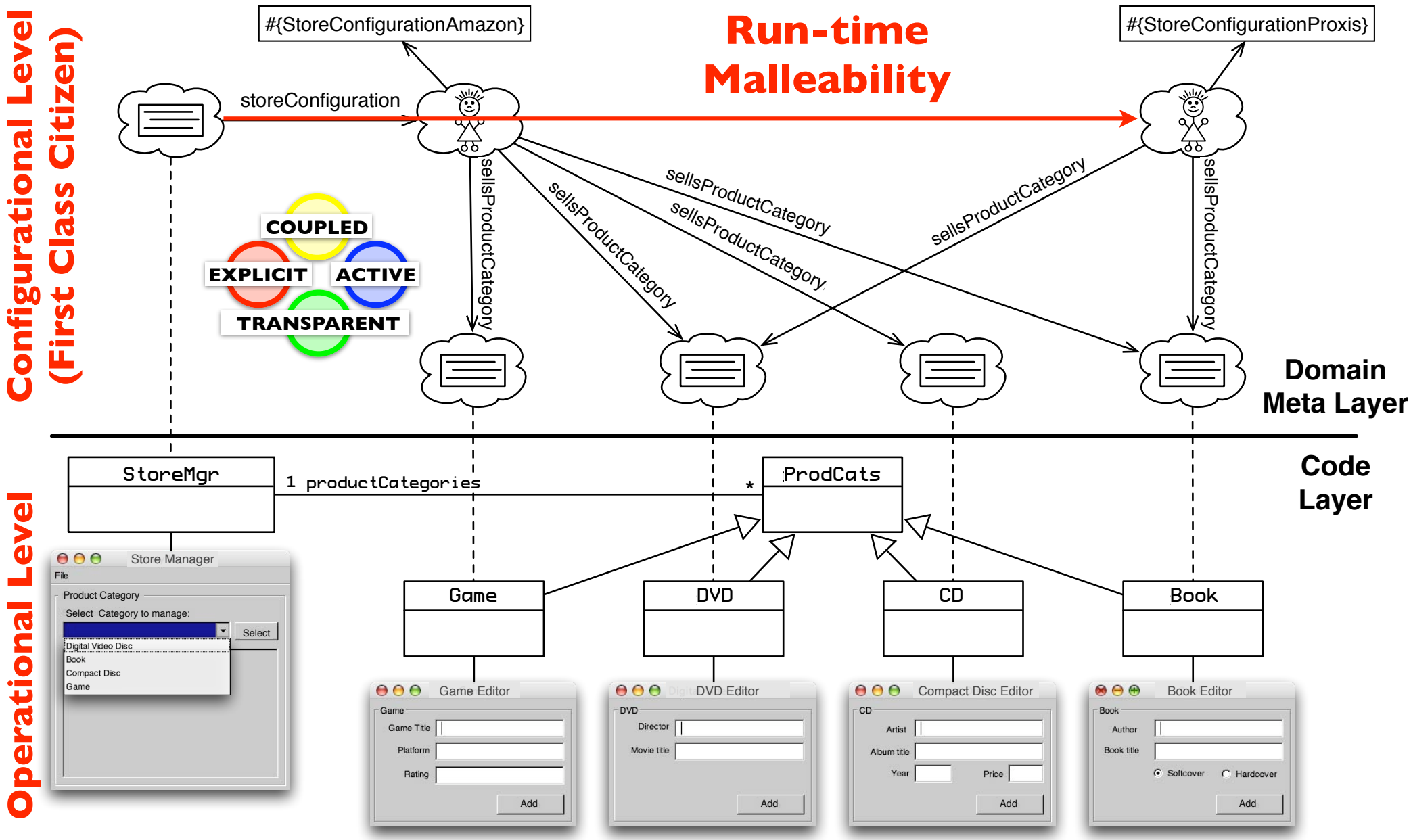
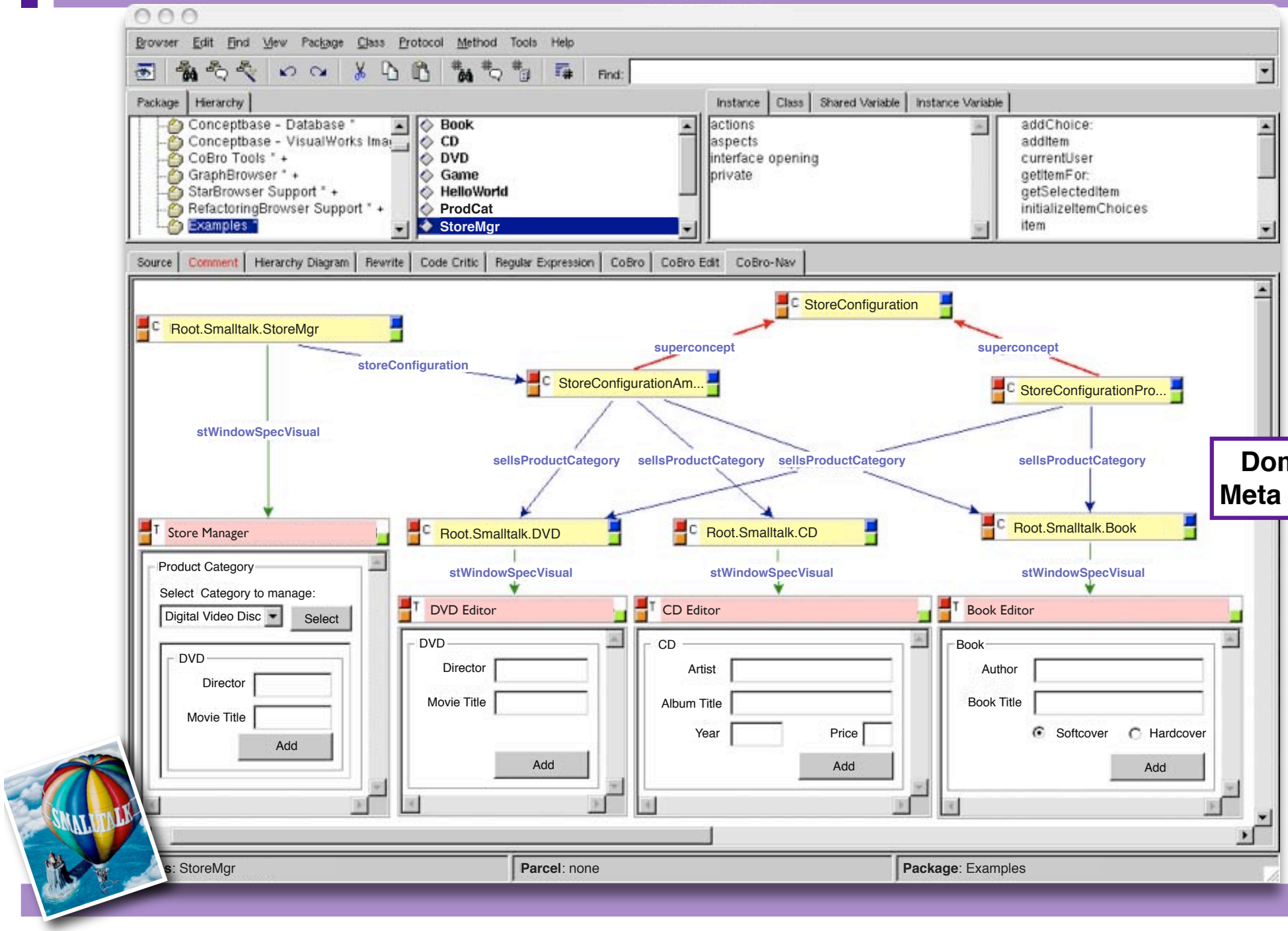
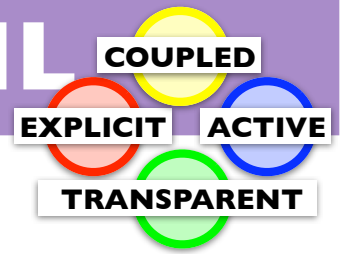


Close Integration Visualworks IDE



Domain Meta Layer

StoreConfiguration in CoBro-CML



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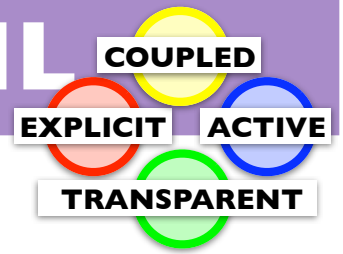


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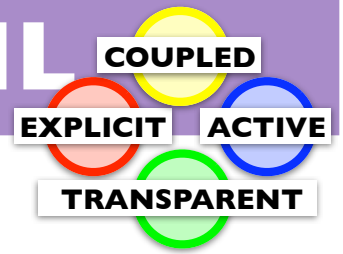


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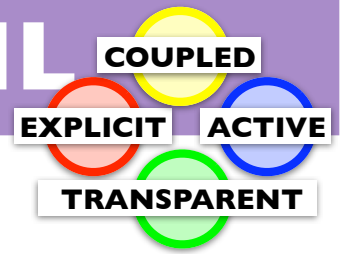


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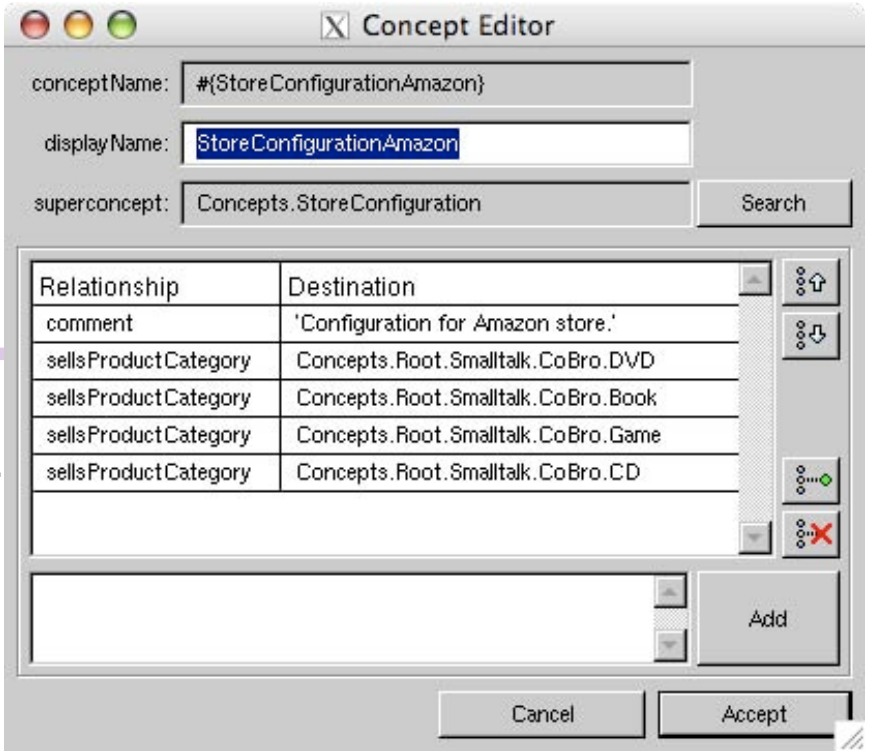

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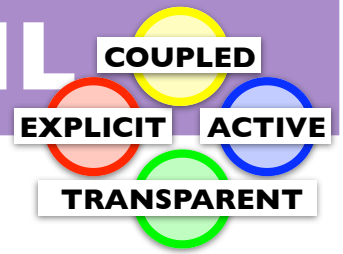


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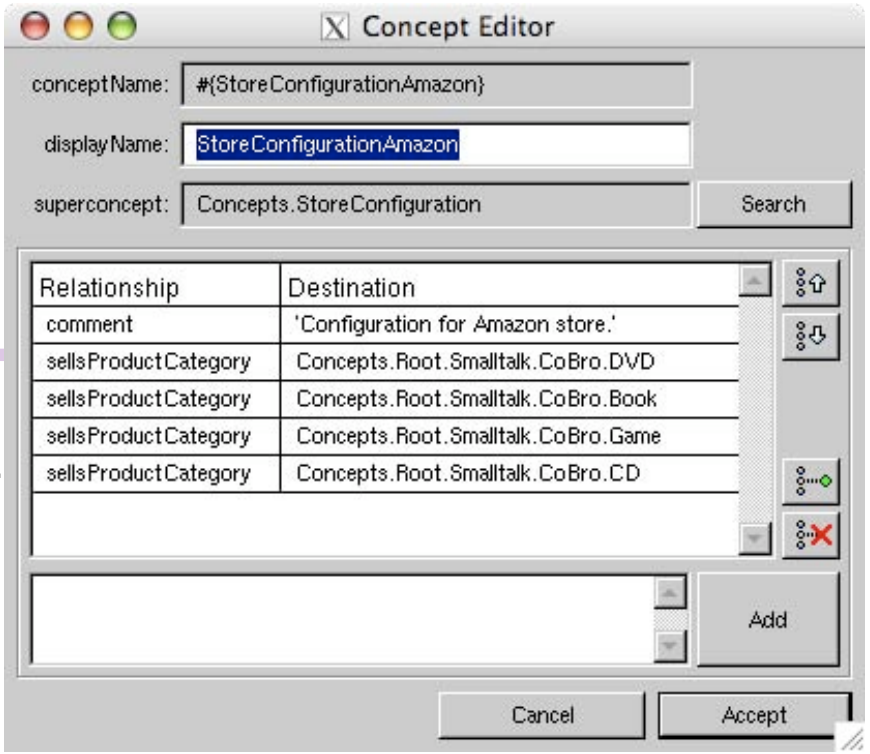


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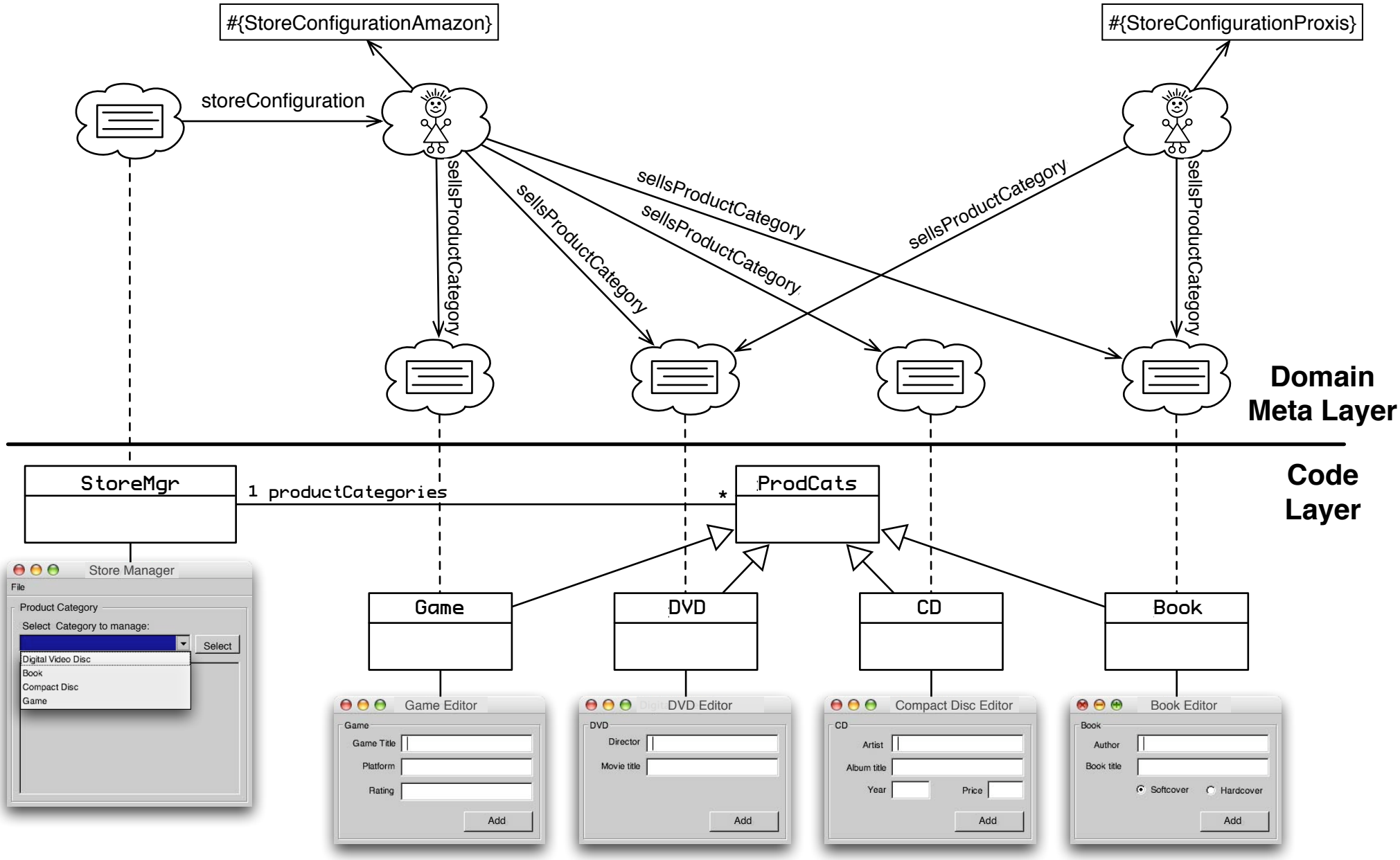
Concepts.StoreMgr storeConfiguration: StoreConfigurationAmazon.
```

Mixing CoBro-CML with Smalltalk



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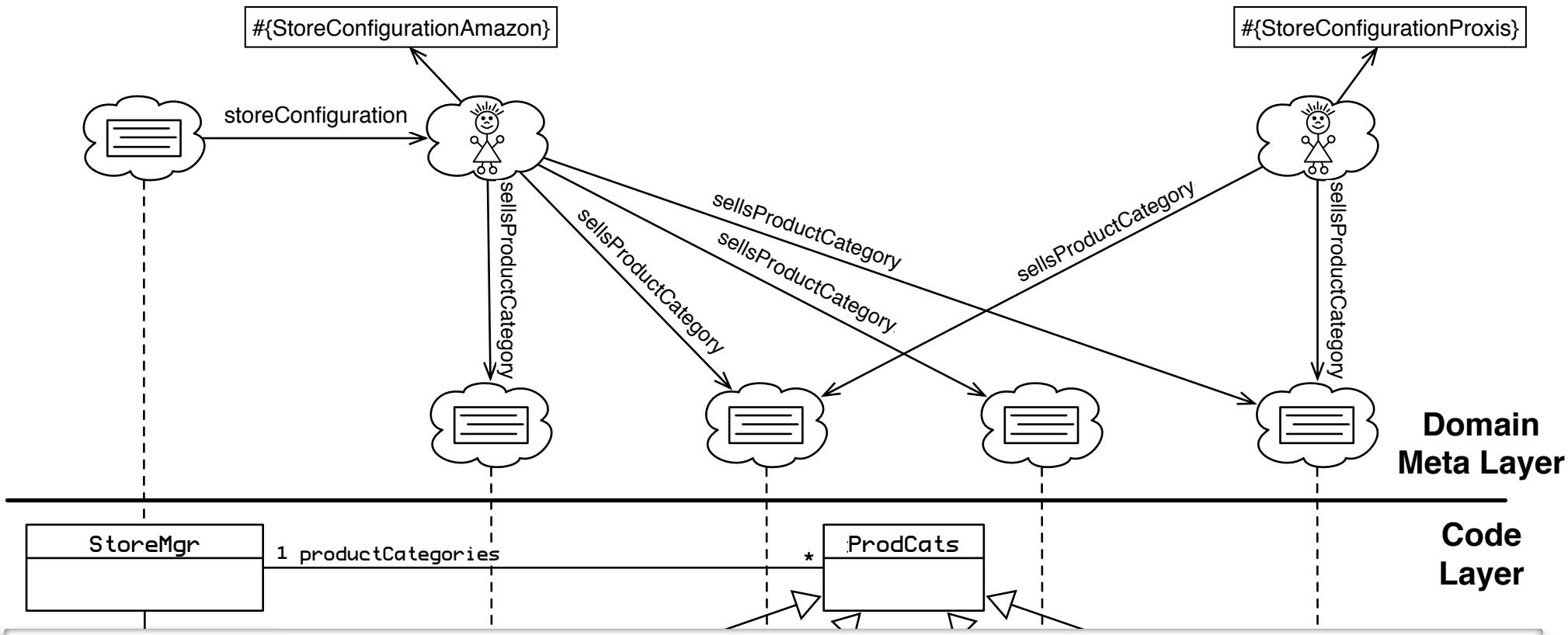


```
StoreMgr>>addCategoryToConfig: aCategory
    |myConfig|
    myConfig := self class asConcept storeConfiguration.
    maxCategories := Concepts.sellsProductCategory multiplicity second.
    myConfig sellsProductCategory size <= maxCategories
       ifTrue: [ myConfig sellsProductCategory: aCategory ; save.]
       ifFalse: [ Dialog warn: 'No more categories allowed !' ].
```

More Variability: ShippingRestrictions

International Shipping

Items from Amazon Marketplace can be shipped to several international regions, but cannot be shipped to **Africa, Island Nations, Israel, South America, or the Middle East.**

Read more about shipping to U.S. protectorates or APO/FPO addresses.

Restrictions

The following items can be shipped to almost all destinations outside the U.S.:

- **books***
- **DVDs**
- **music**
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   superconcept: Concepts.GeographicalRegion).
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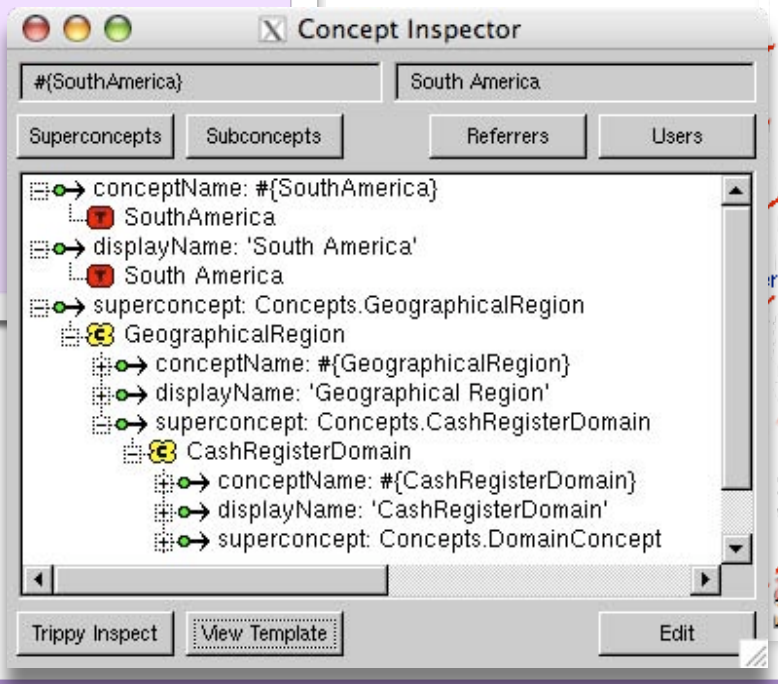

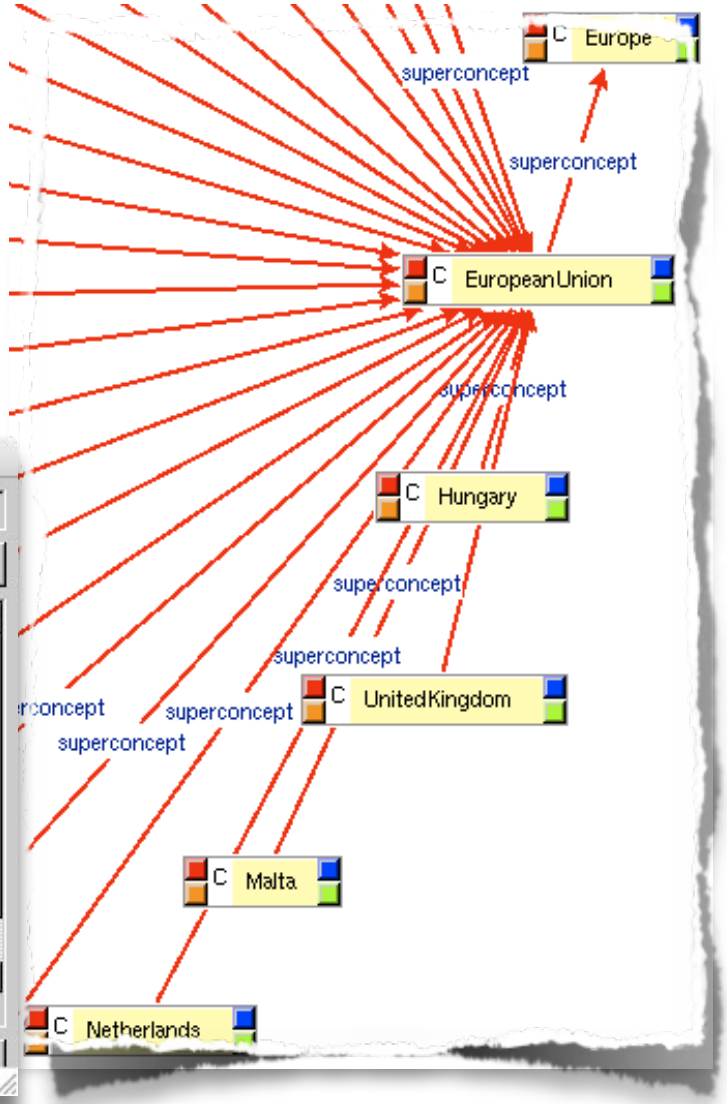

More Variability: ShippingRestrictions

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(Concepts
   defineConcept: #{RestrictionForInternational}
   displayName: 'Shipping Restriction For International'
   superconcept: Concepts.ShippingRestriction)
   restrictedLocations: #(Concepts.LatinAmerica Concepts.Israel
                          Concepts.Africa ...) ;
   restrictedProductCategories: #(Concepts.Jewelry Concepts.KitchenItems
                                  Concepts.SportingGoods ...) ;
   comment: 'Items of our market place can be ...'.
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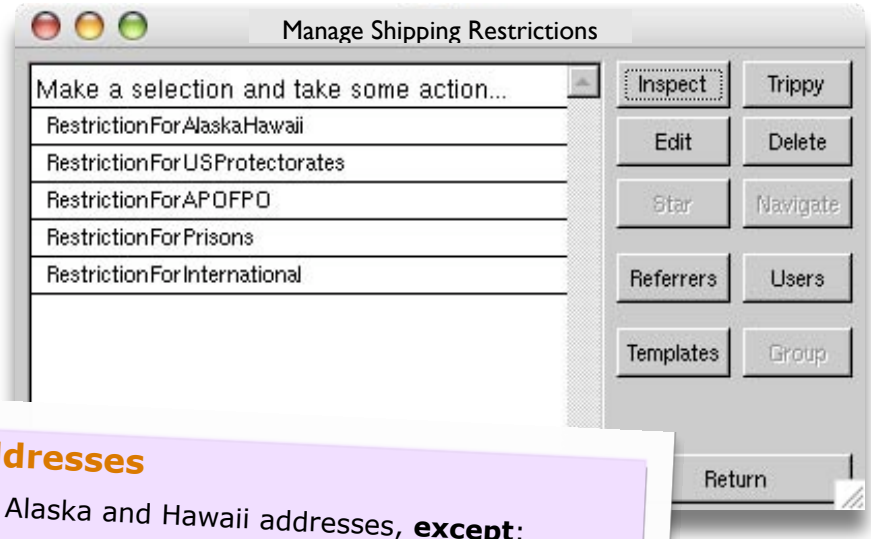

U.S. Protectorates (including Puerto Rico)

Only the following items **can** be shipped to U.S. Protectorates:

- **baby items**
- **books**
- **DVDs**
- **music**
- **software**
- **toys**
- **VHS videos**
- **video games**

Alaska and Hawaii Addresses

Most items can be shipped to Alaska and Hawaii addresses, **except**:

- **grocery items**
- **gourmet food items**

...

Fun with Validators & Interpreters

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Concepts.StoreConfiguration
  configurationValidator:
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Concepts.Belgium flag inspect
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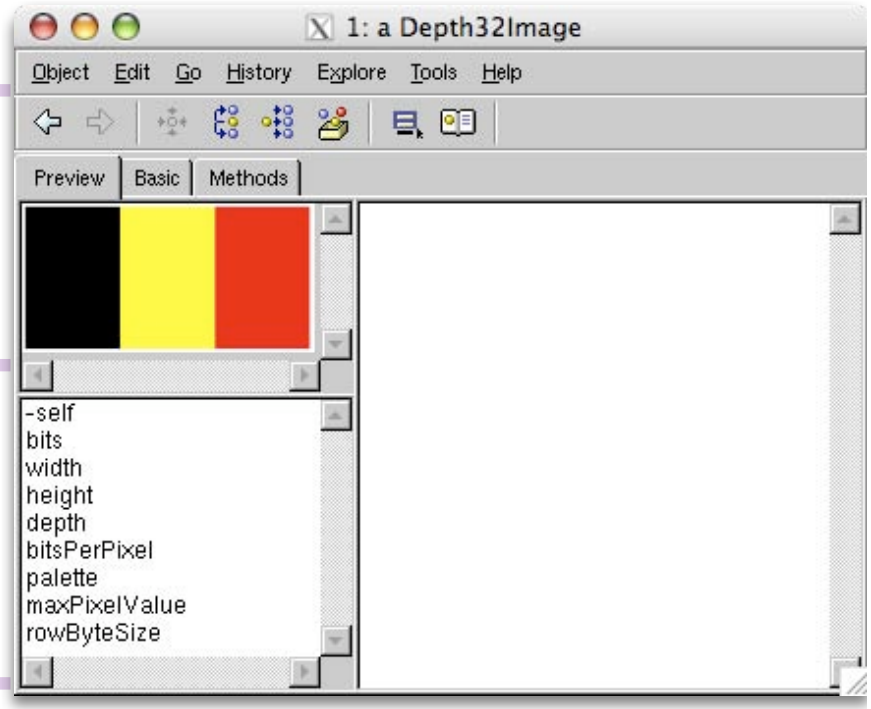

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(Concepts
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   multiplicity: #(1 #n) ;
   destinationType: Concepts.STImage.
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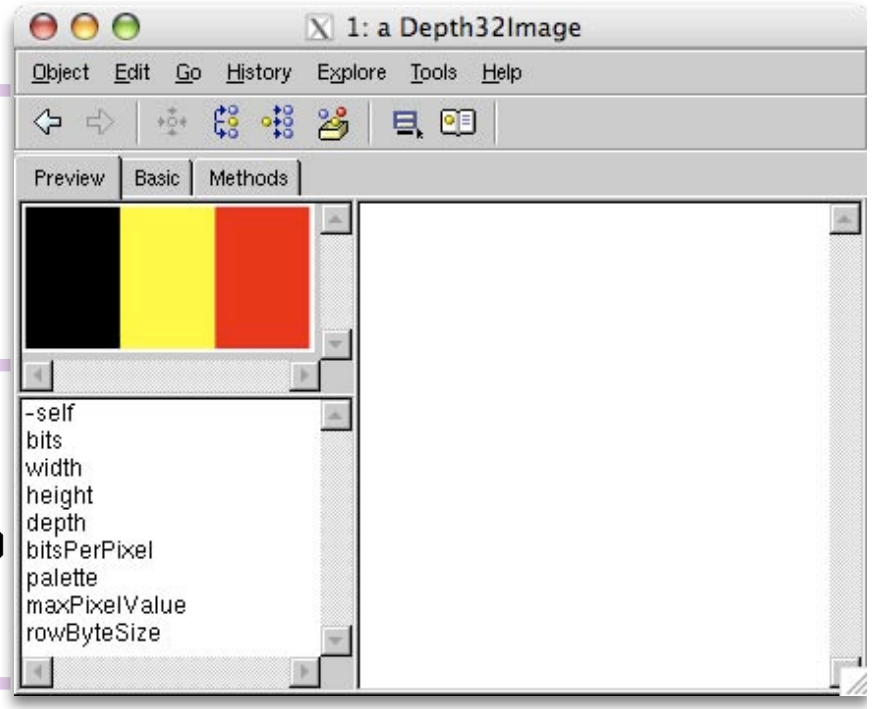

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   multiplicity: #(1 #n) ;
   destinationType: Concepts.STImage.
```
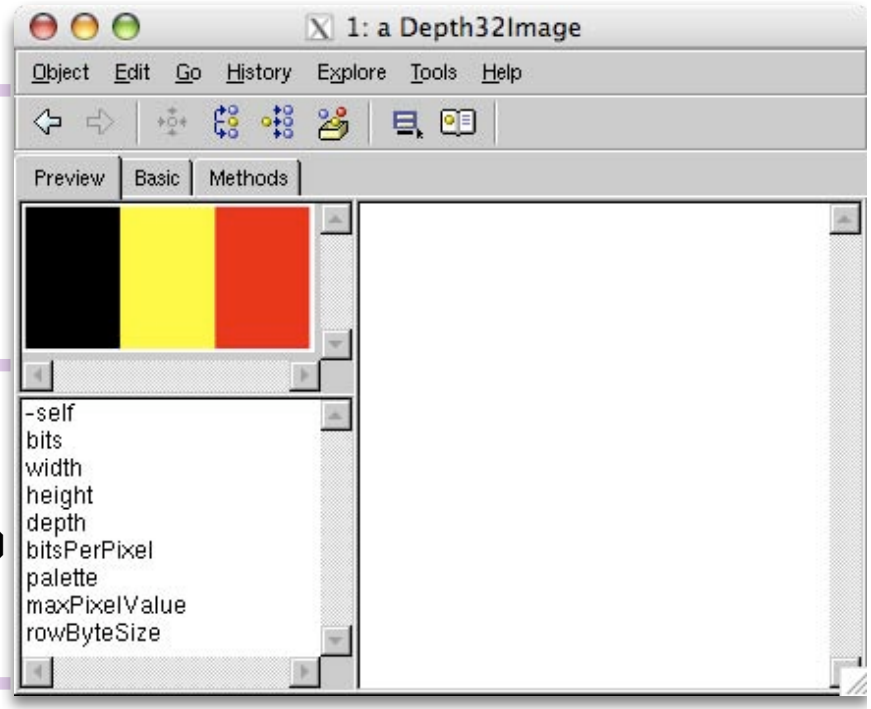

```
(Concepts defineConcept: #{STImage}
   displayName: 'STImage'
   superconcept: Concepts.SmalltalkTerminal)
   valueValidator: '[:receiver :relation : destination|
                    destination asFilename exists]' ;
   valueInterpreter: '[:receiver :relation : destination|
                      (ImageReader fromFile: destination asFilename)
                         image]'
```

```
Concepts.Belgium flag inspect
```



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  - Guidelines, Patterns, Considerations, ...

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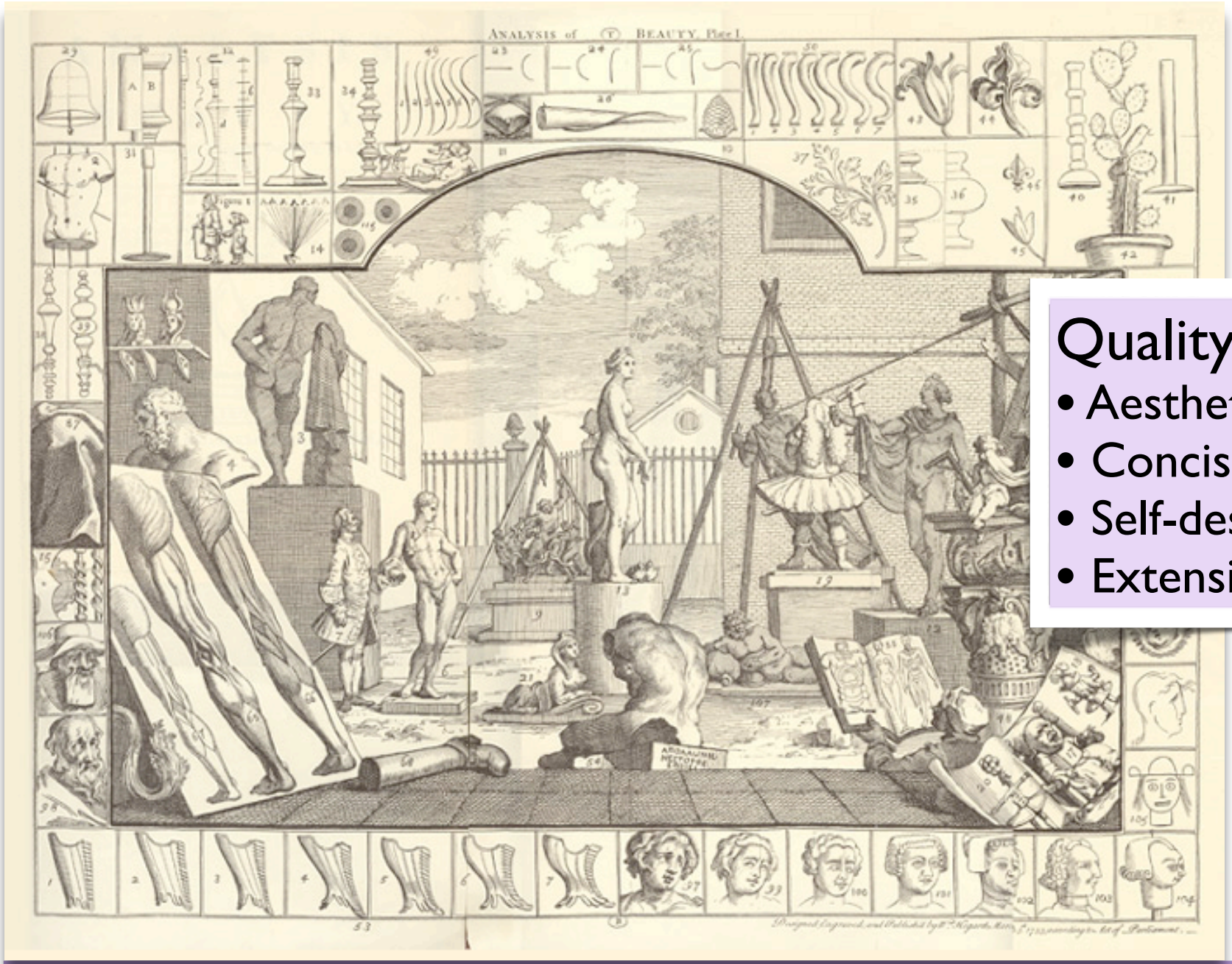
- Feature Diagrams to model the variability
- Explore the power of valueValidators & valueInterpreters
- Explore CoBro as a Meta-CASE tool
- Establish "Methodology"-side of C3
  - Guidelines, Patterns, Considerations, ...
- How to check if the variability is indeed supported "efficiently"? Quality Measures

W. Hogarth - "The Analysis of Beauty"



Quality Measures?

- Aesthetic
- Concise
- Self-descriptive
- Extensible ...

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Renewed interest in dynamic languages
a coincidence?

Questions?

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Dirk Deridder

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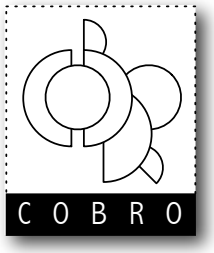
B-1050 Brussel

Belgium



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