Magritte

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Who am I?

- Academics
  - PhD Student, University of Bern
- Industrial
  - Software Engineer, netstyle.ch
- Communities
  - Author of Magritte and Pier, and some other open-source projects
  - Contributor to Seaside and Squeak

Agenda

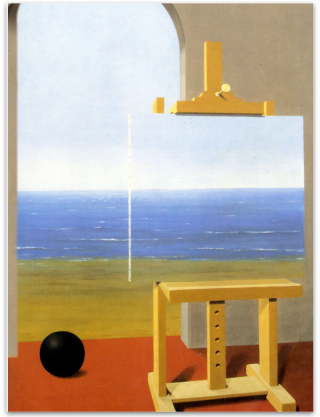
- Introduction
- Examples
- Implementation
- Customization

- Hands-on Exercises

Magritte

Introduction

Describe once,
Get everywhere



What is it useful for?

- Introspection
- Reflection
- Documentation
- *Viewer building*
- *Editor building*
- Report building
- *Data validation*
- Query processing
- Object persistency
- Object indexing
- Object setup
- Object verification
- *Object adaption*
- *Object customization*

and much more

Why is it useful?

- Describe once, get everywhere.
- Automatically build views and editors, process queries and store objects.
- Extensibility of classes is ensured.
- Fully customizable, e.g., it is possible to replace any automatically generated view with a modified or customized one.

Why is it cool?

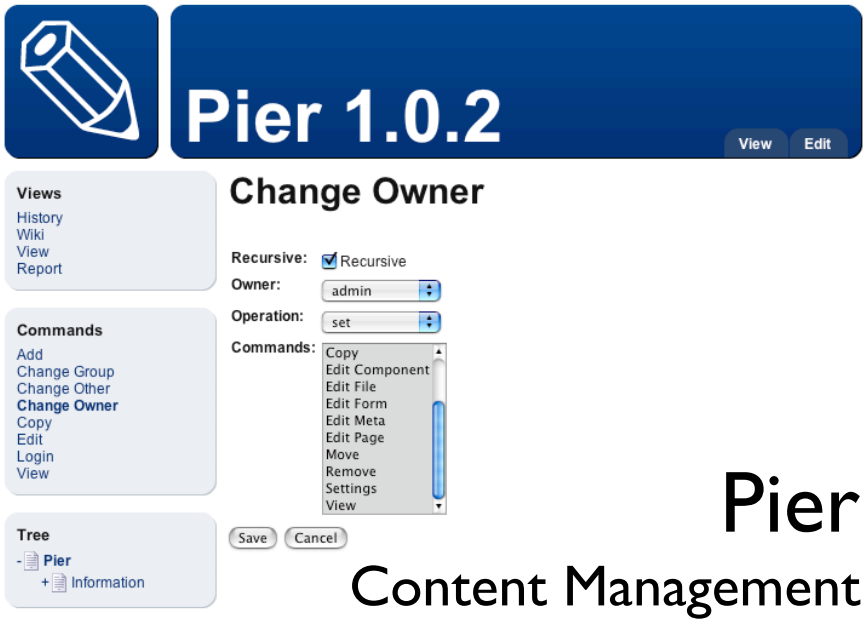
- Describe once, get everywhere.
- Be more productive.
- Lower coupling in software components.
- Do more, with less code.
- Do more, with less hacking.

What is it used for? (1)

- Pier – a meta-described collaborative web-application framework.
- Aare – a proprietary workflow definition and runtime engine with integrated document management system.
- Conrad – a conference registration and management system.

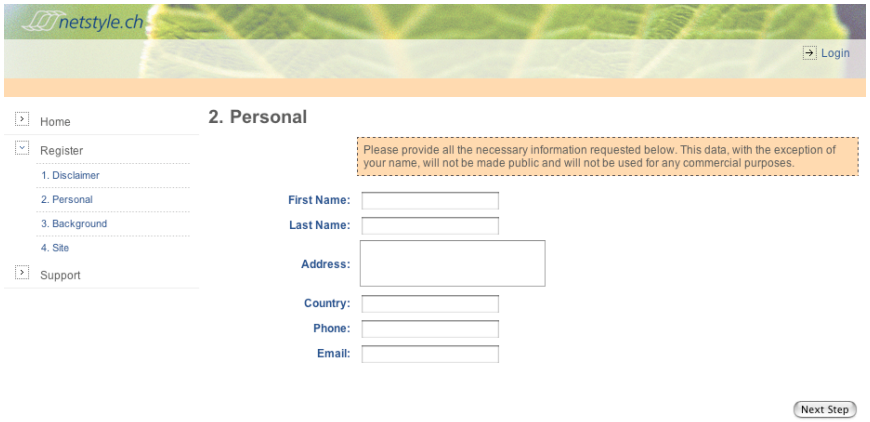
What is it used for? (2)

- Seaside-Hosting – free hosting service for non-commercial Seaside applications.
- DigiSens – a proprietary monitoring system for high precision sensors.
- cmsbox – the next generation of a content management system.



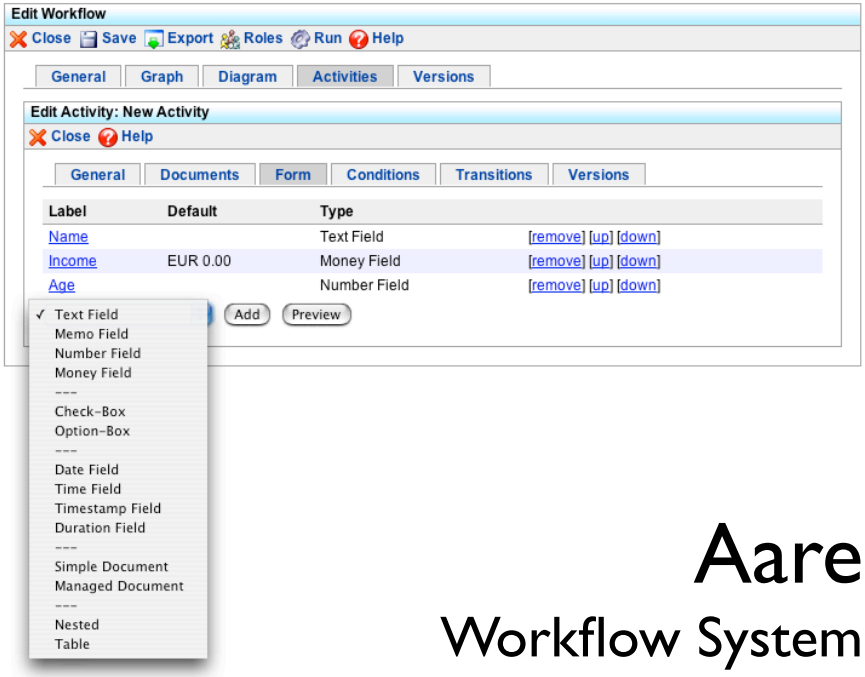
Pier

Content Management



Seaside-Hosting

Hosting Application



Aare

Workflow System

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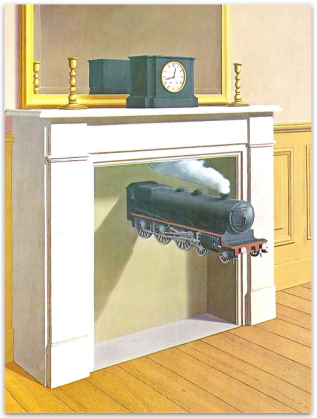
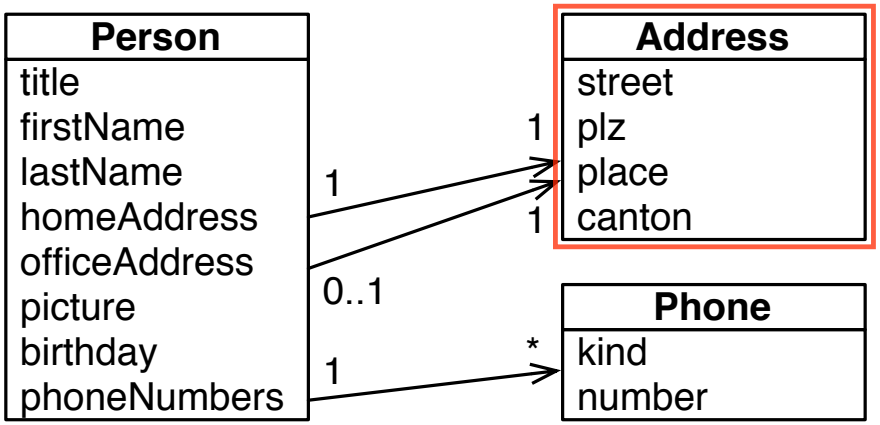
Examples

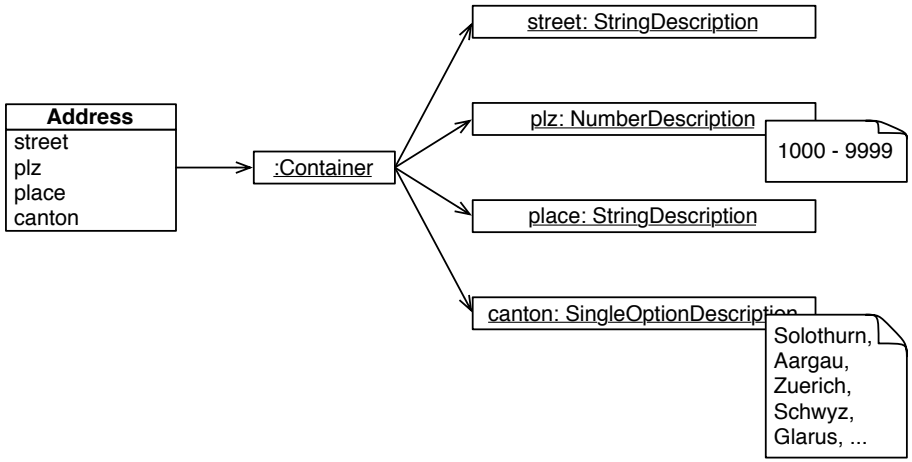
Describe once,
Get everywhere



Address Book



"Describing" the Address



Defining Descriptions

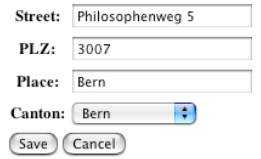
- A object is described by adding methods named `#description*` (naming convention) to the *class-side* answering different description-entities.
- All descriptions will be *automatically collected* and put into a container description when sending `#description` to the object.
- Descriptions can be built programmatically.

Describing the Address

```
MAAddressModel class>>descriptionStreet
    ^ MAStringDescription auto: 'street' label: 'Street' priority: 10.

MAAddressModel class>>descriptionPlz
    ^ (MANumberDescription auto: 'plz' label: 'PLZ' priority: 20)
        min: 1000 max: 9999;
        yourself.

MAAddressModel class>>descriptionPlace
    ^ MAStringDescription auto: 'place' label: 'Place' priority: 30.

MAAddressModel class>>descriptionCanton
    ^ (MASingleOptionDescription auto: 'canton' label: 'Canton' priority: 40)
        options: #( 'Bern' 'Solothurn' 'Aargau' 'Zuerich' 'Schwyz' 'Glarus' ...);
        reference: MAStringDescription new;
        beSorted;
        yourself.
```

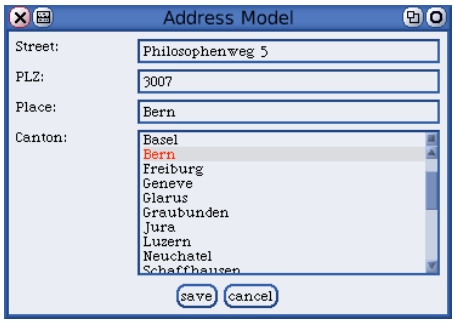

Seaside Interface

```
result := self call: (aModel asComponent
    addValidatedForm;
    yourself).
```

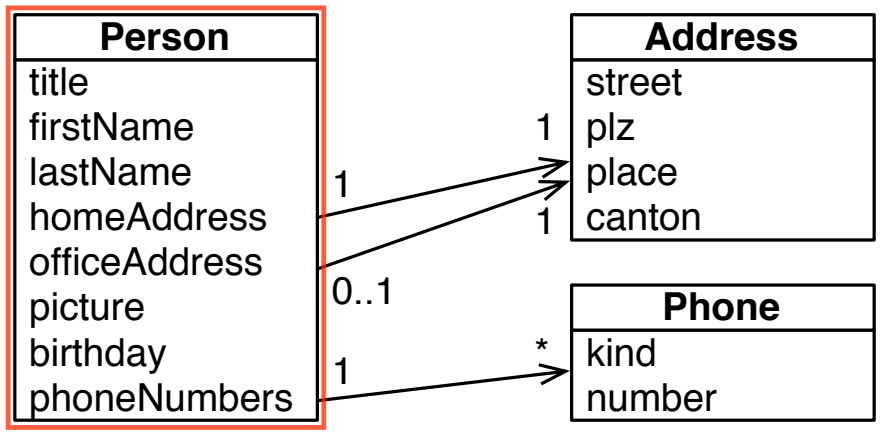


Morphic Interface

```
result := aModel asMorph
    addButtons;
    addWindow;
    callInWorld.
```



Address Book



Describing the Person (1)

```
MAPersonModel class>>descriptionTitle
    ^ (MASingleOptionDescription auto: 'title' label: 'Title' priority: 10)
        options: #( 'Mr.' 'Mrs.' 'Ms.' 'Miss.' );
        yourself.

MAPersonModel class>>descriptionFirstName
    ^ (MAStringDescription auto: 'firstName' label: 'First Name' priority: 20)
        beRequired;
        yourself.

MAPersonModel class>>descriptionLastName
    ^ (MAStringDescription auto: 'lastName' label: 'Last Name' priority: 30)
        beRequired;
        yourself.
```


Describing the Person (2)

```
MAPersonModel class>>descriptionHomeAddress
    ^ (MAToOneRelationDescription auto: 'homeAddress' label: 'Home Address')
        classes: (Array with: MAAddressModel);
        yourself.

MAPersonModel class>>descriptionOfficeAddress
    ^ (MAToOneRelationDescription auto: 'officeAddress' label: 'Office Address')
        classes: (Array with: MAAddressModel);
        yourself.

MAPersonModel class>>descriptionPicture
    ^ (MAFileDescription auto: 'picture' label: 'Picture')
        addCondition: [ :value | value isImage ] labelled: 'Image expected';
        yourself.
```


Describing the Person (3)

```
MAPersonModel class>>descriptionPhoneNumbers
    ^ (MAToManyRelationDescription auto: 'phoneNumbers' label: 'P. Numbers')
        classes: (Array with: MAPhoneNumber);
        default: Array new;
        yourself.

MAPersonModel class>>descriptionBirthday
    ^ MADateDescription auto: 'birthday' label: 'Birthday'.

MAPersonModel class>>descriptionAge
    ^ (MANumberDescription selector: #age label: 'Age')
        beReadonly;
        yourself.
```


Recapitulation

- Put your descriptions on the *class-side* according to the *naming-convention*.
- Ask your object for its *description-container* by sending #description.
- Ask your object for an *User-Interface* by sending #asComponent or #asMorph.

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Implementation

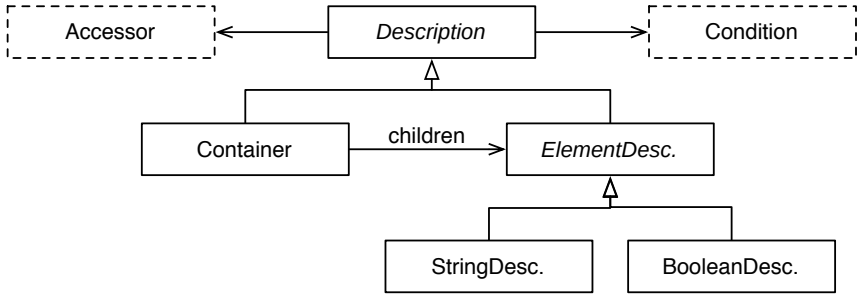
Describe once,
Get everywhere

Descriptions

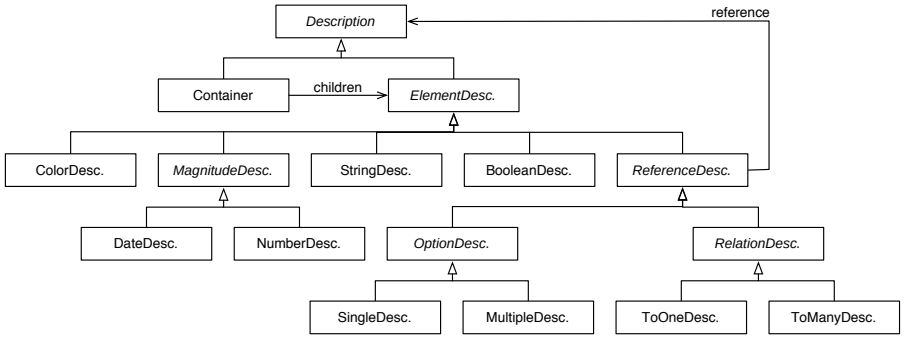
- Problem
  - Smalltalk classes are all very different and require different configuration possibilities.
- Example
  - `Boolean` and `String` are not polymorphic, therefor different code for printing, parsing, serializing, editing, comparing, querying, etc. is necessary.
- Solution
  - Introduce a descriptive hierarchy that can be instantiated, configured and composed.

Descriptions

a composite pattern
to describe model-classes/-instances



Descriptions

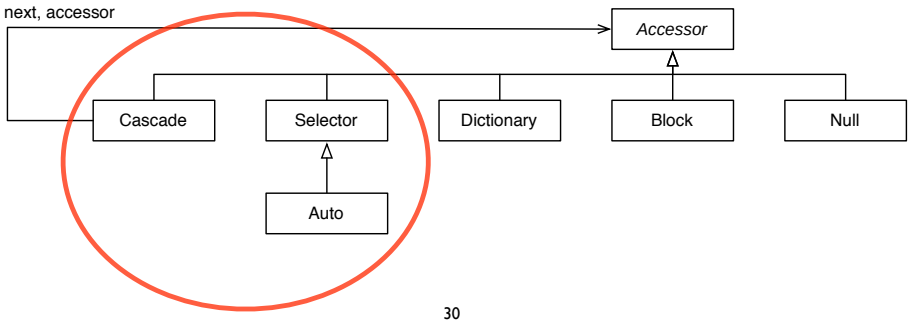


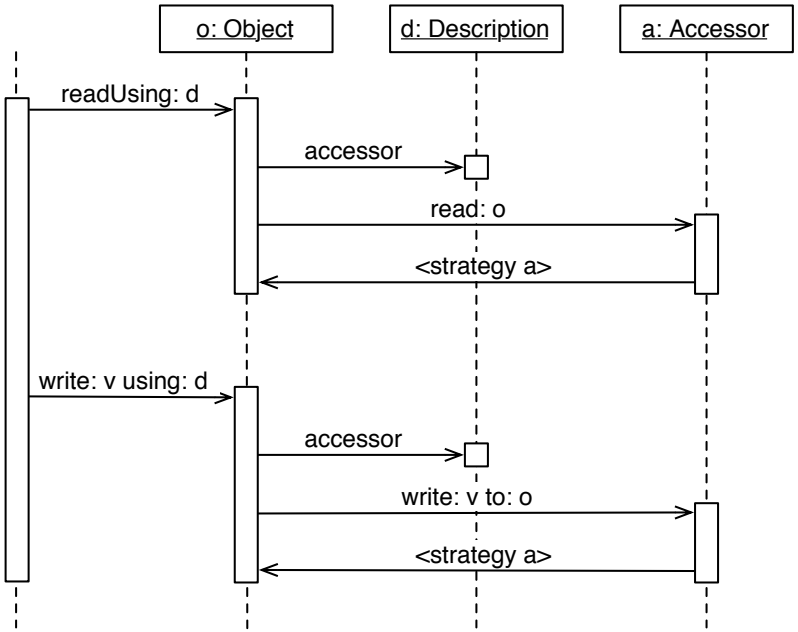
Accessors

- Problem
  - In Smalltalk data can be stored and accessed in very different ways.
- Examples
  - Accessor methods, chains of accessor methods, instance-variables, dictionaries, blocks, etc.
- Solution
  - Provide a strategy pattern to be able to access the data trough a common interface.

Accessors

a strategy pattern
to access model-entities



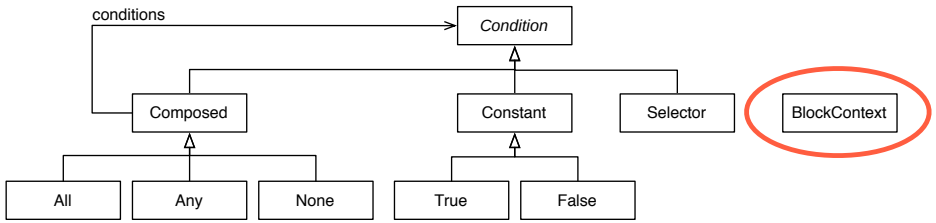


Conditions

- Problems
  - End users want to visually compose conditions.
  - Instances of BlockContext can be hardly serialized.
- Solution
  - Introduce condition objects that can be composed to describe constraints on objects and data.

Conditions

a composite pattern
to model constraints

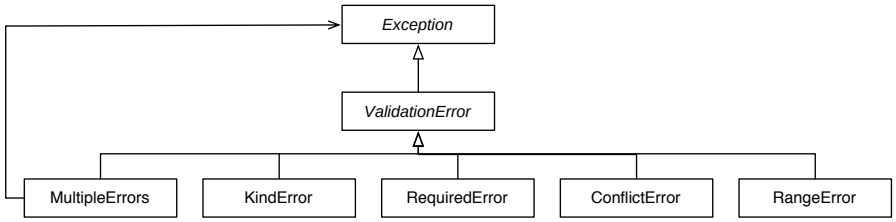


Exceptions

- Problems
  - Actions on the meta-model can fail.
  - Objects might not match a given meta-model.
  - Software would like to avoid errors.
  - End users want readable error messages.
- Solution
  - Introduce an exception hierarchy knowing about the description, the failure and a human-readable error message.

Exceptions

a composite pattern
of smalltalk exceptions

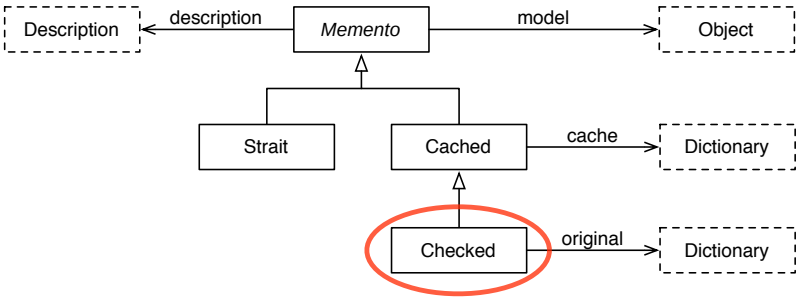


Mementos

- Problems
  - Editing might turn a model (temporarily) invalid.
  - Canceling an edit shouldn't change the model.
  - Concurrent edits of the same model should be detected and (manually) merged.
- Solution
  - Introduce mementos that behave like the original model and that delay modifications until they are proven to be valid.

Mementos

a proxy pattern
to cache model-entities



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Customization

Describe once,
Get everywhere

Dynamic Descriptions

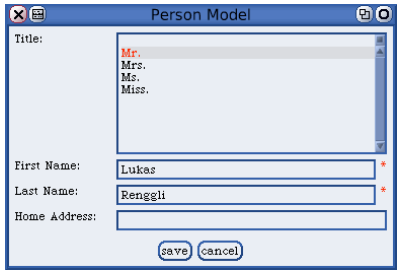
- Problem
  - Instances might want to *dynamically* filter, add or modify their descriptions.
  - Users of a described object often *don't need all the available descriptions*.
- Solution
  - Override #description on the instance-side to modify the default description-container.
  - Add other methods returning different *filtered* or *modified* sets of your descriptions.

Building Descriptions Dynamically

```
" select descriptions "
MAPersonModel>>descriptionPrivateData
    ^ self description select: [ :each |
        #( title firstName lastName homeAddress )
            includes: each accessor selector ].

" add another description "
MAPersonModel>>descriptionWithEmail
    ^ self description copy
        add: (MAStringDescription auto: 'email' label: 'E-Mail' priority: 35);
        yourself.

" modify existing description "
MAPersonModel>>descriptionWithRequiredImage
    ^ self description collect: [ :each |
        each accessor selector = #picture
            ifTrue: [ each copy beRequired ]
            ifFalse: [ each ] ].
```

Using Dynamic Descriptions

```
model := MAPersonModel new.

“ get a morph “
morph := model descriptionPrivateData
      asMorphOn: model.

“ get a component “
component := model descriptionPrivateData
      asComponentOn: model.
```



Custom Validation

- Problem
  - A lot of *slightly* different validation strategies leads to an explosion of the description class-hierarchy.
- Example
  - A number must be in a certain *range*.
  - An e-mail address must match a *regular-expression*.
- Solution
  - Additional validation rules can be added to all descriptions.

Validation Rules

- Use #addCondition:labelled: to add additional conditions to descriptions that will be *automatically checked* before committing to the model.
- The first argument is a block taking one argument, that should return true if the argument validates.
- Using a *block-closure* is possible, but you will loose the possibility to serialize the containing description. Send it the message #asCondition before adding to parse it and keep it as serialize-able *AST* within the description.

Validation Examples

```
(MANumberDescription selector: #age label: ‘Age’)
      addCondition: [ :value | value isInteger and: [ value between: 0 and: 100 ] ]
      labelled: ‘invalid age’;
      ...

(MAStringDescription selector: #email label: ‘E-Mail’)
      addCondition: [ :value | value matches: ‘#*@#*.#*’ ]
      labelled: ‘invalid e-mail’;
      ...

(MADateDescription selector: #party label: ‘Party’)
      addCondition: [ :value | self possiblePartyDates includes: value ]
      labelled: ‘party hard’;
      ...
```

Custom Description

- Problem
  - In some cases it might happen that there is no description provided to use with a model class.
- Example
  - Money: amount and currency.
  - Url: scheme, domain, port, path, parameters, etc.
- Solution
  - Create your own description.

Your own Description

- Create a subclass of `MAElementDescription`.
- On the class-side override:
  - `#isAbstract` to return `false`.
  - `#label` to return the name of the description.
- On the instance-side override:
  - `#kind` to return the base-class.
  - `#acceptMagritte:` to enable visiting.
  - `#validateSpecific:` to validate.
- Create a view, if you want to use it for UI building.

Tips for Builders

- Have a look at existing descriptions.
- Carefully choose the right superclass.
- Reuse the behaviour from the superclass.
- Parsing, printing and (de)serialization is implemented in vistiors:
  - `MAStringReader`, `MAStringWriter`
  - `MABinaryReader`, `MABinaryWriter`

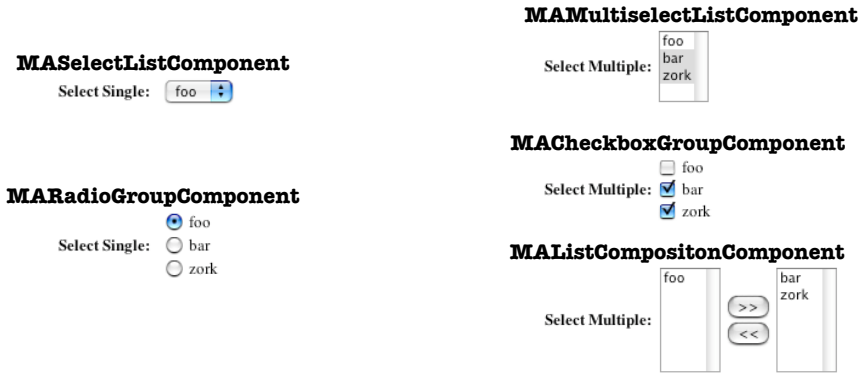
Custom View

- Problems
  - Custom descriptions mostly need a *new view*.
  - Applications might need a *special view* for existing descriptions to adapt a better user experience.
- Example
  - Money: an input-field for the amount and a drop-down box to select the currency.
- Solution
  - Choose a different view or create your own.

Different Views

Single Option

Multiple Option



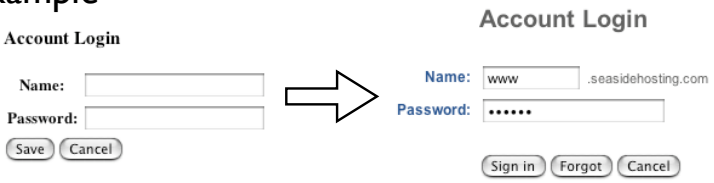
aDescription componentClass: aClass

Your own View

- Create a subclass of MADescriptionComponent.
- Override #renderEditorOn: and/or #renderViewerOn: as necessary.
- Use your custom view together with your description by using the accessor #componentClass:.
- Possibly add your custom view to its description into #defaultComponentClasses (there is no clean way to do that right now, Pragmas would help).

Custom Rendering

- Problem
  - Automatic built UIs are often not that user-friendly, and they all look more or less the same.
- Example



- Solution
  - Use CSS and customize the rendering of your UI.

Possibility 1

- Create a subclass of WAComponent.
- Create an i-var holding onto the automatically built component:
  dialog := aModel asComponent
- Don't forget to return it as a child!
- Implement your own rendering code, accessing the magritte sub-views by calling:
  dialog childAt: aModel class descriptionFoo
- Commit your model by sending:
  dialog commit

Possibility 2

- Create a new subclass of MAComponentRenderer.
- Implement the new visitor to get the layout you need.
- Override the method #descriptionContainer in your model like this:

```
MyModel class>>descriptionContainer
  ^ super descriptionContainer
      componentRenderer: MyRendererClass;
      yourself.
```

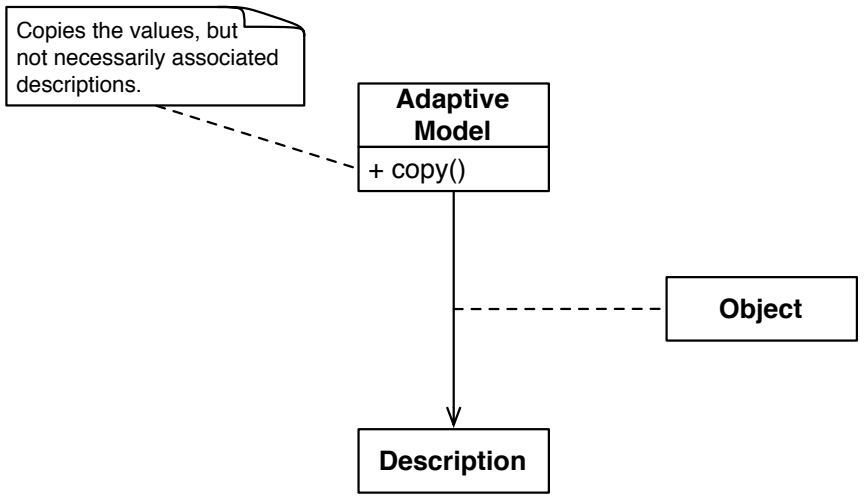

Possibility 3

- Create a new subclass of MAContainerComponent.
- Override the method #renderContentOn: to get the layout you need (avoiding the vistor).
- Override the method #descriptionContainer in your model like this:

```
MyModel class>>descriptionContainer
  ^ super descriptionContainer
      componentClass: MyComponentClass;
      yourself.
```


Adaptive Model

- Problem
  - End users require quick changes in their software.
  - End users want to customize and build their own meta-models on the fly.
- Example
  - Add additional fields to an address database.
- Solution
  - Magritte is self described.



Adaptive Model 1

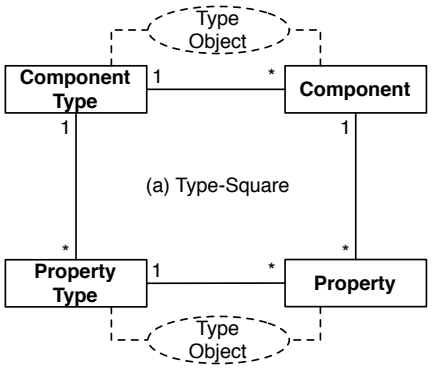
- Create a subclass of MAAdaptiveModel
- Create an editor for the adaptive descriptions: anAdaptiveModel description asComponent

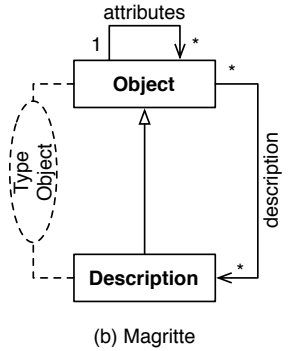
Adaptive Model 2

- Add an instance-variable description to your object and override #description.
- Add an instance-variable values to your object that is initialized with a Dictionary.
- Override two methods with something like:

```
AdaptiveModel>>readUsing: aDescription
        ^ values at: aDescription ifAbsent: [ aDescription default ]

AdaptiveModel>>rwrite: anObject using: aDescription
        values at: aDescription put: anObject
```


Type-Square





Conclusion

- Describe once, get everywhere.
- Ensure extensibility and maintainability.
- Automate boring tasks, like building and validating GUIs.
- Be adaptive.

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Meta Described Web Application Development

http://www.iam.unibe.ch/~scg/Archive/Diploma/Reng06a.pdf