Designing Interactive Systems II

Computer Science Graduate Programme SS 2009

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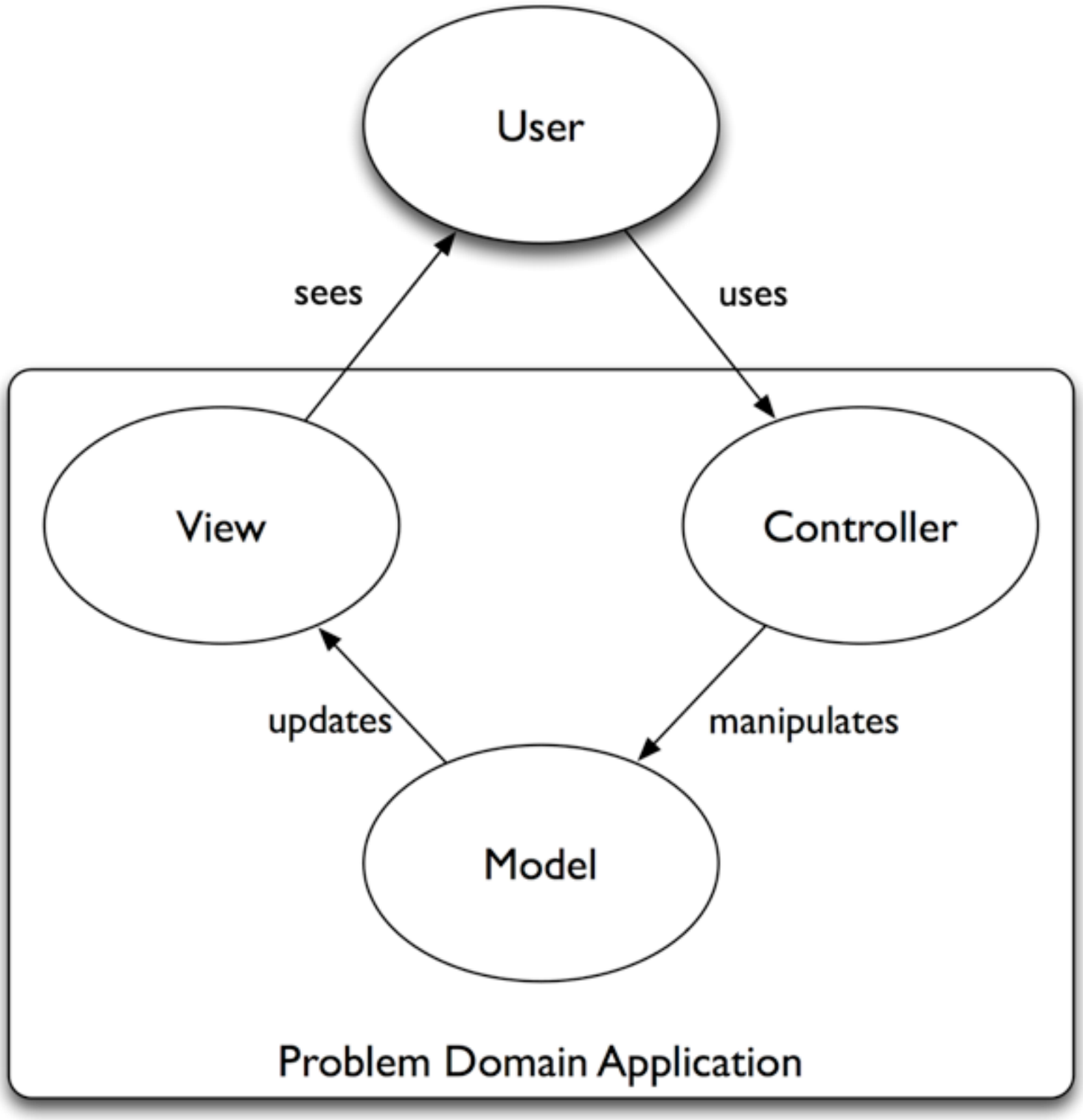
Model-View-Controller

- Central concept behind Smalltalk-80 and its first multiwindow GUI interface
- View: Manages graphical/textual output
- Controller: Interprets user input (mouse,kbd) and tells model and/or view to change
- Model: manages data and behavior of application domain, responds to (View) requests about its state and (Controller) requests to change its state


User
sees
uses
View
Controller
updates
manipulates
Model
Problem Domain Application

Model-View-Controller

- Smalltalk-80 has abstract objects *Model, View, Controller*
- *View & Controller* need little added code; offer standardized display and input techniques
- *Models* cannot be standardized that way; any object can be a model
  - Example: String as model for a simple editor

Passive Models

- Simplest case
- Controller responsible for notifying the view of any changes, because it interprets user input
- Model not responsible for triggering anything, unaware of the MVC triad

Active Models

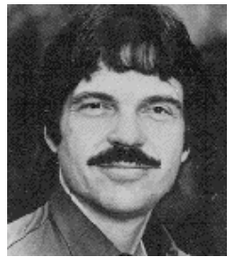
- Most models cannot be so passive
- Need to inform all(!) dependent views when the model's state changes (by sending *update* msg.)
- When a View is given its model, it registers itself as a dependent of that model

View and Controller

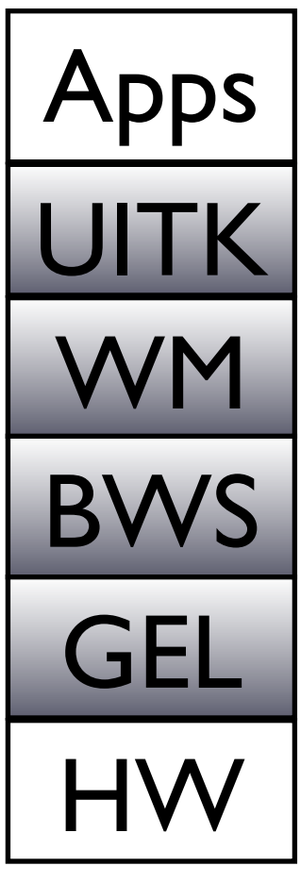
- Each view is associated with a unique controller and vice versa (through instance variables *controller* and *view*)
- They also both have a *model* instance variable
- The view is responsible for establishing these links

Subviews

- Views are nested
- topView has StandardSystemController for moving windows (→ Window Manager task)
- subViews have associated controllers for their particular purpose (buttons,...)
- Bidirectional pointers (*subViews, superView)* establish tree structure

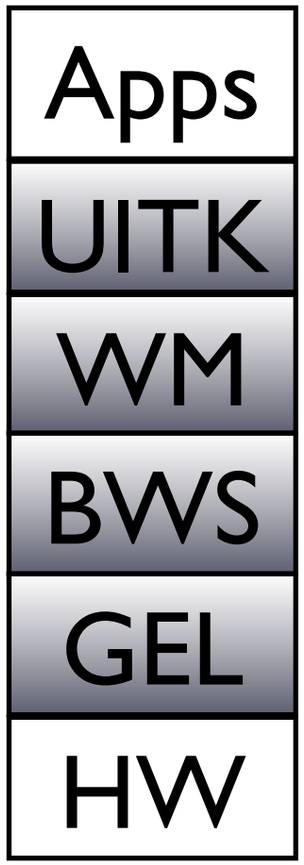


Smalltalk: History



- Common ancestor of all window systems
- Alan Kay (PARC, early 70's): *Dynabook*
- Influenced by Simula, Sketchpad (DIS I), Logo
- Initially on 64K Alto
- Used in 70s to teach OO to school children…
- Introduced windows, scrolling, pop-up menus, virtual desktop, MVC

Smalltalk: Architecture



- Machine-dependent Virtual Machine (byte-code interpreter)
- Machine-independent Virtual Image (Smalltalk classes)
- Complete universe, simplest WS archit.
  - OS, language, WS, tools: *single address space, single process structure,* communicate with procedure calls
  - Initially, OS & WS merged, on bare machine
  - Later, WS on top of OS, but still "universe"

Smalltalk: Architecture

- Squeak: Recent open-source implementation (since 1996) by Alan Kay and others
- Smalltalk is a purely object-oriented and simple language
- Messages are sent to objects
  - Result := Object message: Parameters

Morphic

- User interface construction environment for Smalltalk
- Originally devised in the mid-90s [Maloney'95]
- Directness
  - Change look&feel of widgets by pointing at them
  - No separate "GUI editor view"
- Liveness
  - UI is always active and working
  - No separate "edit" and "run" modes
- Reduces UI development time, lowers cognitive load, real-world analogy
- Supports multiple users working simultaneously(!)

Morphic: Structural Reification

- Widgets are called morphs
- Any morph can be a container (hold submorphs)
- Submorphs managed through container, handle events first

Morphic: Structural Reification

- Advantage: entire dynamic widget tree consists of real morphs—Structural Reification—, enabling directness since every part of the widget tree can be manipulated directly
  - E.g., turn labeled button into button with movie on it
  - Extreme case: Editor with every character as morph
- Applications are just big composite morphs built by direct manipulation, including connections between control and target morphs(!)

Morphic: Layout Reification

- Layout morphs automatically and continuously lay out their children and make layout policy tangible—Layout Reification
  - Row & Column Layout morphs
- Find compromise for submorph space requests, pass single space request on to parent
- Minimum size and resizing policy as attributes, H&V independent
  - rigid, space fill, shrinkwrap

In-Class Exercise: Implementing Layout

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- Answer:
  - 1st pass: Compute minimum size of all submorphs bottom-up
  - 2nd pass: Distribute available space between submorphs top-down

In-Class Exercise: Implementing Layout

- Algorithm to determine the layout of a morph that includes a tree of submorphs?
- Answer:
  - 1st pass: Compute minimum size of all submorphs bottom-up
  - 2nd pass: Distribute available space between submorphs top-down
- Optimizations?
  - Deferred layout: Don't layout until visible
  - Pruning: Maintain layoutOK flag for subtrees, do not compute subtree layout if flag ok and required space available
  - Site Selection: Try to limit recomputation to subtree up to next likely stable (e.g. rigid) morph

Review

- What is the difference between Smalltalk, Squeak, and Morphic?
- How did the original Smalltalk implement the window system layer architecture?
- What are the most particular qualities of Morphic as a UI toolkit?
- What are morphs, and what is special about them?
- How does Morphic implement widget layout?

Morphic: Ubiquitous Animation

- Morphs can have autonomous behavior, usually appearing as animation (clock,…) (intrinsic step method, triggered by system each frame or less often, from activity list)
- Also, animation behaviors (move, scale, change color) can be assigned to any morph (as external activity, frame- or time-based, several pacing options, triggered from activity list n times)
- These two are orthogonal

Morphic: Ubiquitous Animation

- Multiple animations active concurrently
- Animations can be composited concurrently or sequentially, abort by user possible (e.g. delete file)
- Increases Liveness, allows objects to observe others

Managing redraws

- Damage List
  - Add bounding box of each changed morph to list (at both locations if moving)
  - Each frame, redraw all morphs intersecting each bounding box in damage list, back-to-front off screen, then copy to screen (double buffering)
- Improvements
  - Merge overlapping bounding boxes when reported
  - Prune submorph drawing to damage rectangle (works well with Row&Column morphs)
  - Don't draw occluded morphs (requires each morph to fill its bounding box)

Morphic: Live Editing

- No edit/run modes
  - +: No mode changes, no cognitive load, works with n users
  - How distinguish operating from editing gestures?
    - Context-sensitive meta menu on right click
    - Includes access to code for morph, decomposable
- Special commands to access submorphs (spatial demultiplexing), specify additional operands

Getting Started...

Welcome to...

Squeak 3.0

Squeak is a work in progress based on Smalltalk-80, with which it is still reasonably compatible. Every Squeak release includes all source code for the Squeak system, as well as all source code for its Virtual Machine (VM, or interpreter, also written in Smalltalk).

Browser openBrowser

[Blue items in this window are active text. If an item contains a URL, it will require internet access and may take a while to load].

Not only is all source code included, and changeable at will, it is also completely open and free. The Squeak system image runs bit-identically across all platforms, and VMs are available for just about every computer and operating system available. The history of the Squeak project can be read at

ftp://st.cs.uiuc.edu/Smalltalk/Squeak/docs/OOPSLA.Squeak.html

The Squeak license and most other relevant information can be found on the Squeak Home Page,

http://www.Squeak.org

Morphic

This release of Squeak uses the
Squeak also includes an MVC ar
projects (see the world menu 'o

Game Project

Process Browser

Method Finder

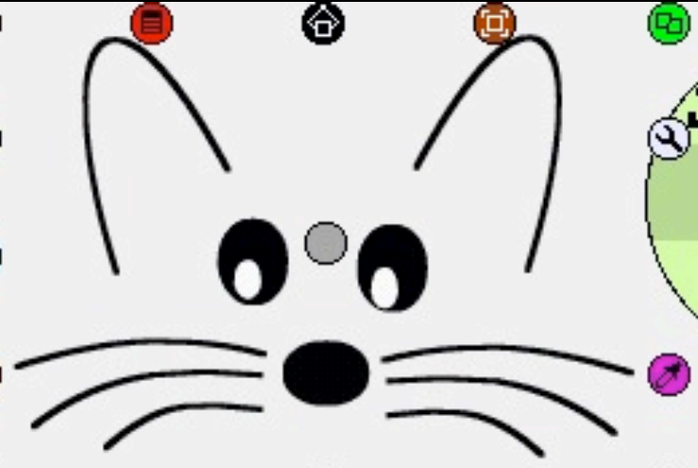
#(1 2 3 4). #(2 3). true

*Collection includesAllOf:

#(1 2 3 4) includesAllOf: #(2 3) --> true
#(1 2 3 4) includesAnyOf: #(2 3) --> tru
#(1 2 3 4) windowReqNewLabel: #(2 3)
#(1 2 3 4) ~= #(2 3) --> true
#(1 2 3 4) ~~ #(2 3) --> true

Type a fragment of a selector in the top pane. Accept it.

Or, use an example to find a method in the system. Type receiver, args, and answer in the top pane with periods between the items. 3. 4. 7



SqueakLogo

The Worlds of Squeak

open...
dismiss this menu
browser
package browser
method finder
workspace
file list
file...
transcript
inner world
simple change sor
dual change sorte
email reader
web browser
IRC chat
mvc project
morphic proje

Senders of add:afterIndex: [4]

OrderedCollection hierarchy

Collections-Sequenceable

ProtoObject
Object
Collection
SequenceableCollect
OrderedCollection
GraphicSymbol

instance | ? | class

-- all --
accessing
copying
adding
removing
enumerating
private
testing

add:
add:after:
add:afterIndex:
add:before:
addAll:
addAllFirst:
addAllLast:
addFirst:
addLast:

di 3/15/1999 14:01 • adding • 1 implementor • in no change set •

senders | implementors | versions | inheritance | hierarchy | inst vars | class vars

add: newObject afterIndex: index
"Add the argument, newObject, as an element of the receiver. Put it in the sequence just after index. Answer newObject."

self insert: newObject before: firstIndex + index.
↑ newObject

Smalltalk: Evaluation

- Availability: high (Squeak,...)
- Productivity: medium (depending on tools, libs used)
- Parallelism: originally none, now external
  - But linguistic crash protection
- Performance: medium (high OO overhead since everything is an object)
- Graphic model: originally RasterOp
- Style: flexible (see Morphic, for example)
- Extensibility: highest (full source available to user, code browser)

Smalltalk: Evaluation

- Adaptability: low (no explicit structured user resource concept; although storing entire image possible)
- Resource sharing: high
- Distribution: none originally, yes with Squeak
- API structure: pure OO, Smalltalk language only
- API comfort: initially low, higher with Squeak&Morphic
- Independency: High (due to MVC paradigm)
- Communication: flexible (objects pass messages)