

Reusability - When It Works , When It Does Not. Data with a Point of View.

A. Goldberg

Reuse	Reuse
<h3>Why this topic?</h3> <p>Focus is on graphical, interactive applications</p> <ul style="list-style-type: none"> • Rapid initial development • Rapid response to the need for change <p>Reusability is important in order to</p> <ul style="list-style-type: none"> • Improve on software productivity • Help in employing expertise 	<h3>Examples:</h3> <p>All examples come from applications or tools from the Smalltalk-80 programming system.</p> <p>Smalltalk-80 is:</p> <ul style="list-style-type: none"> • an object-oriented programming language • a set of program development tools including: <ul style="list-style-type: none"> symbolic debugger source code browsers dynamic cross reference help facilities static inspectors text and picture editors change management • "desktop" screen controller and graphical user interface • integrated environment for delivering applications
<p><input type="radio"/> Definitions <input type="radio"/> Where <input type="radio"/> Issues <input type="radio"/> Examples <input type="radio"/> Re-Users <input type="radio"/> Complaints</p>	

Reuse	Reuse
<h3>Definitions:</h3> <ul style="list-style-type: none"> • Object an encapsulation of data (properties) and the operations on that data (behavior) • Message a request to an object to carry out one of its operations • Method the procedure executed in response to a message • Class a description of a group of objects that have similar properties and behavior • Instance a member of a class with distinguished properties 	<h3>Reuse:</h3> <p>To take something created for one purpose to be used for another purpose.</p> <p>In each case, something stays the same and something changes.</p>
<p><input checked="" type="radio"/> Definitions <input type="radio"/> Where <input type="radio"/> Issues <input type="radio"/> Examples <input type="radio"/> Re-Users <input type="radio"/> Complaints</p>	<p><input checked="" type="radio"/> Definitions <input type="radio"/> Where <input type="radio"/> Issues <input type="radio"/> Examples <input type="radio"/> Re-Users <input type="radio"/> Complaints</p>

Reuse

Model of information which is text.
Display container for text which is a **Workspace**.

Workspace
Where's the Party?

- again
- undo
- copy
- cut
- paste
- do it
- print it
- inspect
- accept
- cancel
- hardcopy
- style
- font

Definitions Where Issues
 Examples Re-Users Complaints

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Reuse

Model of information which is text.
The text stays the same, the emphasis changes.

Workspace
Where's the Party?

- again
- undo
- copy
- cut
- paste
- do it
- print it
- inspect
- accept
- cancel
- hardcopy
- style
- font

select a different font style

Workspace
Where is the Party?

choose large style

font
default
fixed
loop
large
small

Workspace
Where's the Party?

and make the text bold

Definitions Where Issues
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Reuse

Model of information which is text.
The container changes to a **Terminal**.

Terminal
stp@vermont: Where's the Party?
unmatched '.

stp@vermont: whereis the.Party
theParty: /usr/local/bin/the.Party

- again
- undo
- copy
- cut
- paste
- do it
- print it
- inspect
- accept
- cancel
- hardcopy
- style
- font

Definitions Where Issues
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Reuse

Model of information which is text.
or to a **Mail Reader**.

STAMP Mail Reader - NEW MAIL

Date: 19 April 1988 7:02:00 pm
From: helene
To: Adoss
Subject: Party?

Where is the Party?

- again
- undo
- copy
- cut
- paste
- do it
- print it
- inspect
- accept
- cancel
- hardcopy
- style
- font

or to a **Prompt**

Where's the Party?
At Mike's

Definitions Where Issues
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Reuse

Model of information which is text.

The Workspace stays the same, the text changes.

Workspace

Form from user writeMacPaint: 'F43'

- again
- undo
- copy
- cut
- paste
- do it
- print it
- inspect
- accept
- cancel
- hardcopy
- style
- font

Definitions
 Where
 Issues

Examples
 Re-Users
 Complaints

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Reuse

Model of information is code in text form, which stays the same.

The container is a Browser with a hierarchical indexing scheme into the code.

System	Point	initialize-release	dr again
Collections-Stream	Quadrangle	accessing	filler:radius
Collections-Super	Rectangle	coloring	hulbert:radius
Graphics-Display		moving	hulbertz
Graphics-Paths		geometric: let id:	mandala:diameter:
Graphics-Views			
Graphics-Editors			
Graphics-Support			
	INSTANCE	CLASS	

```

spiral: n angles a
  "Draw a double squiral directly on the display."

  "Display white.
  Pen new spiral: 200 angles 89; home; spiral: 200 angles -89."

  1 to n do:
    [il | self go: i; turn: a]
    
```

Definitions
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 Issues

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 Complaints

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Reuse

Model of information is code in text form, which stays the same.

The container is a Debugger that gives access to the sequence of procedure calls.

```

User
Pen>>turn:
SmallInteger(Number)>>to:do:
Pen>>spiral:angles
spiral: n angles a
  "Draw a double squiral directly on the display."

  "Display white.
  Pen new spiral: 200 angles 89; home; spiral: 200 angles -89."

  1 to n do:
    [il | self go: i; turn: a]
    
```

self	Pen	n	48
destForm		a	
sourceForm			
halfToneFd			

Definitions
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Reuse

Model of information is code in text form, which stays the same.

The container is a FileList that gives access to the code stored on a file in a machine readable format.

```

File List
Printing
Smalltalk88-N
Tutorials
Utilities

From Smalltalk-88, Version 2.2 of July 4, 1987 on 19 April 1988 at 14:50:00 am:1
A
Pen methodFor: 'geometric designs'

spiral: n angles a
  "Draw a double squiral directly on the display."

  "Display white.
  Pen new spiral: 200 angles 89; home; spiral: 200 angles -89."

  1 to n do:
    [il | self go: i; turn: a] |
    
```

again
undo
copy
cut
paste
do it
print it
inspect
got
spaw
hardcopy
style
font

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Reuse


Model of information is a picture, which stays the same.

The container is a document in which the picture appears.

Document Editor

In the example below, we can see the progress of the weather front across the mid-west during the Tuesday following its arrival at the border in North Dakota.

One can also see how the concentration of the front has been decreased by its passage through the Black Mountains on Monday.



Weather Front on Tuesday Afternoon

In the following sections, we will discuss the development of this type of storm and the steps of their usual evolution into the type of dangerous weather disturbance we plan to investigate in the next chapter.

Definitions Where Issues
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Reuse

Model of information is a picture, which stays the same.

The container is a map editor with which the picture is the background for itinerary information.

Map Editor - Route - Vermont



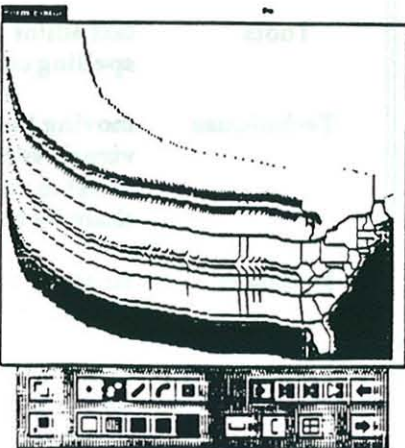
Definitions Where Issues
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Reuse

Model of information is a picture, which stays the same.

The container is a paint palette, that stays the same, with which the picture becomes the paint brush.



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Reuse

Model of information is code in text form, which stays the same.

The container is a kind of browser with indices into the information.

The filters for the browser changes.

System Browser

Collections-Supper	Circle	accessing	file out
Graphics-Primitives	Curve	displaying	print out
Graphics-Display	Line		spawn
Graphics-Views	LinearFit		undo
Graphics-Editors	Spline		implementor
Graphics-Support			messages
			move
			remove

center: aPoint radius: anInteger quadrant: section

"The receiver is an Arc for the quadrant specified by section. The size of the arc is defined by the center and its radius."

center = aPoint.
radius = anInteger.
quadrant = section

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Reuse

Additional filters for browsing.

System Browser

Collections- Graphics-P Graphics-Di Graphics-P Graphics-Vi Graphics-Ed Graphics-Suppo	file out print out spawn spawn hierarchy hierarchy definition comment protocol find method rename remove	Accessing displaying center center: center: center:radius: quadrant quadrant:
---	--	--

center: aPoint radius: anInteger quadrant: section
 "The receiver is an Arc for the quadrant specified by section. The size of the arc is defined by the center and its radius."
 center ← aPoint
 radius ← anInteger
 quadrant ← section

Hierarchy Category Browser

Hierarchy DisplayObject Path Circle	Accessing displaying	center: center:radius: quadrant: quadrant: radius: radius:
--	-------------------------	---

center: aPoint radius: anInteger quadrant: section
 "The receiver is an Arc for the quadrant specified by section. The size of the arc is defined by the center and its radius."
 center ← aPoint.
 radius ← anInteger.
 quadrant ← section

Method Browser

center: aPoint radius: anInteger quadrant: section "The receiver is an Arc for the quadrant specified by section. The size of the arc is defined by the center and its radius." center ← aPoint. radius ← anInteger. quadrant ← section	again undo copy out paste do it print it inspect accept cancel format spawn explain hardcopy style font
---	--

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Reuse

Additional filters for browsing.

System Browser

Collections-Suppo Graphics-Primetr Graphics-Display Graphics-F Graphics-Views Graphics-Editors Graphics-Support	Circle Curve Line Linearfit class	file out print out print send send implementers messages quadrant move remove
---	---	--

center: aPoint radius: anInteger quadrant: section
 "The receiver is an Arc for the quadrant specified by section. The size of the arc is defined by the center and its radius."
 center ← aPoint.
 radius ← anInteger.
 quadrant ← section

Method Browser

center: aPoint radius: anInteger quadrant: section "The receiver is an Arc for the quadrant specified by section. The size of the arc is defined by the center and its radius." center ← aPoint. radius ← anInteger. quadrant ← section	again undo copy out paste do it print it inspect cancel format spawn explain hardcopy style font
---	--

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Reuse

Model of information is code in text form, which stays the same.

The container is a kind of "view" with multiple subviews, one dependent on selections in the other to determine content.

The technique of indexing stays the same, but the specific container changes.

System Browser

Collections-Suppo Graphics-Primetr Graphics-Display Graphics-F Graphics-Views Graphics-Editors Graphics-Support	Circle Curve Line Linearfit class	file out print out print send send implementers messages quadrant move remove
---	---	--

center: aPoint radius: anInteger quadrant: section
 "The receiver is an Arc for the quadrant specified by section. The size of the arc is defined by the center and its radius."
 center ← aPoint.
 radius ← anInteger.
 quadrant ← section

Method Browser

center: aPoint radius: anInteger quadrant: section "The receiver is an Arc for the quadrant specified by section. The size of the arc is defined by the center and its radius." center ← aPoint. radius ← anInteger. quadrant ← section	again undo copy out paste do it print it inspect cancel format spawn explain hardcopy style font
---	--

Definitions Where Issues
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Reuse

Where is Reuse Found?

- Things**
 - Code
 - algorithms
 - data structures
 - protocols
 - Tools
 - text editor
 - spelling corrector
 - Techniques
 - moving through space
 - visual feedback
 - direct manipulation
 - share by cut 'n paste
 - Processes
 - structured analysis
 - instructional sequences
 - Frameworks
 - metaphors (desktop, cardstack)
 - kits (browser, simulation)
 - help

Definitions Where Issues
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Reuse	Reuse
<h2 data-bbox="316 197 858 235">Reuse in Object Oriented Design</h2> <p data-bbox="316 342 778 405">Create an instance of an existing class [similar to a library package].</p> <p data-bbox="316 461 820 524">Send a set of messages to a named object [similar to the use of formal parameter].</p> <p data-bbox="316 580 900 696">Create a subclass of an existing class, adding or specializing functionality [similar to cascaded libraries defined at link time].</p>	<h2 data-bbox="951 203 1406 241">What are the Design Issues?</h2> <p data-bbox="967 309 1465 338">Abstract versus Concrete Representation</p> <p data-bbox="967 398 1414 427">Default versus Specialized Behavior</p> <p data-bbox="967 495 1086 524">Factoring</p> <p data-bbox="967 580 1374 609">Specialization or Refinement via</p> <p data-bbox="983 642 1190 672">parameterization</p> <p data-bbox="983 705 1490 734">subclassing (deep vs shallow of hierarchy)</p> <p data-bbox="983 768 1110 797">delegation</p> <hr/> <p data-bbox="1034 1003 1453 1061"> <input type="radio"/> Definitions <input type="radio"/> Where <input checked="" type="radio"/> Issues <input type="radio"/> Examples <input type="radio"/> Re-Users <input type="radio"/> Complaints </p>
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Reuse	Reuse
<h2 data-bbox="300 1261 804 1290">Abstract versus Concrete Representation</h2> <p data-bbox="316 1350 783 1413">Tight, fixed formal specifications at the abstract level.</p> <p data-bbox="316 1447 762 1509">Making more concrete means adding "meaning".</p> <h2 data-bbox="300 1588 756 1617">Default versus Specialized Behavior</h2> <p data-bbox="316 1680 807 1771">Looser specifications at the abstract level where meaning is provided minimally and in the sense of constraints.</p> <p data-bbox="316 1805 812 1868">Making more concrete means replacing a definition within the constraints.</p>	<h2 data-bbox="983 1261 1481 1290">Abstract versus Concrete Representation</h2> <p data-bbox="991 1350 1350 1379">Example: Number Hierarchy</p> <p data-bbox="1038 1424 1118 1453">Object</p> <ul style="list-style-type: none"> <li data-bbox="1062 1469 1203 1498">Magnitude <li data-bbox="1123 1514 1246 1543">Character <li data-bbox="1123 1559 1182 1588">Date <li data-bbox="1123 1603 1187 1632">Time <li data-bbox="1123 1648 1230 1677">Number <ul style="list-style-type: none"> <li data-bbox="1174 1693 1241 1722">Float <li data-bbox="1174 1738 1278 1767">Fraction <li data-bbox="1174 1783 1270 1812">Integer <ul style="list-style-type: none"> <li data-bbox="1230 1827 1501 1856">LargeNegativeInteger <li data-bbox="1230 1872 1490 1901">LargePositiveInteger <li data-bbox="1230 1917 1394 1946">SmallInteger
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Reuse

Number Hierarchy Protocol Example

Number
 arithmetic
 *
 self subclassResponsibility
 /
 self subclassResponsibility

truncation and roundoff
 roundTo: aNumber
 ↑(self / aNumber) rounded * aNumber

For example
 6.6 roundTo: 10 yields 10

Definitions Where Issues
 Examples Re-Users Complaints

Reuse

Example: Collection Hierarchy

Object
 Collection
 SequenceableCollection
 ArrayedCollection
 Array
 ByteArray
 String
 Symbol
 Text
 Interval
 LinkedList
 OrderedCollection
 SortedCollection

Bag
Set
Dictionary
 IdentityDictionary
 LiteralDictionary

Definitions Where Issues
 Examples Re-Users Complaints

Reuse

Collection Hierarchy Protocol Example

Collection
 enumerating
 do: aBlock
 self subclassResponsibility

collect: aBlock
 | newCollection |
 newCollection ←self species new.
 self do: [:each |
 newCollection add: (aBlock value: each)].
 ↑ newCollection

select: aBlock
 | newCollection |
 newCollection - self species new.
 self do: [:each |
 (aBlock value: each) ifTrue:
 [newCollection add: each]].
 ↑ newCollection

Definitions Where Issues
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Reuse

Default versus Specialized Behavior

Example: Kit for Event-Driven Simulation

REPORT 2: WashandDry	cut
Truck 1 Duration 28.4	paste
Visited: Washing Drying	copy
Paying	undo
Feature: 'bigtruck'	redo
Truck 2 Duration 28.4	clear
Visited: Washing Drying	print
Paying	
Feature: 'mediumtruck'	
Truck 3 Duration 33.5	
Visited: Washing Drying	
Paying	
Feature: 'mediumtruck'	
Truck 4 Duration 32.5	
Visited: Washing Drying	
Paying	
Feature: 'mediumtruck'	

Category	Component	Interface
Station	Station	
Worker	Worker	
Job	Job	
Printer	Printer	

Definitions Where Issues
 Examples Re-Users Complaints

Reuse

Default versus Specialized Behavior

Example: Presentation Viewing

```
display
  self displayBorder.
  self displayView.
  self displaySubViews.
```

```
displayBorder
  self drawFrame

displayView
  ^ self

displaySubViews
  subViews do: [:each | each display]
```

Definitions Where Issues
 Examples Re-Users Complaints

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Reuse

Default versus Specialized Behavior

Example: User Interaction Controller

```
controlActivity
  self controllInitialize.
  self controlLoop.
  self controlTerminate.
```

```
controlInitialize
  nil

controlLoop
  self isControlWanted
  ifTrue: [self doActivities]

controlTerminate
  nil
```

Definitions Where Issues
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Reuse

Example from Model-View-Controller Hierarchy

Object

```
Model
  Text
  TextCollection
  Terminal

View
  TextView
  CodeView
  OnlyWhenSelectedCodeView

Controller
  MouseMenuController
  ScrollController
  ParagraphEditor
  TextEditor
  CodeController
  AlwaysAcceptCodeController
  OnlyWhenSelectedCodeController
```

Definitions Where Issues
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Reuse

Factoring

Architectural Example

Streaming Example

Model-View-Controller Example

Definitions Where Issues
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Reuse

Factoring Architectural Example

searching, querying, learning

Layout and authoring

Programming

application delivery metaphor support

parts library

UIF

model library

model

kernel classes

virtual machine implementation

Database

hardware and OS

Definitions Where Issues
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Reuse

Factoring Streaming Example

Concept of Streaming

Streaming over files

Divide into reusable interface

frontend: stream with buffered information

backend: buffered data accessors

Frontends are reusable and can change the backend at a lower effort

Definitions Where Issues
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Reuse

Factoring Model-View-Controller Example

Model
Structured Information

View
Presentation

Controller
Interaction

Definitions Where Issues
 Examples Re-Users Complaints

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Reuse

Factoring Model-View-Controller Example

Model is the structured information.

every object is a model

objects are dependent on one another for the purpose of reporting that change has occurred

system must provide dependency structure and updating mechanism

Definitions Where Issues
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Reuse

Factoring Model-View-Controller Example

View is the mediator and transformer of the parts of a model.

display an image by calling upon graphic symbol primitives or idioms

as container of other views, provide the transformation of coordinates in order to build up a structured picture

system must provide displayable objects

Definitions Where Issues
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Reuse

Factoring Model-View-Controller Example

Viewing is handled by the superclass View.

A simple view is a graphical presentation of some aspect of model. For each kind of view, a display method is devised that queries the model for pertinent information.

Definitions Where Issues
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Reuse

Factoring Model-View-Controller Example

Viewing is handled by the superclass View.

A complex view is made up of several views. Complex views may be nested.

Class View handles the relative coordinate systems of nested views.

Definitions Where Issues
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Reuse

Factoring Model-View-Controller Example

Controller is the coordinator of user actions.

schedule user actions such as keyboard presses or other input devices

handle access and change commands to the view and the model

Definitions Where Issues
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Customization

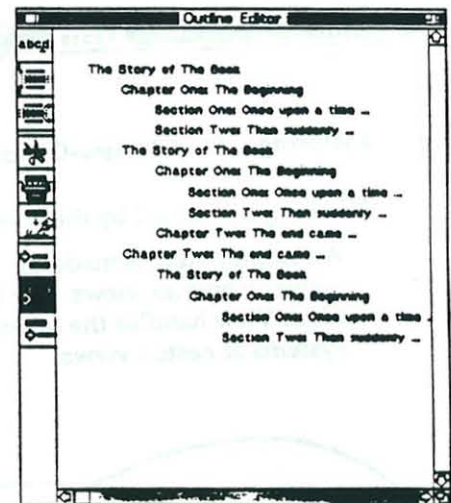
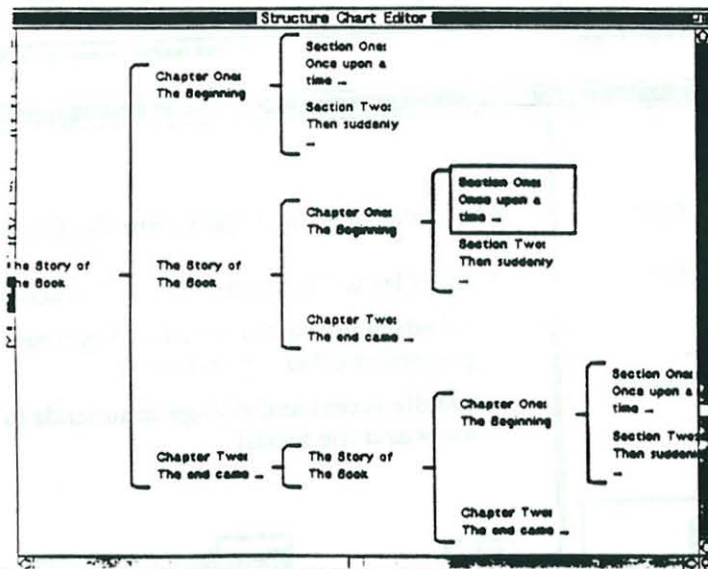
A special kind of reuse...

The way to direct a computer on a preferred approach to behavior:

- modify default behavior,
- specialize abstract behavior,
- compose new visual layouts,
- compose new profiles for physical interaction.

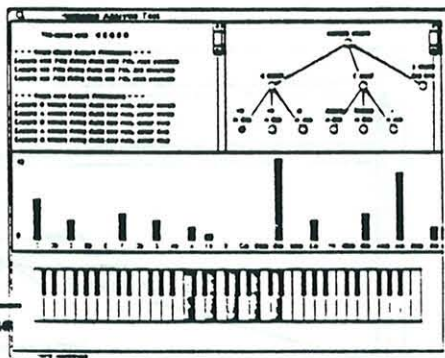
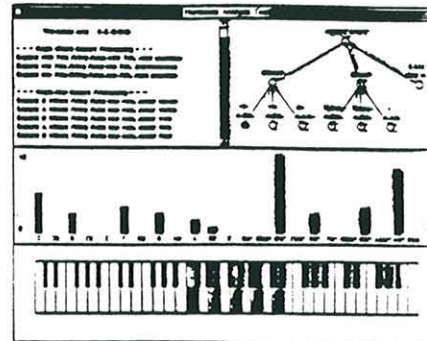
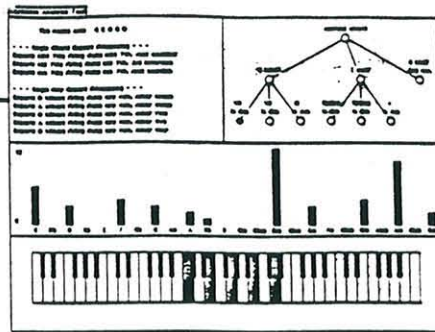
Pluggability

Customization by adapting container views and controllers to models.

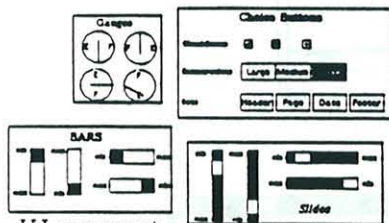


Pluggability

Three examples of different "personalities" presenting the same information.

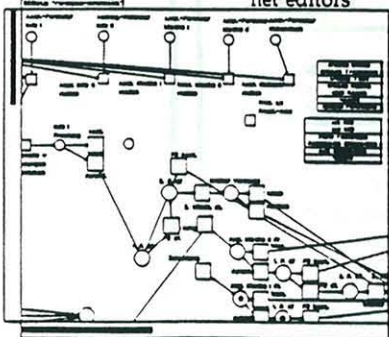


Alternative and Experimental User Interfaces

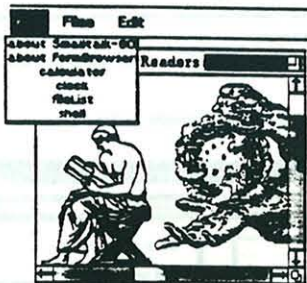
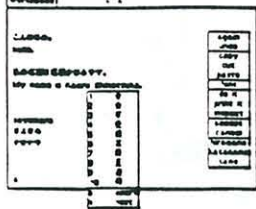


U.I component palettes

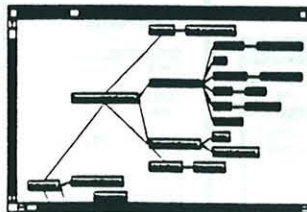
graph and net editors



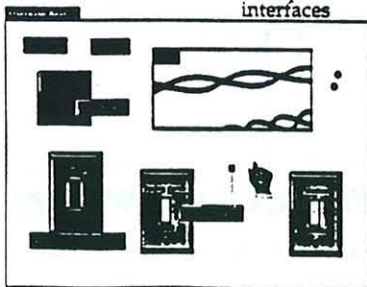
extended language support



pluggable look-and-feel



direct manipulation interfaces

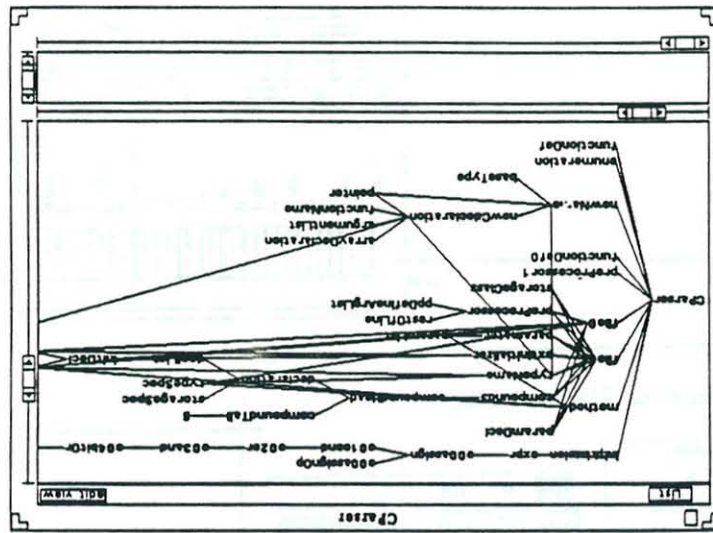
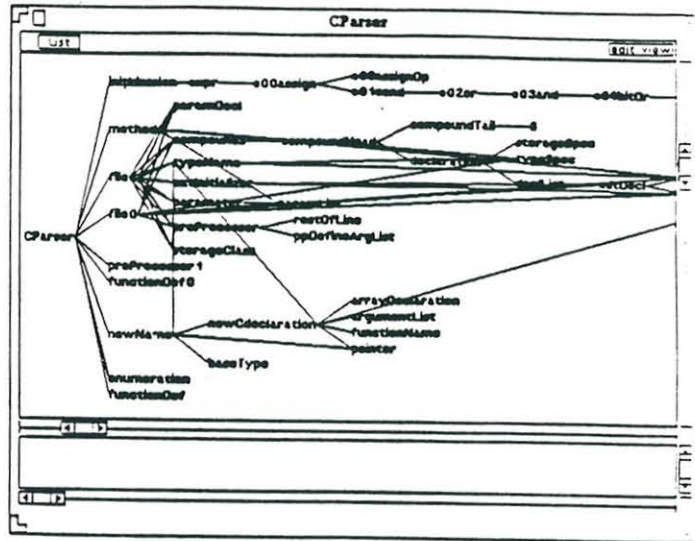


Pluggability

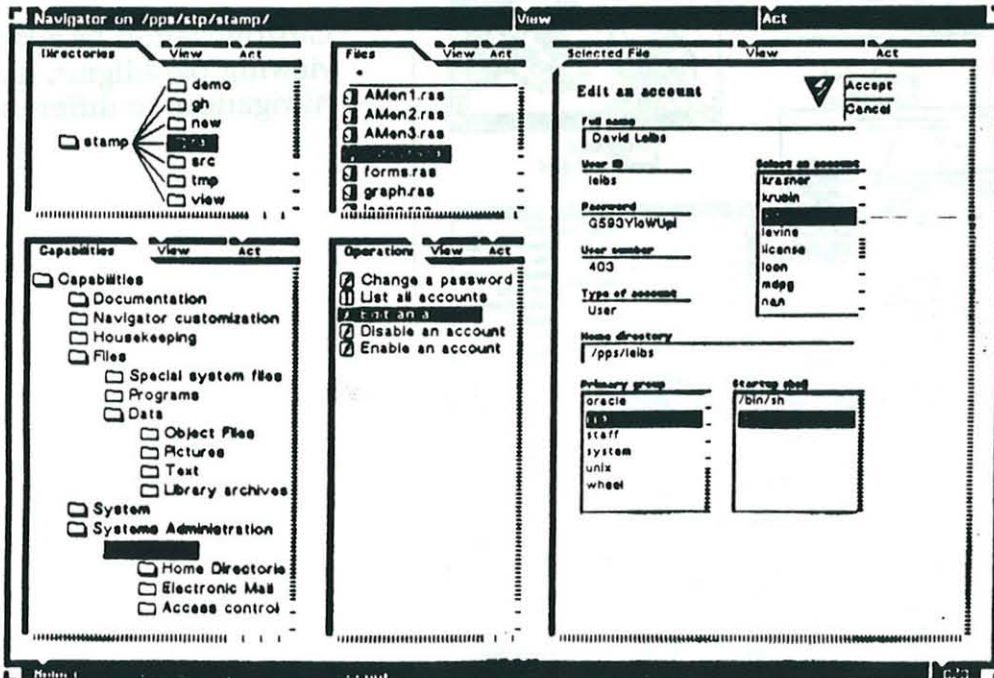
Customization by adapting viewing paradigms, like navigation, to different models.

Pluggability

Navigation of Unix files and directories.



ParcPlace Navigator Example Slides



Navigator in capability space showing the standard user account management dialog