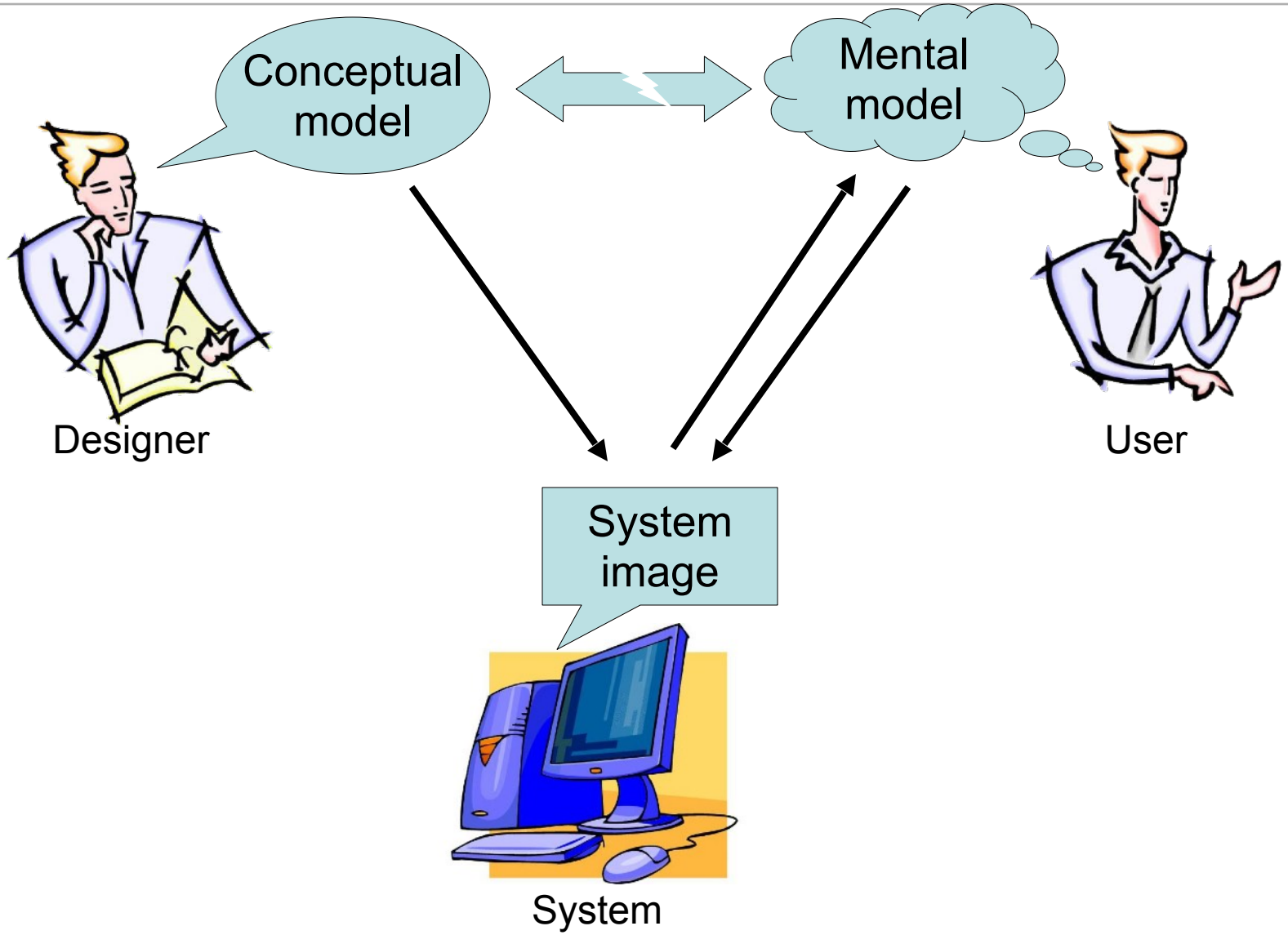
Conceptual modeling

Michel Beaudouin-Lafon - mbl@lisn.fr
Laboratoire Interdisciplinaire des Sciences du Numérique (LISN)
Ex Situ - http://ex-situ.lri.fr

Interactive system



Conceptual modeling

Conceptual model

- How the designer wants the user to see the system
- Must hide technical aspects
- Must refer to what the user will use the system for

System image

- What the user sees of the system (including its documentation)
- Used by users to create their mental model

User mental model

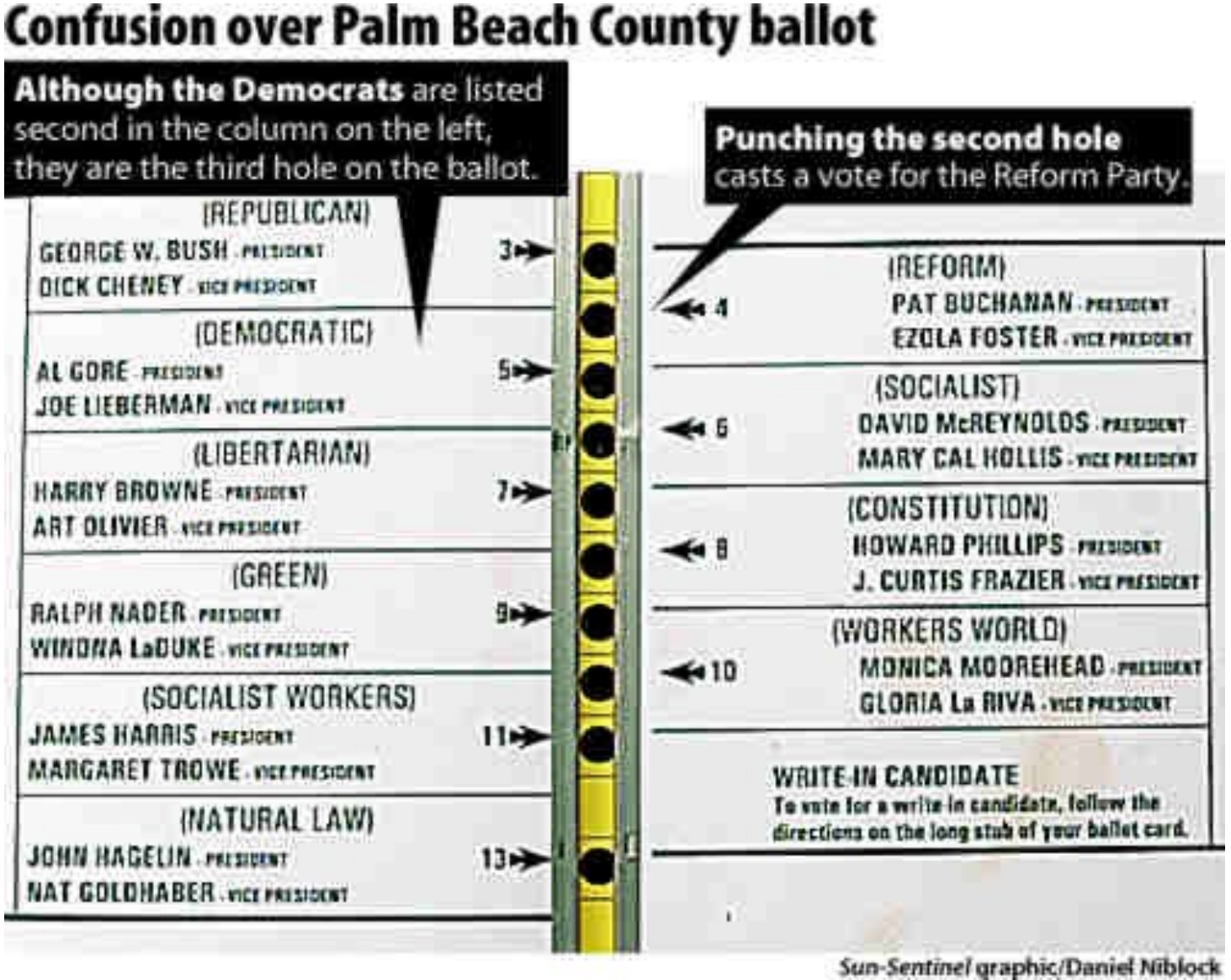
- Created based on the users' understanding of the system image, their use of the system, what others have told them about the system, etc.

Conceptual modeling

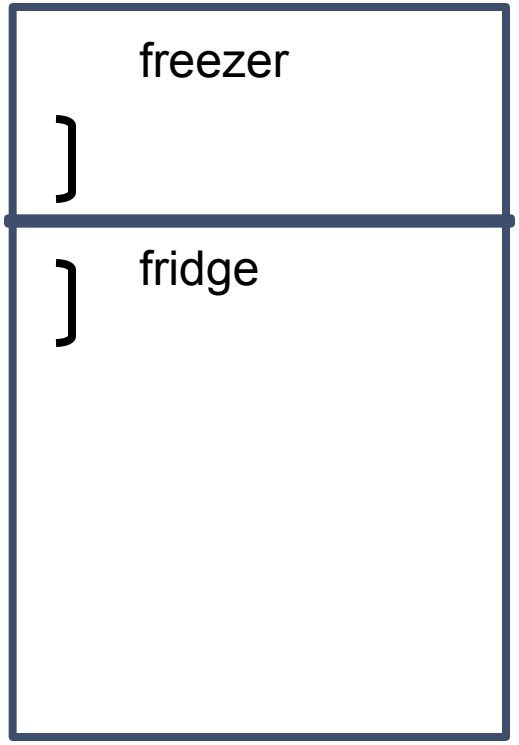
In case of poor correspondence:

- Manipulation errors
- Frustration
- Lower productivity

Example


Confusion over Palm Beach County ballot
Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.
Punching the second hole casts a vote for the Reform Party.
(REPUBLICAN)
GEORGE W. BUSH - PRESIDENT
DICK CHENEY - VICE PRESIDENT
3
(DEMOCRATIC)
AL GORE - PRESIDENT
JOE LIEBERMAN - VICE PRESIDENT
5
(LIBERTARIAN)
HARRY BROWNE - PRESIDENT
ART OLIVIER - VICE PRESIDENT
7
(GREEN)
RALPH NADER - PRESIDENT
WINONA LaDUKE - VICE PRESIDENT
9
(SOCIALIST WORKERS)
JAMES HARRIS - PRESIDENT
MARGARET TROWE - VICE PRESIDENT
11
(NATURAL LAW)
JOHN HAGELIN - PRESIDENT
NAT GOLDHABER - VICE PRESIDENT
13
(REFORM)
PAT BUCHANAN - PRESIDENT
EZOLA FOSTER - VICE PRESIDENT
4
(SOCIALIST)
DAVID McREYNOLDS - PRESIDENT
MARY CAL HOLLIS - VICE PRESIDENT
6
(CONSTITUTION)
HOWARD PHILLIPS - PRESIDENT
J. CURTIS FRAZIER - VICE PRESIDENT
8
(WORKERS WORLD)
MONICA MOOREHEAD - PRESIDENT
GLORIA La RIVA - VICE PRESIDENT
10
WRITE-IN CANDIDATE
To vote for a write-in candidate, follow the directions on the long stub of your ballot card.
Sun-Sentinel graphic/Daniel Niblock

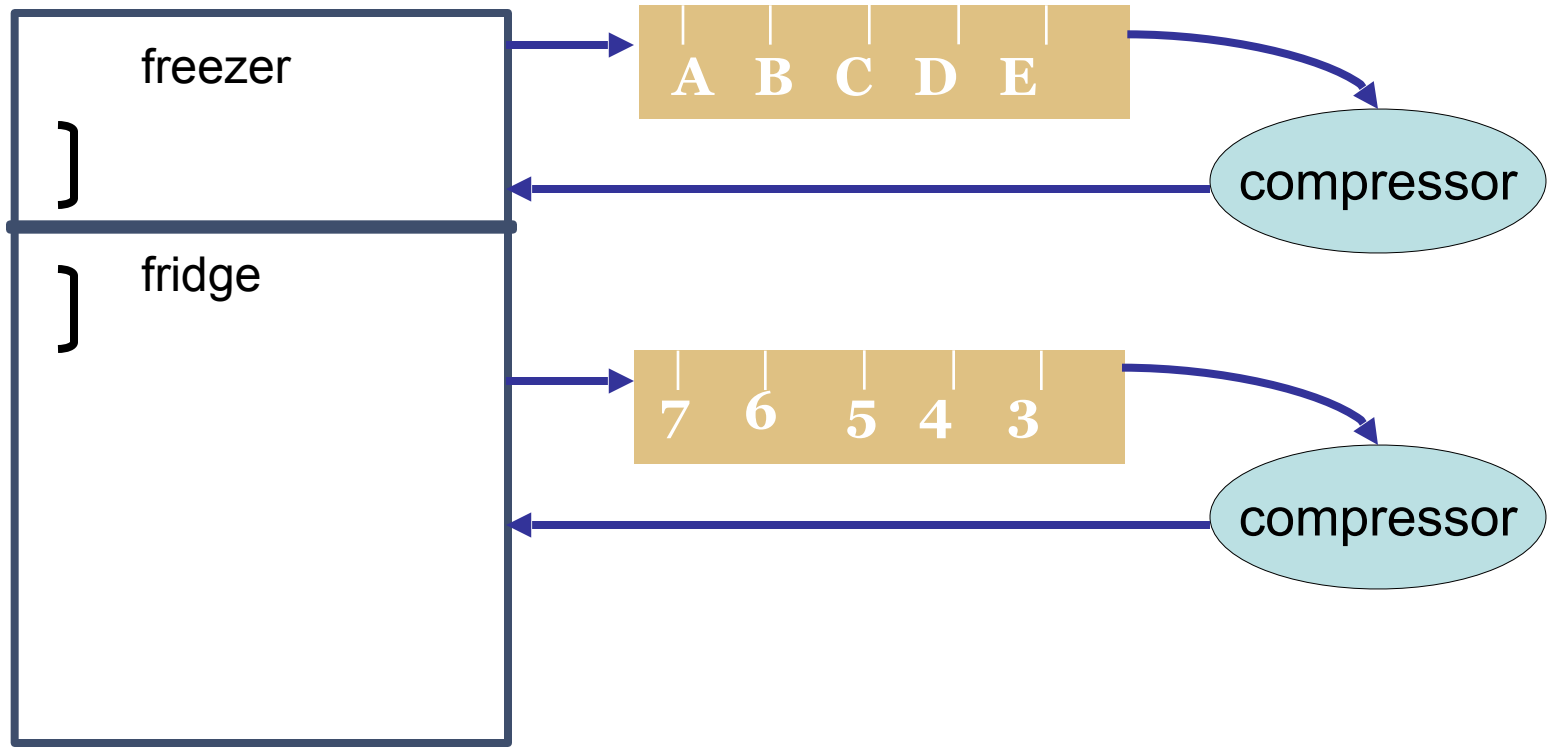
Example : Fridge



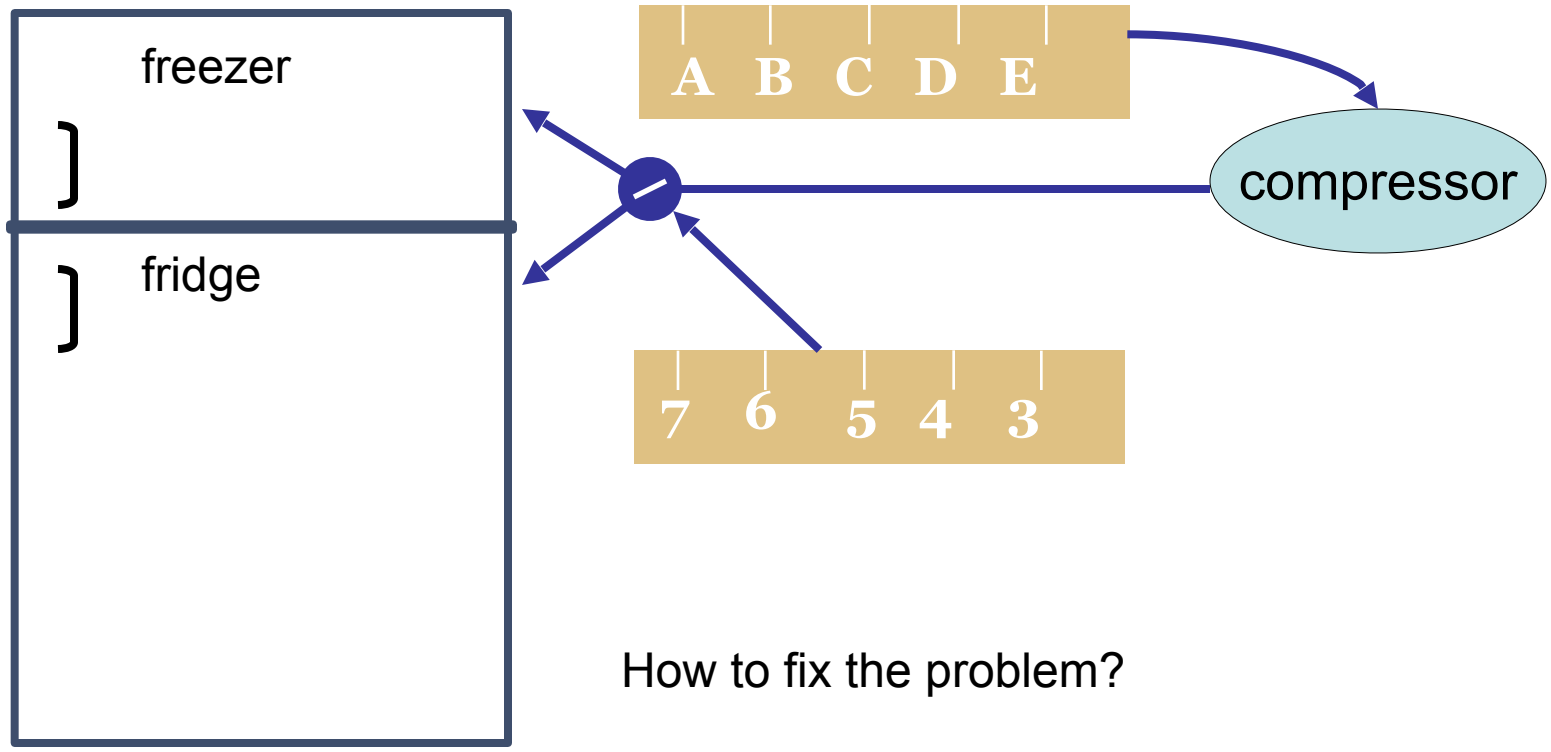
Normal Settings	**C** and **5**
Colder Fresh Food	**C** and **6-7**
Coldest Fresh Food	**B** and **8-9**
Colder Freezer	**D** and **7-8**
Warmer Fresh Food	**C** and **4-1**
OFF *(both)*	**0**

What is your conceptual model?

A likely mental model



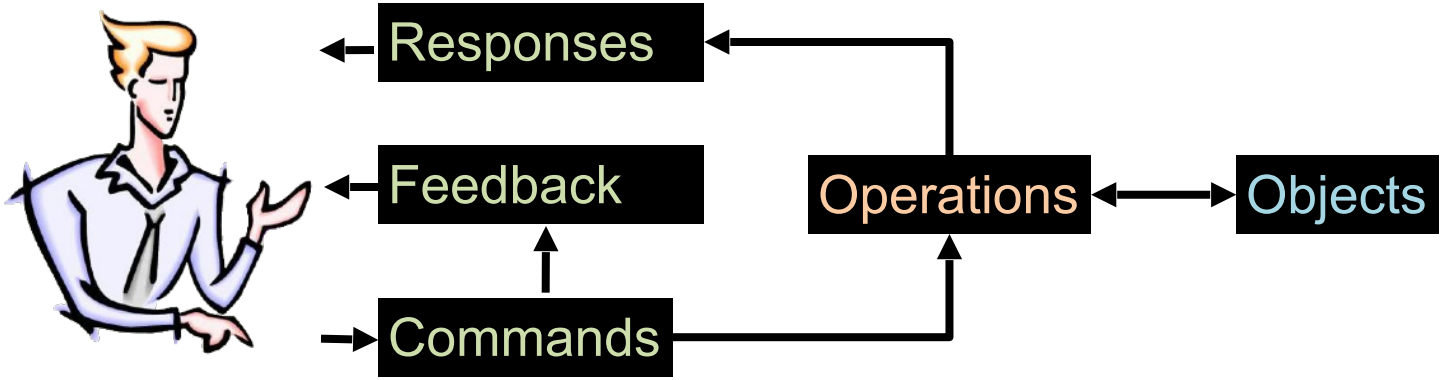
Real conceptual model



How to fix the problem?

Change the controls so they match what users expect
Change the controls so they reflect how it really works

Organizing the conceptual model



Identify the **objects**:

What the user wants to manipulate

Identify the **operations**:

What the user wants to do with the objects

Identify the **commands**:

How the user can activate the operations

Interaction tables

Organize the conceptual model into two tables:

Objects	Representations	Properties	Operations
File	Icon (according to file type) + name	Path Type, name, size, … 	Delete Rename …

Operations	Commands	Feedback	Responses
Delete a file	Drag-and-drop the icon into the trash	The ghost of the icon follows the cursor	The icon disappears and the trash can gets bigger
	Select file and hit the Delete key	Selected icon gets highlighted	The icon moves towards the trash can and disappears

Beware!

An interface object is not a conceptual object
An interface object is not a conceptual object
An interface object is not a conceptual object
An interface object is not a conceptual object
An interface object is not a conceptual object

A button is not a conceptual object
A menu is not a conceptual object
A dialog box is not a conceptual object

Direct manipulation of (representations of) conceptual objects
vs
Indirect manipulation of these objects through interface objects

Case studies

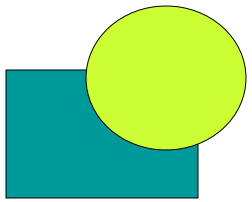
Conceptual models of different graphical editors

- Pixel-based images (Photoshop)
- Vector-based images (Illustrator)

Other case studies (not covered here)

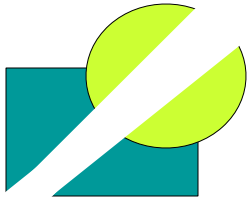
- Editor for images described as planar maps
- Web browser
- File browser
- Text editor
- Mail reader
- ...

Drawing tools

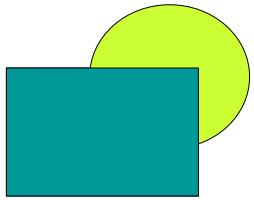


What is this drawing made of?

How to create this drawing?



It is a set of pixels
that can be erased



It is a rectangle and a circle
that can be moved

Two broad categories

- Editing **bitmaps** – images made out of pixels
  - Basic objects: set of pixels (areas)
  - Basic operations:
    - Define an area
    - Apply an operation to the pixels in an area

- Editing **vectors** – images made out of geometrical shapes
  - Basic objects: a stack of vector-based objects
  - Basic operations:
    - Modify the geometry (shape) of an object
    - Modify the graphical attributes of an object
    - Change the stacking order (2D1/2)

Editing bitmaps

Objects	Representations	Properties	Operations
Area			

Editing bitmaps

Objects	Representations	Properties	Operations
Area	“Marching ants” (blinking outline)	The set of pixels inside the area	Define Modify Fill

Editing bitmaps

Operations	Commands	Feedback	Responses
Define an area			
Paint the selected area			

Editing bitmaps

Operations	Commands	Feedback	Responses
Define an area	Select rectangle tool + Click-and-drag a rectangle	Cursor change Display ghost rectangle	Area surrounded by “marching ants”
Paint the selected area			

Editing bitmaps

Operations	Commands	Feedback	Responses
Define an area	Select rectangle tool + Click-and-drag a rectangle	Cursor change Display ghost rectangle	Area surrounded by “marching ants”
	Select lasso tool + Outline the area	Cusor change Display ghost outline	Area surrounded by “marching ants”
Paint the selected area			

Editing bitmaps

Operations	Commands	Feedback	Responses
Define an area	Select rectangle tool + Click-and-drag a rectangle	Cursor change Display ghost rectangle	Area surrounded by “marching ants”
	Select lasso tool + Outline the area	Cusor change Display ghost outline	Area surrounded by “marching ants”
Paint the selected area	Select brush tool + Click-and-drag to paint	Cursor change Display ink	Apply current color to the path of the brush
	Select paint bucket tool + Click the area	Cursor change	Selected area is filled with the current color

Editing bitmaps

Operations	Commands	Feedback	Responses
Modify the selected area			
Transform the selected area			

Editing bitmaps

Operations	Commands	Feedback	Responses
Modify the selected area	Command “Invert” in the “Selection” menu		Exchanges the selected and non-selected areas
	Command “Extend” in the “Selection” menu		Extends the selection by one pixel
Transform the selected area			

Editing bitmaps

Operations	Commands	Feedback	Responses
Modify the selected area	Command “Invert” in the “Selection” menu		Exchanges the selected and non-selected areas
	Command “Extend” in the “Selection” menu		Extends the selection by one pixel
Transform the selected area	Select an item in the “Filters” menu	Dialog box with parameters of the filter	Apply the filter to the selected area
	etc.	...	...

Editing bitmaps

Objects	Representations	Properties	Operations
Area	“Marching ants” (blinking outline)	The set of pixels inside the area	Define Modify Fill

Editing bitmaps

Objects	Representations	Properties	Operations
Area	“Marching ants” (blinking outline)	The set of pixels inside the area	Define Modify Fill
Brush			

Editing bitmaps

Objects	Representations	Properties	Operations
Area	“Marching ants” (blinking outline)	The set of pixels inside the area	Define Modify Fill
Brush	Cursor shape	Shape Transparency Color	Paint

Editing bitmaps

Objects	Representations	Properties	Operations
Area	“Marching ants” (blinking outline)	The set of pixels inside the area	Define Modify Fill
Brush	Cursor shape	Shape Transparency Color	Paint
Tool set	Tool palette	List of tools Selected tool	Select tool
etc.	...		

Vector-based editing

Objects	Representations	Properties	Operations
Vector-based shapes			

Vector-based editing

Objects	Representations	Properties	Operations
Vector-based shapes	Graphical shape	Geometry Graphical attributes	Create Modify Change attributes

Vector-based editing

Operations	Commands	Feedback	Responses
Create an object			
Select one or more object			

Vector-based editing

Operations	Commands	Feedback	Responses
Create an object	Select an object type in the palette + Click-and-drag	Cursor change Rubber-band the object shape	Creates new shape with current attributes on top of all other
Select one or more object			

Vector-based editing

Operations	Commands	Feedback	Responses
Create an object	Select an object type in the palette + Click-and-drag	Cursor change Rubber-band the object shape	Creates new shape with current attributes on top of all other
	Select the pencil+ Click-and-drag each control point	Cursor change Each click-and-drag defines a point and its tangent	Creates new shape with current attributes on top of all other shapes
Select one or more object			

Vector-based editing

Operations	Commands	Feedback	Responses
Create an object	Select an object type in the palette + Click-and-drag	Cursor change Rubber-band the object shape	Creates new shape with current attributes on top of all other
	Select the pencil+ Click-and-drag each control point	Cursor change Each click-and-drag defines a point and its tangent	Creates new shape with current attributes on top of all other shapes
Select one or more object	Click an object		Adds handles to the selected object
	Click on the background+ drag	Ghost of the selection rectangle	Adds handles to the selected objects

Vector-based editing

Operations	Commands	Feedback	Responses
Modify the geometry of an object			
Modify the attributes of an object			
Change the stacking order			

Vector-based editing

Operations	Commands	Feedback	Responses
Modify the geometry of an object	Select object + click-and-drag the handles	Ghost of the reshaped object	Changes the shape of the object
Modify the attributes of an object			
Change the stacking order			

Vector-based editing

Operations	Commands	Feedback	Responses
Modify the geometry of an object	Select object + click-and-drag the handles	Ghost of the reshaped object	Changes the shape of the object
Modify the attributes of an object	Click object + Use the attributes inspector	Values of the attributes are displayed in inspector	Applies new values to the object
Change the stacking order			

Vector-based editing

Operations	Commands	Feedback	Responses
Modify the geometry of an object	Select object + click-and-drag the handles	Ghost of the reshaped object	Changes the shape of the object
Modify the attributes of an object	Click object + Use the attributes inspector	Values of the attributes are displayed in inspector	Applies new values to the object
Change the stacking order	Click object + select command “bring to front” or “send to back”		Puts the object on top or below all others
	Click object + select command “Order” + slider	The stacking of the object changes according to the slider	Changes the stacking order of the object

Vector-based editing

Objects	Representations	Properties	Operations
Vector-based shapes	Graphical shape	Geometry Graphical attributes	Create Modify Change attributes

Vector-based editing

Objects	Representations	Properties	Operations
Vector-based shapes	Graphical shape	Geometry Graphical attributes	Create Modify Change attributes
Style			

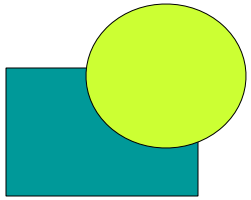
Vector-based editing

Objects	Representations	Properties	Operations
Vector-based shapes	Graphical shape	Geometry Graphical attributes	Create Modify Change attributes
Style	Attribute inspector	Background color Foreground color Thickness Transparency	Change attribute value

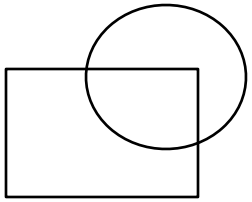
Vector-based editing

Objects	Representations	Properties	Operations
Vector-based shapes	Graphical shape	Geometry Graphical attributes	Create Modify Change attributes
Style	Attribute inspector	Background color Foreground color Thickness Transparency	Change attribute value
Tool set	Tool palette	List of tools Selected tool	Select
etc.	...		

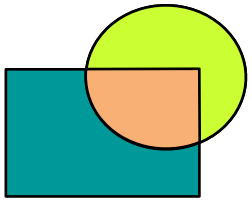
Another way to draw: planar maps



What is this drawing made of?
How to create this drawing?



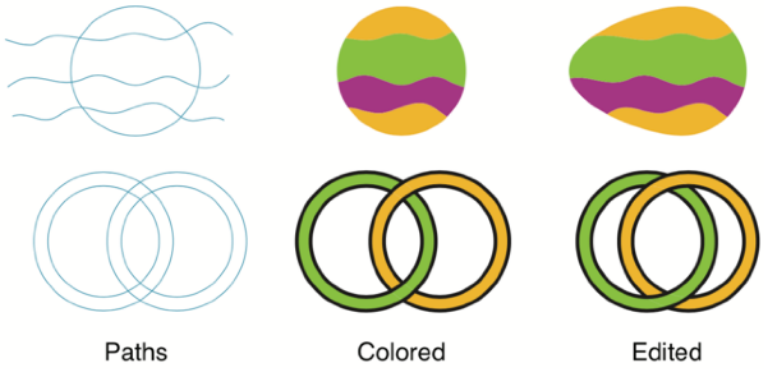
A set of intersecting shapes

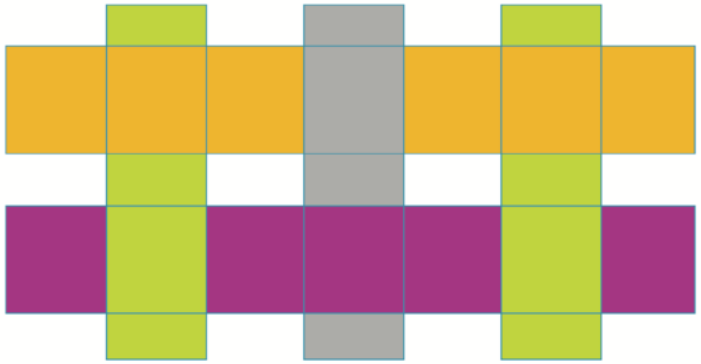


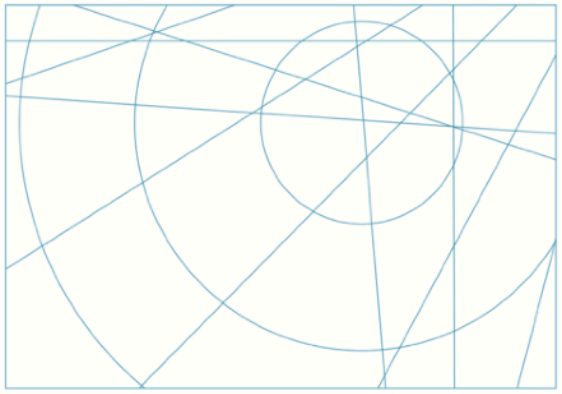
Segments can be removed
Areas can be painted

Planar maps

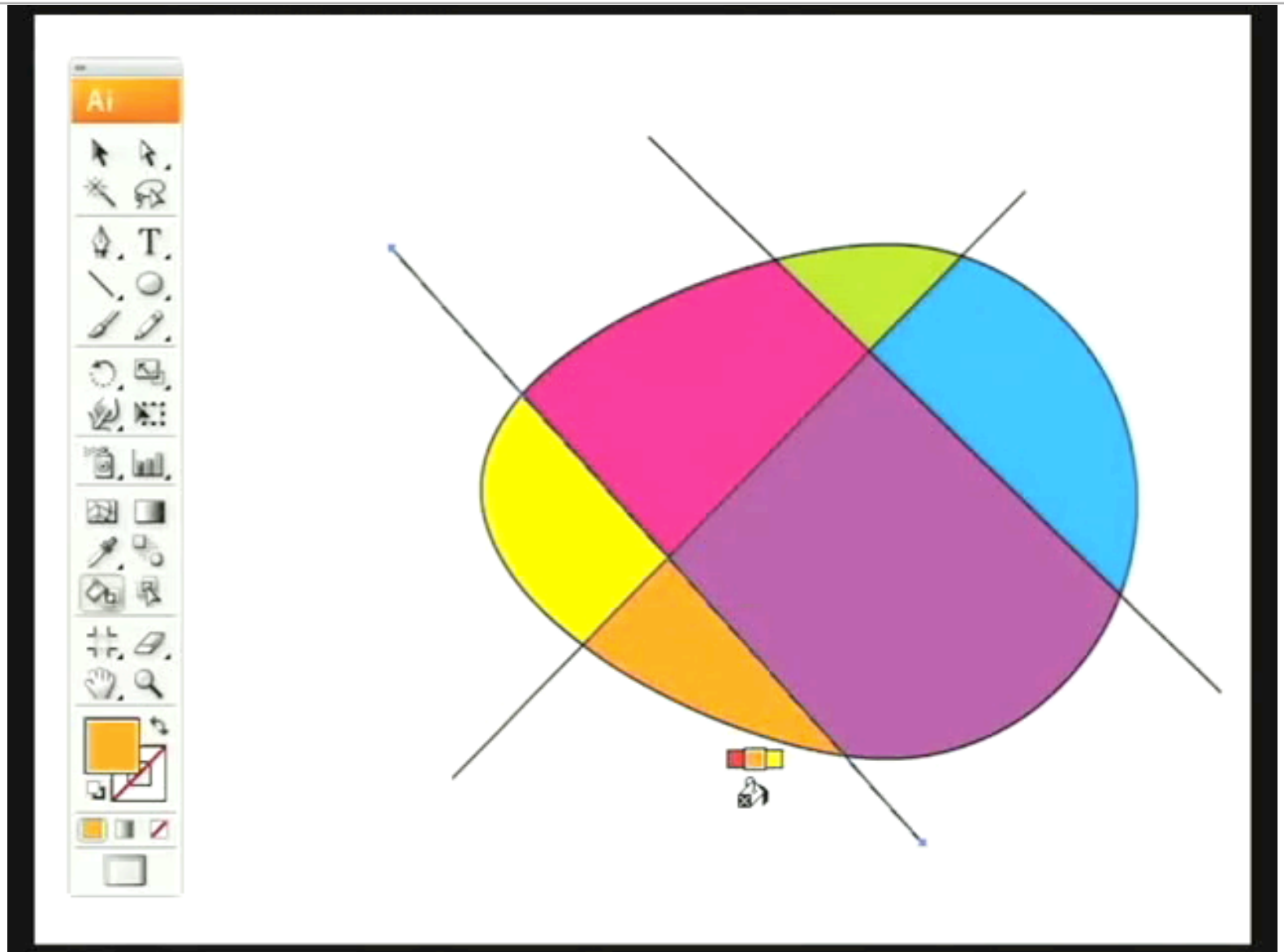
Powerful drawing model



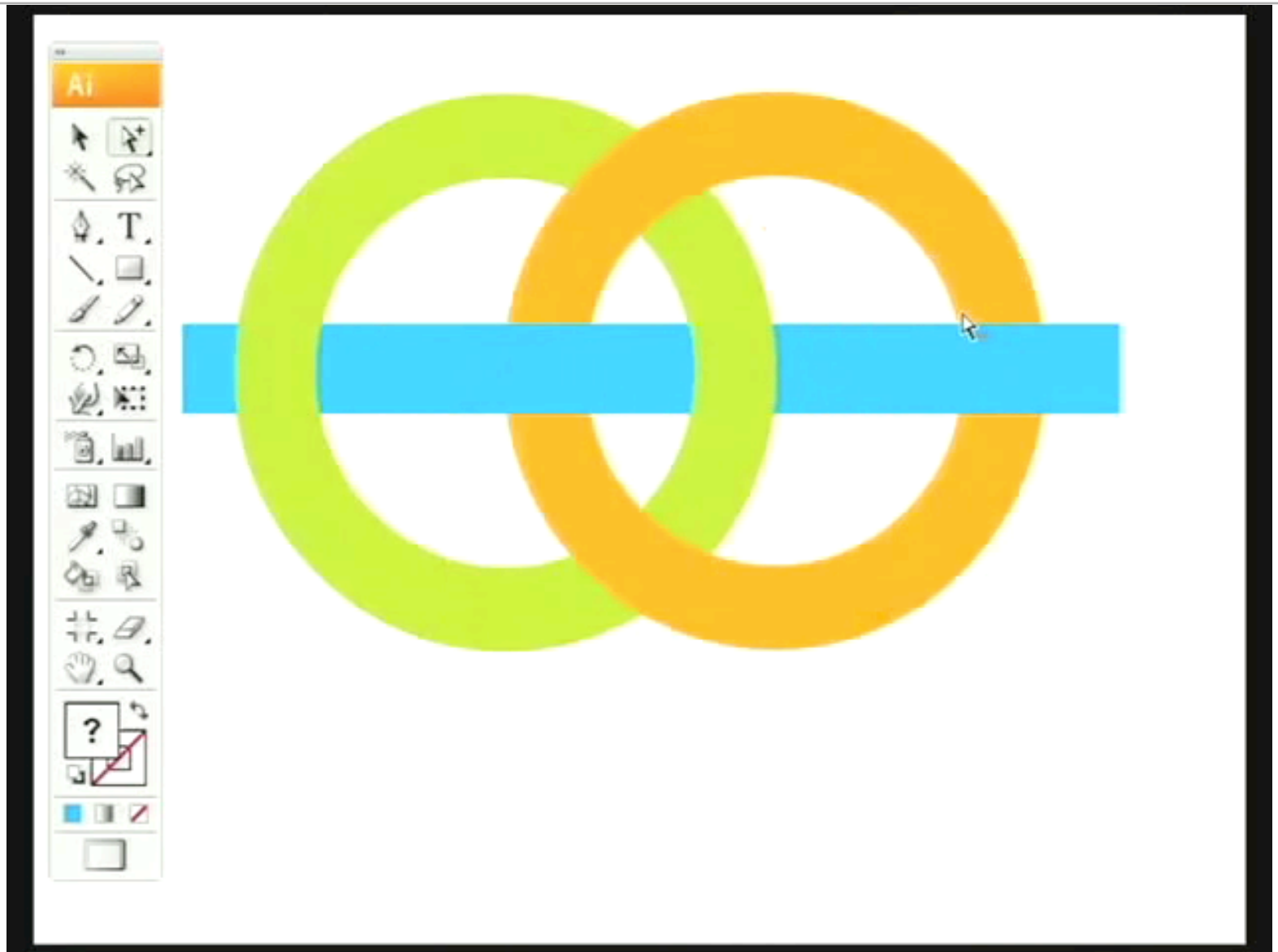




Dynamic planar maps



Dynamic planar maps



Some rules

Group commands by category
- Manage the workspace
- Global editing (layout of objects, ...)
- Local editing (individual object)
- etc.

Verify completeness
- Same operations in both tables
- Each property should be visible and editable

Verify consistency
- Similar interactions have similar effects

Evaluating a conceptual model

Using *scenarios* and *storyboards*

- Describe realistic sequences of interaction
- Verify that they are covered by the model

Using *walkthroughs*

- Verify (and have others verify) the criteria described in the previous slides

Using *prototypes*

- Implement some of the techniques to test and refine them

Some rules

Apply design principles

Reification

Identify new objects

ex : Tool palette = object

Polymorphism

Create commands that apply to different objects

ex : Which existing commands
apply to the palette itself?

Reuse

Output reuse: favor commands that reuse
existing objects

Conclusion

The conceptual model is at the heart of an interactive system

Conceptual modeling is a creative activity

- One cannot simply apply rules

User-centered design

- Analyse interaction from the point of view of the user

Participatory design

- Involve users along the design process to understand their needs, validate design choices, and take advantage of their ideas and suggestions