

# Interaction Styles

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Chapter 6 (Schneiderman & Plaisant)

Chapter 5 (Dix et al)

Credit for Slides: Dr. Saul Greenberg, Drs. Dix and Finlay, and Ms Tiffany Tang

# Interaction Styles

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- What kind of interaction styles are there?
- How do they affect the user?

## Use and Context

Human Social Organization



Human-Machine Fit and Adaptation

Human

Applications

Computer

Human  
Information  
Processing

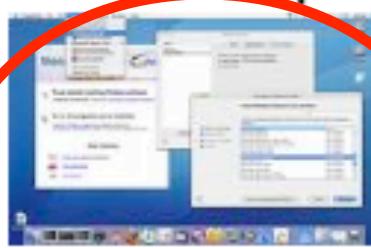


Language,  
Communication,  
Interaction

Ergonomics



I/O Devices



Interface Metaphors



Graphic Design



Dialogue  
Techniques

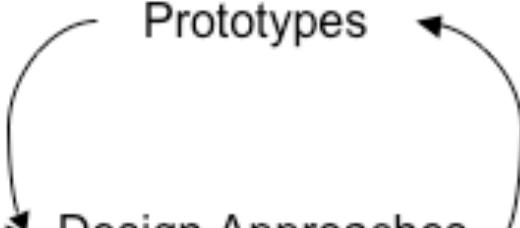
Evaluation  
Techniques

Prototypes

Design Approaches

Implementation  
Techniques and Tools

Development Process



# Interaction Styles

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- Task: Move a file from one directory to another
  - Command-based system:
    - *command file target\_directory*
    - e.g. UNIX: `mv HelloWorld.java COMP201`
  - How about in GUI systems?
    - Click on file, drag it to target directory.
- Both are interactive.
- Which is more intuitive?

# Direct Manipulation

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- General idea:
  - Natural representation of task objects
  - Actions promote notion of performing task directly
    - As opposed to going through an intermediary like a computer.
  - Like driving a car using the steering wheel, as opposed to typing in “turn left 30 degrees”

# Direct Manipulation

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- Defined in 1982 by Ben Shneiderman
- Central ideas:
  - Visibility of the objects of interest
  - Incremental action at the interface with rapid feedback
  - Reversibility of all actions to encourage exploration
  - Syntactic correctness of all actions
  - Command languages replaced by actions directly on visible objects

# Direct Manipulation

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- What did all that mean?
- Continuous representation of the objects and actions of interest with meaningful visual metaphors
- Physical actions and presses of labeled buttons, instead of complex syntax
- Rapid incremental reversible actions
- Effects on objects of interest is visible immediately.

Example: resizing a rectangle by dragging its edges.

# Direct Manipulation

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- What did all that do?
  - Objects understood in terms of their visual characteristics
    - Affordances, constraints
  - Actions understood in terms of their effects on the screen
    - Causality
  - Intuitively reasonable actions can be performed at any time: interface behaves as though the interaction was with a real-world object rather than with an abstract system.
    - Feeling that user is working directly on the task.
      - Conceptual Model

“A subtle thing happens when everything is visible:  
the display becomes reality” — Xerox Star inventors



# Cycle Pro Watch

## Empowering The Local Cyclist

Ipsum dolor sit amet, consectetuer adipiscing elit. In aliquam. Sed nec est. Suspendisse ante turpis, tempor eu, pellentesque vitae, dapibus a, erat. Praesent pulvinar. Phasellus quis pede. Maecenas ac risus. Nulla rutrum justo eu enim. Curabitur in metus a tellus lobortis ultrices. Mauris fermentum. Praesent dapibus, nisl sit amet tempus blandit, orci urna tempor magna, et adipiscing odio neque iaculis massa. Morbi ut nulla. Integer malesuada augue sed purus. Cras velit. In ipsum eros, mattis nec, dapibus quis, semper eu, dui. What to do you [want it to say](#)



Save as Draft

Revert Back to Live Version

Make This Draft Live



```
a  
ed is the standard Unix text editor.  
This is line number two.  
.2i  
.  
%l  
ed is the standard Unix text editor.$  
$  
This is line number two.$  
3s/two/three/  
,l  
ed is the standard Unix text editor.$  
$  
This is line number three.$  
w text  
65  
q
```

Resulting file:

ed is the standard Unix text editor.

This is line number three.

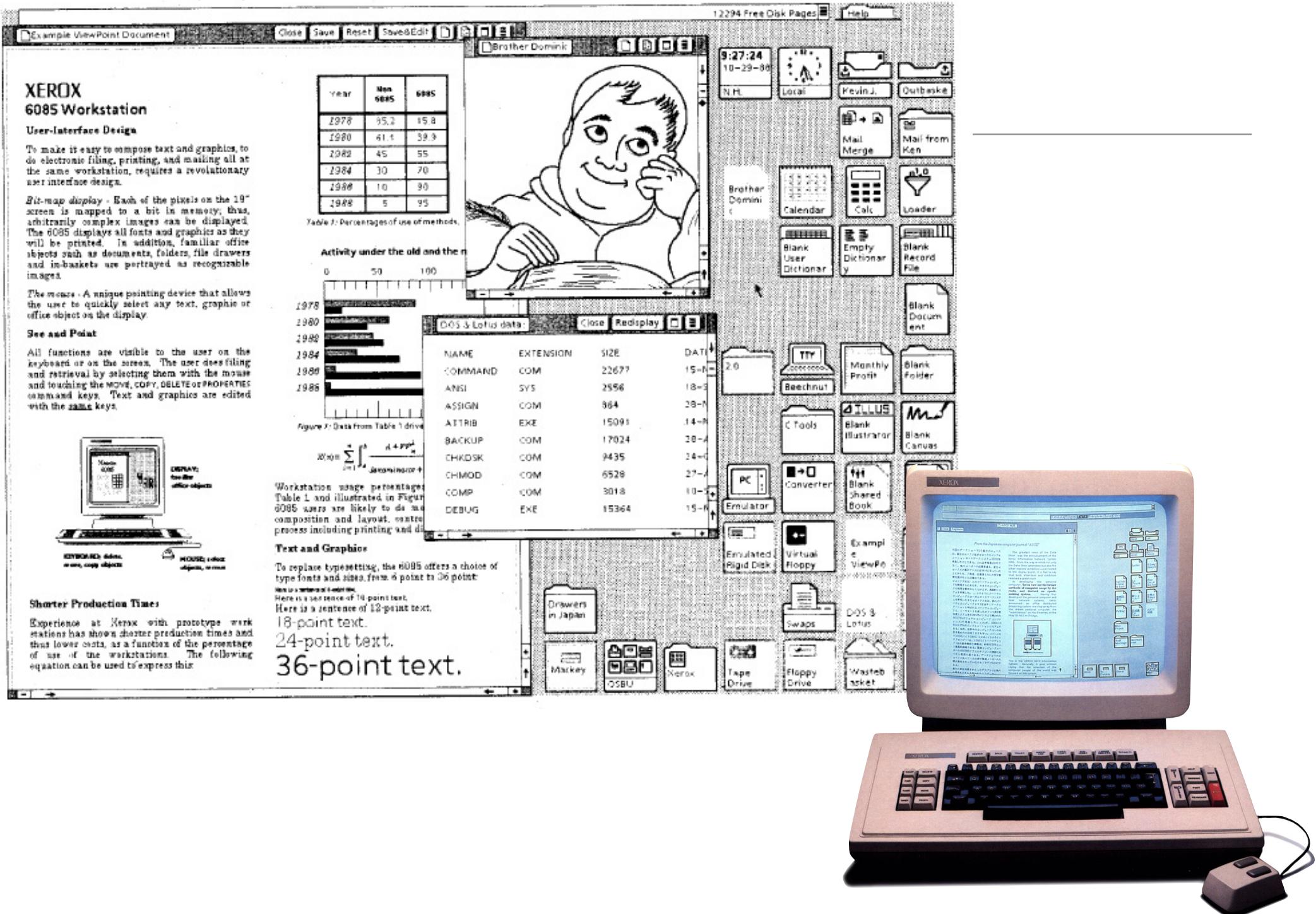
# Xerox Star

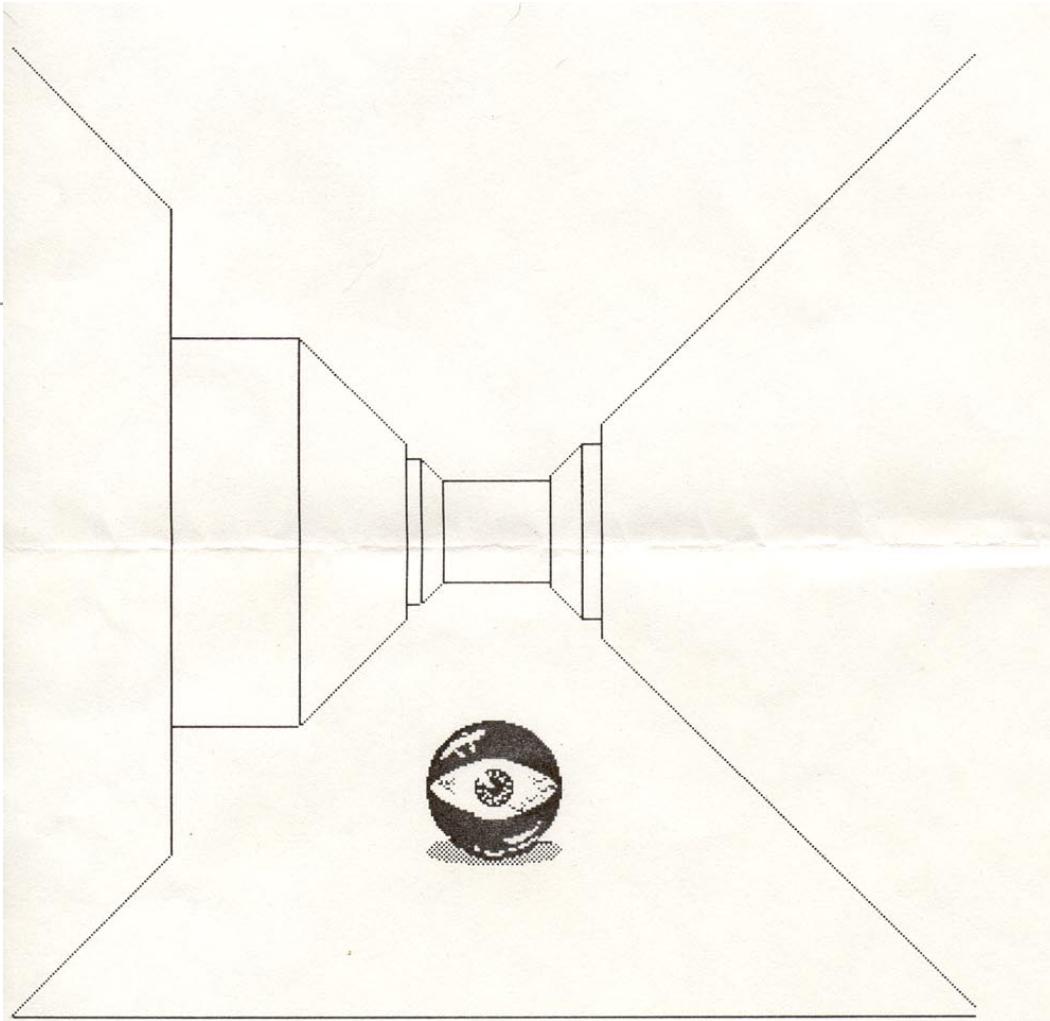
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- The first graphical desktop system.

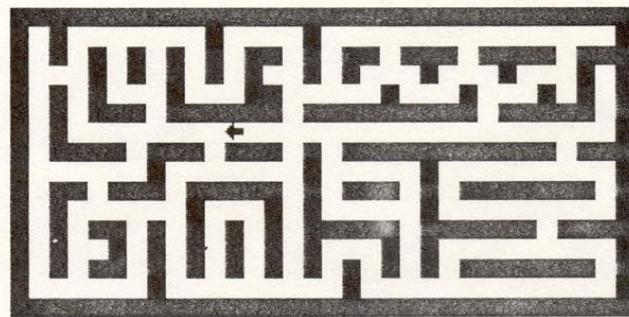
- Introduced to us:

- Desktop metaphor
- Windowing System
- Mouse
- Bitmapped Display





It even had a 3-D  
first person shooter  
game.



SH 10  
bloodshot -10

# Direct Manipulation and Computer Commands

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- With the advent of GUI programming and direct manipulation, commands to the computer started changing as well...

# Computer Commands and Programming

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- Syntactic vs. Semantic
- Procedural vs. Object-Oriented.
- Difference: What do we focus on?
  - The tokens parsed from the source file (syntactic) or the actual operations (semantic)?
  - The actions that we do (procedural), or the objects that do these actions? (OO)

# Shneiderman's Syntactic/Semantic Model

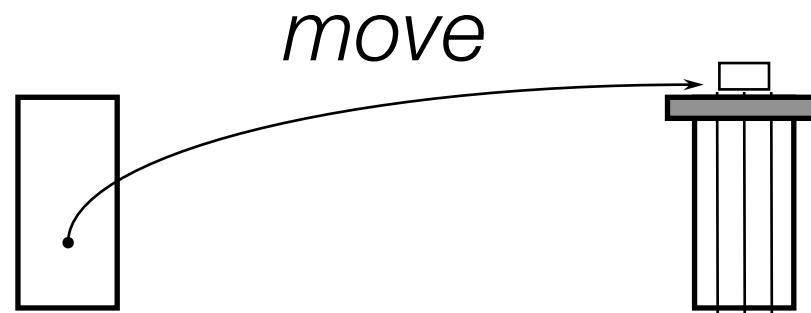
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- Theory to explain and predict human behavior in an interactive system
- Other theories that we have already seen:
  - Fitt's Law
  - Keystroke Level Model
  - 7 stages of interaction

# Computer Commands

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- Recall: moving a file from one directory to another
  - UNIX: `cp <filename> <target directory>`
  - Windows: Click on the file, drag it to another folder.



# The Early Days...

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- DOS and UNIX used command-based languages.
- Rules or combinations of commands and signals
  - Device-dependent details of how to use the system
  - Uses a “grammar” to determine what is a valid action and what is not.
  - Focus was on the syntax of the command.
  - Examples:
    - backspace key = delete previous character
    - right mouse button = raise menu
    - grep < word> <file> = finding a word in a file
    - tab = moves to next field in a form

# Action-Object Interaction

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- First select the action to be performed.
- Then select the objects on which to perform that action.
- Emphasis is on the actions (the “verbs”), rather than on the objects (the “nouns”)
- Computer is at the center, a tool which performs different actions.

# Problems with Syntax

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- Hard to learn
  - What does Ctrl-v have to do with “paste”?
  - Often arbitrary, or hidden in long-lost technical details!
- Easy to forget
  - Good for experts, but tough for casual users.
  - Most users aren’t experts, though!
  - And most people don’t care how the computer works, they just want to get their job done!

# Problems with Syntax

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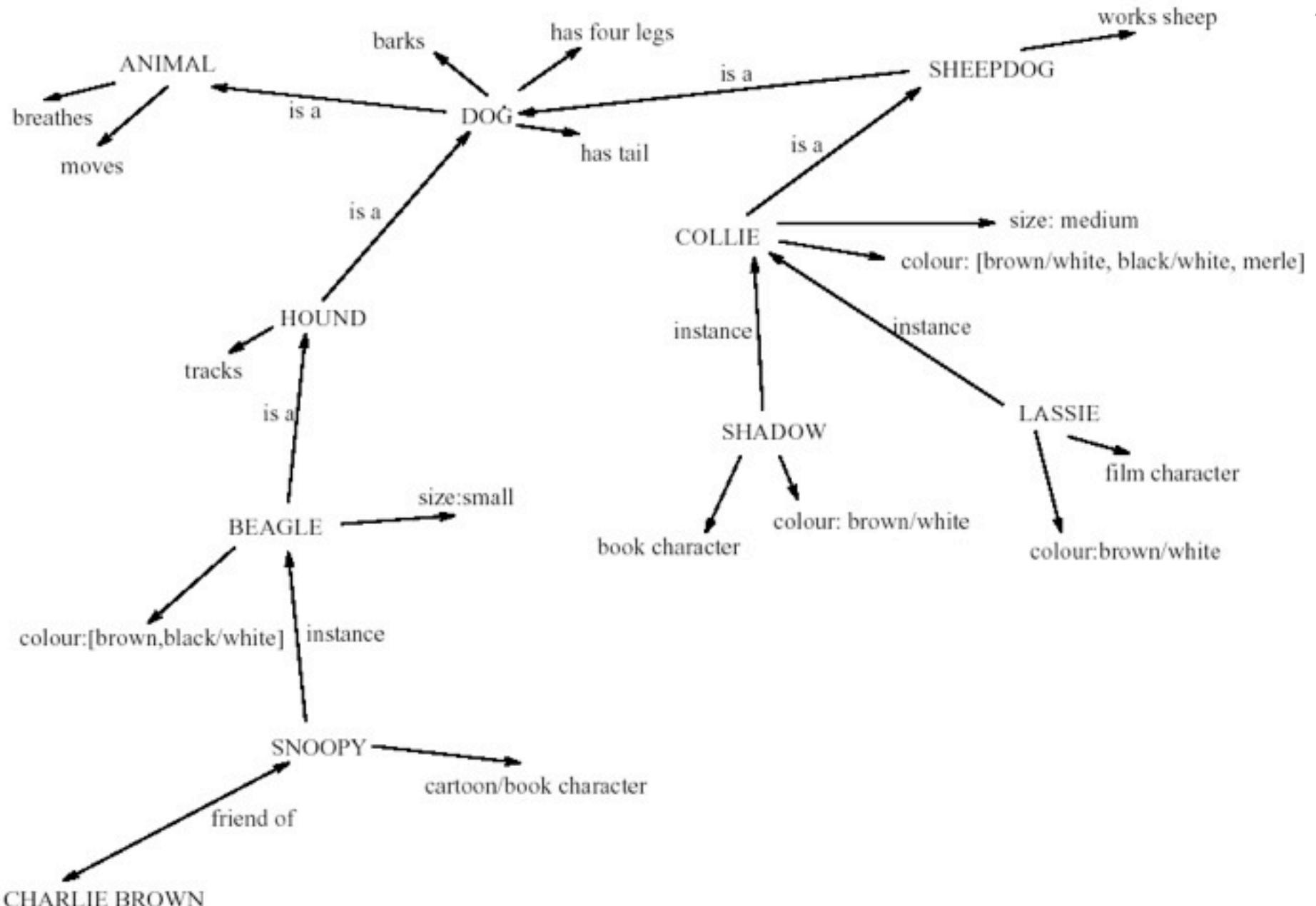
- Users must maintain lots of device-dependent details in memory!
  - E.g. “save” in vi is “w”, in emacs is “Ctrl-x-Ctrl-s”
  - E.g. Which action erases a character
  - E.g. Which function key do I press to go back to the previous screen?
- Takes user’s mind off the task at hand
  - Need to shift mind-mode from task to the tool (to remember the correct syntax or command)

# Semantic Knowledge

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- Semantic Memory
  - Part of long-term memory
  - Allows access to information
  - Contains representation of relationships between pieces of information
  - Supports inference and logical reasoning

# Model of Semantic Knowledge in LTM



# Semantic Knowledge

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- Properties of Semantic Knowledge

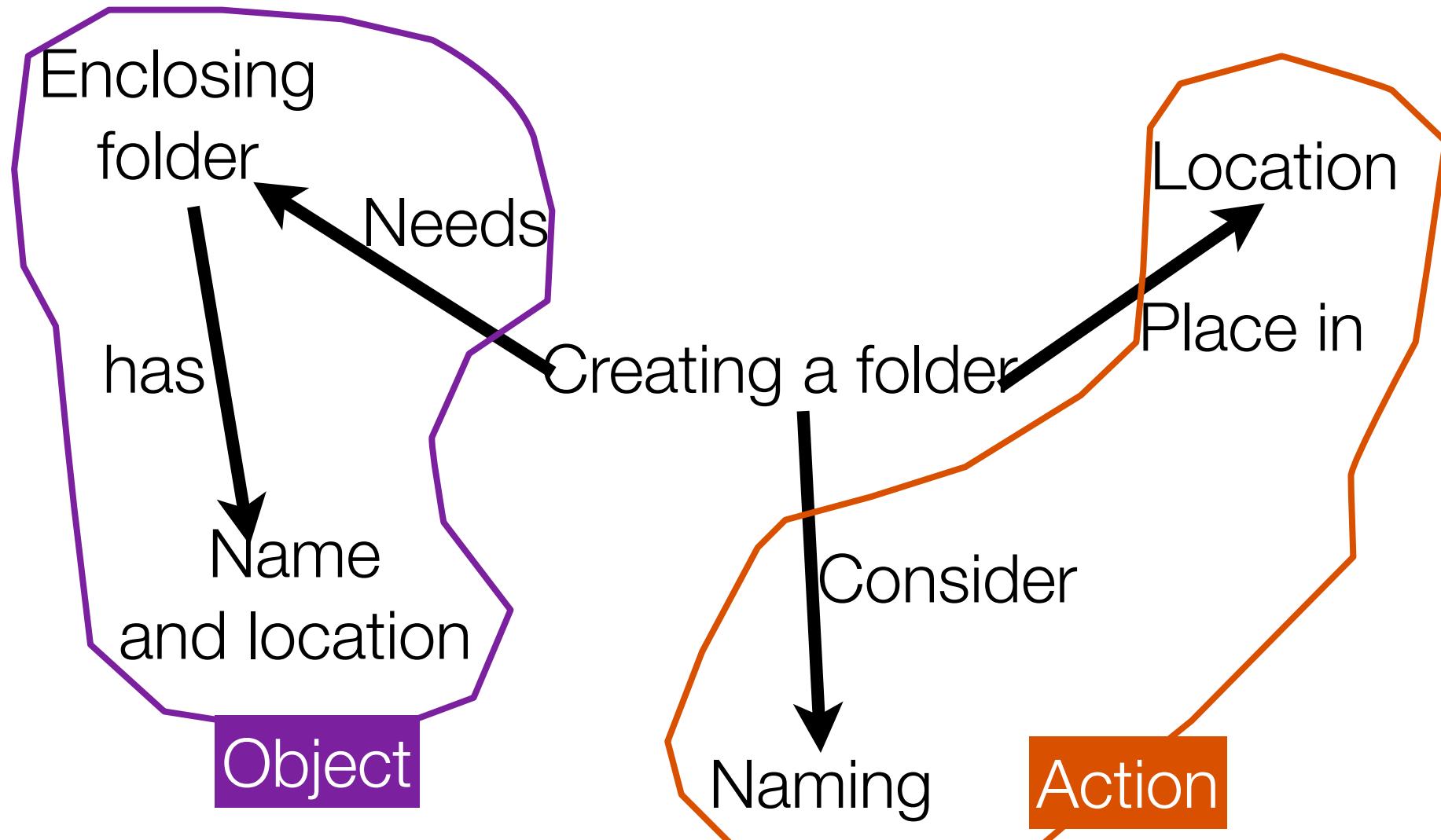
- Relatively stable in memory

- High Level Concepts

- Logical Structure

- Cognitive Model Produced

# Semantic Knowledge for Computer Concepts



# Semantic Knowledge for Computer Concepts

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- Objects
  - Stored information as files, with name, creation date, owner; “grouped together” information as directories
- Actions
  - Saving a file, creating backups, etc
  - Usually follows a hierarchical structure.
    - High level concepts decomposed to many low level concepts

# Semantic knowledge for Computer Concepts

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- People learn computer concepts by:
  - Meaningful Learning
  - Demonstrations
  - Explanations of Features
  - Trial by error
  - Model of concepts (abstract, concrete, analogical)
    - E.g. File hierarchies are like file/folder systems

# Semantic Model of Computer Knowledge

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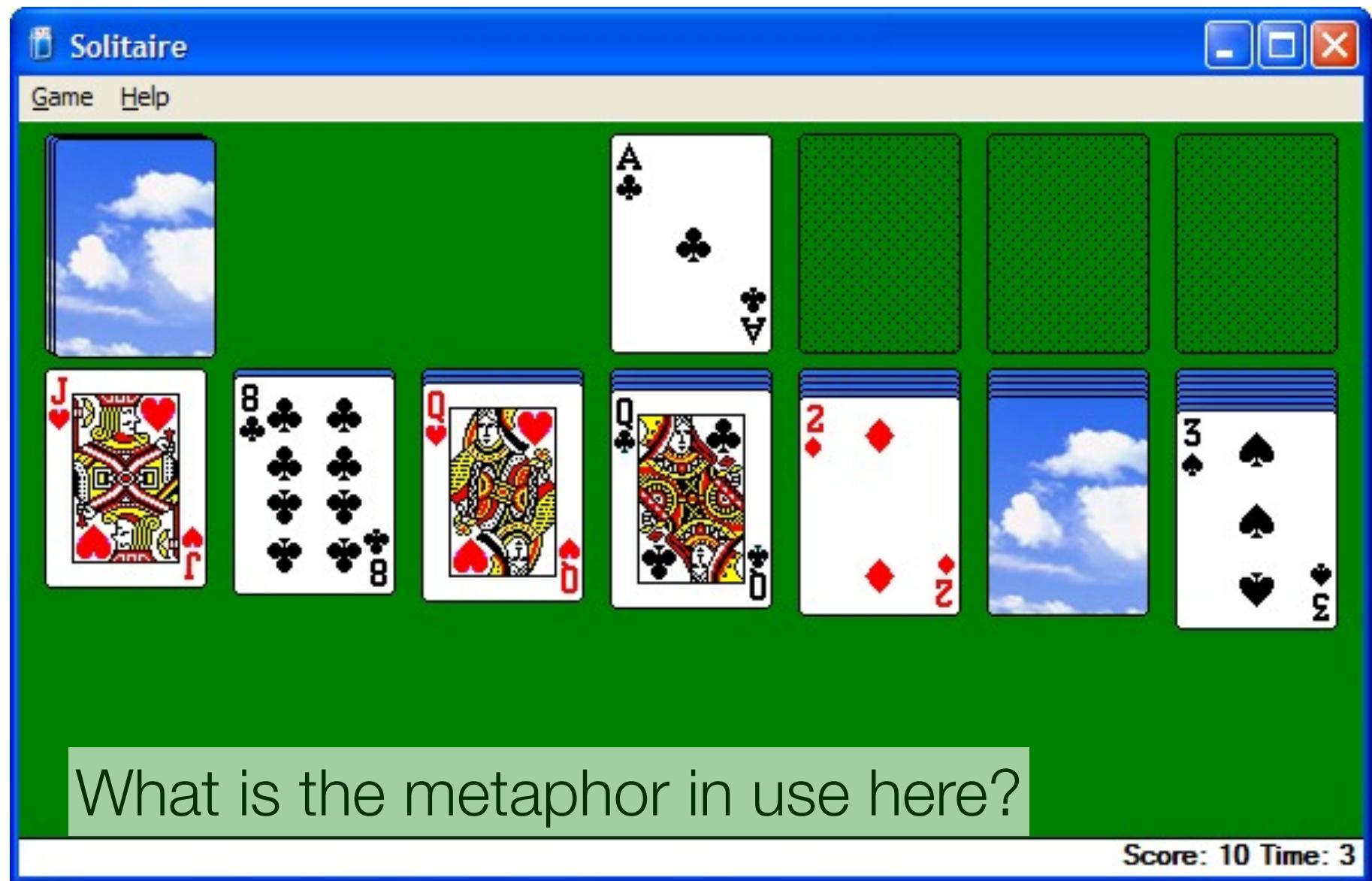
- How do we help them to learn?
- Computer Semantics
  - Allow computer artifacts to be represented as task artifacts
    - E.g. Office workers: files/folders represent hierarchical directory/file system
  - Information Hiding
    - Don't force people to know computer concepts that aren't relevant to their work
    - Maybe: try to get people to forget about the computer?

# Object-Action Interaction

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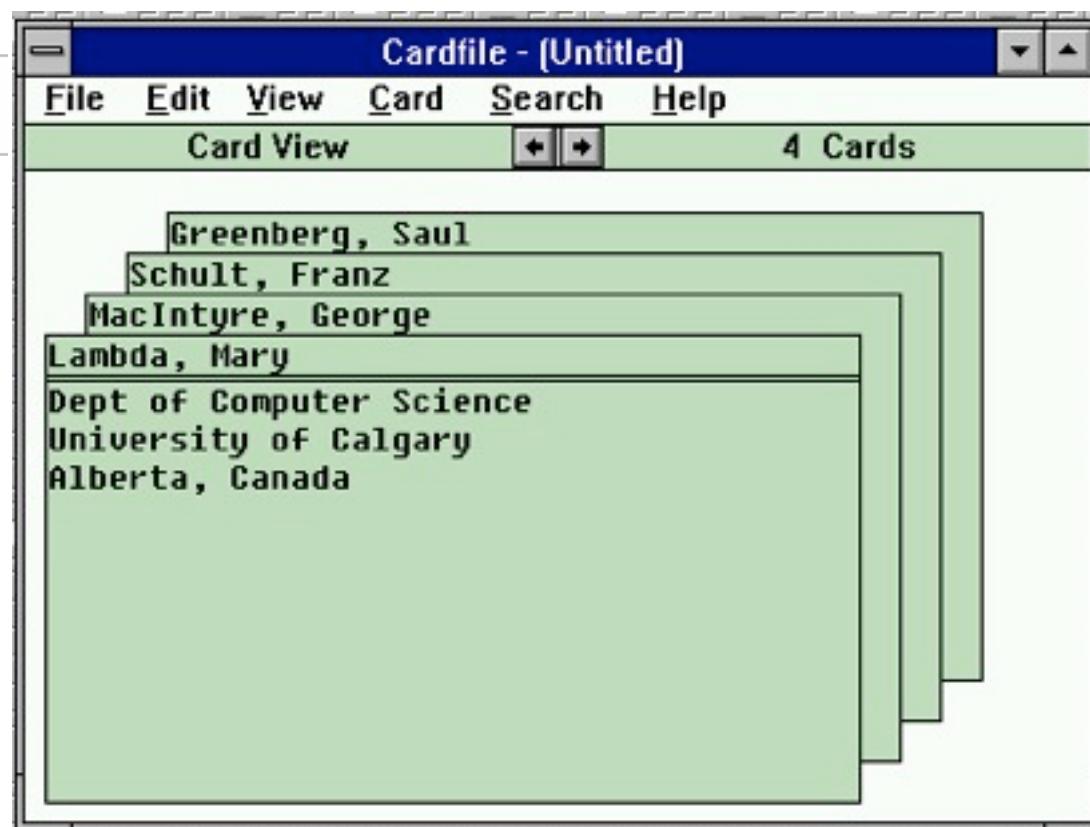
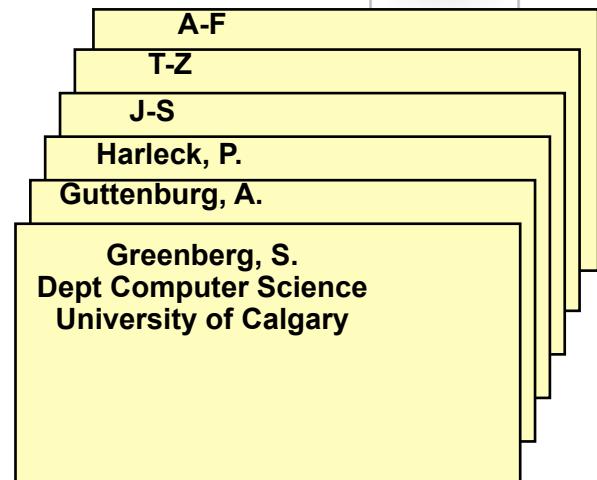
- First select the object, then the actions to be performed on it.
- Computer is a medium
- Metaphors map real-world objects to computer objects
- Actions are direct manipulations applied to visual representations of objects and actions

# Solitaire



Microsoft Solitaire

# Contact lists

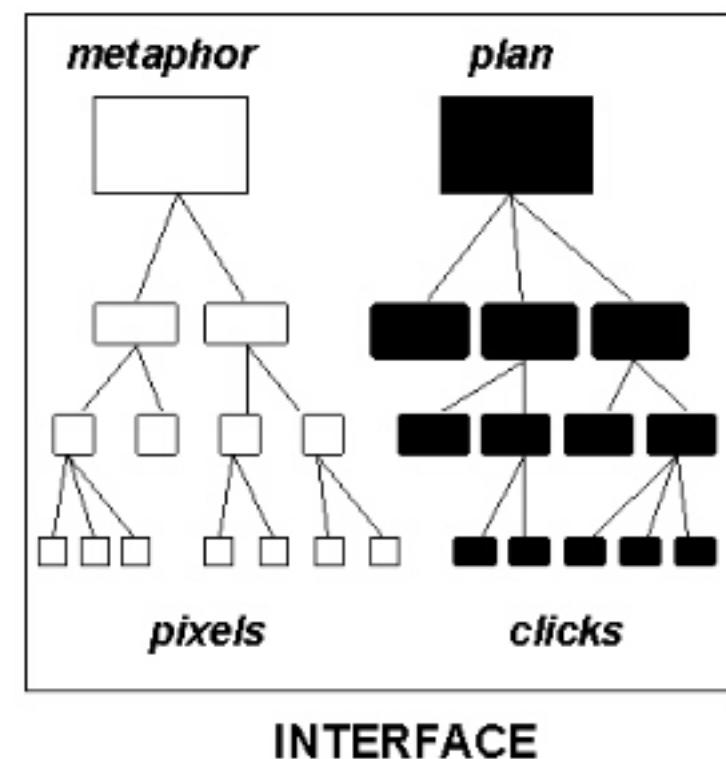
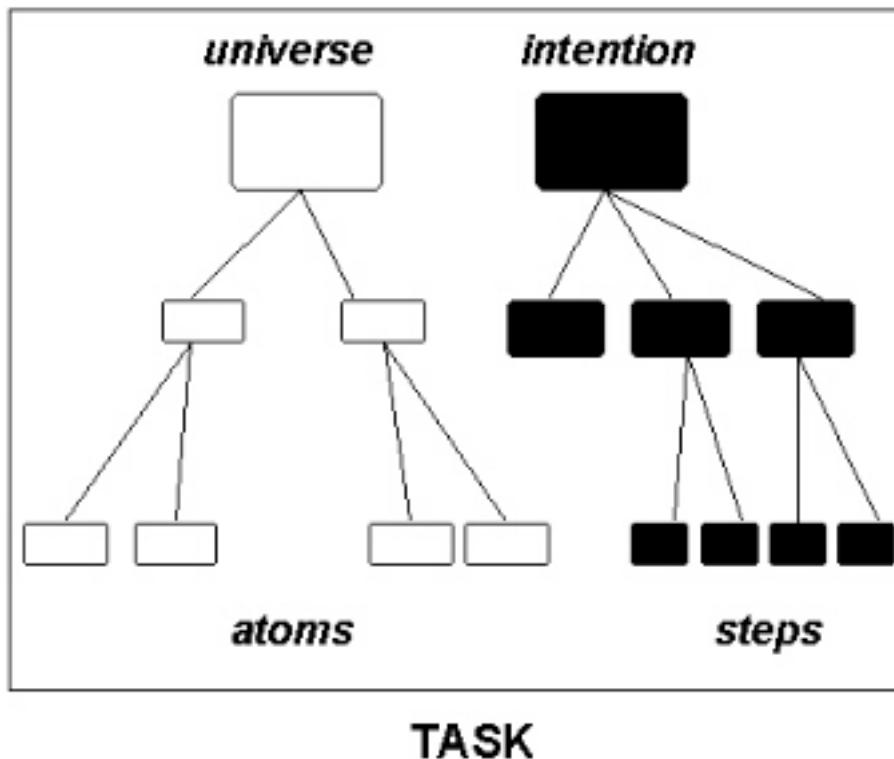


*Rolodex*

What is the metaphor in use here?

# Object-Action Interaction

- Real world objects and intentions are mapped to the interface world of metaphors and plans.



# Object-Action Interaction

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- Emphasis has shifted to “What can we do with these objects?”
- In other words: emphasis is on the object (the “noun”), rather than the action (the “verb”).

# Object-Action Interface Design

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- What do we need to do if we want to have good OAI design?
  - Understand the task
    - Look at real-world objects
    - Look at actions applied to those objects.
  - Create metaphoric representations of interface objects and actions
    - Move a file: literally, physically move a file into another folder.
    - Delete a file: literally, move the file into the trashcan.
  - Make these interface actions visible to the user.

# Dynamic Queries

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- Another example of OAI and direct manipulation.
- Perform searches and queries by
  - Adjusting sliders, buttons, check boxes, and other control widgets
  - Displaying immediate updates as the control is adjusted

# Google Earth

Search

Fly To Find Businesses Directions

e.g., 37 25.818' N, 122 05.36' W

Places

Layers

View: Core

Primary Database

- Terrain
- Geographic Web
- Featured Content
- Global Awareness
- roads
- 3D Buildings
- borders
- Populated Places
- Alternative Place Names
- Dining
- Lodging
- Google Earth Community
- Shopping and Services
- Transportation
- Geographic Features

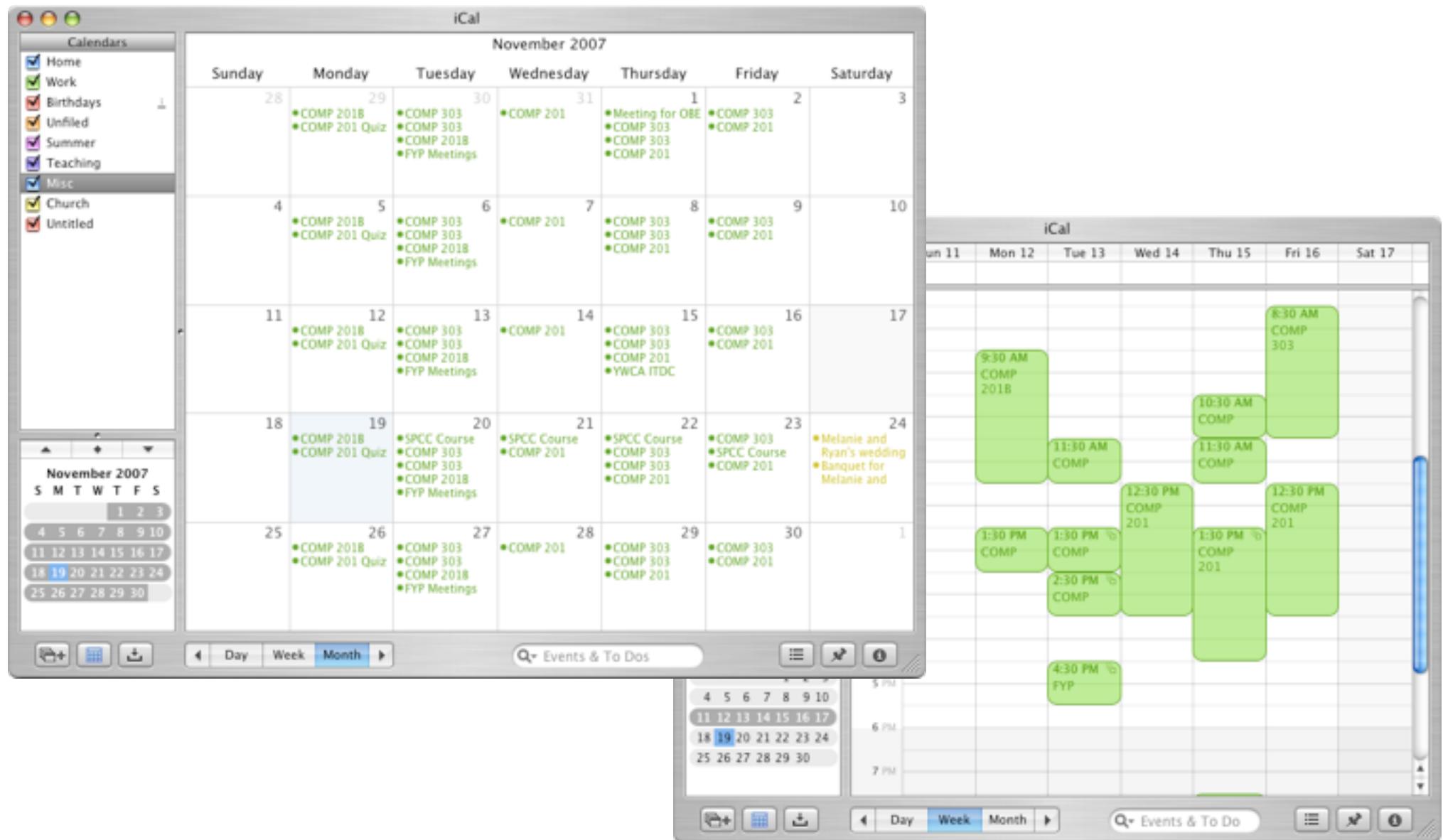
Pointer 22°17'39.59" N 114°09'25.02" E elev 41 m Streaming 100% Eye alt 10.77 km

# OAI and Direct Manipulation

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- “The norm” nowadays.
- The holy grail of HCI?
- Should everything be made directly manipulable?
- What are the problems with OAI and Direct Manipulation?

# Representation affects what we can directly manipulate



# Good or Bad?

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Final Project

Name	Date Modified	Size	Kind
Animal_ProgramSkeleton.java	6 November 2007, 1:08 PM	4 KB	Java S...ce File
Animal.class	6 November 2007, 1:13 PM	4 KB	Jar La...ument
Animal.java	Today, 9:40 AM	4 KB	Java S...ce File
Animal.java~	6 November 2007, 1:08 PM	4 KB	Document
Animal1_01234567d.class	6 November 2007, 1:13 PM	4 KB	Jar La...ument
Animal1_01234567d.java	Today, 9:40 AM	4 KB	Java S...ce File
Animal1_01234567d.java~	6 November 2007, 1:09 PM	4 KB	Document
Animal1_02345678d.class	6 November 2007, 1:13 PM	4 KB	Jar La...ument
Animal1_02345678d.java	Today, 9:40 AM	4 KB	Java S...ce File
Animal1_02345678d.java~	6 November 2007, 1:11 PM	4 KB	Document
Animal2_01234567d.class	6 November 2007, 1:13 PM	4 KB	Jar La...ument
Animal2_01234567d.java	Today, 9:40 AM	8 KB	Java S...ce File
Animal2_01234567d.java~	6 November 2007, 1:12 PM	8 KB	Document
Animal2_02345678d.class	6 November 2007, 1:13 PM	4 KB	Jar La...ument
Animal2_02345678d.java	Today, 9:40 AM	4 KB	Java S...ce File
Animal2_02345678d.java~	6 November 2007, 1:11 PM	4 KB	Document
FinalProjectPart1.html	Today, 9:44 AM	16 KB	HTML ...ment
FinalProjectPart1.html~	Yesterday, 5:41 PM	16 KB	Document
Game.class	Yesterday, 4:31 PM	4 KB	Jar La...ument
Game.java	Today, 9:40 AM	8 KB	Java S...ce File
Game.java~	Yesterday, 4:31 PM	8 KB	Document
Map.class	Yesterday, 5:35 PM	8 KB	Jar La...ument

Task: Remove all emacs backup files (those ending in  
~)

UNIX: rm \*~

Direct Manipulation: ????



View Sections

Text Box

Shapes

Table

Chart

Comment

Track Changes

Inspector

Media

Colors

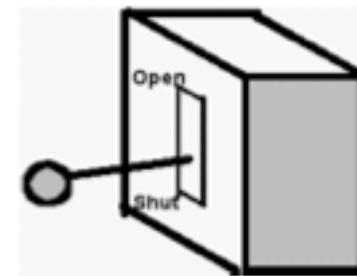
Fonts

0 4 6 8 10 12 14 16 18 20

## Exercise: Applying the Psychology of Everyday Things

(Adapted from Prof Saul Greenberg's notes)

A particular power plant had many valves situated around the plant. Whenever some setting had to be changed, operators would walk to the room where a particular valve was located, and move it by hand to the desired setting. The control for the valve was a lever that looks like the figure on the right. If the lever was in between the two positions, the valve would be partially open.



An overhaul at the power plant motorized the valves such that they could be electronically controlled. The IT team at the plant was hired to create a new interface widget to control these valves from a computer dashboard, so that the operators wouldn't need to keep on walking back and forth between their stations and the levers. The computer is built on a UNIX system, so a traditional UNIX 3-button mouse is used. The team decided to model the valve settings by combining conventional buttons, popup menus and dialog boxes.

The widget looks like a button (shown to the left of the below figure).

Task: Italicize the highlighted words.

Currently: Ctrl-i, or use the menu

Direct Manipulation: ????

# Direct and abstract manipulation

- Most good applications mix the two for power

Human Information Processing Question

Part a: I am looking for *biological* characteristics and constraints. Examples of these are the visual acuity of humans, or the hearing frequency range of humans. Bear in mind that things such as optical illusions and the Gestalt laws arise from human *perception* of visual signals and are not really visual characteristics as such.

Part b: I am looking for differences between LTM and STM. There are three differences: capacity, decay and access time.

Part c: Read the question properly. I am asking for a situation in which audio output would be *preferable* to visual output. Many students put down scenarios where the user is seeing-impaired and thus cannot read the monitor screen. These are scenarios where audio output is *necessary*, rather than *preferable*. I did give partial credit for these answers, but full marks will only be given for convincing and correct situations.

Part d: Again, many students are confusing perception with memory capabilities. The human STM can remember  $7 \pm 2$  items of information. The first two strings are made up of chunks, which are remembered as *one single item*. Therefore, the first two strings are of length 3 chunks each. The third string is not constructed of recognizable chunks, therefore

Direct  
Manipulation:  
WYSIWYG  
document

Abstractions:  
Buttons,  
menus, dialog  
boxes

# Advantages and Disadvantages

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- Advantages:
  - Immediate Feedback
  - Reversible Actions
  - Actions and manipulated visual objects are in the same place
- Disadvantages:
  - Needs more screen space
  - Less suitable for tasks where more detailed feedback information is needed or for abstract operations.

# OAI vs. AOI

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- OAI is:
  - More “natural”
  - Easier to learn and remember
  - Generic commands are supported
    - E.g. Drag-n-drop can be done on folders, files, paragraphs, text, numbers, etc.
- AOI is:
  - Batch-friendly
  - Pipeline-friendly
  - More efficient

# What you now know

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- Direct Manipulation
  - What this is, how this came about
- Object-Action vs. Action-Object
  - Pros and cons
- Designing an object-action interface
  - How do we make sure that it makes sense to the user?