CS3205 – HCI in Software Development

Mental and Conceptual Models

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Outline of Topics

- Chapter 2 of the ID Book
- Conceptual models
  - Mental models
  - Metaphors
- Interaction styles
- This is helpful in thinking about: Prototyping, design

- But first, some history
  - Let's get to this topic by looking at the history of an important example

1968 – Douglas Engelbart

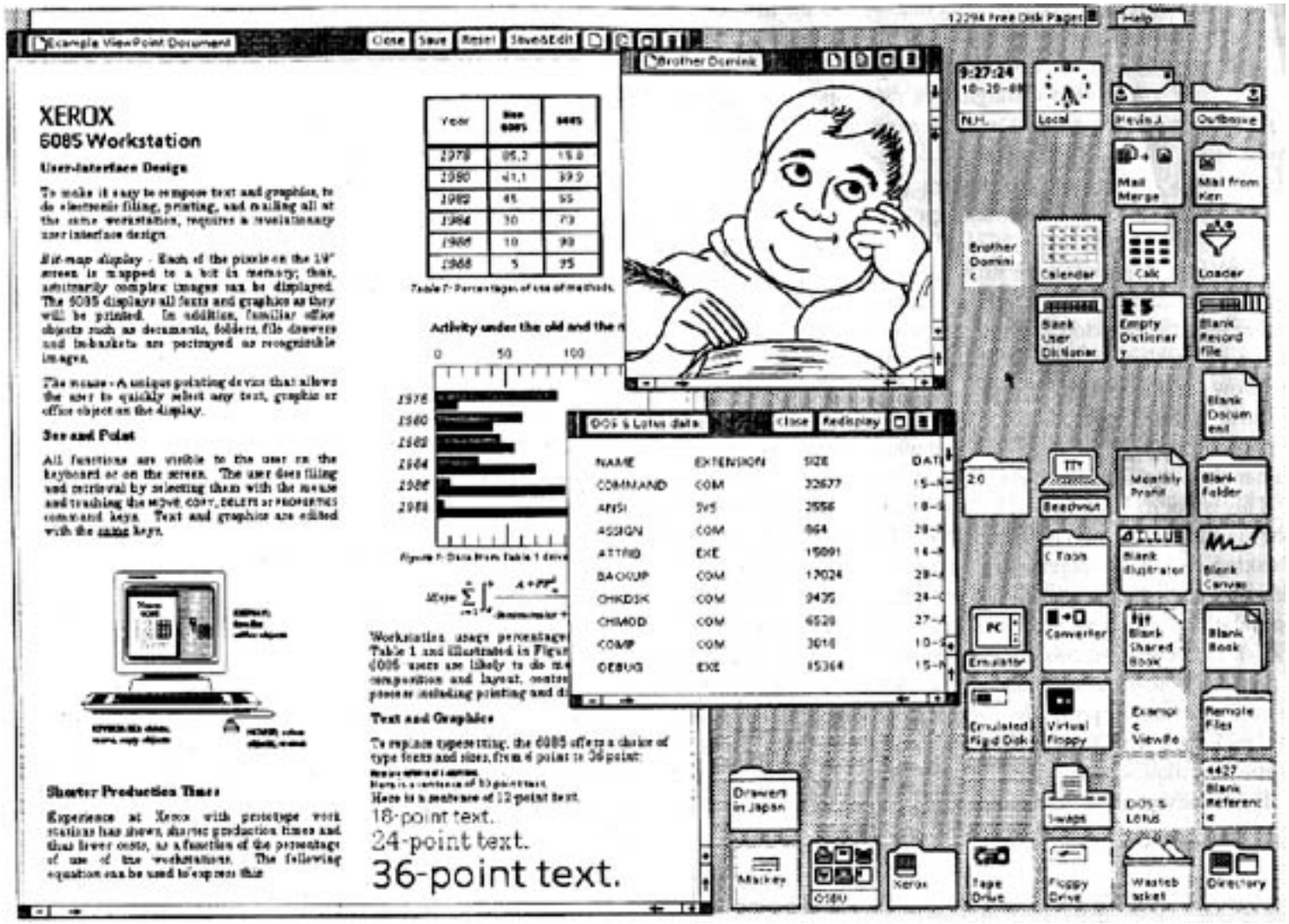
- NLS or “oN-Line System”
  - Later renamed Augment
- First GUI
  - Mouse
  - Hypertext Links
  - Raster-scan video monitors
  - Screen Windowing
- https://en.wikipedia.org/wiki/Douglas_Engelbart

The Mother of All Demo's

- Kind of a weird title, but hey!
  - http://www.youtube.com/watch?v=yJDv-zdhzMY
- Bitmapped screens, mouse, selection, hypertext
  - all part of what we think of GUIs on desktop interfaces

- Engelbart's work influenced those at this famous organization:
  1970: Palo Alto Research Center (PARC)
  - Created by Xerox
  - Goal: First commercial GUI

Xerox Star Workstation Interface



The Desktop: a Conceptual Model

- Need to first think about how the system will appear to users (i.e. how they will understand it)

- A **conceptual model** is a high level description of:
  - "the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended"

Mental Models

- Also hear term *mental model*. Same thing?
- Norman:
  - "The models people have of themselves, others, the environment and the things with which they interact. People form mental models through experience, training, and instruction."
- Often a more specific idea than conceptual model
  - I.e. focuses on a specific system

For either Idea…

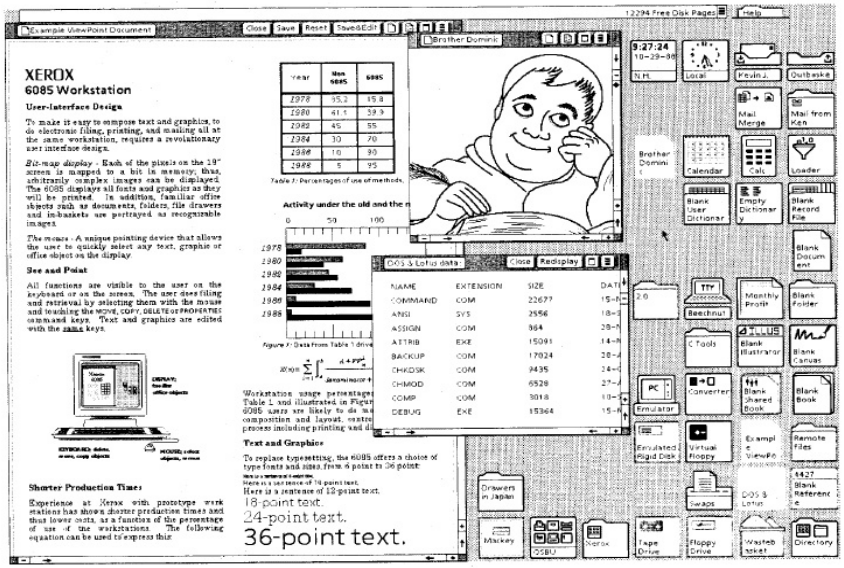
- You want to understand what the user already has in their head
- Then, you want to:
  - Maybe build your system in response to this
  - Work to create a different model in their head as they use your system
- When making design decisions, always keep in mind how the user will understand the underlying model

Understanding a conceptual model

- How will the user think about the system? Possibly based on:
  1. Data or objects
  2. Types of operations (activities) done
  3. A metaphor
- Are there existing systems, concepts that will influence how the user will think about the system?
- What kind of interface metaphor, if any, will be appropriate?
- What kinds of interaction modes and styles to use?
- Breakdowns?
  - Web apps (e.g. SIS) and back-button

(1) Conceptual Model based on Objects

- Usually based on an analogy with something in the physical world
- Examples include books, tools, vehicles
- Classic: Xerox Workstation's Star Interface (1981)
  - based on office objects



https://en.wikipedia.org/wiki/Xerox_Star#User_interface

What's Familiar?

What's Familiar?

- Documents: text on white "paper"
- Folders
- Icons for tasks related to devices.
  - Printer, mailbox, terminal, clock
- A physical 2D space to arrange things

- BTW, the interface SW:
  - Was object-oriented. All things had properties.
  - Supported embedding or integrating things into other documents by drag-and-drop

(2) Conceptual Models Based on Activities

- Four general types of activities for interacting

1. Giving instructions
   - issuing commands using keyboard and function keys and selecting options via menus
2. Conversing
   - interacting with the system as if having a conversation
3. Manipulating and navigating
   - acting on objects and interacting with virtual objects
4. Exploring and browsing
   - finding out and learning things

Consider #3: Manipulating and Navigating

- Involves dragging, selecting, opening, closing and zooming actions on virtual objects
- Exploit's users' knowledge of how they move and manipulate in the physical world
- Exemplified by
  - what you see is what you get (WYSIWYG) and
  - the *direct manipulation* approach (DM)
- Shneiderman (1983) coined the term DM
  - came from his fascination with computer games at the time

Core Principles of DM

- Continuous representation of objects and actions of interest
- Physical actions and button pressing instead of issuing commands with complex syntax
- Rapid reversible actions with immediate feedback on object of interest

Advantages of DM

- Give me some!
  - (Usability terms are welcome!)

Benefits of DM

- Novices can learn the basic functionality quickly
- Experienced users can work extremely rapidly to carry out a wide range of tasks, even defining new functions
- Intermittent users can retain operational concepts over time
- Error messages rarely needed
- Users can immediately see if their actions are furthering their goals and if not do something else
- Users experience less anxiety
- Users gain confidence and mastery and feel in control

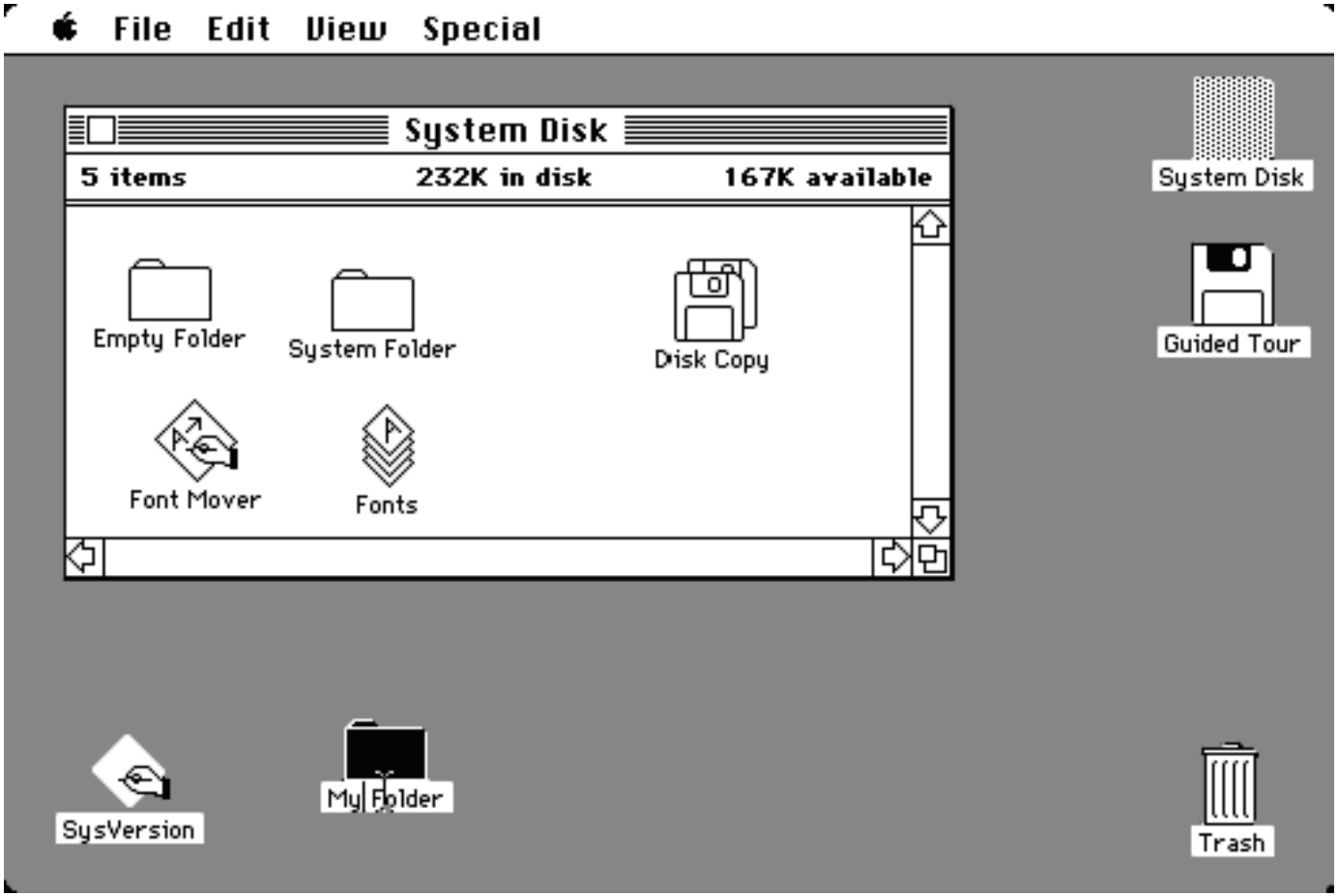
Disadvantages of DM

- Some people take the metaphor of direct manipulation too literally
- Not all tasks can be described by objects and not all actions can be done directly
- Some tasks are better achieved through delegating
  - e.g. spell checking
- Can become screen space 'gobblers'
- May not scale down to small displays
- Moving a mouse around the screen can be slower than pressing function keys to do same actions
  - But touch screens better than pointing devices

Where have we Arrived in Lecture?

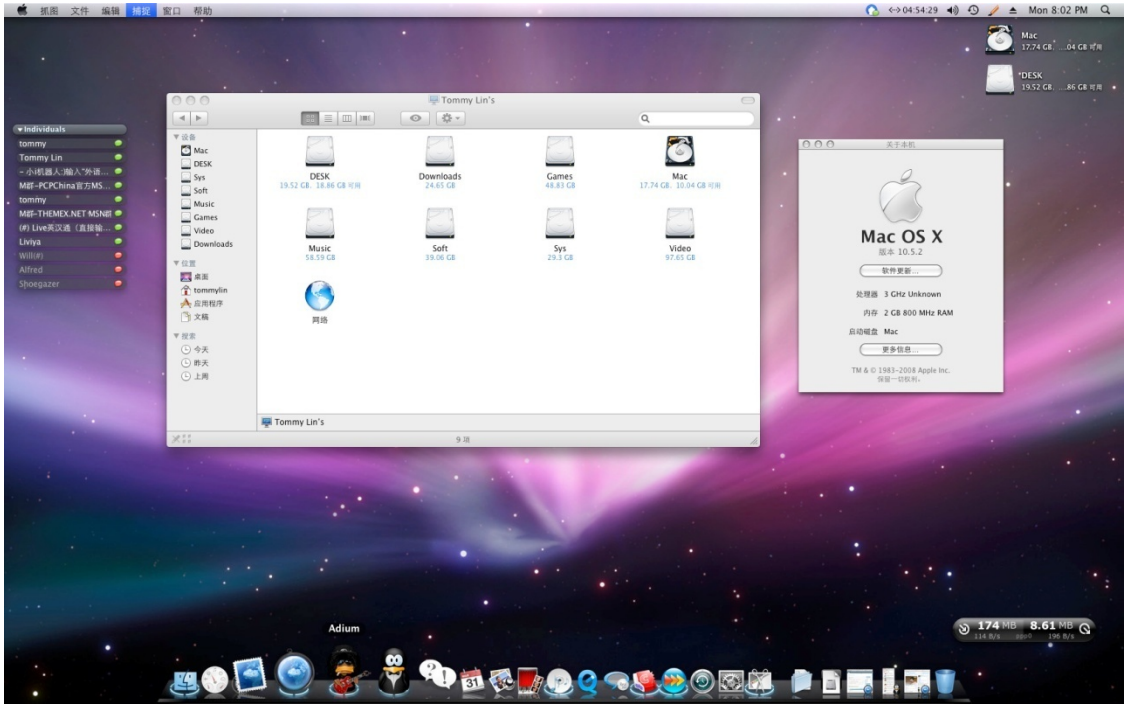
- Xerox Workstation's Star interface
- Introduced desktop conceptual model for interacting with a computer based system
  - A conceptual model based on objects
- Supported direct manipulation of those objects
  - A conceptual model based on the activity of direct manipulation
    - Drag and drop, cut and paste, embed something, start something
- The desktop metaphor is a historic and important example of a conceptual model

1984 - Macintosh



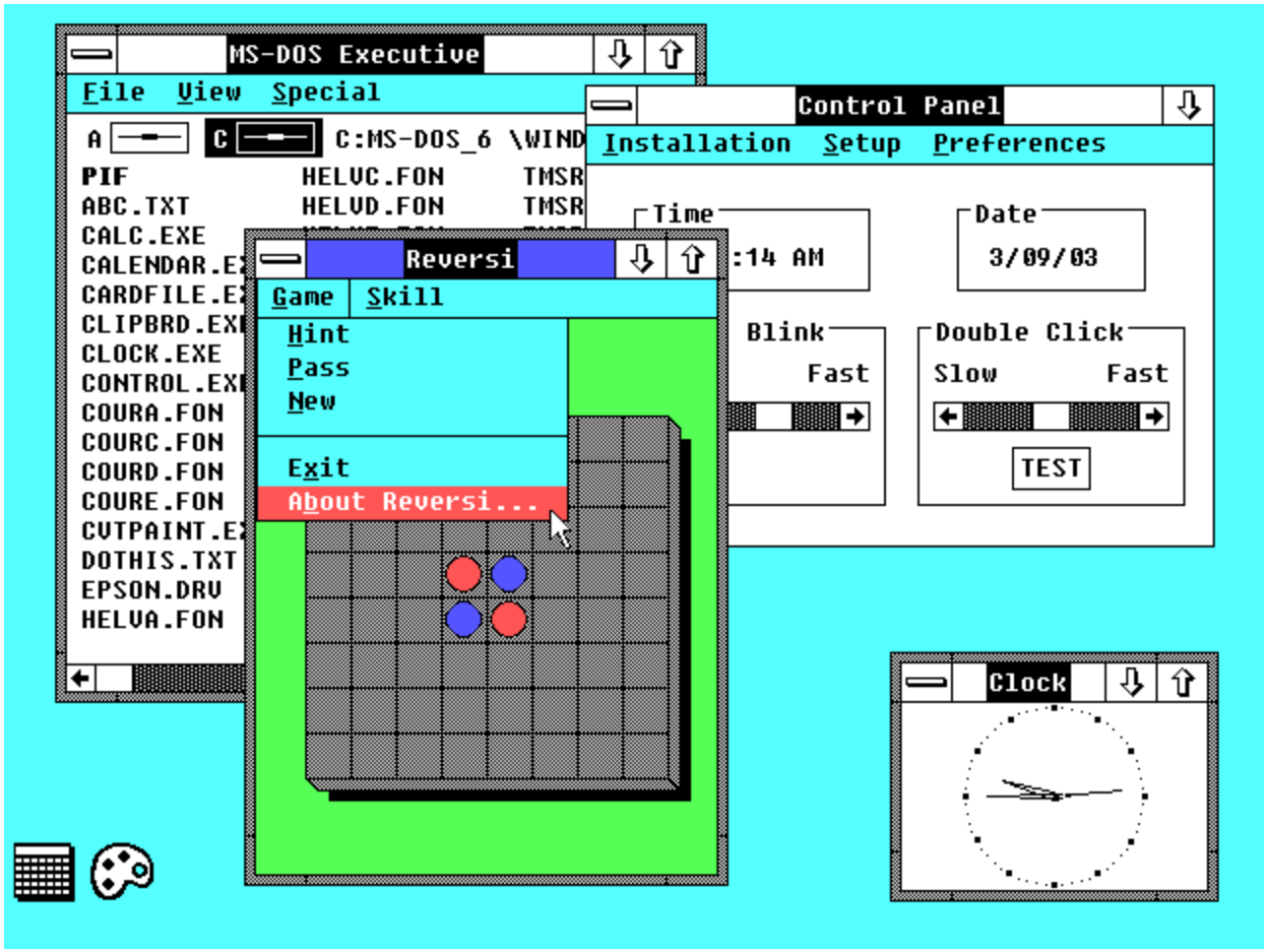
- Small but enthusiastic constituency.
- Today, more of a bandwagon thing going on.

OS X – Quite Different!



- More use of colors, icons.
- Added the Dock.
- Gelcap style buttons
- Etc.

Windows 1.0


MS-DOS Executive
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PIF
ABC.TXT
CALC.EXE
CALENDAR.EX
CARDFILE.EX
CLIPBRD.EXE
CLOCK.EXE
CONTROL.EXE
COURA.FON
COURC.FON
COURD.FON
COURE.FON
CVTPAINT.EX
DOTHIS.TXT
EPSON.DRV
HELVA.FON
HELVC.FON
HELVD.FON
TMSR
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Game Skill
Hint
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Control Panel
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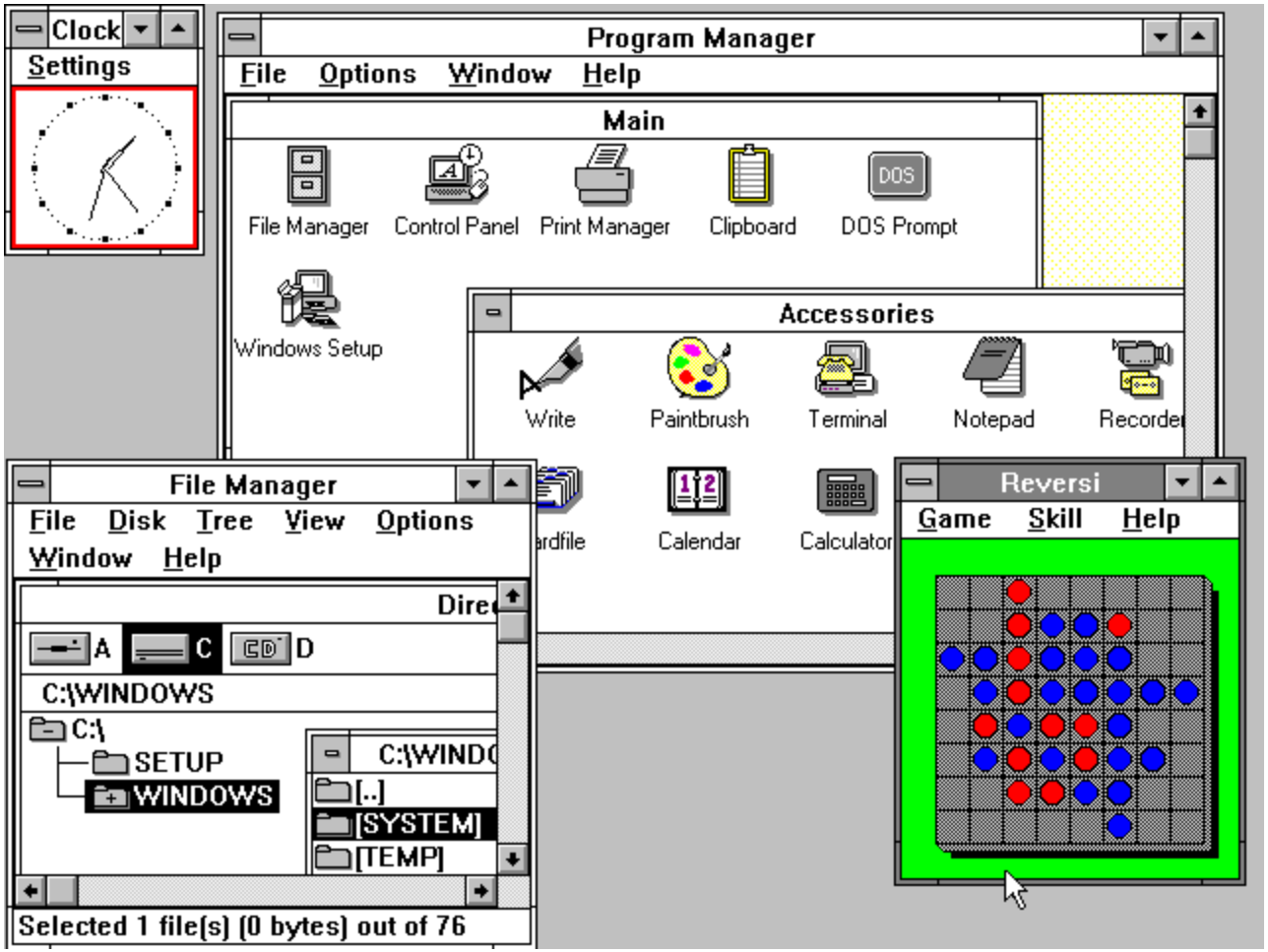
TEST
Clock

Windows 3.0


Clock
Settings
Program Manager
File Options Window Help
Main
File Manager
Control Panel
Print Manager
Clipboard
DOS Prompt
Windows Setup
Accessories
Write
Paintbrush
Terminal
Notepad
Calendar
Calculator
File Manager
File Disk Tree View Options
Window Help
A C D
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C:\
SETUP
WINDOWS
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[SYSTEM]
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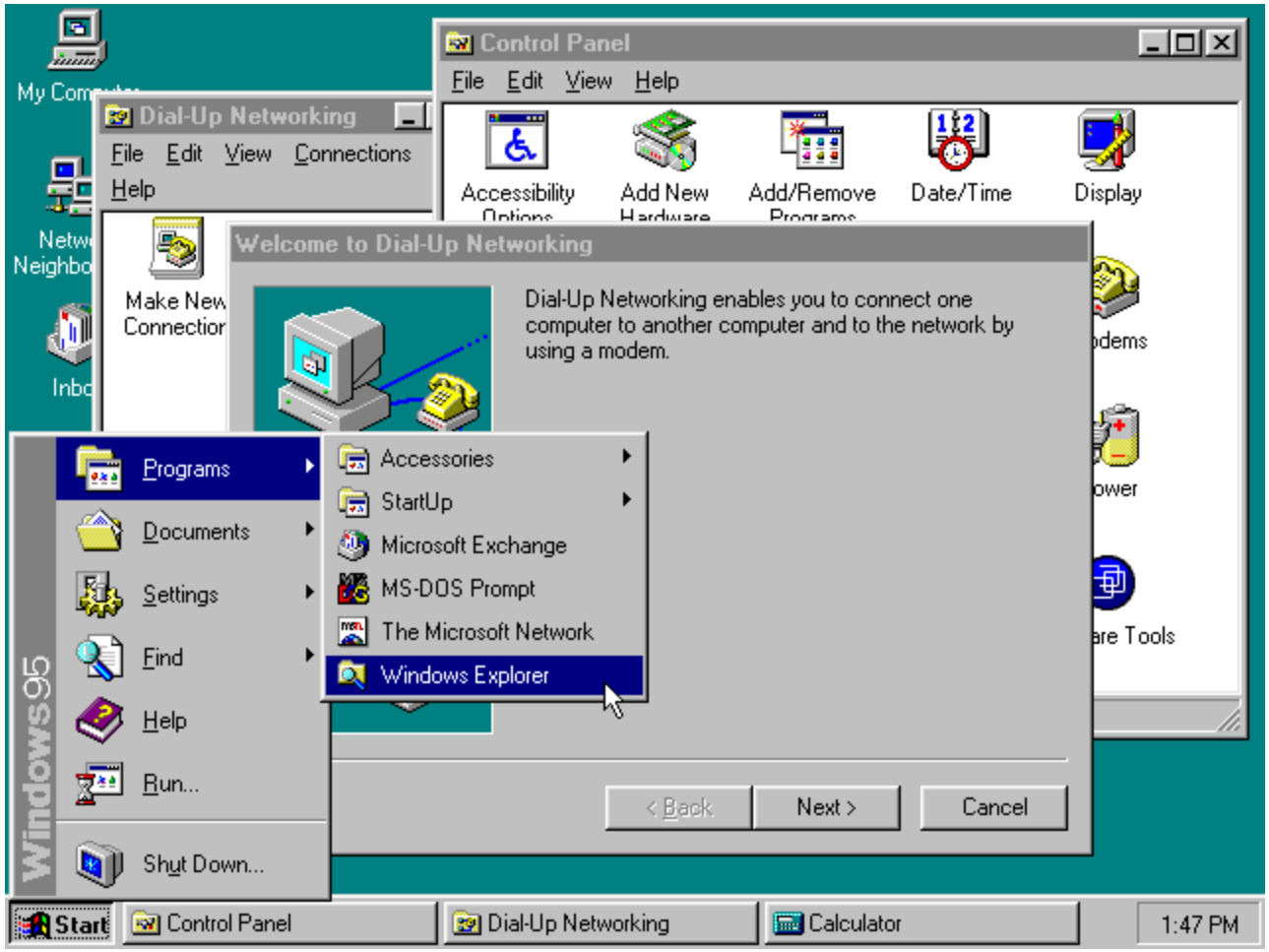
Selected 1 file(s) (0 bytes) out of 76
Reversi
Game Skill Help

Windows 95


Control Panel
File Edit View Help
Accessibility Options
Add New Hardware
Add/Remove Programs
Date/Time
Display
Dial-Up Networking
File Edit View Connections Help
Make New Connection
Welcome to Dial-Up Networking
Dial-Up Networking enables you to connect one computer to another computer and to the network by using a modem.
< Back
Next >
Cancel
Programs
Documents
Settings
Find
Help
Run...
Shut Down...
Windows95
Accessories
StartUp
Microsoft Exchange
MS-DOS Prompt
The Microsoft Network
Windows Explorer
Start
Control Panel
Dial-Up Networking
Calculator
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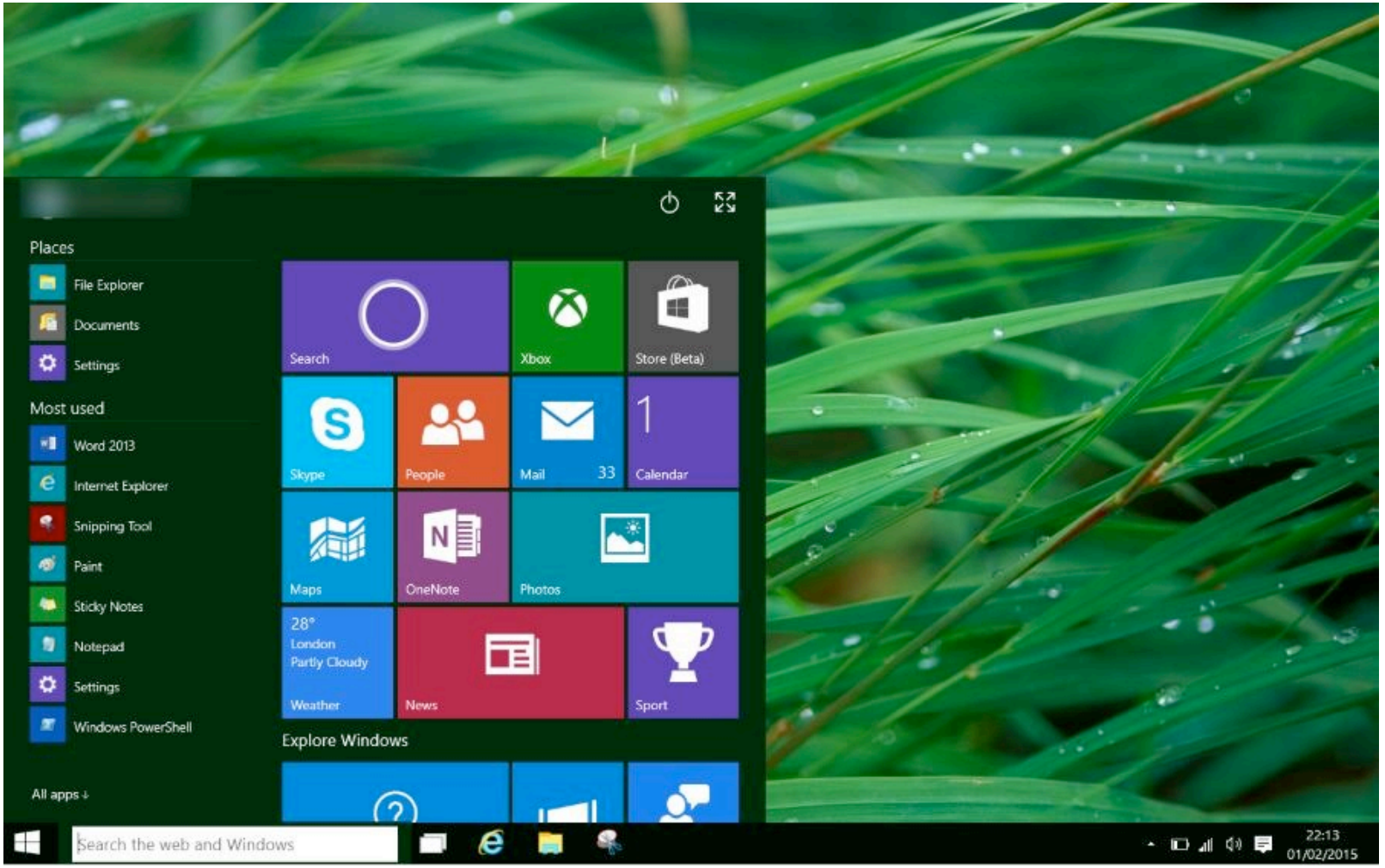
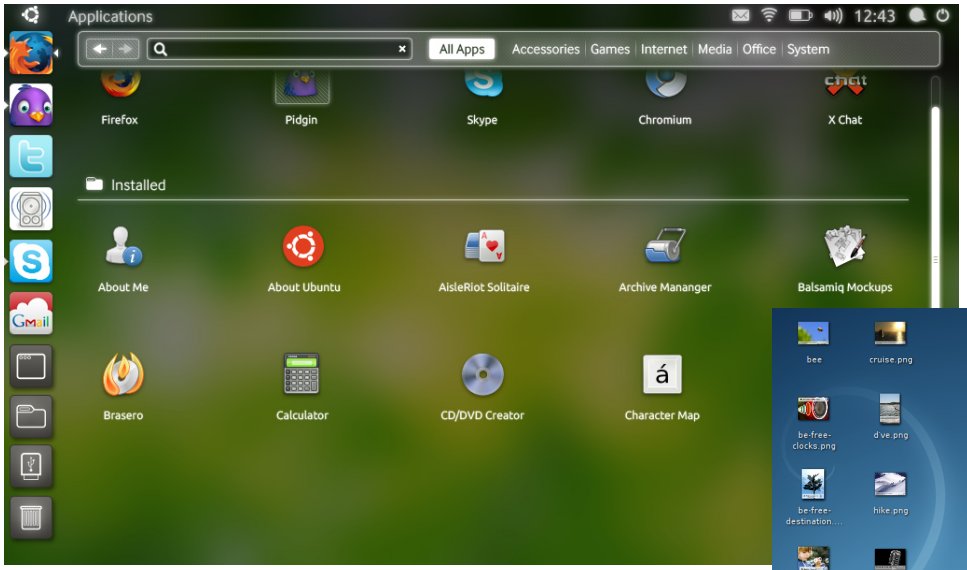
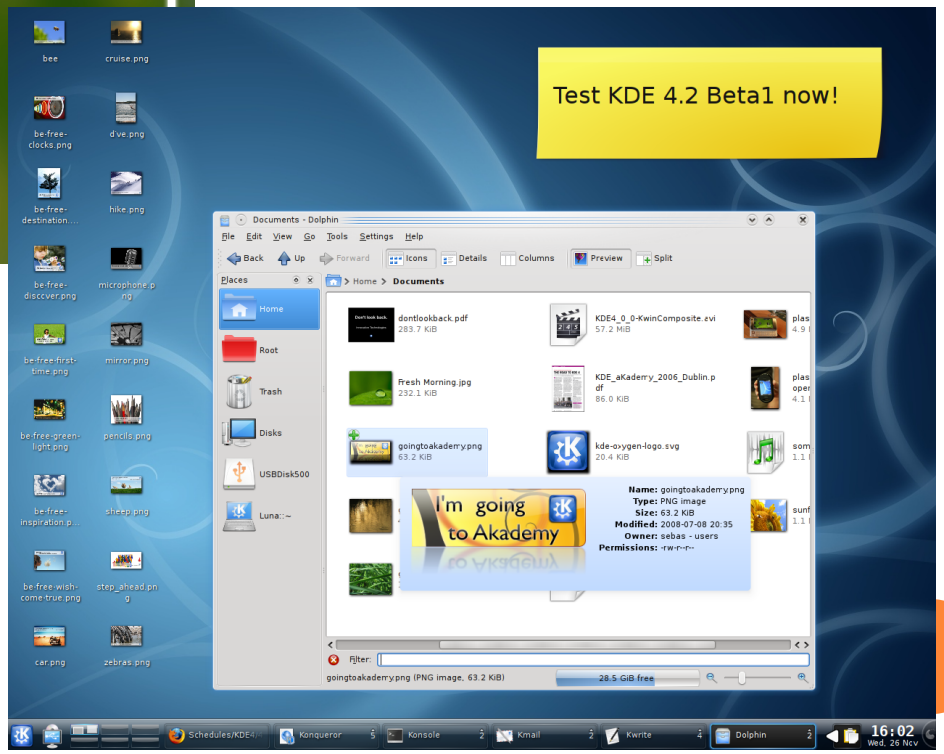
Windows Vista (Aero)

Windows 10


Places
File Explorer
Documents
Settings
Most used
Word 2013
Internet Explorer
Snipping Tool
Paint
Sticky Notes
Notepad
Settings
Windows PowerShell
All apps
Search
Xbox
Store (Beta)
Skype
People
Mail
33
1
Calendar
Maps
OneNote
Photos
28°
London
Partly Cloudy
Weather
News
Sport
Explore Windows
Search the web and Windows
22:13
01/02/2015

On Linux: Gnome & KDE





Is it Weird?

- They ALL use the same overall paradigm
  - Desktop
  - Windows
  - Etc.

- Why might this be the case?

Moving on…Windows BOB

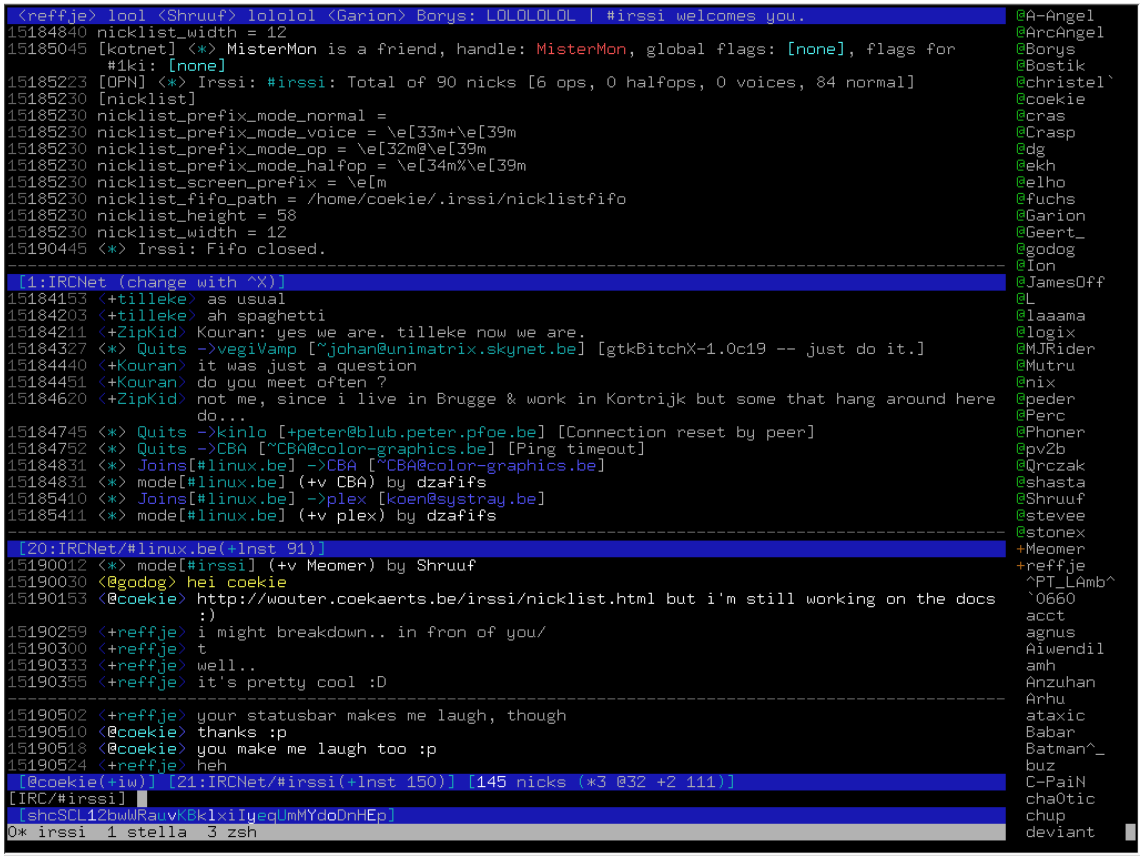
- Just…why?

Why Does the Desktop Paradigm Work?

- Windows BOB flopped
  - But why?
  - Why did the desktop paradigm that we use now prevail?

An Alternative

- The old way: a console or terminal
  - You type, the system responds



Another conceptual model based on activities

- #2 in our earlier list: *Giving Instructions*
- Where users instruct the system and tell it what to do
  - e.g. tell the time, print a file, save a file
- Implementations: typing, pressing buttons, etc.
- Very common conceptual model, underlying a diversity of devices and systems
  - e.g. word processors, VCRs, vending machines
- Main benefit is that instructing supports quick and efficient interaction
  - good for repetitive kinds of actions performed on multiple objects

Self Check: You should be Able to Discuss

- What are some of the advantages and disadvantages of desktop environments versus console environments?

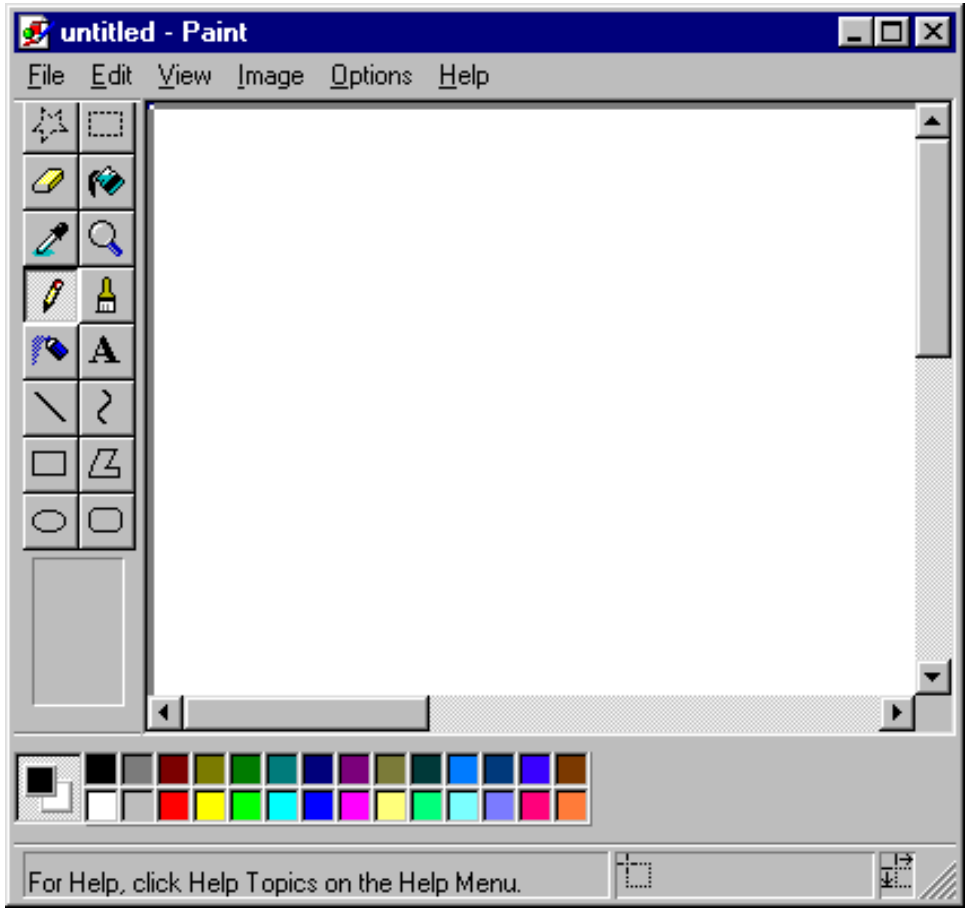
- What kinds of users use each respective environment?

Important Lesson

- Some users (power users) actually benefit from the increased control provided by the console
  - Conceptual model: giving instructions
- Other users (beginners) benefit from the more restricted but "noob" friendly windowed environments
  - Conceptual models: Desktop View, Direct Manipulation
- Thus, the design of an interface is **HIGHLY DEPENDENT** on the expected user base!
  - We will look at this in more detail later.

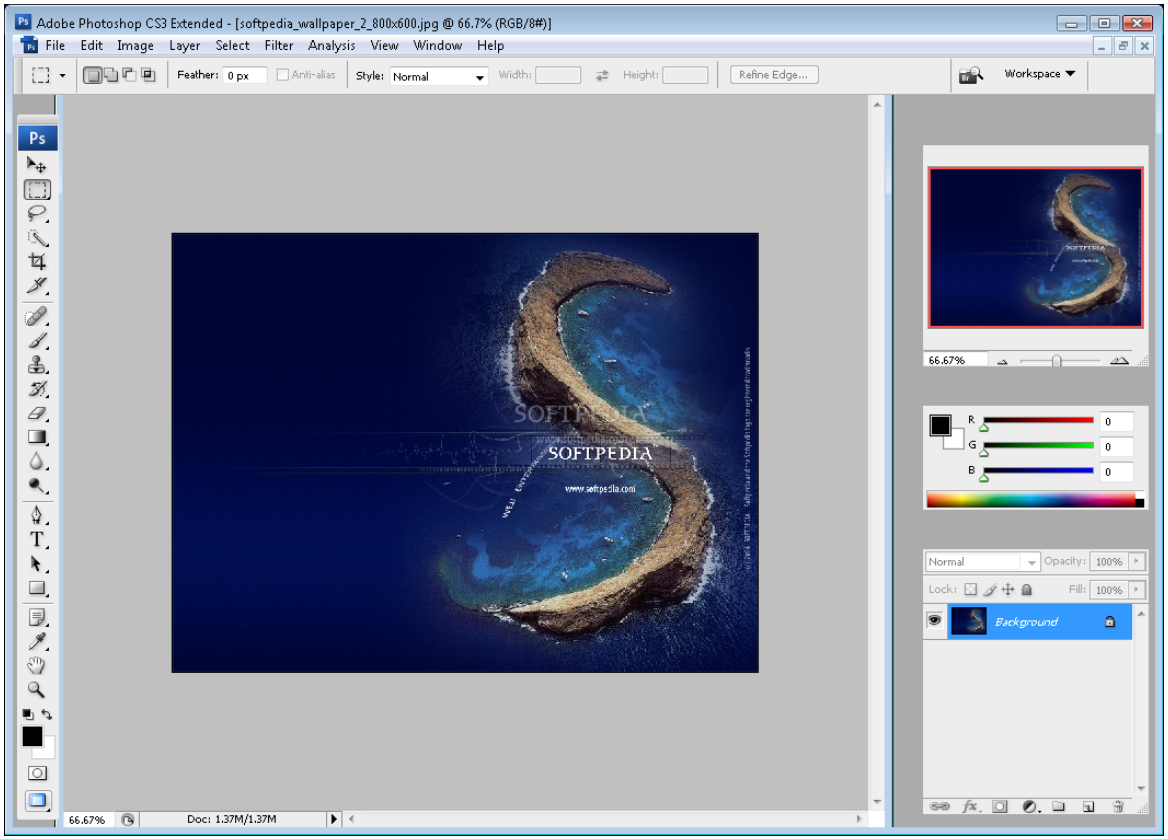
Anotehr Example (Paint vs. Photoshop)

- Microsoft Paint is designed for users mostly unfamiliar with photo editing performing very simple tasks.



Photoshop

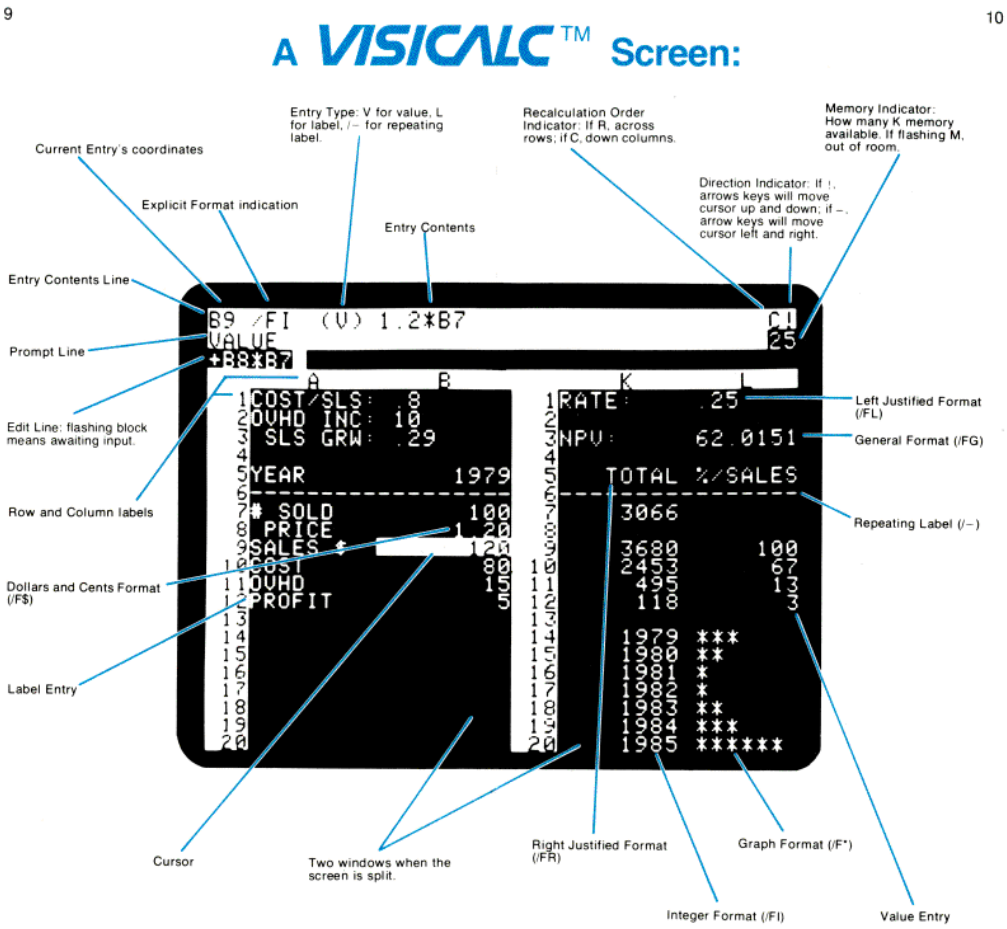
- More difficult to use but more powerful. Designed for serious photo editors, artists, etc.



Other Examples like the Desktop?

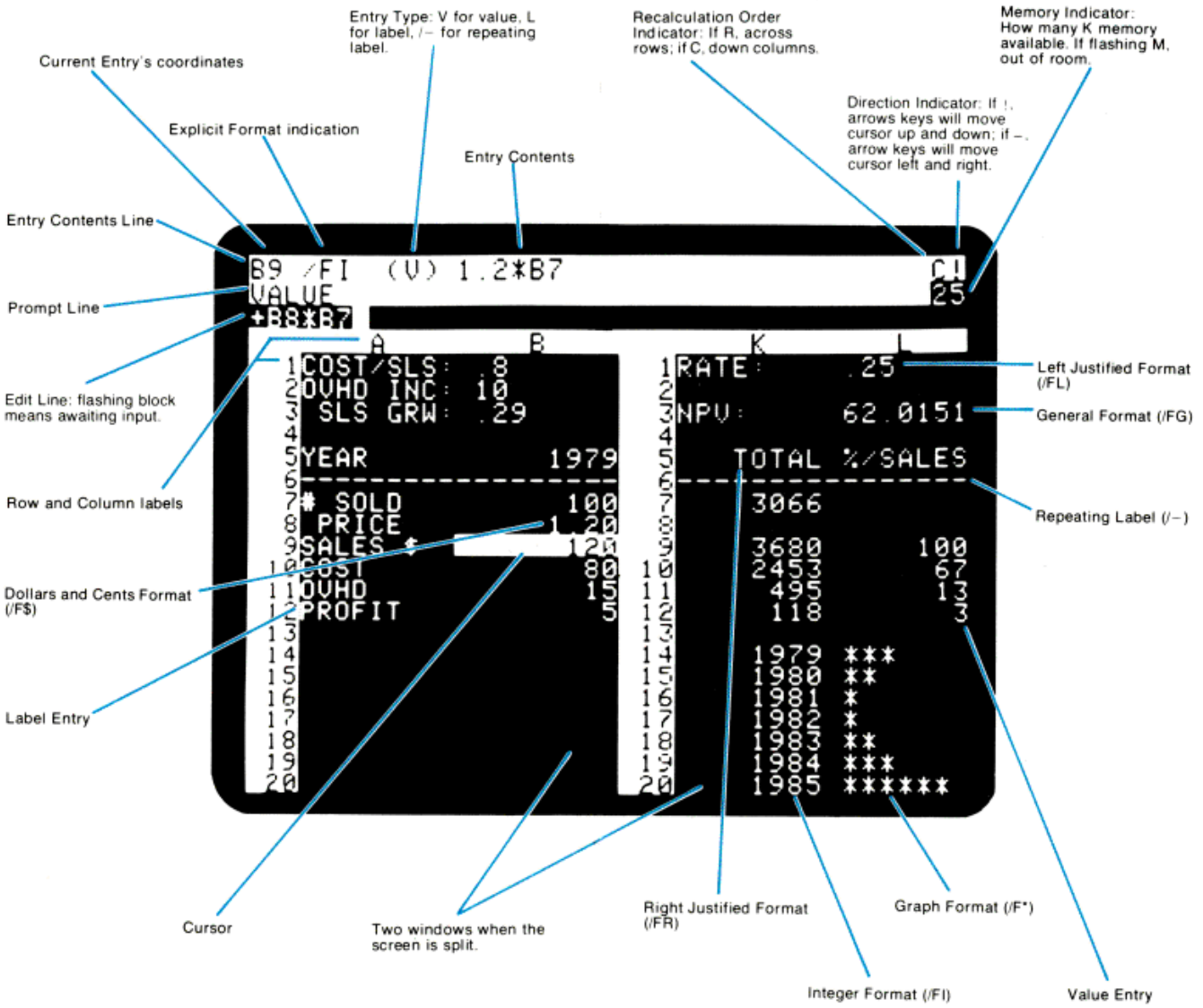
Another classic: the spreadsheet (Bricklin)

- Analogous to ledger sheet
- Interactive and computational
- Easy to understand
- Greatly extending what accountants and others could do



www.bricklin.com/history/refcards.htm

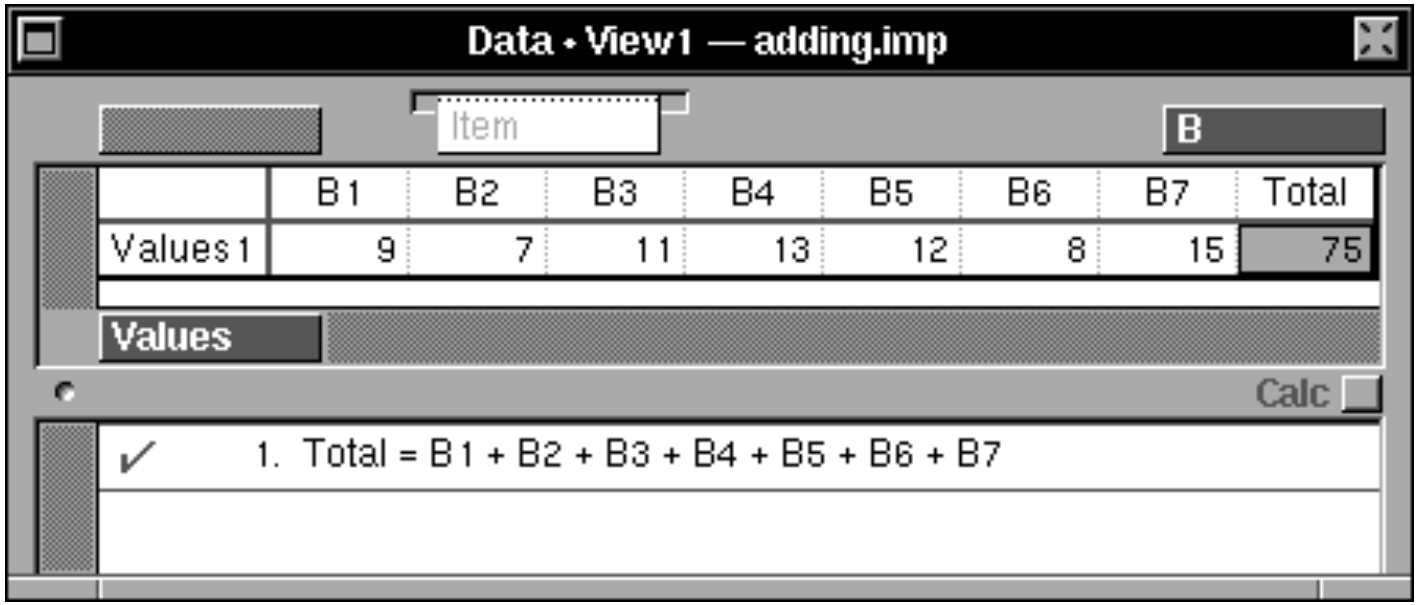
A VISICALC™ Screen:

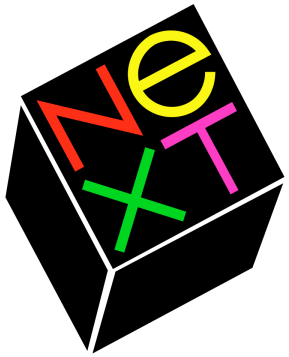


Spreadsheet metaphors

- Do users of Excel
  - Think of ledgers?
  - Use it to do “what if” analyses?
- What do we do?
- Keep lists!
- What tasks are useful for lists?
  - Sort by column
  - Filter by criteria
  - Summarize
  - See Data menu in Excel

Lotus Improv (1991–1996)





IN OUR WORLD, LOTUS REINVENTS THE SPREADSHEET.

We say, "Here's a new computer." You say, "Let's see the software." It's a perfectly human reaction.

So rather than start by talking about processors and megahertz, we'd like to start by showing you the impressive things you can do with the NeXTstation. Today.

On this display is Improv,™ from the creators of Lotus 1-2-3.® While at first glance it may look suspiciously like an ordinary spreadsheet, it could very well change the way people look at forecasting and analysis.

In Lotus' own words, "With Improv, we have literally reinvented the spreadsheet – a job that was made much simpler by NeXT technology."

The revolution of Improv is that once you've entered your data, you can easily rearrange it in countless new ways – and gain insights you could never get from a traditional spreadsheet.

That's because Improv isn't structured like a traditional spreadsheet. To understand exactly how it works, take a look at the column and row headings in the sample screen.

Rather than use letters and numbers to describe data, it lets you use real words, like "Tons"

Lotus Improv: a new era in spreadsheets made possible by NeXT technology. It lets you change views of data simply by dragging "tiles" from one location to another.

1. Each tile represents a category of column or row headings. ("Measure," for example, is the category tile for the headings "Tons" and "Dollar Value.") Tiles placed above the spreadsheet determine the columns, and those below determine the rows.

2. The order of tiles dictates the spreadsheet's structure. "Quarter" headings are now listed under each "Material." Reverse the tiles and materials will be broken out under each quarter.

3. All formulas are listed in one place, not buried in cells. And being in English, they'll always make sense.

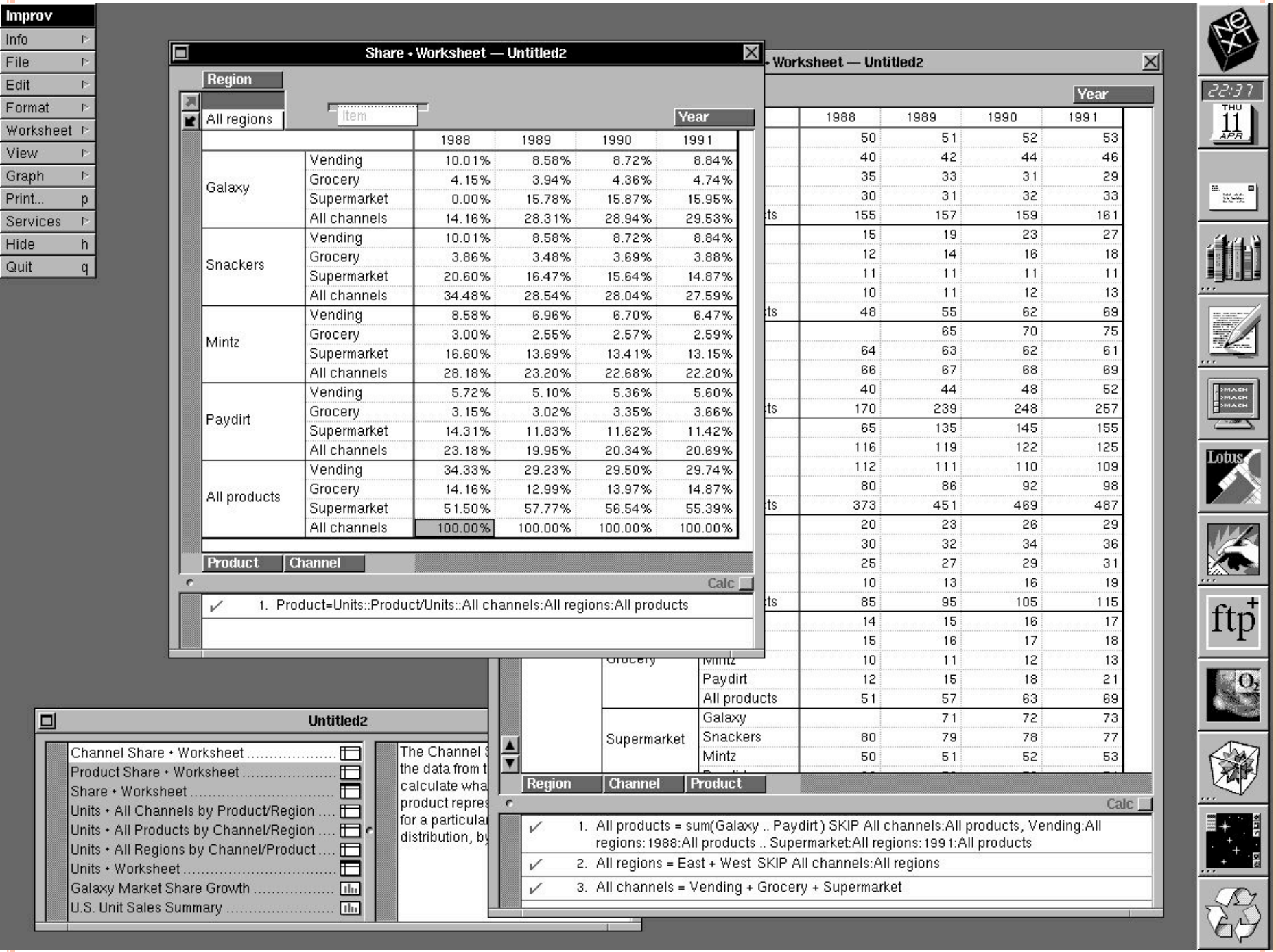
4. Improv spreadsheets can be a stack of "pages." Now each page is a year – but drag the "Quarter" tile here, and you'll have a page for each quarter's data.

5. The item dispenser lets you create new headings in a category quickly. Type "Jan" and get a sequence of months. Type "1990" and get a progression of years.

6. Improv can make even the most innocuous spreadsheet breathe fire. In seconds, you can turn data into editable 3D presentation graphics in many styles.

7. A single file can contain different views of spreadsheets and graphics, with a description of each. So at a glance, you'll know exactly what each view proves.

8. You can even attach voice memos to your work, to make a point more clearly – or passionately.



Ideas in Lotus Improv

- Each tile represents a category.
- Categories can be row or column headings.
- The order of tile implies a structure. More than 2D. Hierarchical!
  - Like a multi-dimensional database
- Separated: data, views, formulas
- Formulas listed in one place. We reference cells as named ranges
  - Not =A5+C3. Instead: cost = price + tax
- Spreadsheets can be a stack of pages.
  - (We now have sheets in workbooks.)
  - A single file can contain multiple views and graphics.
- More info:
  - http://en.wikipedia.org/wiki/Lotus_Improv
  - Simson Garfinkel: http://simson.net/clips/1991/91.NW.Improv.html
  - Search for images to see screen shots

Another Conceptual Model #4 of those Based on Activities Exploring and Browsing

- Search! Search engines – we use them a lot
- Really, a conceptual model? Sure:
  - Amazon, YouTube, help systems, libraries, etc.
- Users just understand this model
  - Training needed? Nope!
- A good approach for many problems
  - When? Why?

amazon Prime

All | head horse mask

Experian | Browse credit cards | Ad

Departments | Browsing History | Ann's Amazon.com | Today's Deals | Hello, Ann Your Account | Prime | Lists | 0 Cart

1-16 of 500+ results for **"head horse mask"**

Sort by Relevance

Show results for

Costumes & Accessories
- Men's Costume Masks
- Women's Costume Masks
- + See more

Toys & Games
- Kids' Costume Masks
- + See more

Beauty & Personal Care
- Facial Masks

+ See All 23 Departments

Refine by

Amazon Prime

Prime

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Derby Originals Horse Fly Masks at Wholesale Price

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by BengPro

$12.99 Prime

Some colors are Prime eligible

4.5 ▾ 13

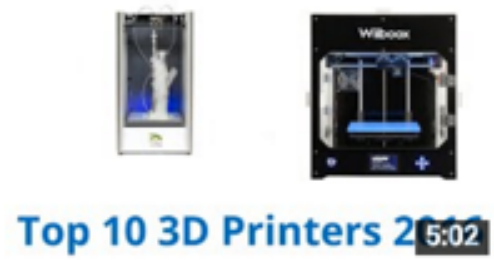
YouTube

interface prototyping

Upload

Filters

About 42,400 results



2016's Top 10 3D Printers

Ad ezvid

14,939 views

Use Our Video Review & Get The Best Our Top Pick Will Surprise You!

Importance & Value of Prototyping in UI/UX Design

Mike Locke

9 months ago • 2,886 views

http://www.mlwebco.com - In this video I talk about the importance and value of prototyping and why you should list it as a skill on ...

Using After Effects for UI Animation Prototypes

Tuts+ Web Design

2 years ago • 125,254 views

In this screencast tutorial we're going to prototype an app UI animation. We'll take a Photoshop layout, then bring it to life using ...

iPhone User Interface Design, Paper Prototype study

cgblend

5 years ago • 46,882 views

When we study User Interface, we often use Paper Prototyping to see how

Where are we?

- How will the user think about the system? Based on…
  - Functions, user operations (did that before)
  - Data or objects (just did that)
  - **Interface metaphors (coming soon!)**
- Note:
  - A conceptual model can be like a "large" metaphor
  - Let's talk now about more fine-grained interactions, using interface metaphors

Interface Metaphors

- In general, a metaphor means we want some part of an interface to be remind the user of a physical entity ("real-world") and some of its properties
  - e.g. desktop metaphor, web portals, GUI button, slider
- Can be based on activity, object or a combination of both
- Some part → the overall conceptual model, or some smaller component
- Exploit user's familiar knowledge, helping them to understand 'the unfamiliar' (something new)
  - Leverage what we know of this to understand more aspects of the unfamiliar functionality
  - Eventually, the metaphor becomes "the familiar" (and we may forget about its real-world counterpart)

Examples of Metaphors

- Gimme some!

Benefits of Interface Metaphors

- Makes learning new systems easier
- Helps users understand the underlying conceptual model
- Can be very innovative and enable the realm of computers and their applications to be made more accessible to a greater diversity of users

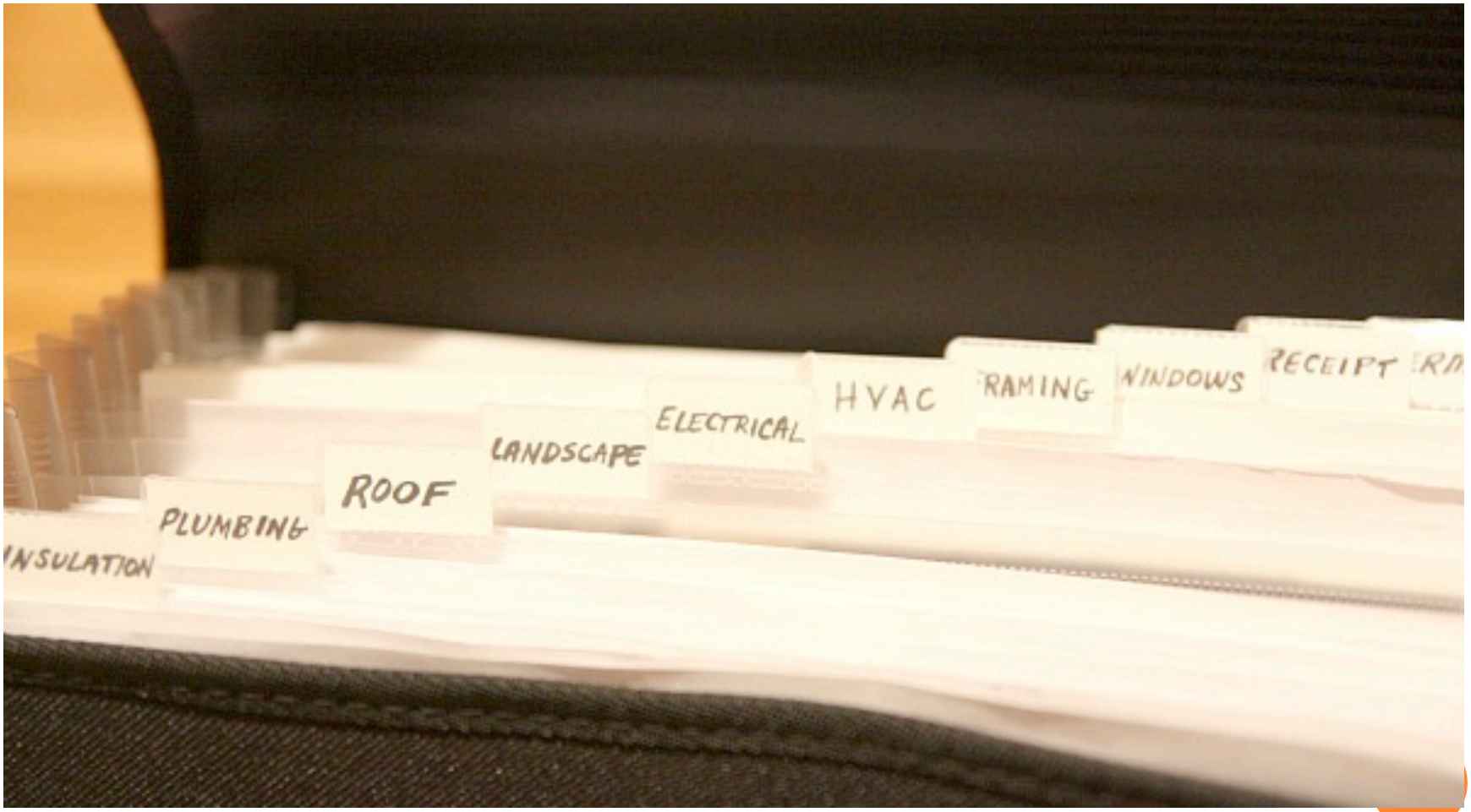
- But, there can be problems with metaphors, right?
  - Give me some examples!

Problems with Interface Metaphors

- Go too far, or forced. (See next examples.)
- Break conventional and cultural rules
  - e.g. trash can / recycle bin placed on desktop

- Can constrain designers in the way they conceptualize a problem space
- Conflict with design principles
- Forces users to only understand the system in terms of the metaphor
- Designers can inadvertently use bad existing designs and transfer the bad parts over
- Limits designers' imagination in coming up with new conceptual models

Tabbed Folders in the Real-World

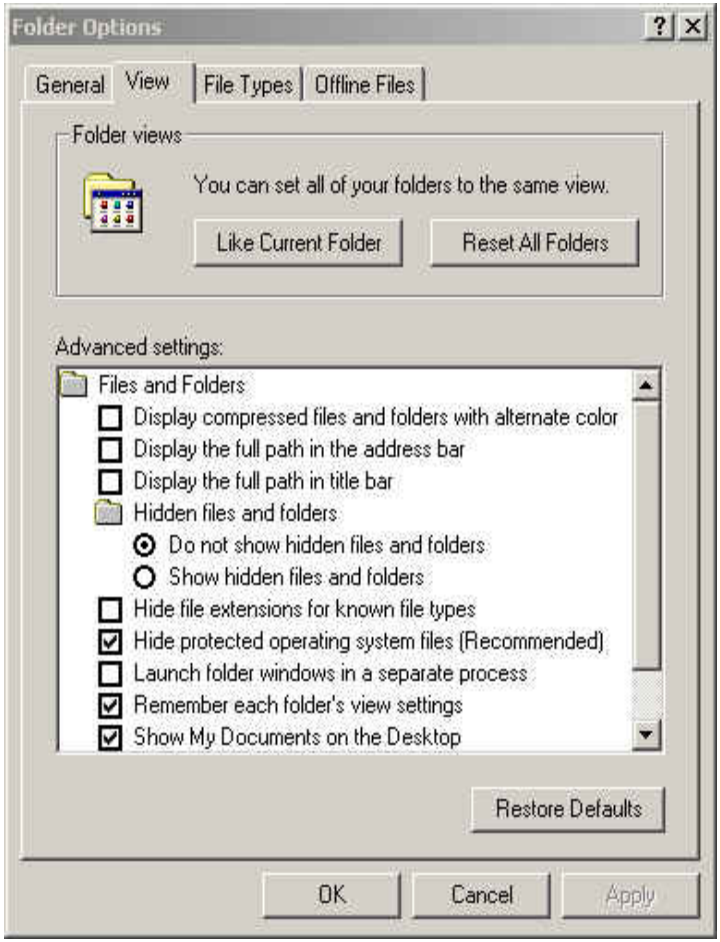


Problematic Metaphor Example #1

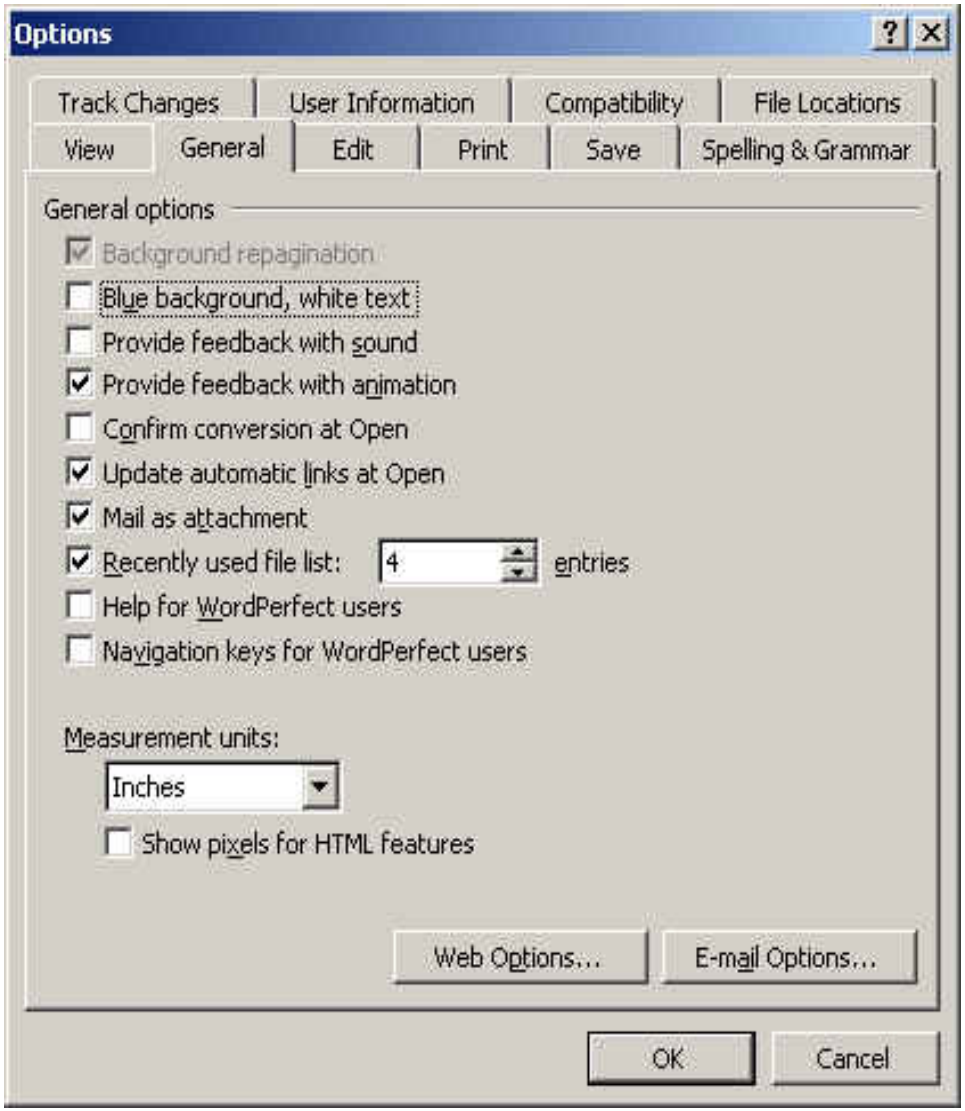
- Files and folder: OK, we're good with those
- Great! So why not Folders as an organizing container for other things?
  - E.g. Options when you have too many for one window.
  - One solution:

Tabbed Menus

- What if you <u>really</u> have <u>a lot</u> of options?

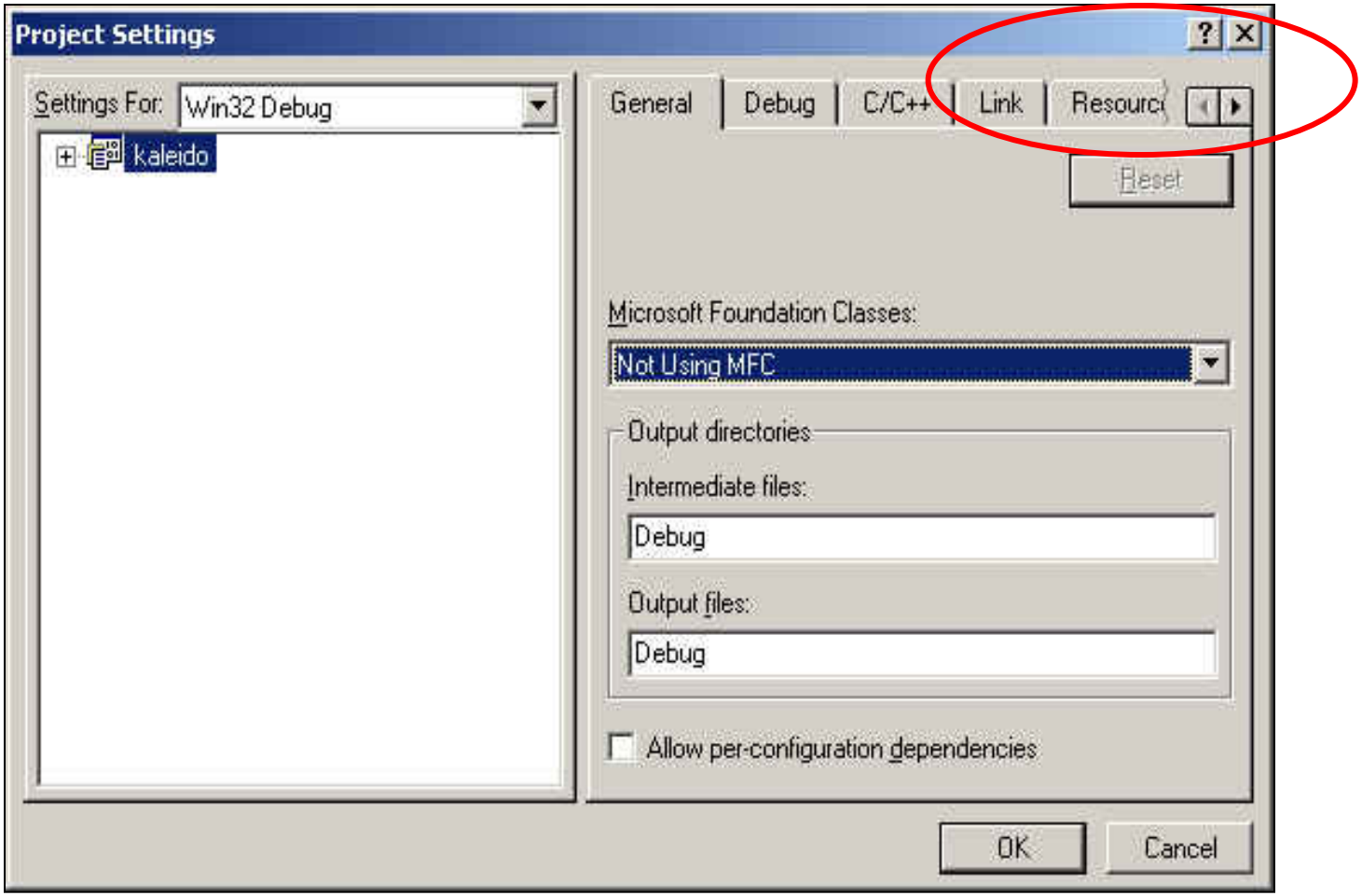


Multiple Rows of Tabs



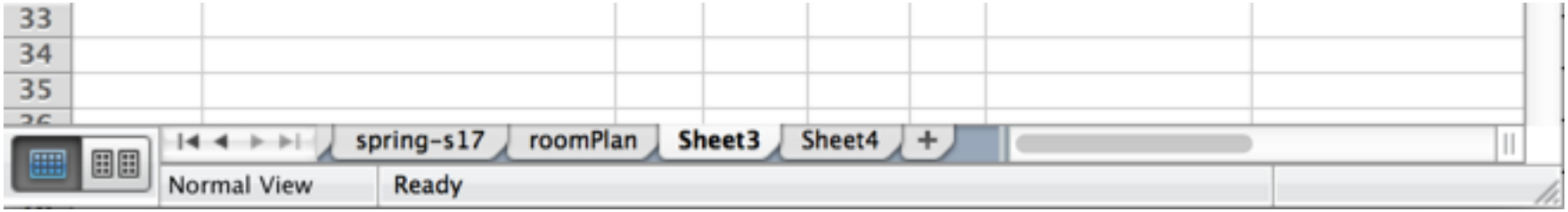
- Issues with this?
- Can you explain why this is so irritating?

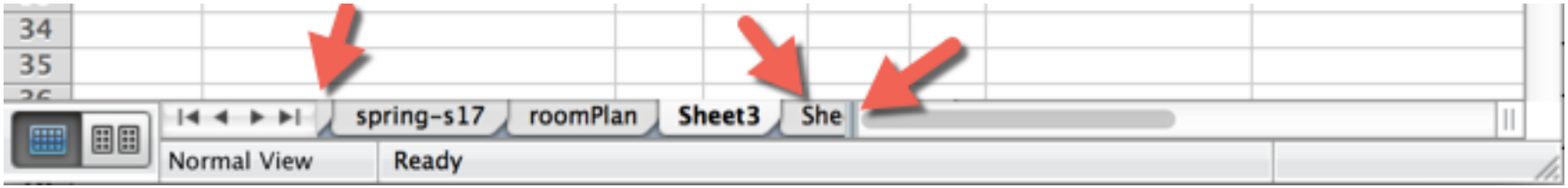
Can We "Fix" Tabs When We Have Many?



Can We "Fix" Tabs When We Have Many?

- Tabs for Sheets in an Excel Workbook





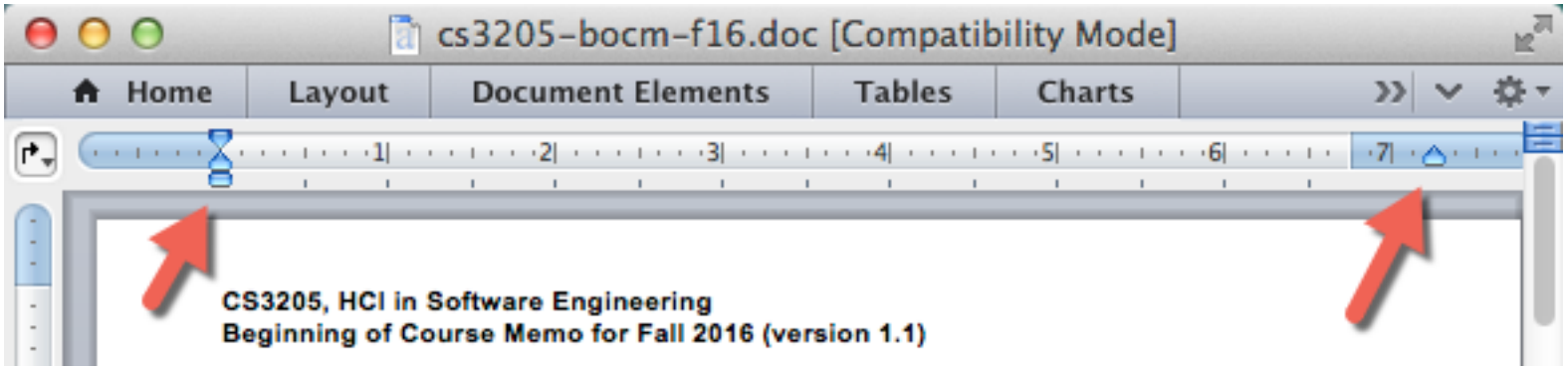
Other Solutions?

- Yes
- Let's wait until later in the course when we talk about "physical" interface design

- For now, the point is:
  - Metaphor
  - Breaks down, when some aspect of a conceptual model is violated

- Same issue is behind this next example, too!

Problematic Metaphor Example #2



- What's the idea here?
  - Metaphor of the tab and margin settings on typewriters
- What principle(s)?
  - OK affordance: clear you want to slide them
  - Poor mapping: three "knobs" that do what exactly?
- Important:
  - Violates our conceptual model of adjacent objects in the physical world

Summing Up

- Leveraging what the user knows about the real-world (other systems) to help them understand how to use current system
  - Conceptual model (of the entire application)
    - Mental model
    - Could be based on: objects, types of activities, a "big" metaphor
  - Interface metaphor (for entire system's interface, or some smaller component)
    - A direct matching between your interface and something a "real-world" entity
- Can improve aspects of usability
  - You should be able to explain why
- Can fail
  - You should be able to explain why

Reminders / Road Map

- Conceptual Models
  - How user thinks of your system
    - Based on: objects, or activities, or a metaphor
  - Categories of models based on activities
    - Giving Instructions
    - Conversing
    - Manipulating and navigating
    - Exploring and browsing
    - (Read textbook for more info on these!)
- Interface metaphors
- **"Interaction Styles"**
  - What kind of physical interface do we use to support the conceptual model

From Interaction "Mode" to "Style"

- Interaction mode (what we discussed before):
  - what the user is doing when interacting with a system:
    instructing, talking, browsing, or other
- Interaction style:
  - the kind of interface you implement to support the mode
    - Speech
    - Menu-based
    - Direct manipulation, touch
    - Forms
    - Gesture

Interaction Styles

- A physical UI be built upon various mechanisms
  - Command line
  - Menu selection
  - Form-fill
  - Direct manipulation
    - mouse, pen, touch, etc.
  - Anthropomorphic
    - Voice, ink (Tablet PCs), motion (Kinect, Leap), Virtual Reality, Skin (?!)

Which Style to Choose?

- Need to determine requirements and user needs
- Take the budget and other constraints into account
- Also will depend on suitability of technology for activity being supported

Conclusion: What's the relevance of all this?

- Conceptual and mental models
  - Users bring existing models with them
  - You can leverage this or create a new model for your system
  - May lead to high-level conceptual model for your interface
- Interaction Mode and Interaction Style
  - What's the high-level way a user interacts with a new system? (Why? What's the benefit?)
  - Is there a high-level metaphor / model?
  - Can lower-level metaphors be used in lower-level UI design?
- (All this is Chapter 2 of ID Book. Read it!)

Questions!