Human-Computer Interaction

6–Interfaces and Interactions Part I

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Objectives

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- Understand today‘s user interface paradigms in the context of their historical development.
- Critically revisit the user interface metaphors current systems are based upon.
- Develop an understanding of how user interface design shapes interactions with computers.
- Gain insights into new forms of HCI beyond traditional desktop interfaces.

Overview

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- History of Human Computer Interfaces and Interaction with Computers
- Basic GUI Concepts
- The WIMP-Paradigm
- Next-Generation GUIs

UI Evolution

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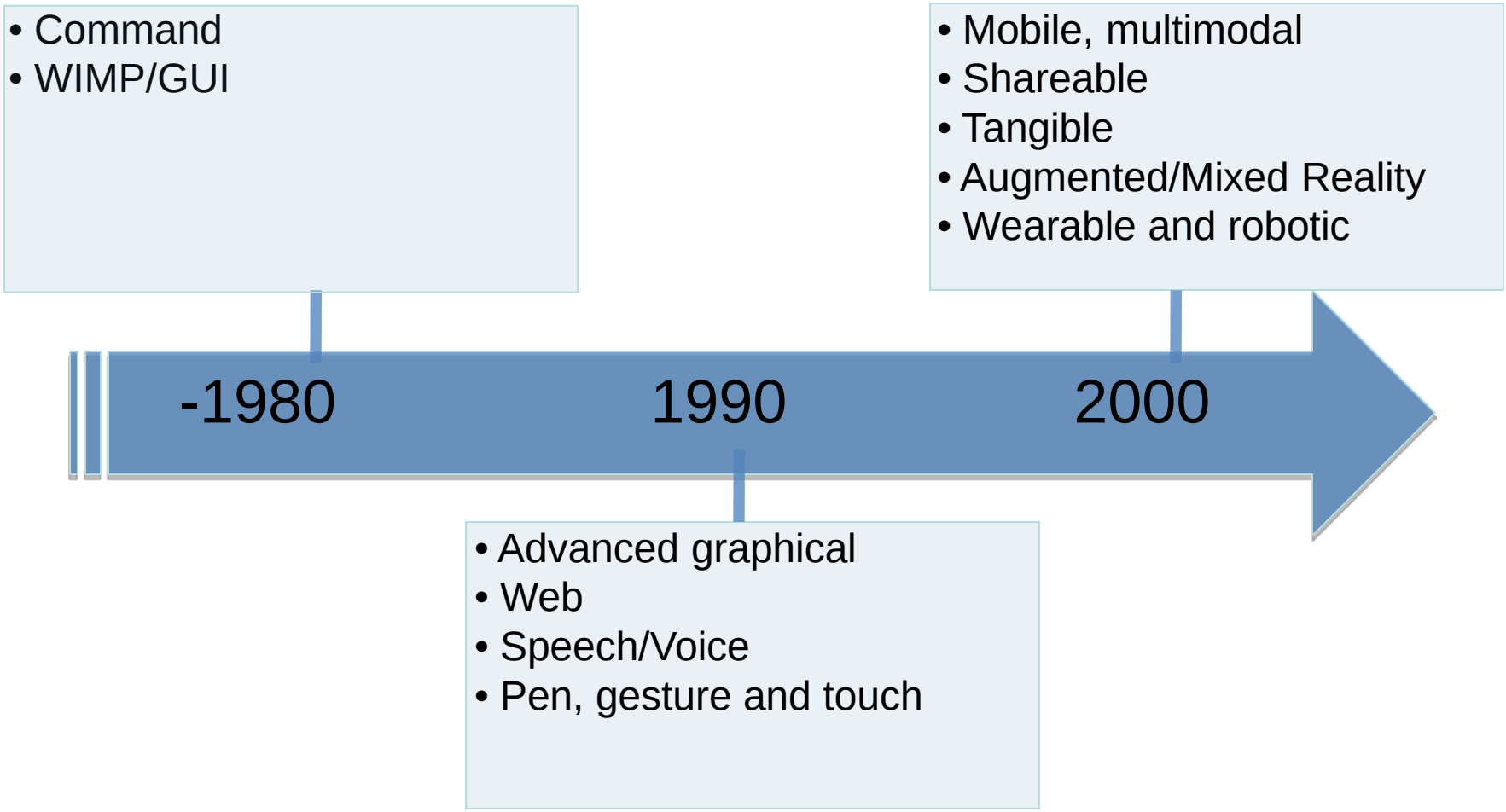

As We May Think

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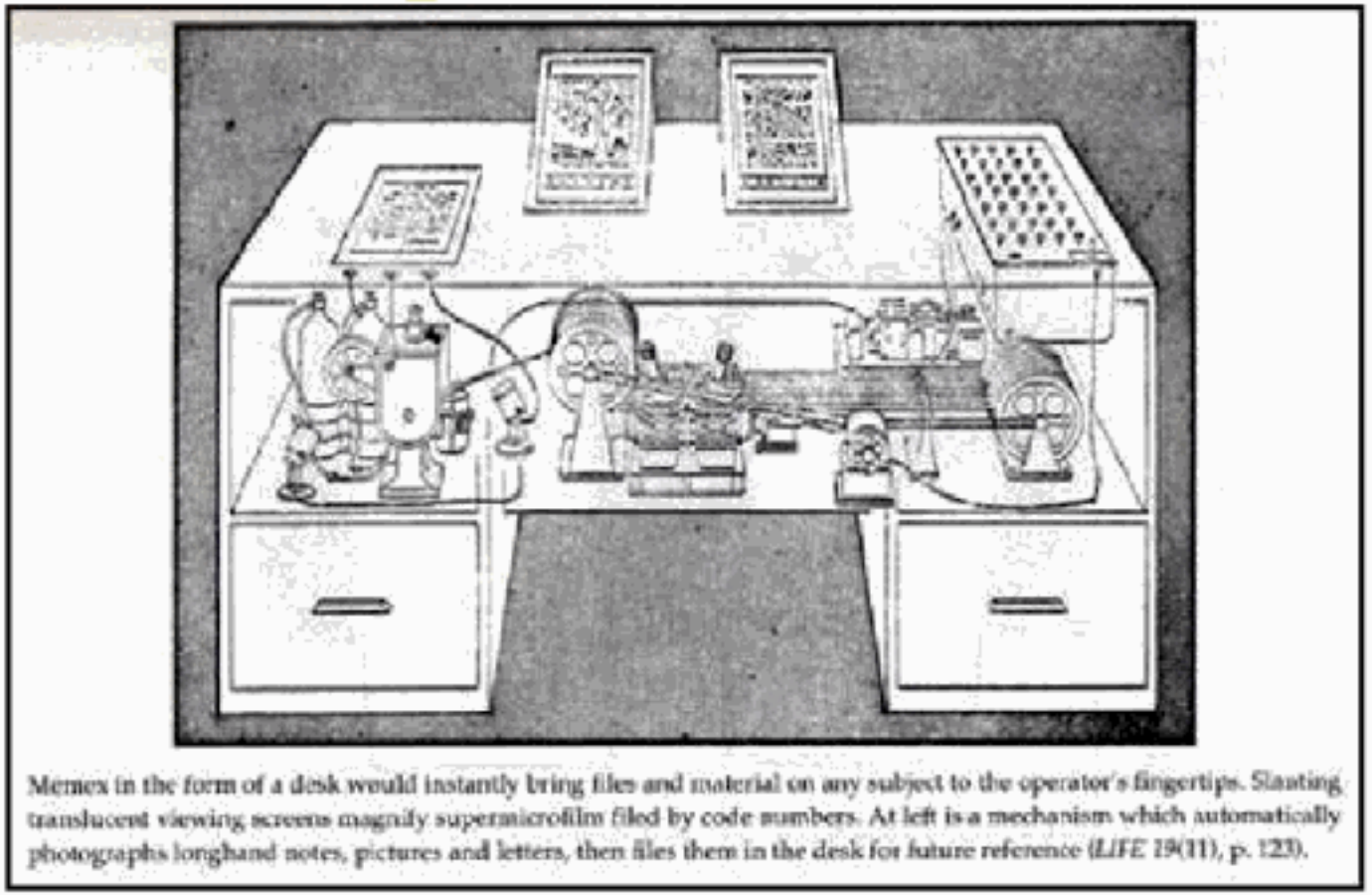
- „Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, "memex" will do. [...] It consists of a desk, and while it can presumably be operated from a distance, it is primarily the piece of furniture at which he works. On the top are slanting translucent screens, on which material can be projected for convenient reading. There is a keyboard, and sets of buttons and levers. Otherwise it looks like an ordinary desk. [...] If the user wishes to consult a certain book, he taps its code on the keyboard, and the title page of the book promptly appears before him, projected onto one of his viewing positions. Frequently-used codes are mnemonic, so that he seldom consults his code book; but when he does, a single tap of a key projects it for his use.“

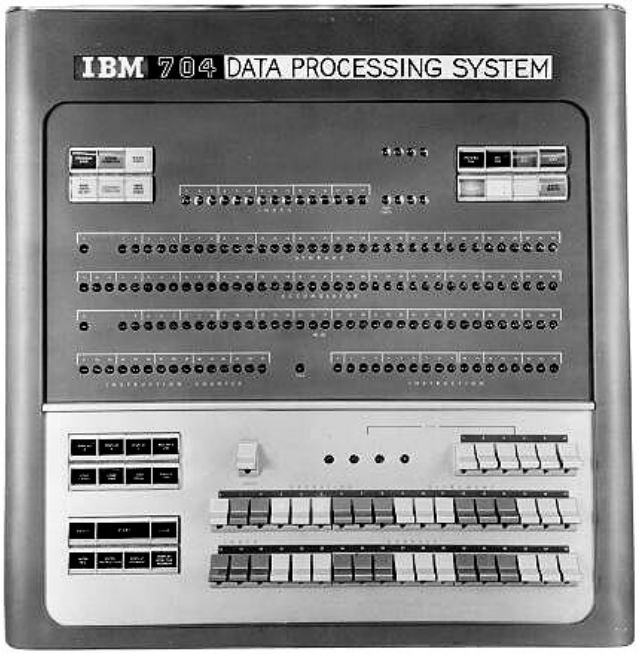
Vannevar Bush: As We May Think, 1945

Memex Design Sketch



Memex in the form of a desk would instantly bring files and material on any subject to the operator's fingertips. Slanting translucent viewing screens magnify supermicrofilm filed by code numbers. At left is a mechanism which automatically photographs longhand notes, pictures and letters, then files them in the desk for future reference (*LIFE* 19(11), p. 123).

Historic HCI - Batchprocessing



IBM 704 operator‘s panel
(1954)

IBM 702 operator‘s console
(1953)

Source: http://www-03.ibm.com/ibm/history/exhibits/mainframe/mainframe_album.html

Historic HCI - Batchprocessing

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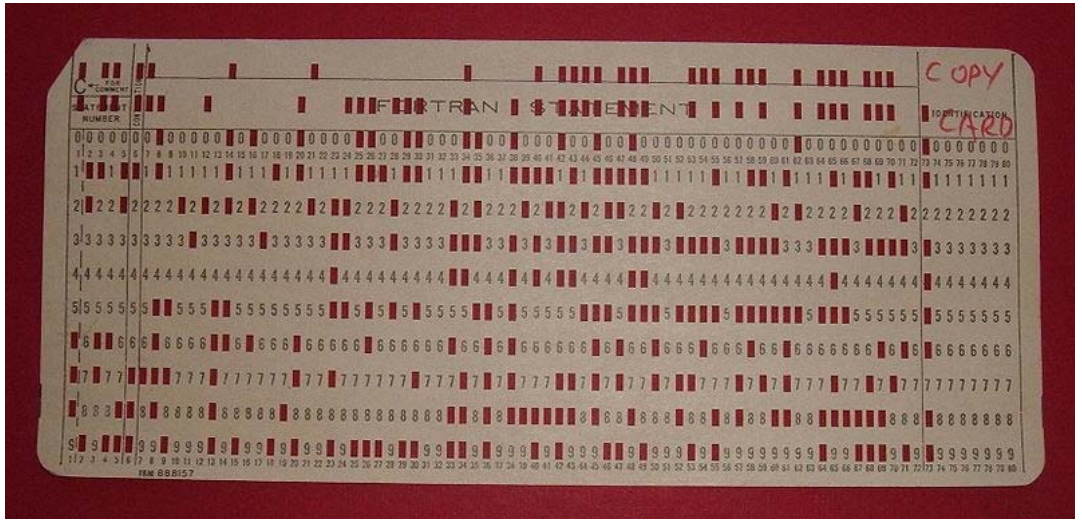
- HCI = programming
- Programs & data stored on punching cards

IBM 1442 card reader (70s)

Source: http://en.wikipedia.org/wiki/File:IBM1442.corestore.jpg



IBM 1130 boot loader (70s)

Source: http://en.wikipedia.org/wiki/File:IBM1130CopyCard.agr.jpg

Historic Mobile HCI

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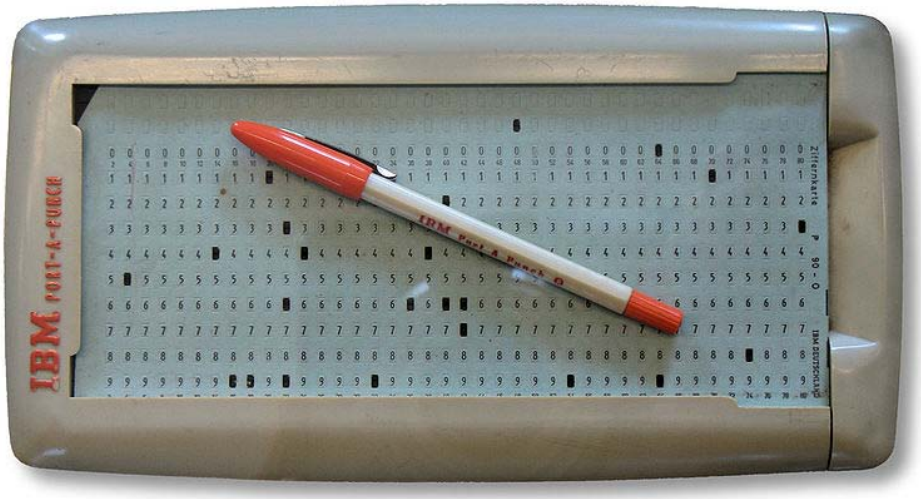
- Mobile HCI in the 50s

Designed to fit in the pocket, Port-A-Punch made it possible to create punched card documents anywhere. The product was intended for "on-the-spot" recording operations—such as physical inventories, job tickets and statistical surveys—because it eliminated the need for preliminary writing or typing of source documents.



IBM Port-A-Punch (1958)

taken from: IBM Archives

Source: http://commons.wikimedia.org/wiki/File:IBM_Port-A-Punch.jpg

Interactive HCI

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- Interact with user during the execution of a program

Thinking Machines 1959

Interactive HCI (II)

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- Availability of screens capable of displaying text allows for immediate interaction
- Dialogue-driven Interfaces
  - Q&A between system and user
  - System guides user through task
  - Fixed algorithms, no deviations from precoded path
- More flexibility with computers capable of storing more than one program at a time → computer can take commands

Interactive HCI (III)

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- REPL … Read-Eval-Print Loop
- Example: BASH Command Line Interface

The GUI Revolution

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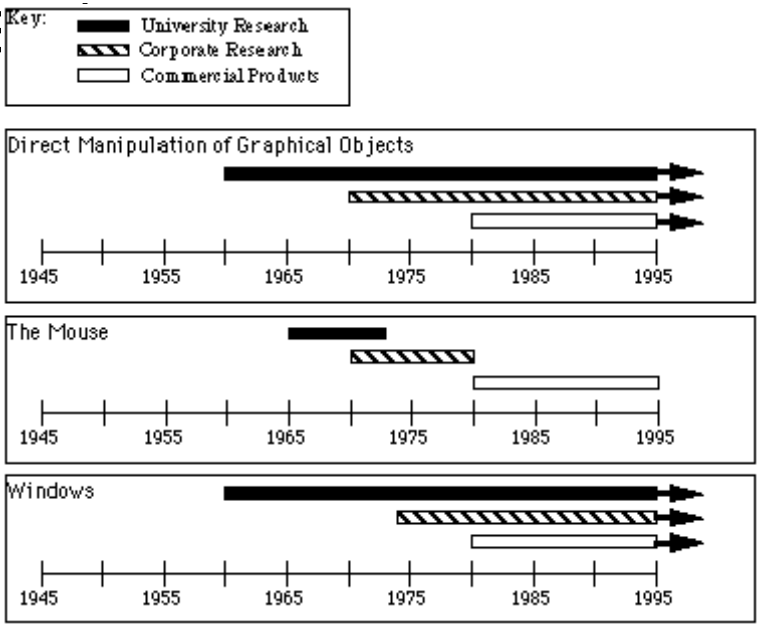
- Graphical User Interfaces (GUIs) enable users to interact with computers more naturally
- Three basic enabling conce
  - Direct Manipulation
  - The Mouse
  - Windows
- Starting in the 60s
- Commercial Breakthough in the 80s



Source: Brad A. Myers, "A Brief History of Human Computer Interaction Technology" ACM interactions. Vol. 5, no. 2, March, 1998. pp. 44-54.

Direct Manipulation

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- Directly manipulate graphical objects on a screen
- Ivan Sutherland (1962/63): Sketchpad

Sketchpad

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- Turning abstractions into perceptually concrete forms
- Computer can store and manipulate visual models
- Human directly interacs with visual models to change computer‘s state
- Visualization can be tailored to fit the task

Direct Manipulation (II)

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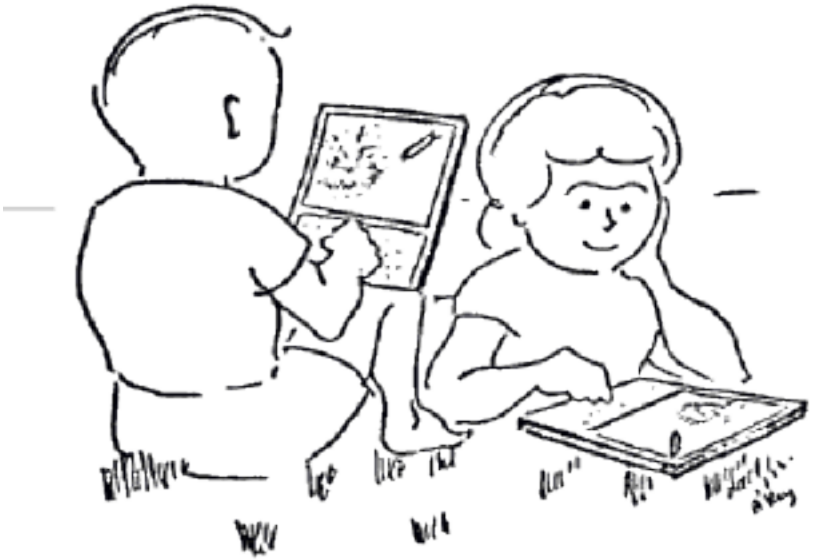
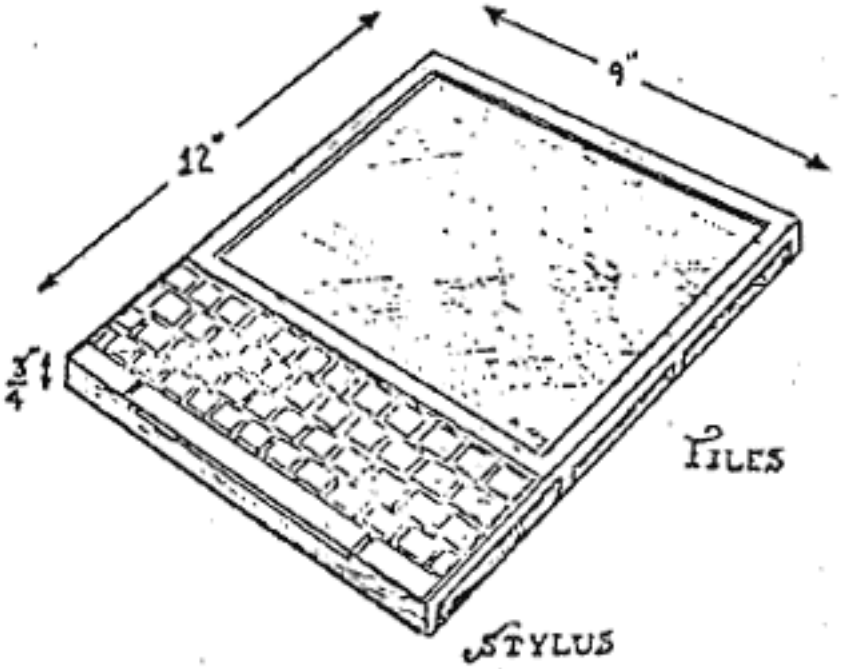
- Alan Kay (1977): The Dynabook Vision





Direct Manipulation - Concepts

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- Shneiderman (1983):
  - Visibility of objects and actions of interest
  - Incremental actions with rapid feedback
  - Reversibility of actions
  - Syntactic correctness of all (possible) actions
  - Pointing actions instead of commands
- WYSIWYG – what you see is what you get
- Input and output happens on the same objects

Stateless vs. Stateful Interaction

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- Execute an action (stateless)
  - Direct change of system state
  - Semantic is clear, result is visible immediatly
  - e.g. type text in a word processor, select an icon
- Describe a (future) action (stateful)
  - Give instructions for actions the system should carry out in the future, e.g. specify constraints
  - Semantics potentially unclear, UI needs to act as a mediator
  - e.g. select bold font, cut (out) a document

The Mouse

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- Douglas Engelbart (1968):„The Mother of all Demos“ – The Mouse

Zur Anzeige wird der QuickTime™ Dekompressor „“ benötigt.

Direct Manipulation + Mouse

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- Douglas Engelbart (1968): „The Mother of all Demos“ – NLS / Augment

Windows

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- Screen area dynamically allocated to perform a certain task
- Already available in Sketchpad and NLS/Augment
- Concept of overlapping windows introduced at Xerox PARC by Alan Kay around 1970-75

Windows (II)

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- Windows serve as containers holding
  - Titlebar
  - Toolsbars
  - Menus
  - The Working Area
- Working area may contain one object (single document interface - SDI) or several objects (multi document interface- MDI)

Direct Manipulation + Mouse + Windows

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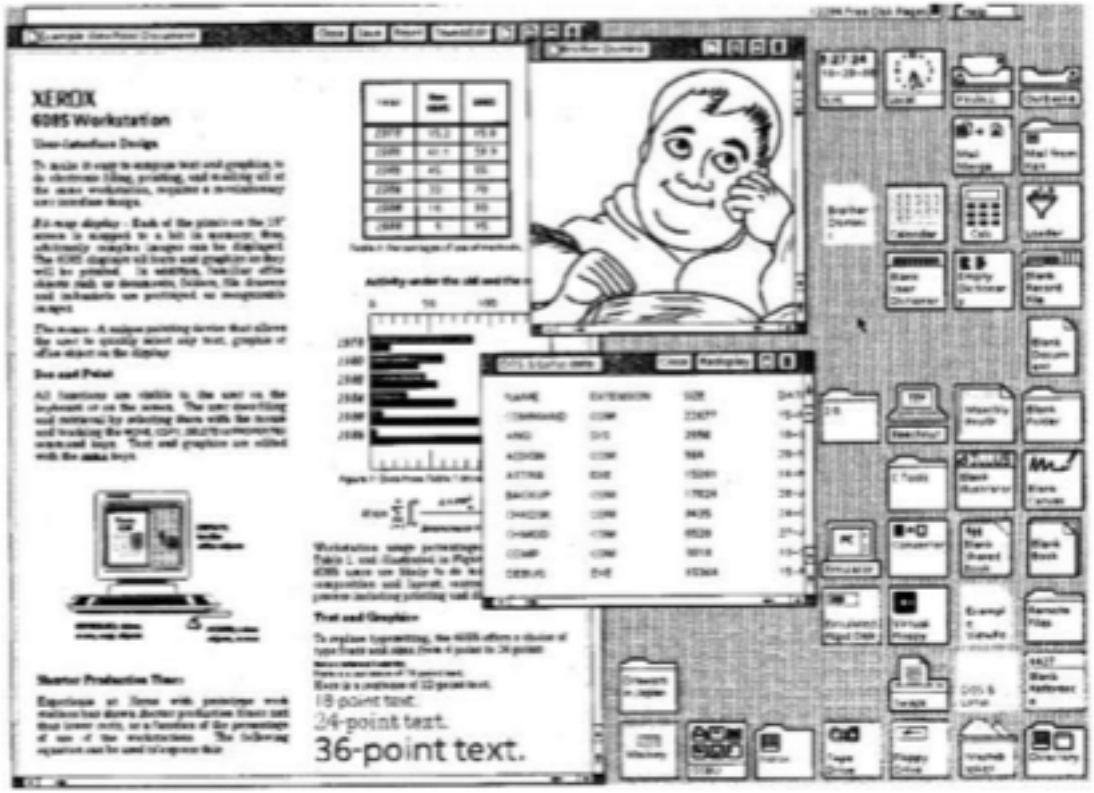
- Xerox Alto / Xerox Star (1982)



Xerox Star

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- Introduction of the Xerox Star in 1982

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The WIMP Paradigm

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- WIMP Concepts
  - Windows
  - Icons
  - Menu
  - Pointing Device
- Introduction of the „Desktop“-Metaphor
  - Source domain: office environment
  - Target domain: computer-based virtual desktop

WIMP - Concepts

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- Drag and Drop
  - Execute actions on objects by dropping them onto/into another object or tool
- Contextual Menu
  - Provide a menu only showing actions that can be performed on the selected object in its current state
- System-wide Clipboard
  - Enable cutting and pasting chunks of information between objects of different types or in different tools

WIMP - Technical Foundation

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- Widget-Toolkits
  - provide building blocks for graphical applications (windows, menus, buttons, text fields, tabs ...)
  - adhere to a unified design specification
  - e.g. MFC, QT, GTK+, Cocoa, ...
- Event-driven Programing
  - react on user events (→ direct manipulation)

Commercial Breakthrough (I)

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- Apple Lisa (1983) Macintosh (1984)

Macintosh

Lisa OS

Commercial Breakthrough (II)

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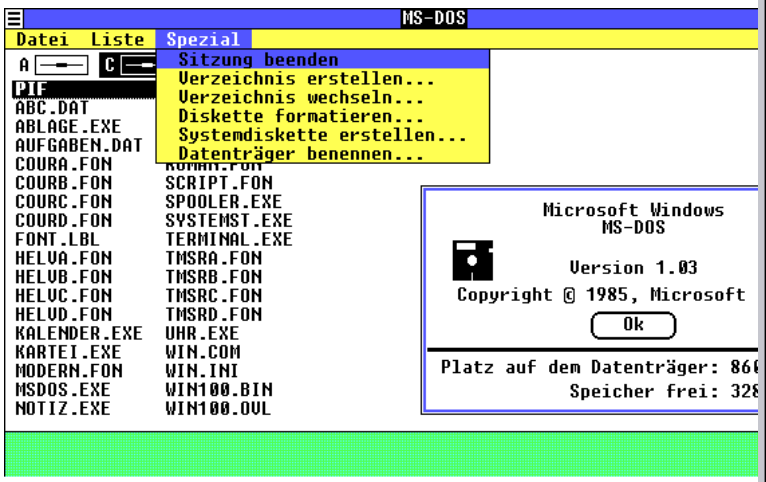
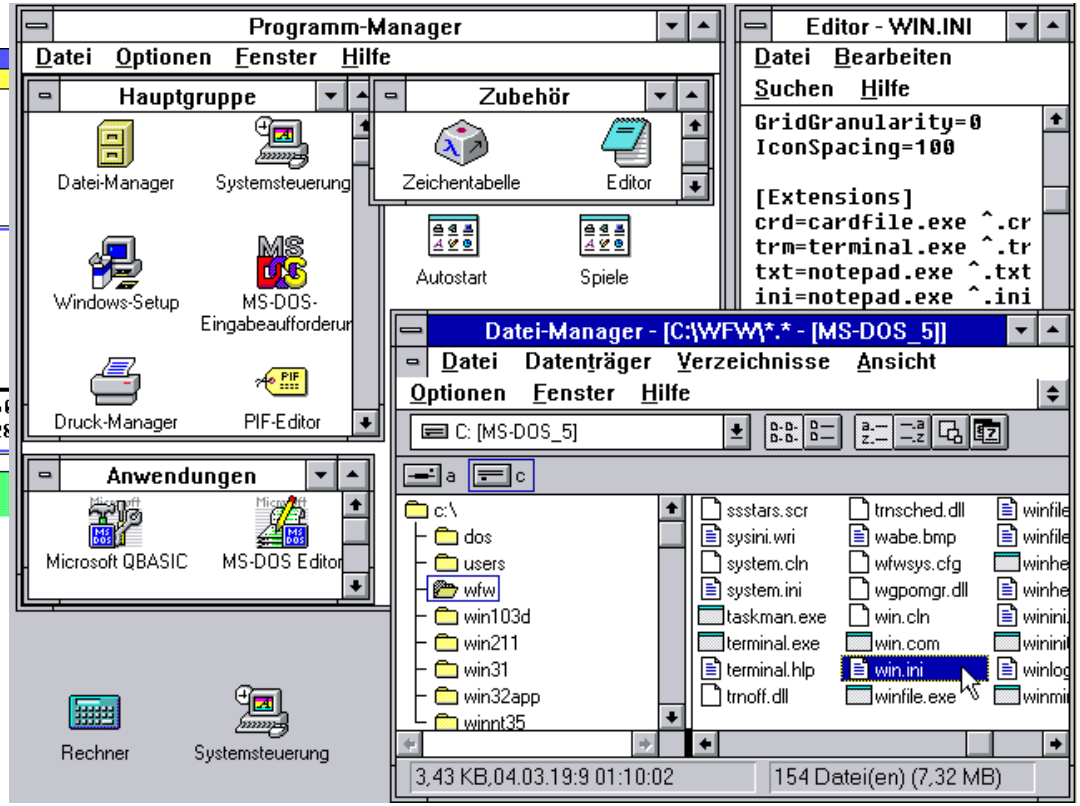
- Microsoft Windows (1985), 3.1 (1992)



Windows 1.0



Windows 3.1

Commercial Breakthrough (III)

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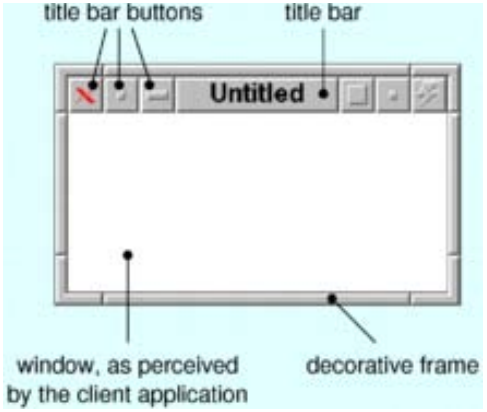
- X Window System (1984), X11 (1987)
  - Client/Server-Approach for graphical information visualization
  - No integrated widget-toolkit → no predtermined UI
  - UI provided by window-managers (e.g. Gnome, KDE, XFCE, ...)



generic X11 window

WIMP-based Systems Evolution (Selection)

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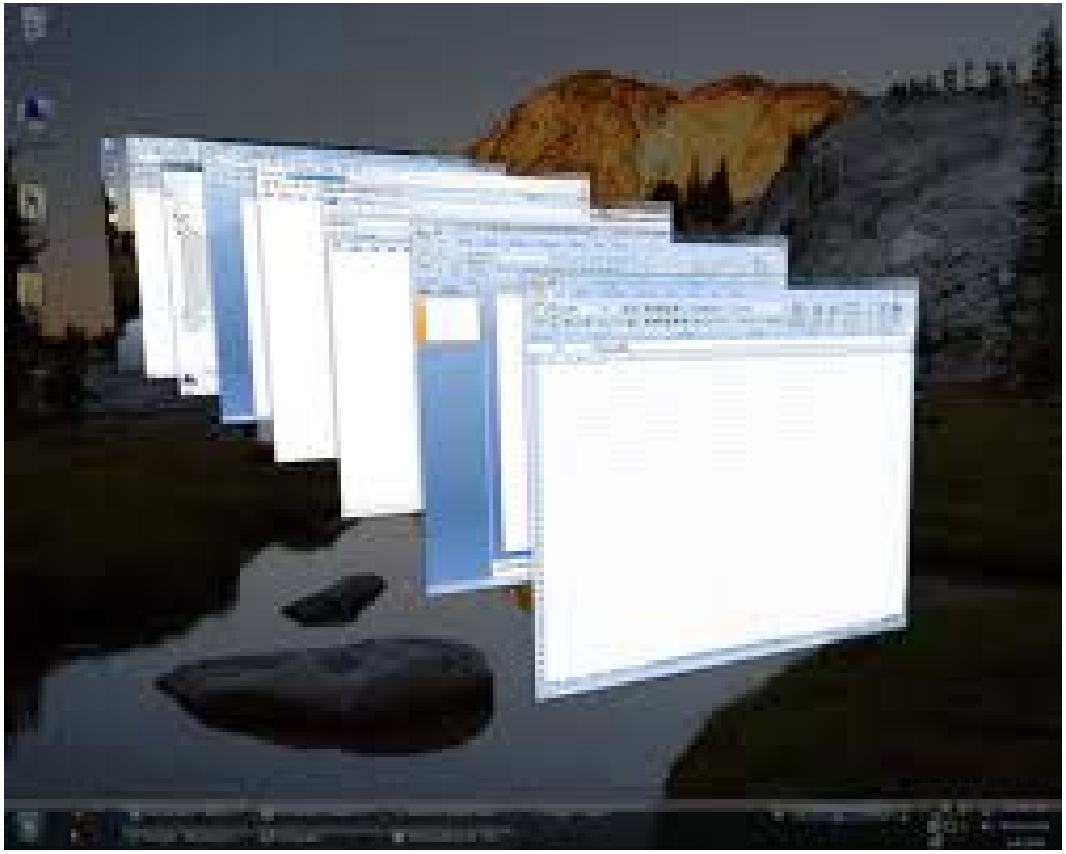
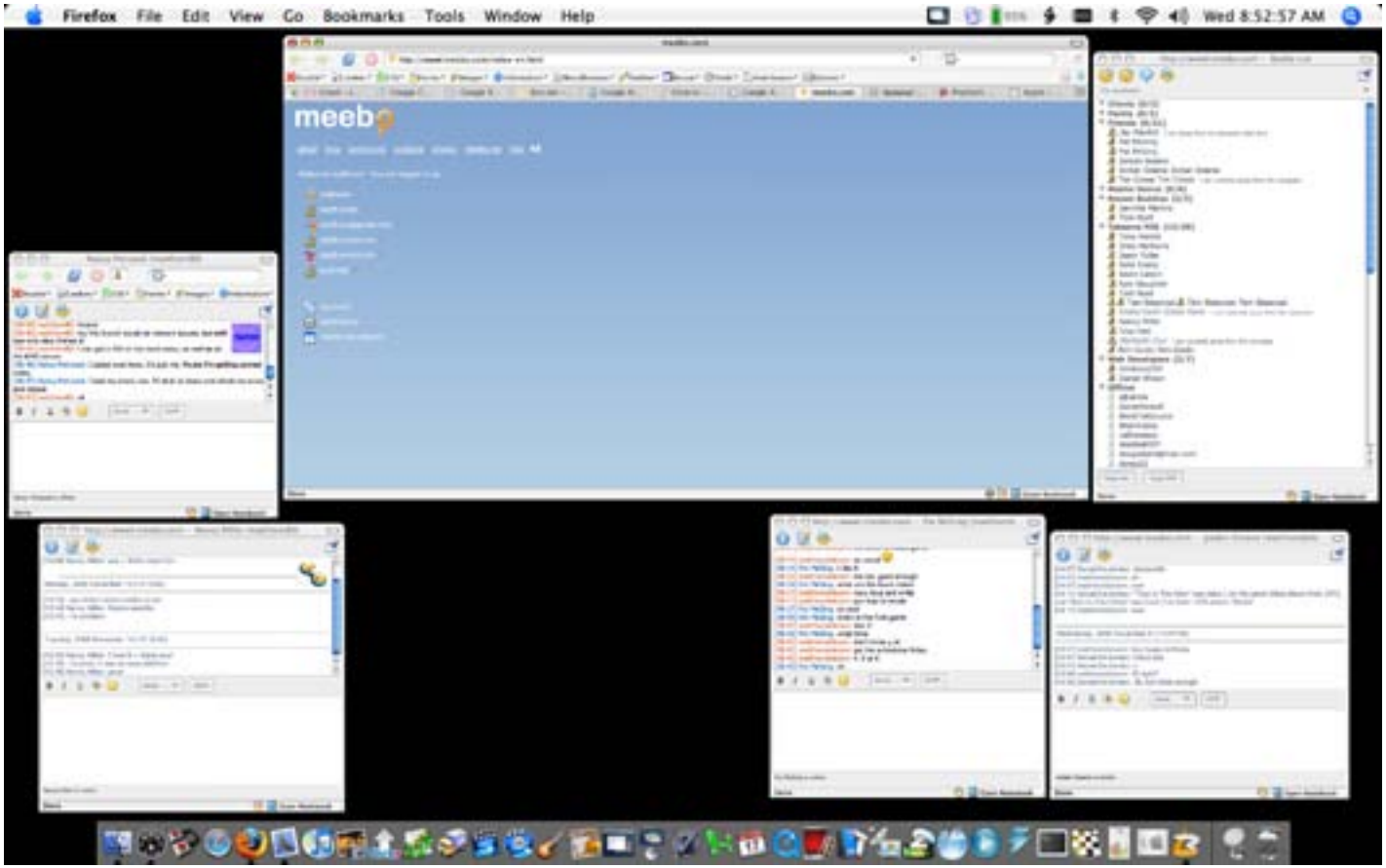
- Microsoft
  - Windows 95 – Introduction of the „Start-button“
  - Windows Vista – Introduction of 3D-Window Management and Window-Preview
- Apple
  - OS X 10.0 – Introduction of the Dock (2001)
  - OS X 10.3 – Introduction of Exposé (2003)
- Unix – X-based Systems
  - Virtual Desktops (1989), Cube (2006)
  - activitybased File Management (under development)

Example: 3D Window Management



Example: Exposé



Example: Virtual Desktop Cube

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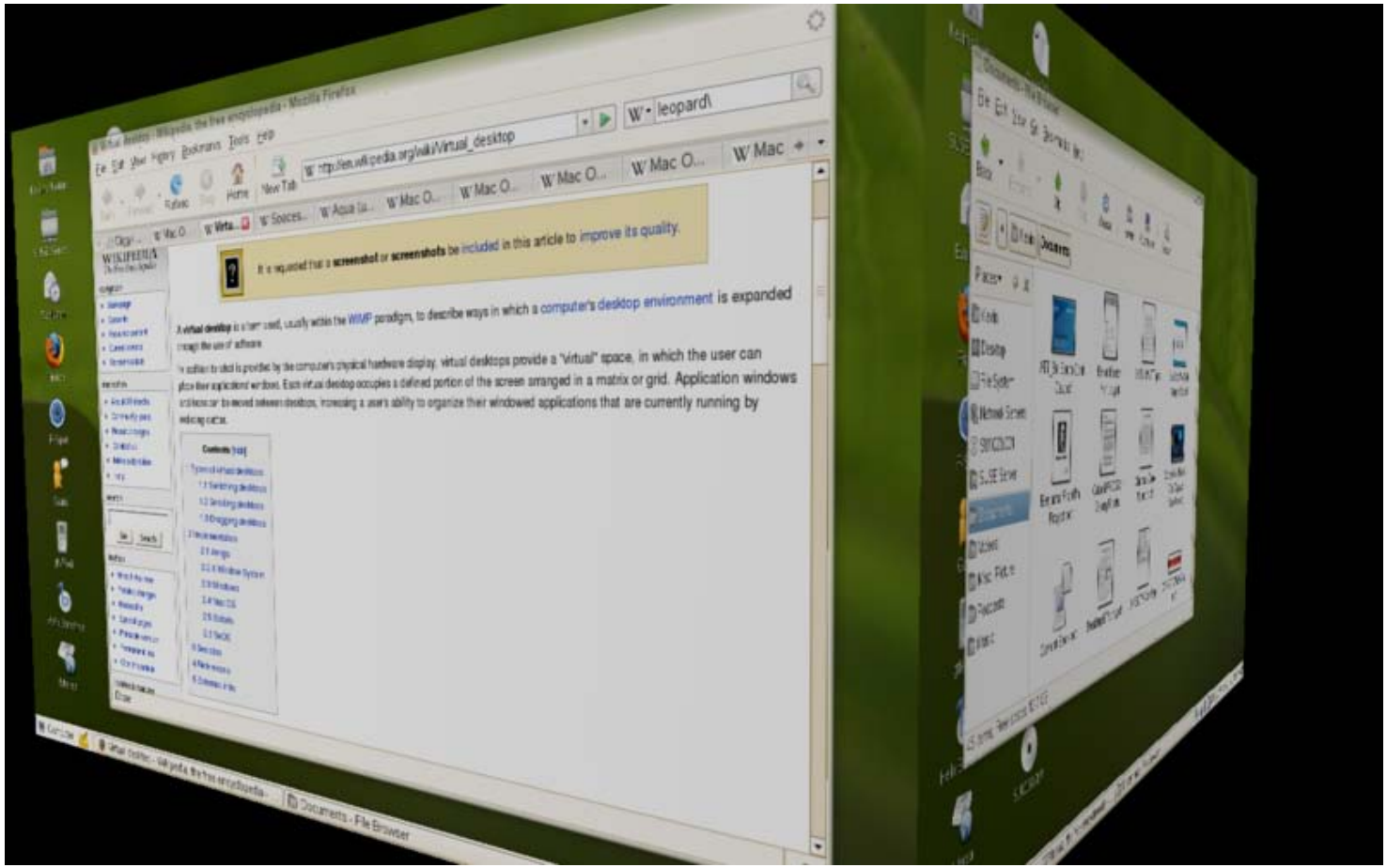

Example: Gnome Activity Journal

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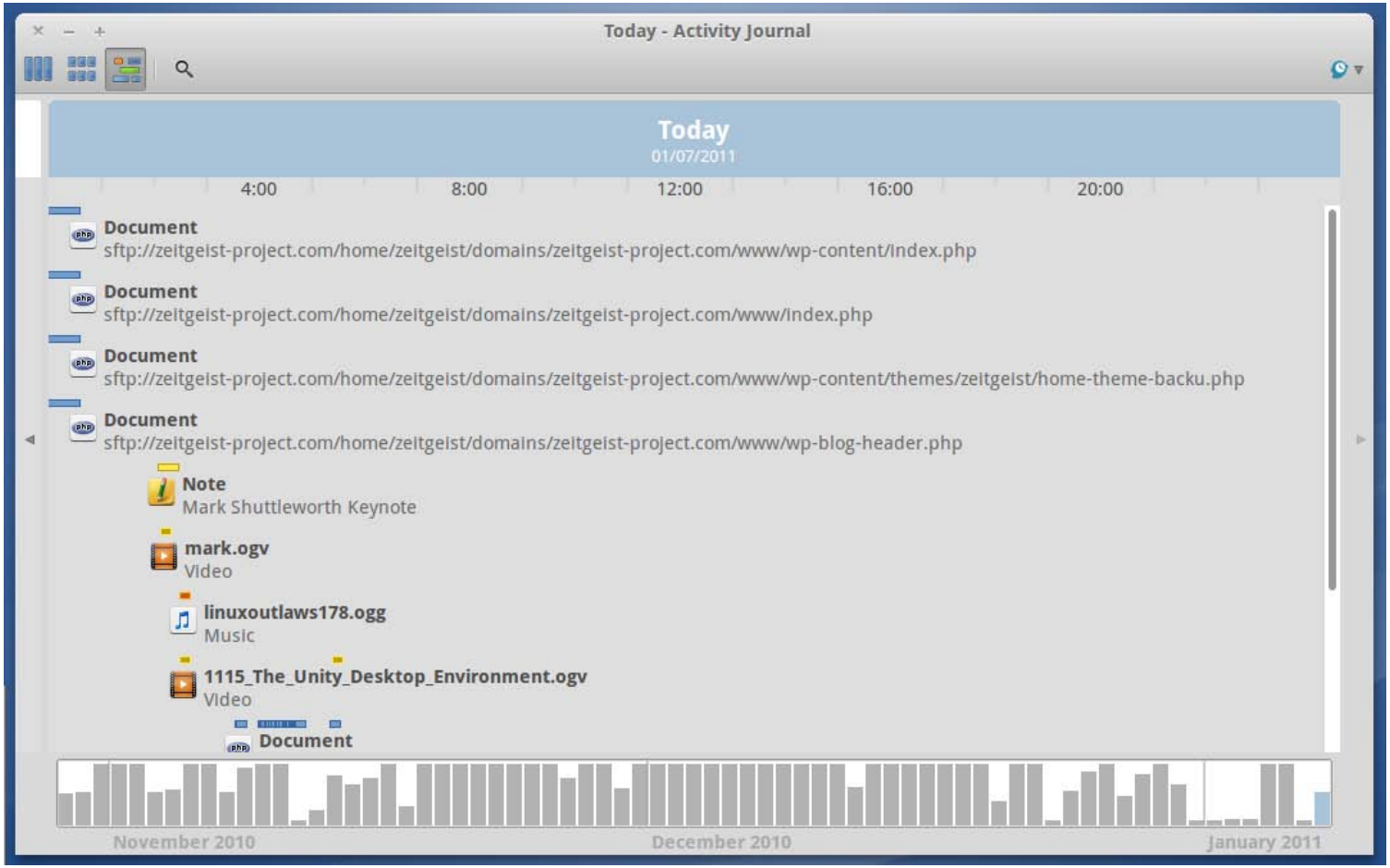

Conceptual WIMP Evolution

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- Mainly window management support
  - Exposé
  - Taskbar Preview
  - Window Switcher
- Some improvements in information management
  - Activity- or timeline-based file access
  - Deep-UI integration for search interfaces

Zoomable UIs – Beyond the Desktop

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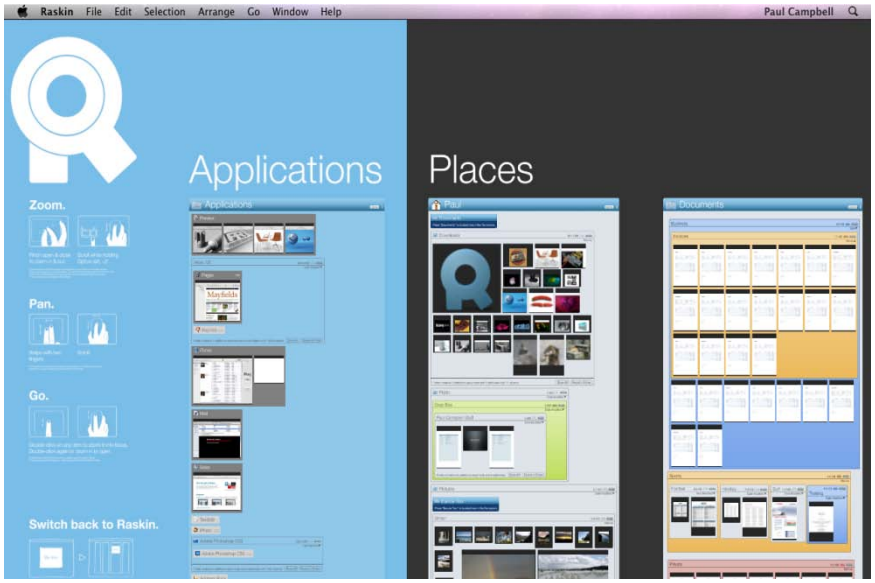
- All entities on a computer are located on one single large plane and can be grouped.
- Navigation is supported by zooming and panning.
- Concept introduced around since 1998 (Promotor: Jef Raskin)

ZUI Example - Raskin



Zur Anzeige wird der QuickTime™ Dekompressor „“ benötigt.

Next Generation WIMP?

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- 3D-“WIMP: BumpTop
  - Zoomable Documents
  - Piles
  - Extended Desktop
  - Support for Multitouch

Next Generation WIMP?

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- radically social 3D-approach: OpenCobalt

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Post-WIMP Interfaces

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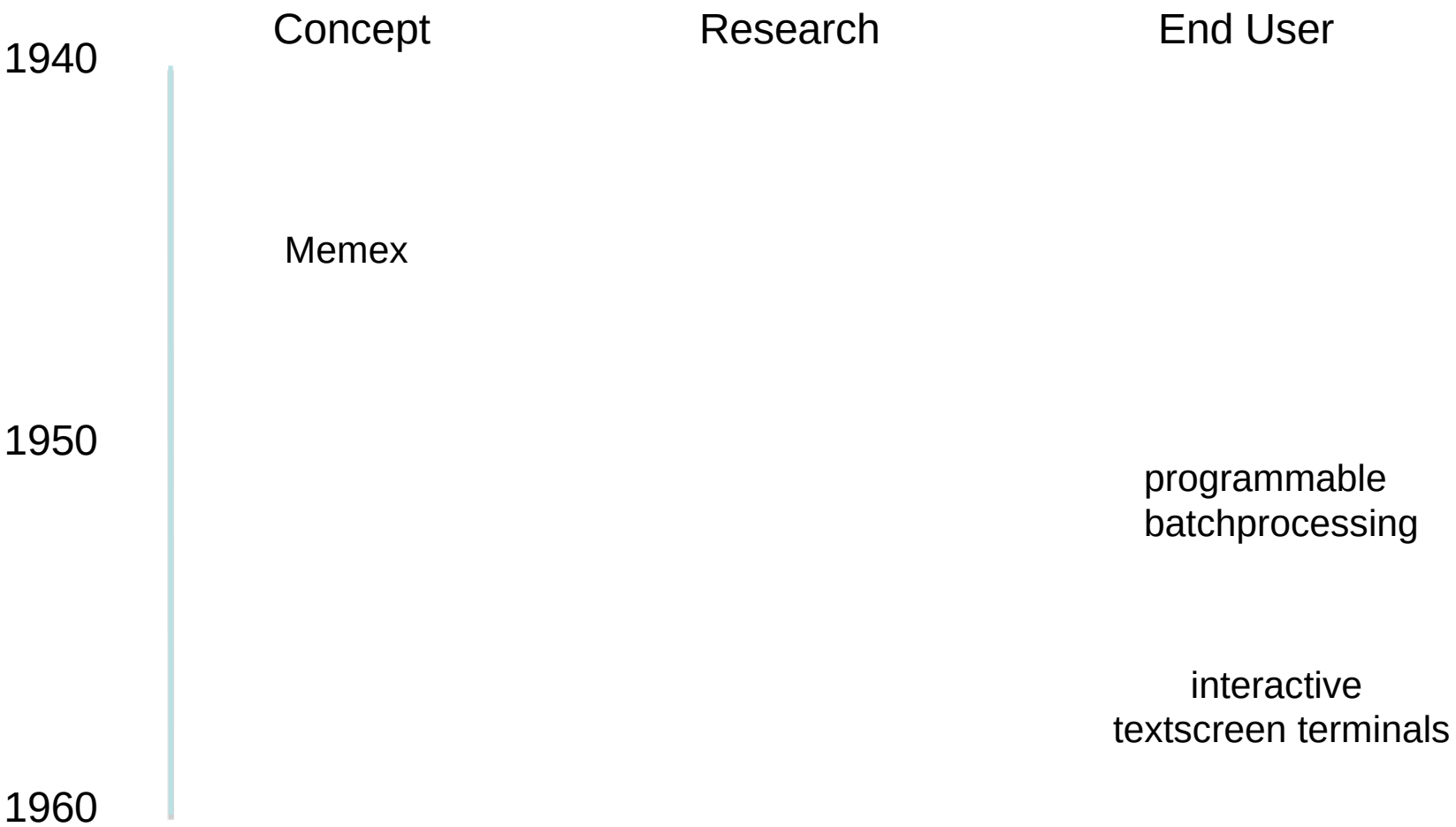
Overview – Timeline (I)



Overview – Timeline (II)

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	Concept	Research	End-User
1960	Direct Manipulation	Sketchpad	
	Windows		
	Mouse	NLS/ Augment	
1970	Overlapping Windows		
	WYSIWYG	Icons	
	Dynabook		
1980			

Overview – Timeline (III)

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	Concept	Research	End-User
1980	WIMP / Desktop	XEROX Alto XEROX Star	Apple Lisa Apple Macintosh X Window System
1990			Microsoft Windows 3.1 Microsoft Windows 95
2000	Zoomable UIs		Mac OS X

Timeline (IV)

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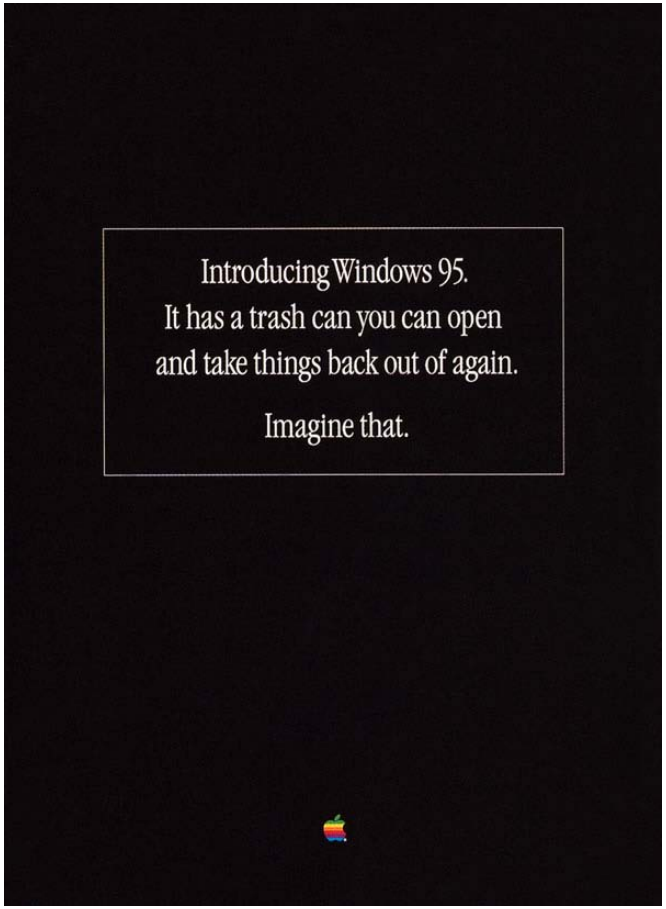
	Concept	Research	End User
2000			
	Social Interaction		
	3D Window Management		OS X 10.3 (Exposé)
		Cooperative 3D Environments	
2010	Activity-/timebased Info-management		Windows Vista/7 (Window Preview)
			Gnome Shell
2020			

WIMP Evolution - Revisited



- Apple introduced the Trashcan 1983 with the Lisa
- Microsoft introduced the same concept in Windows 95
- Actually, Windows calls its solution a Recycle Bin

vs.

Metaphor?

Limits of Metaphors

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- Metaphors can be restrictive
  - Expections may be falsely limited
- Mismatch between source and target domain
  - Non-existing functions might be suggested
- Metaphors may be culturally biased
  - Calendar, Trashcan, ...
- Ease-of-learning vs. ease-of-use
  - Metaphors can hamper development of expertise