History of HCI:
Key systems, people and ideas

Original slides by:

Matthias Rauterberg, Technical University Eindhoven (TU/e), 1997

Modified by:

Valerie Summet, Emory University, 2010

History of Computer Technology

Digital computer grounded in ideas from 1700's & 1800's

Computer technology became available in the 1940's and 1950's

see further: History of Computing

Z3 (1941)

Konrad Zuse's Z3 was the world's first reliable working machine for very complicated arithmetic calculations, which was freely programmable and was based on a binary floating point number and switching system.
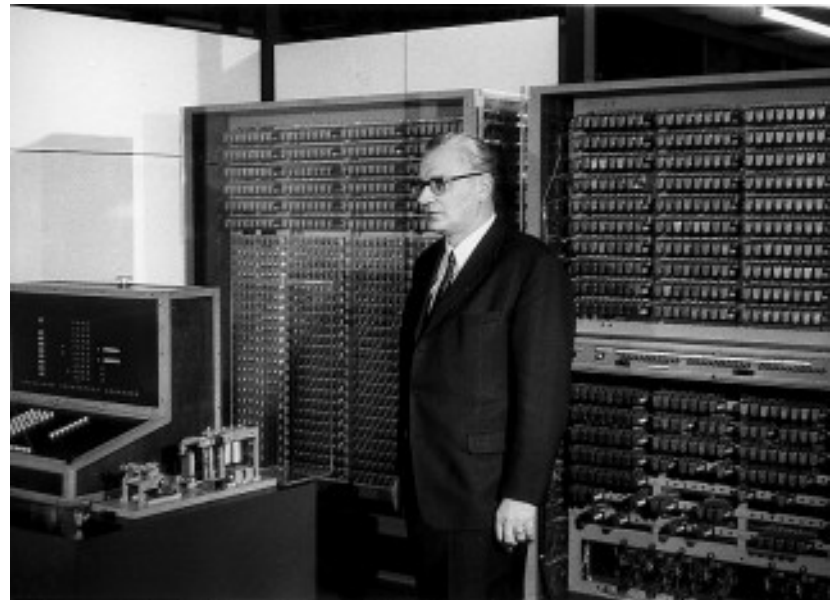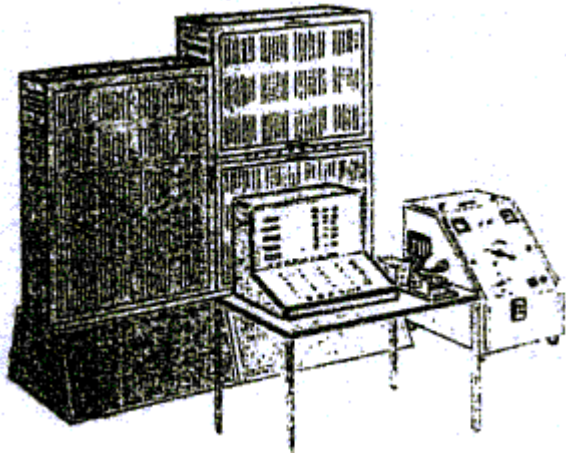
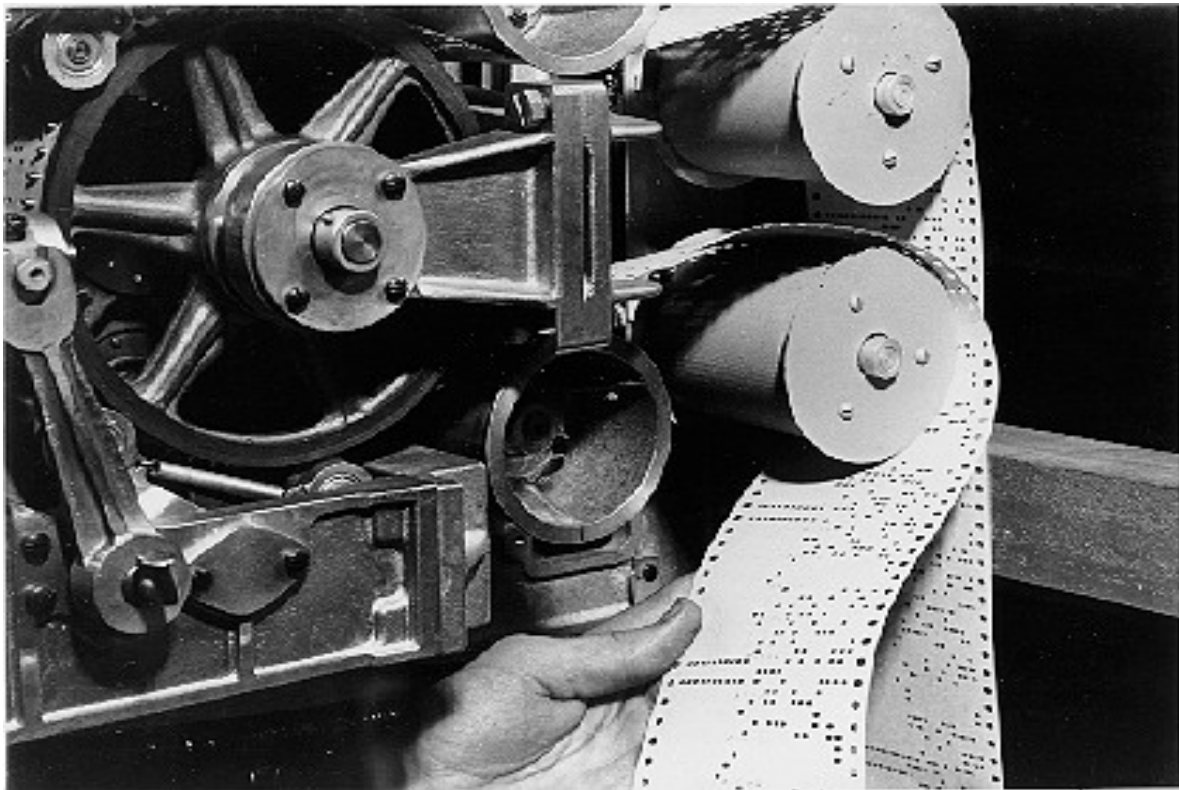**Konrad Zuse in front of his reconstructed Z3**

Eniac (1943)

- – A general view of the ENIAC, the first all electronic numerical integrator and computer in USA.
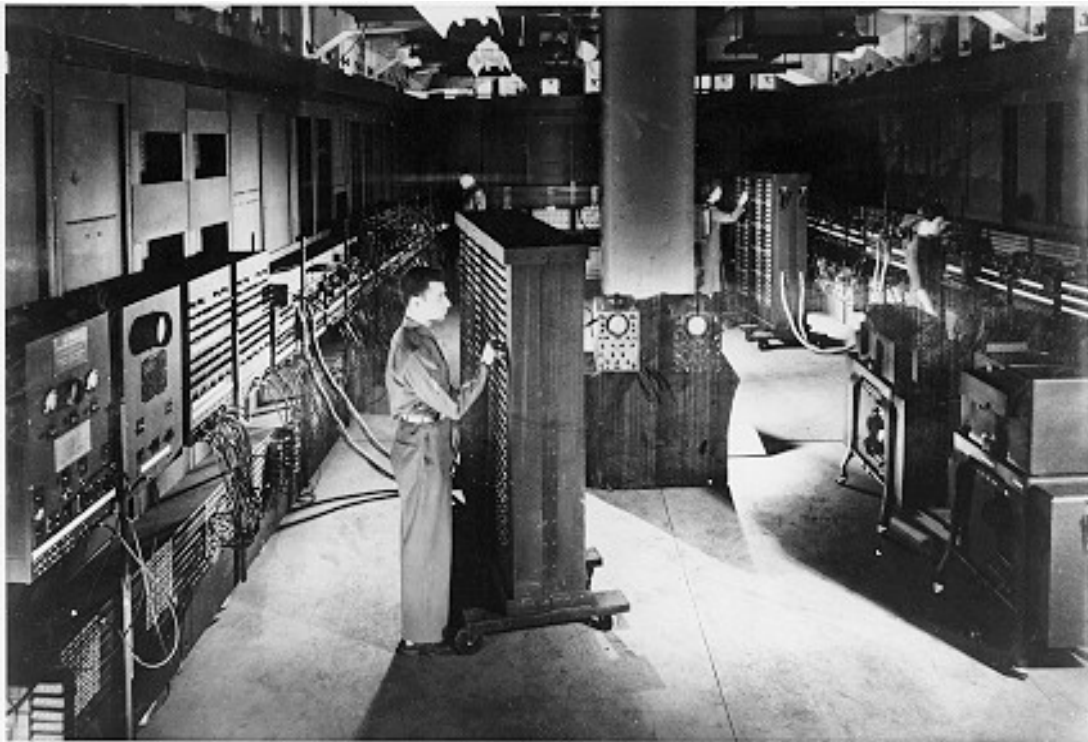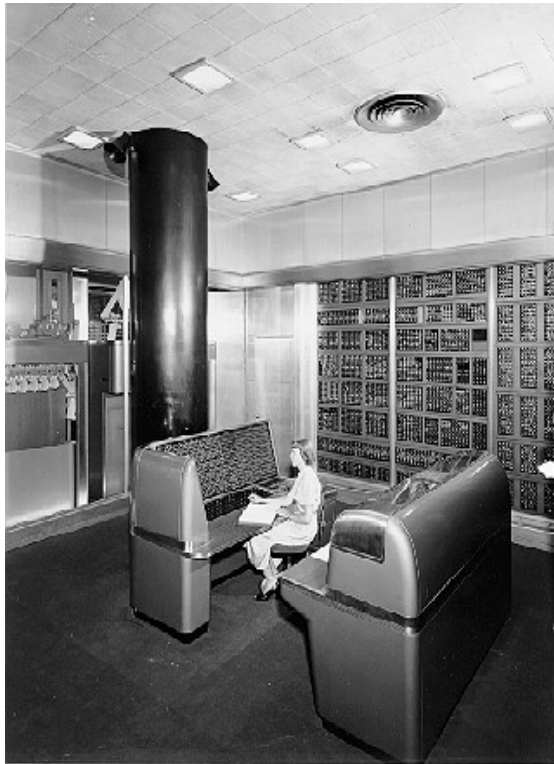

From IBM Archives.
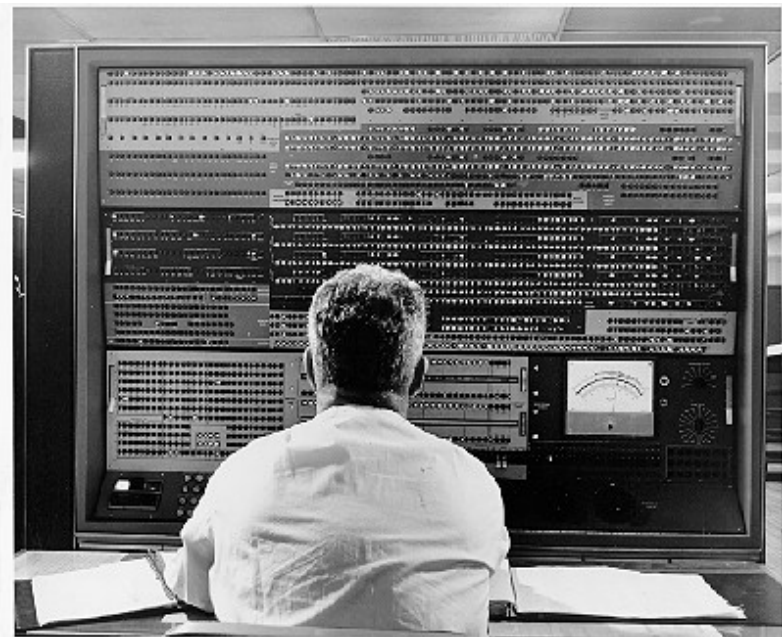
Mark I (1944)

- The Mark I paper tape readers.

Mainframe Computers

IBM SSEC (1948)

Stretch (1961)
A close-up of the Stretch technical control panel

From IBM Archives.   6

Enabling Technology

John Bardeen, William Shockley, and Walter Brattain

1904 Sir John Ambrose Fleming invents the vacuum tube and diode.

1947 the first transistor was invented by Bardeen, Brattain and Shockley in the Bell Labs in the USA.
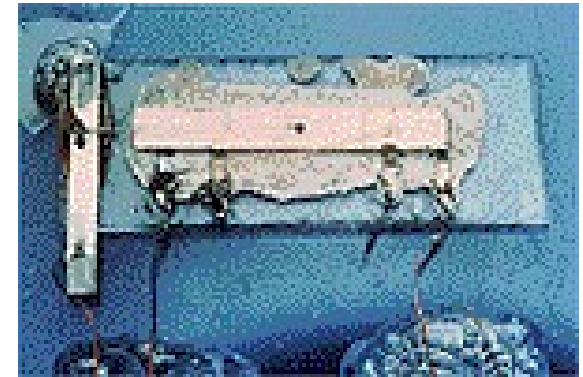
1958 Jack Kilby invented the integrated circuit at Texas Instruments and got the Noble Prize. Comprised of only a transistor and other components on a slice of germanium, Kilby's invention, 7/16-by-1/16-inches in size, revolutionized the electronics industry.

Historical overview of interaction

- **1945** Memex
- **1969** Flex
- **1973** Alto
- **1974** Bravo
- **1974** IBM PC
- **1983** Apple Lisa
- **1984** Apple Macintosh
- **1987** Microsoft Windows

Vannevar Bush (1890-1974)

"As We May Think" - 1945
Atlantic Monthly

"…publication has been extended far beyond our present ability to make real use of the record."
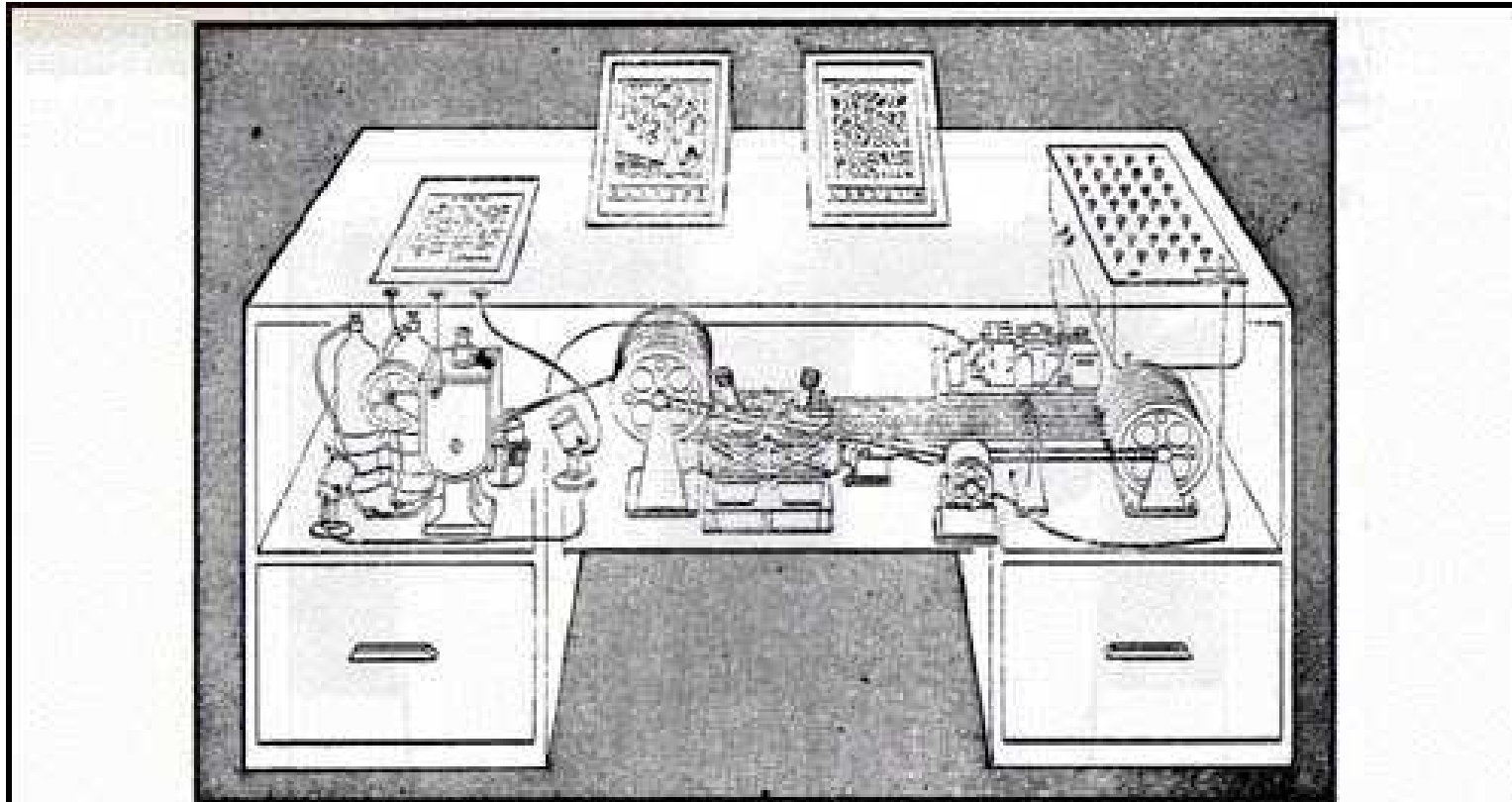
Vannevar Bush (1945)

Postulated **Memex** device

- Can store all records/articles/communications
- Large memory
- Items retrieved by indexing, keywords, cross references
- Can make a trail of links through material etc.

Envisioned as microfilm, not computer

Memex design sketch (1945)

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).

J.R. Licklider (1915-1990)

1960 - Postulated "man-computer symbiosis"

Couple human brains and computing machines tightly to revolutionize information handling

"The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today."

An MIT psychologist who became fascinated with computers after the TX-0 was demonstrated to him. Licklider applied his background in psychology to research how people interacted with computers, and he became known as an expert in human-computer interaction. ARPA took notice and offered Licklider the job of director of its new Information Processing Techniques Office (IPTO). He accepted the position as the founding director and continued his research in human-computer interaction.

Vision/Goals (1945-1995)

Immediate

- Time sharing
- Electronic I/O
- Interactive, real-time system
- Large scale information storage and retrieval

Intermediate

- Combined speech recognition, character recognition, light-pen editing

Long-term

- Natural language understanding
- Speech recognition of arbitrary users
- Heuristic programming

13

Mid 1960's

Computers too expensive for individuals

Led to timesharing: each user gets (buys) a slice of time during which to use the computer.

- increased accessibility
- interactive systems, not jobs
- text processing, editing
- email, shared file system

DEC PDP-1 (1961)

As the world's first commercial interactive computer, the PDP-1 was used by its purchasers to pioneer timesharing systems, making it possible for smaller businesses and laboratories to have access to much more computing power than ever before.
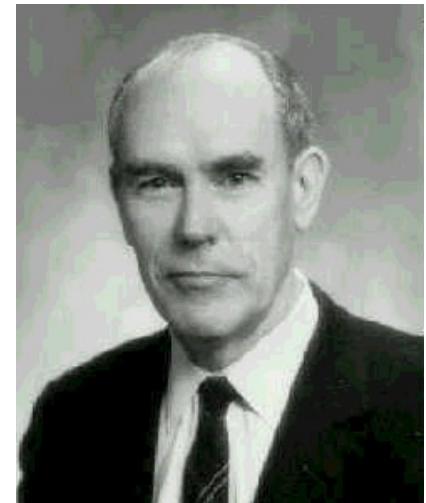
© DEC Inc.

Ivan Sutherland (1938-)

SketchPad: 1963 PhD thesis at MIT
- Breakthrough in computer graphics and displays
- Hierarchy - pictures & subpictures
- Master picture with instances (OOP)
- Constraints
- Icons
- Copying
- Light pen as input device
- Recursive operations

Sketchpad (1963)

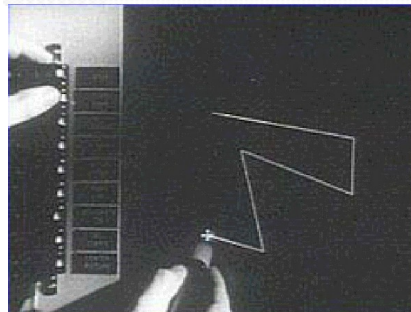Input device: Light pen used on cathode ray tube.

Graphical objects could be drawn and modified through constraints.

Object oriented model.

Copy and paste.

Ivan Sutherland using the console of the TX-2 at MIT

© MIT Lincoln Lab
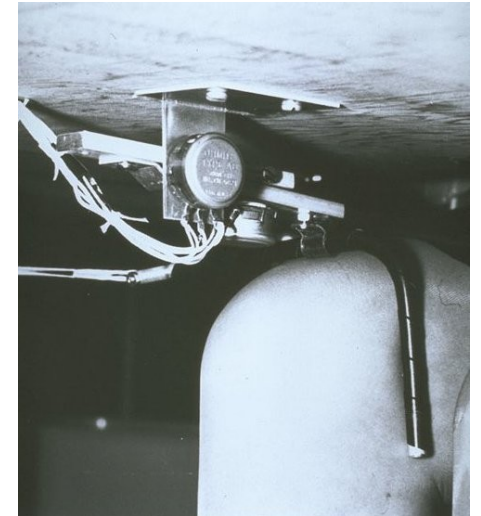
Douglas C. Engelbart (1925 -)

- Engelbart invented the mouse at Stanford Research Institute in 1964.

- Landmark system/demo:

  - hierarchical hypertext, multimedia, mouse, high-resolution display, windows, shared files, electronic messaging, CSCW, teleconferencing, …

  - Augment/NLS system [NLS: oN Line System]
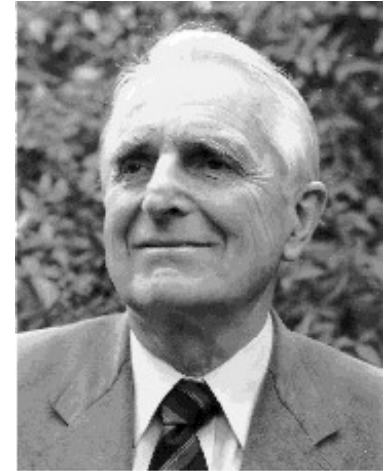
The First Mouse (1964)

Knee control

Augment/NLS (1968)

Famous Augment/NLS Featuring:

• 2-dimensional display, text editting by two persons from different consoles, at the same time.
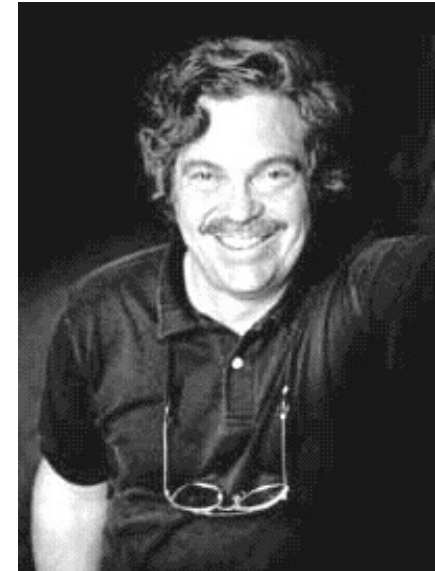
• Links

• Video-conferencing.

• Mouse

Alan C. Kay (1940-)

Worked with Ivan Sutherland on Sketchpad

Dynabook (1969) - Notebook sized computer loaded with multimedia and can store everything

Personal Computing

Desktop Interface Metaphor

"The best way to predict the future is to invent it."

Dynabook (1969)

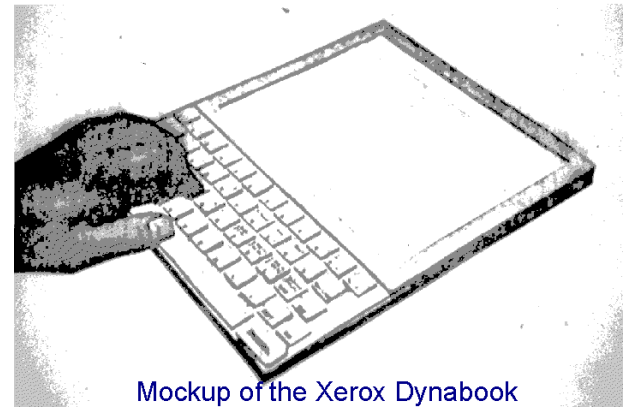First idea of a book-sized computer.

Laptops, tablets, and e-books and readers rolled into one.

Idea of on-screen keyboards

Graphics rather than text.

Alan Kay developed the Dynabook at Xerox PARC.

1972 paper "A Personal Computer for Children of All Ages" sounds very close to iPad usage today.

Mockup of the Xerox Dynabook

© Xerox PARC

Theodor (Ted) H. Nelson (1937-)

- Computers can help people, not just business
- Coined term "hypertext"

"A user interface should be so simple that a beginner in an emergency can understand it within ten seconds."

Nicholas Negroponte (1943-)

- MIT machine architecture & AI group   (1969-1980s)
- Ideas:
  - Wall-sized displays, video disks
  - Touch screen interactions
  - AI in interfaces (agents), speech recognition, multimedia with hypertext
- OLPC movement

© MIT MediaLab, Boston

Personal Computers (PC)

Late '70's
  Apple II
  Z-80 CP/M
  IBM PC

Word processing

Spreadsheets ("Killer apps")

Text and command based (not GUIs!)

Input/output devices

	Input	*Output*
Early days	connecting wires paper tape & punch cards keyboard	lights on display paper teletype
Past	keyboard + cursor keys + mouse + microphone	scrolling glass teletype character terminal bit-mapped screen audio
Today	data gloves + suits computer jewelry natural language	head-mounted displays ubiquitous computing autonomous agents

IBM Mark-8

Introduced in July 1974

Intel 8008 based machine with 256 bytes RAM.

1000-2000 were produced.

First portable computer to really be marketed

Had no ROM.

Market value ~$12,000.

Mark-8 Pictured on right.   *© IBM*

IBM 5100

Introduced in September 1975.

One of several portable computers IBM made before the Personal Computer (PC).

Followed by the 5110, the 5120, the Datamaster, and then finally the 5150 PC.

Gary Berg

© IBM

© M. Rauterberg, TU/e, 1997 - V. Summet, Emory, 2010

IBM PC

Not necessarily the best machine by technological standards

Looked and felt like a "professional computer system."

IBM PC and the numerous PC clones extremely popular.

Cost $1565 (keyboard, system unit, and color capability). Extras: monitor; pin-feed printer; disk drives.

PC-DOS operating system from Microsoft

© *IBM*

From http://www.blinkenlights.com/pc.shtml

Bill Gates (1955-)

- Chairman and chief software architect of Microsoft Corporation

- Left Harvard after junior year to devote his energies to Microsoft, a company he began in 1975 with Paul Allen.

- Believed that the computer would be a valuable tool on every office desktop and in every home.

- Wrote MS-DOS for IBM but talked IBM into letting MS retain licensing rights.

- Software for the PC market

"DOS is ugly and interferes with users' experience."

MS DOS (1981)

Microsoft DOS (Disk Operating System)

Command line user interface.

Microsoft releases MS-DOS 1.0 to IBM, for the original IBM PC in 1981.

© *Microsoft Inc.*

PCs with GUIs

Xerox PARC - mid 1970's

- Invention of the first PC: ALTO
- Local processor, bitmap display, mouse
- Precursor to modern GUI
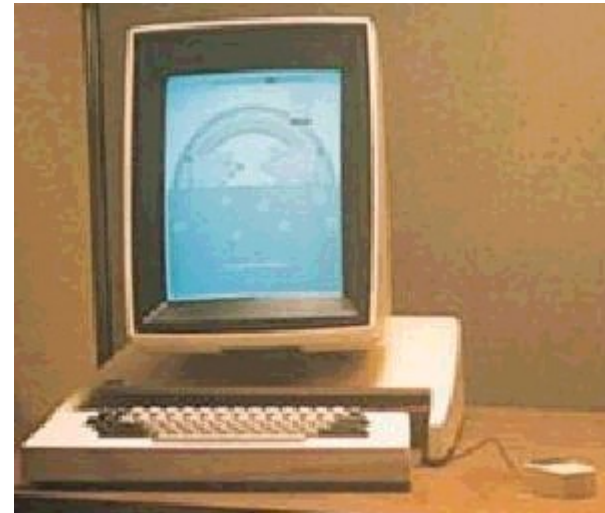- LAN & Ethernet

Xerox Alto (precursor to the Star)

Alto applications:

- **Bravo:** WYSIWYG text editor. (ancestor of MS Word)

- **Laurel:** Electronic mail program.

- **Neptune:** Disk file manipulation program, sort of like sweep..

- **Press:** Document printing program.

- **Sil:** Drawing program.

Total cost: ~40k

      Not commercially feasible

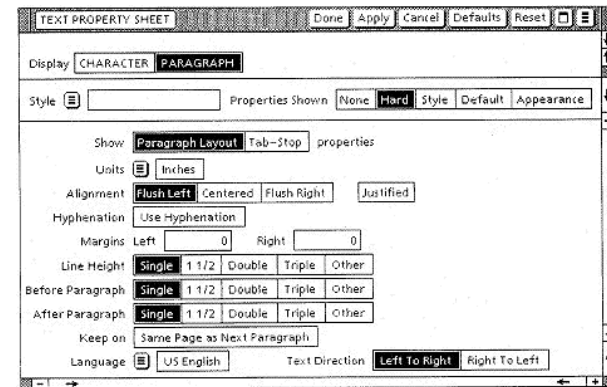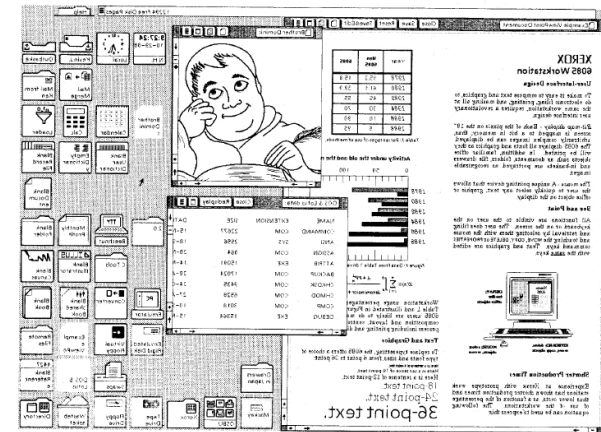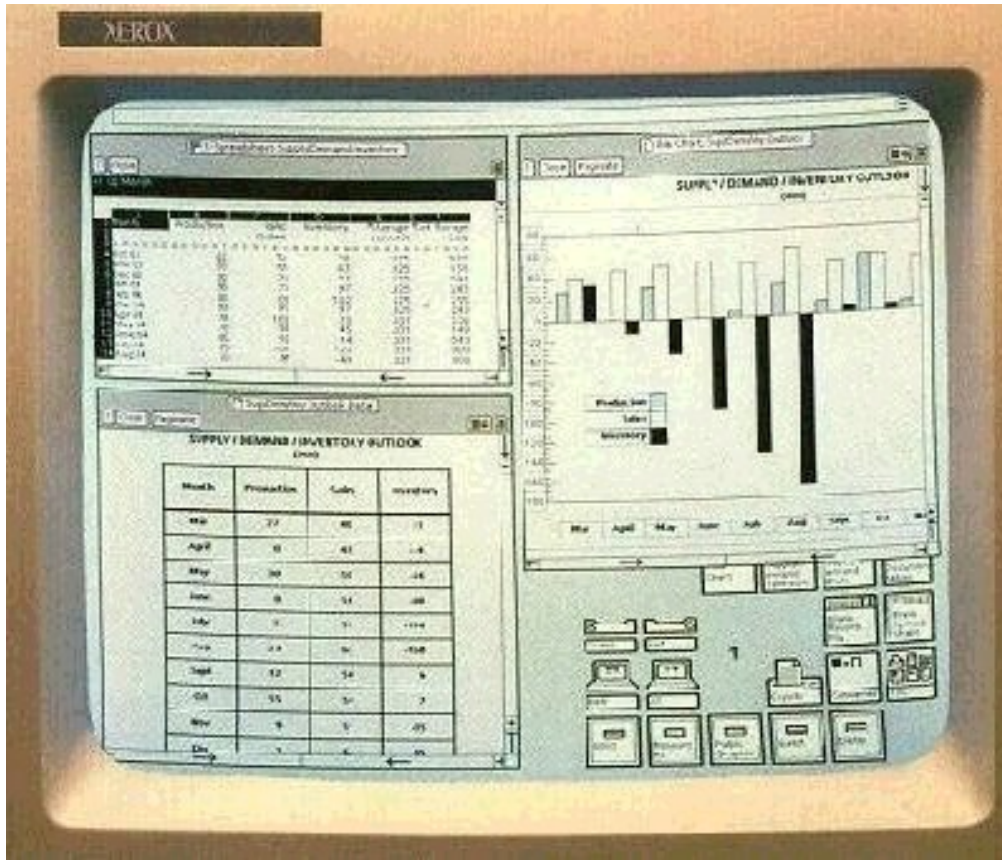*From Xerox Alto Archive*

Xerox Star - 1981

- First commercial PC designed for "business professionals"
  - Desktop metaphor
  - Pointing
  - WYSIWYG
- First system based on usability engineering

Xerox Star (GUI)

Xerox Star (history)

Commercial flop

- $15k cost

  - Couldn't compete with cheaper IBM PCs or Apple's systems.

- Closed architecture

- Lacking key functionality (spreadsheet)

Apple II

Introduced in 1977 and cost $1298.

Plastic case (rarity at the time) painted beige.

Ability to display color graphics.

Expandable RAM (4K to start), 8 expansion slots, 2 game paddles and demo cassette.

Integer BASIC hard-coded on the (included) ROM for easier programming,

© *Apple Inc.*

Apple released an inexpensive disk drive in 1978 for the machine

Apple II series (including Apple IIe and Apple IIgs) drove revenue for 1980s for Apple.

Apple Lisa (1982-83)

Based on ideas of the Xerox Star

More personal rather than office tool
   Still expensive!

Conceptual success, but
   commercial failure

Steve Jobs (1955-)

co-founder Apple Computer Corporation

Apple Lisa (1982-83)

© Apple Inc.

Steve Job's daughter's name is Lisa

First personal computer to use a Graphical User Interface (GUI).

Aimed mainly at large businesses

Claim: The Lisa would increase productivity by making computers easier to work with.

Motorola 68000 Processor running at 5 Mhz, 1 MB of RAM two 5.25" 871k floppy drives, an external 5 MB hard drive, and a built in 12" 720 x 360 monochrome monitor.

Cost $9995

http://www.apple-history.com/lisa.html

Apple Lisa (applications)

LisaWrite: word processor

LisaCalc: spread sheet

LisaGraph: charts

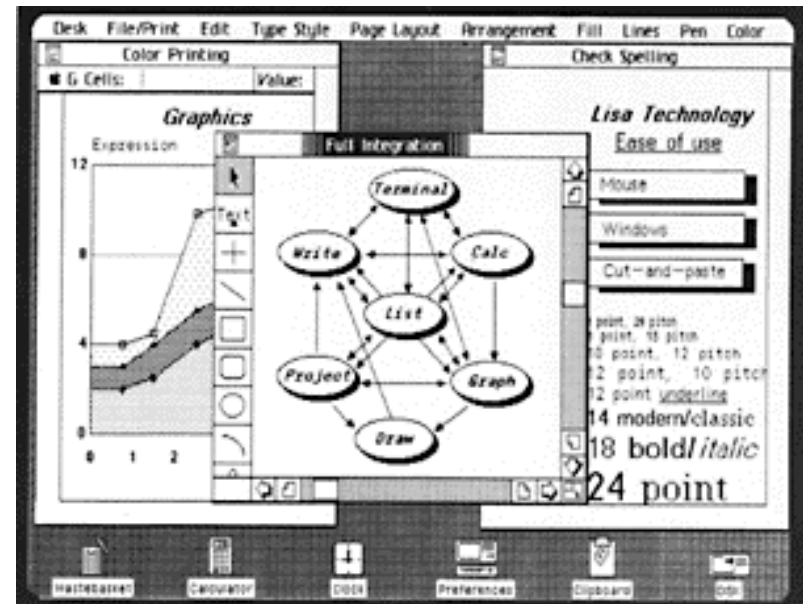LisaList: an outline builder, idea manager

LisaProject: project scheduler

LisaDraw: drawing program
(predecessor to Mac Draw)

LisaTerminal: modem communications
software.

© *Apple Inc.*

Apple Macintosh - 1984

Aggressive pricing - $2500

Not trailblazing, smart copying

Good interface guidelines

3rd party applications

High quality graphics and laser printer (through proprietary connection)

Apple Macintosh (1984)
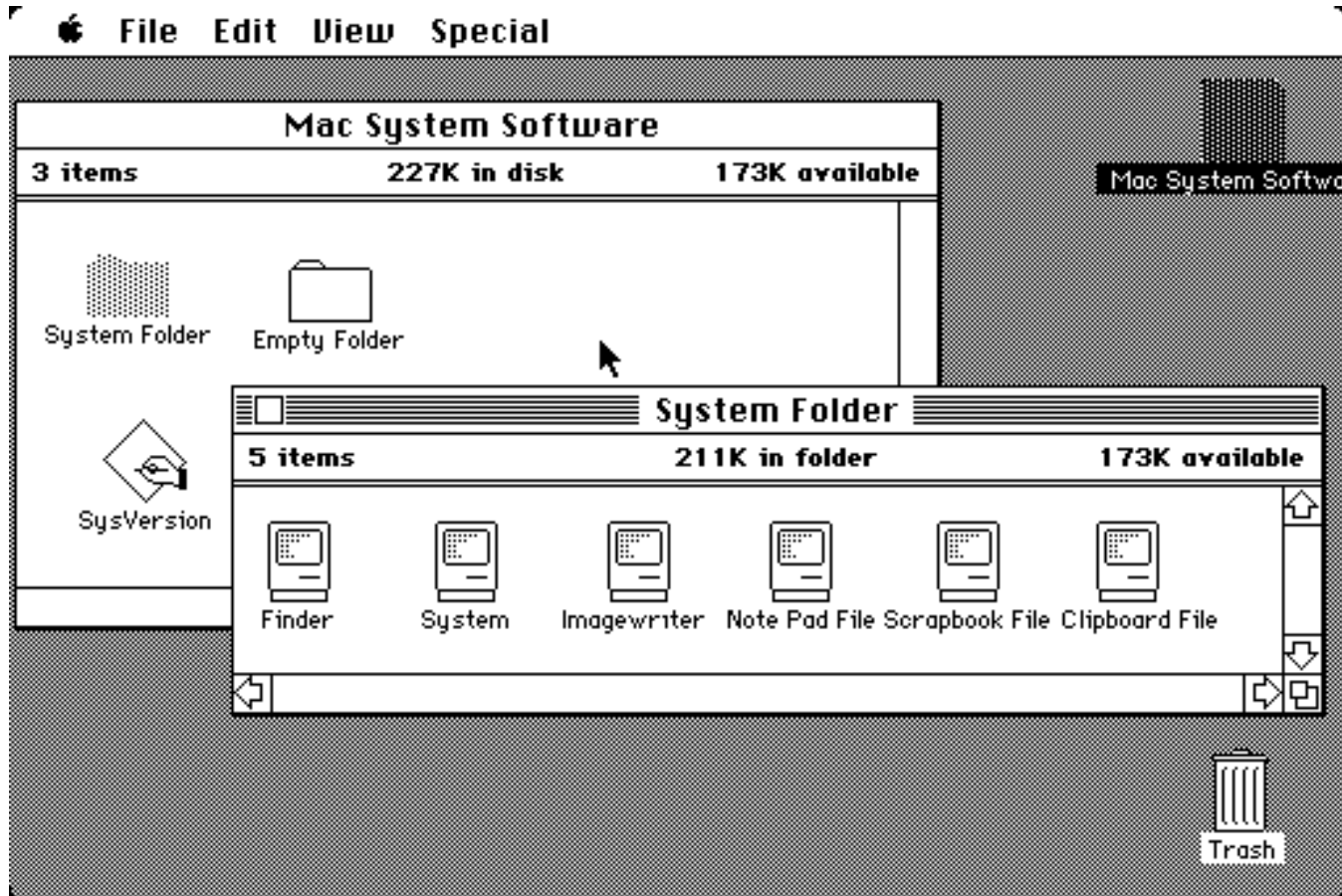

© *Apple Inc.*

First affordable GUI computer.

Built around graphics performance.

Motorola 68000 chip, which was significantly faster than previous processors, running at 8 MHz.

Black and white monitor built in, keyboard and mouse, had a floppy drive that took 400k 3.5" disks.

Introduced System and Finder apps

Apple Macintosh (GUI)

© Apple Inc.

MS Windows (1985)

Announced in Nov. 1983 (after Lisa but before Macintosh).

Built on top of DOS

Windows 1.0 released in Nov. 1985

Very unsuccessful

- No overlapping windows (tiling only)
- Poor memory management (slow)

Windows 2.0 released in Oct. 1987

Windows 1.0
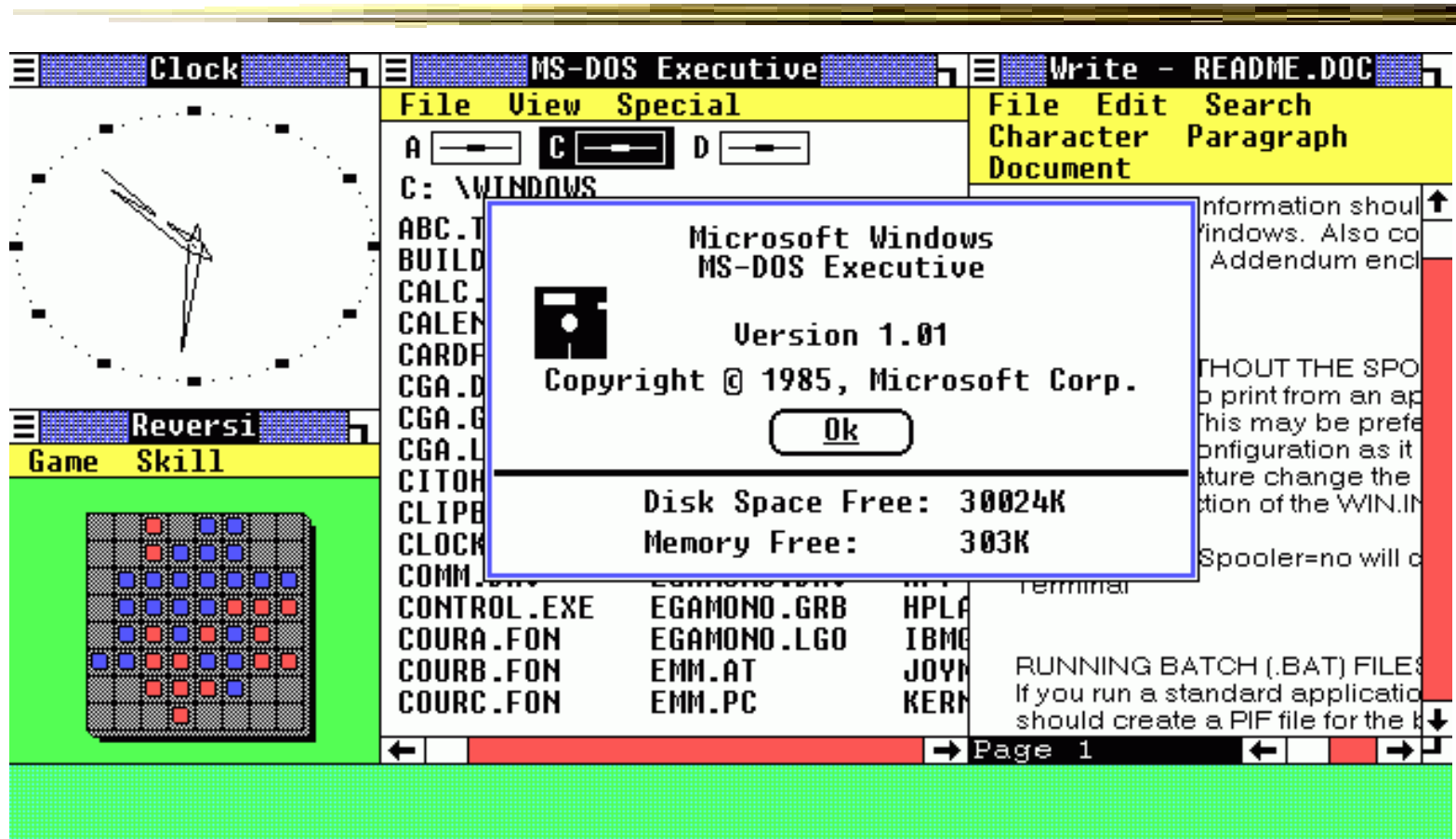
Note non-overlapping windows

45

Microsoft Windows (history)

Steve Jobs complained about Microsoft stealing Mac OS's interface design.

Bill Gates replied: "Hey Steve, just because you broke into Xerox's house before I did and took the TV doesn't mean I can't go in later and take the stereo."

Ben Shneiderman (1947-)

Professor at University of Maryland

Recognized importance of studying how people use software and computers early.

Author of 'Software Psychology: Human Factors in Computer and Information Systems' (1980) in which he coined the term ***direct manipulation***.

Direct Manipulation: concept of user controlling their experience while using an interface by directly (i.e. physically) manipulating files, directories, and programs.

Author of course textbook (originally published in 1987) and <u>Leonardo's Laptop: Human Needs and the New Computing Technologies</u> (2002).

Focus on information visualization and universal usability

Motorola DynaTAC (1983)

Martin Cooper (Motorola) lead a group of research team to develop the first (truly) mobile phone.

Motorola DynaTAC, (Dynamic Adaptive Total Area Coverage)

Weighed 28 oz.

It measured 13 x 3 x 1.75 inches in size (including antenna)

30 circuit boards.

Small LED display available and could only call, dial and listen (what else would you expect?).

Batteries for only 35 minutes of talk time, 8 hours of standby time and needed10 hours to recharge.

Retailed for $3,995

Martin Cooper

Dyna Tac

48

Ubiquitous Computing (1991)

First were mainframes, each shared by lots of people.

Next came the personal computing era.

Next comes ubiquitous computing, or the age of *calm technology*, when technology recedes into the background of our lives.

Mark Weiser is the father of ubiquitous computing (1991).

[Mark Weiser, "The Computer for the 21st Century", *Scientific American,* pp. 94-10, Sept. 1991]
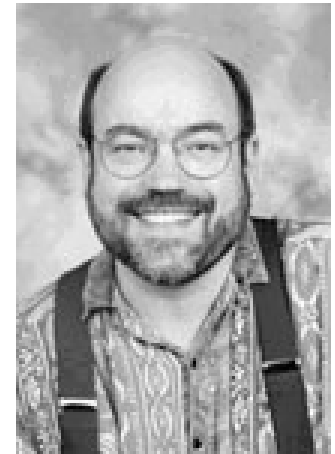
Mark Weiser (1952-1999)

Tim Berners-Lee (1955-)

BORN June 8, 1955, in London

1976 Graduates from Queen's College, Oxford

1980 While at CERN, writes "Enquire"

1989 Proposes global hypertext project called "WorldWideWeb"

1991 The Web debuts on the Internet

1993 University of Illinois releases Mosaic browser

1994 Joins M.I.T. to direct the W3 consortium

1999 Today nearly 150 million people log on to the Internet via WWW

Tim Berners-Lee is considered to be the founder of the World Wide Web.

"First of all, let's get clear the difference. The internet is a collection of computers, which was put together during the 1970's. When I proposed the Web in 1989, the internet had been around for 15 years. You could use e-mail, you could store files on ftp servers, and people could access them, but it was very complicated. The web was the step to make accessing a remote document just one click. The internet spread really quite slowly. It started in research, moved into universities, and many people only heard about it when the web became available as an easy way to use it. " (T. Berners-Lee, 1999)

Where is HCI going?

- Mobile and ubiquitous computing
- Virtual reality (VR) and augmented reality (AR)
- Human-Robot interaction (HRI)
- Computer Supported Collaborative Work (CSCW)
- Speech, voice, and gesture interfaces