

History of Human-Computer Interaction

Handout:

A Historical and Intellectual Perspective

(Chapter 1 from Baecker, Buxton, et al.:

Readings in Human-Computer interaction: Toward the Year 2000)

Focus on People & Systems,

Research Areas,

Breakthrough Developments

History of Human-Computer Interaction

- The Memex (V. Bush)
- Man-Computer Symbiosis (J.C.R. Licklider)
- Time Sharing and Networking
- Sketchpad (I. Sutherland)
- Interactive Computer Graphics
- Hypertext, CSCW, Augmented Human Intellect
- Human Factors, Psychology in HCI Design
- The Personal Workstation
- The Dynabook (Alan Kay)
- The Personal Computer
- Artificial Intelligence
- Modeling Users and Interfaces
- Expanding Research Frontiers (VR, Wearable, Ubicomp...)

History of HCI

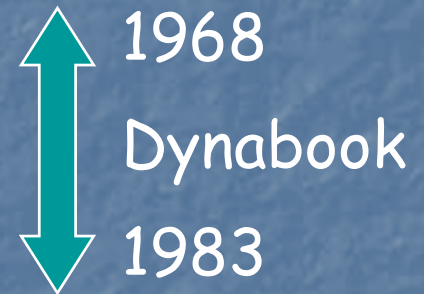
■ Personalities:

- Vannevar Bush - Universal information access
- J.C.R. Licklider - Networking, Agents
- Ivan Sutherland - Sketchpad
- Doug Engelbart - Mouse, GUI, Word proc...
- Ted Nelson - Hypertext
- Alan Kay - OO programming, Laptops
- Don Norman - Cognitive principles
- Jacob Nielsen - Usability

History of HCI

■ Systems:

- Memex - 1945 (concept)
- Sketchpad - 1963
- NLS (oNLine System) - 1963-68
 - (mouse '64)
- Xerox Alto '72, Star '81
- Grid Compass 1983
- Apple Lisa '83, Mac '84, NeXT '88
- Powerbook 1991
- HTML, HTTP 1994
- Apple iPhone 2007



History of HCI

■ Politics

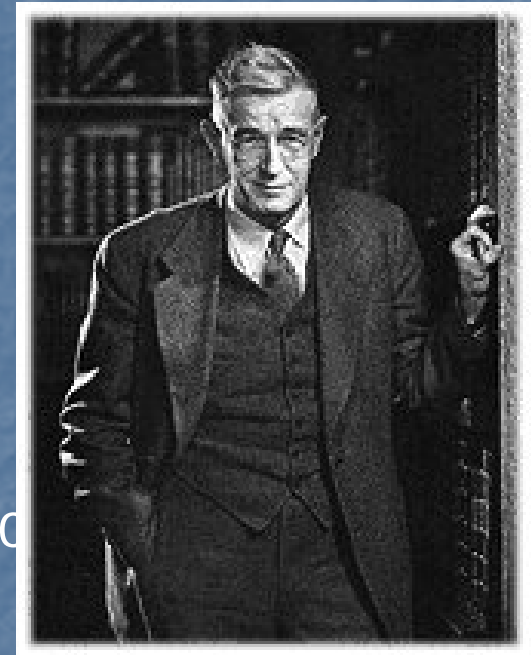
- Military Funding
 - NDRC - OSRD - ARPA – DARPA
- Elite universities (MIT, Stanford, CMU, Berkeley)
- NSF 1950 ➡ present
- Xerox PARC - 1970 ➡ present (2003)
- Apple - NeXT
- Hypertext 1967...
 - Prototypes: HES 1969, ZOG 1975...
 - Xanadu 1981, not funded 'til 87 (Hypercard 1987)
 - 1989 Xanadu -> Autodesk, WWW proposal

Online History

- There was an excellent PBS special on the history of computing that covered most of these topics:
- “Triumph of the Nerds” and “Nerds 2.0.1”
- <http://www.pbs.org/opb/nerds2.0.1/>

People

- Vannevar Bush (1890-1974)
 - Engineer by training (MIT)
 - Differential analyzer - 1930
 - Led computing research in '30s
 - Created military research
 - NDRC '40, OSRD '41-47
 - Managed nuclear weapons research throughout the 40's
 - Wrote "science - the endless frontier" 1945
 - Military consultant through 50's

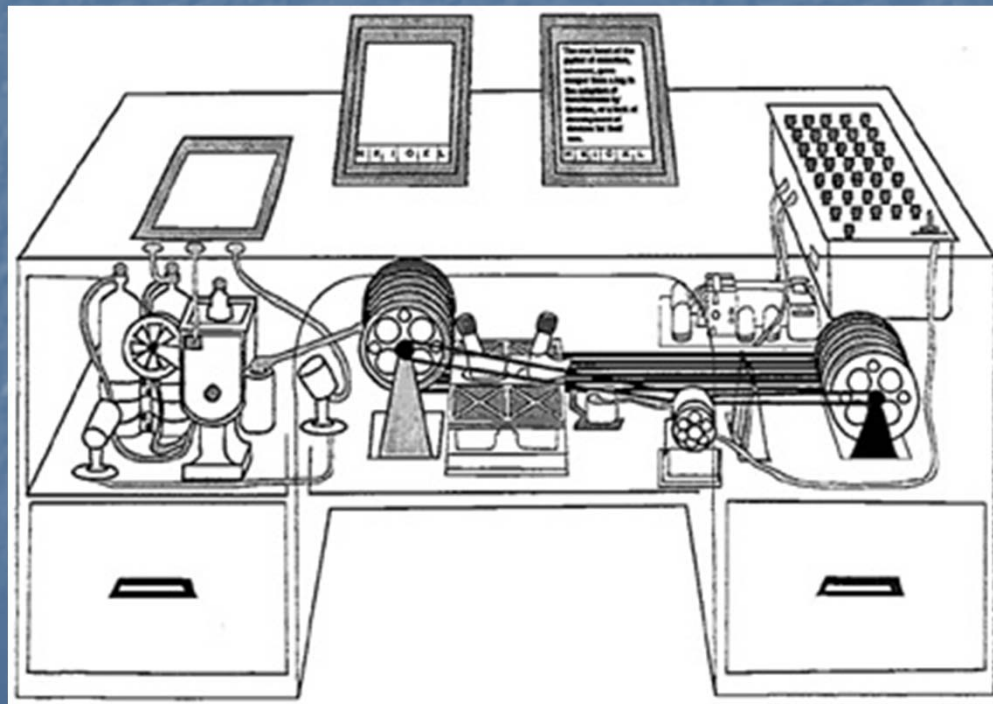


Memex

- It's 1945, what should the ultimate computer look like?
- What should it do?

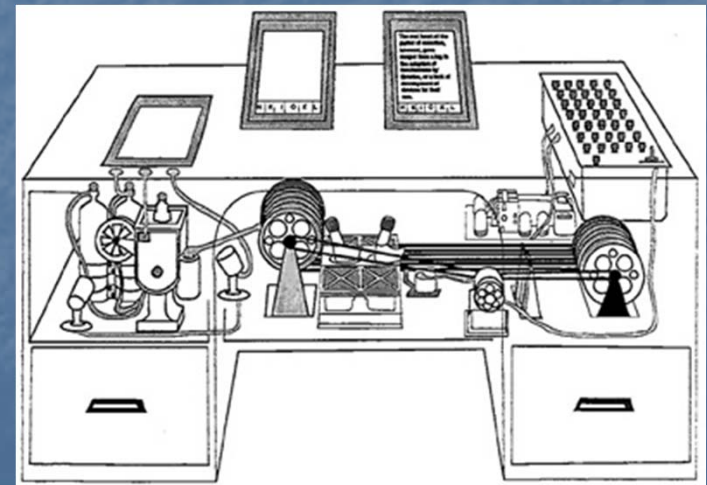
Memex

- Bush's "as we may think" 1945
 - Proposed the "Memex," a very modern computer



Memex

- Individuals store all personal books, records, communications
- Items retrieved rapidly through indexing, keywords, cross references,...
- Can annotate text with margin notes, comments...
- Can construct a trail through the material and save it
- Acts as an external memory



Post-Memex

- After WWII, Bush continued to push for analogue computers (and against digital).

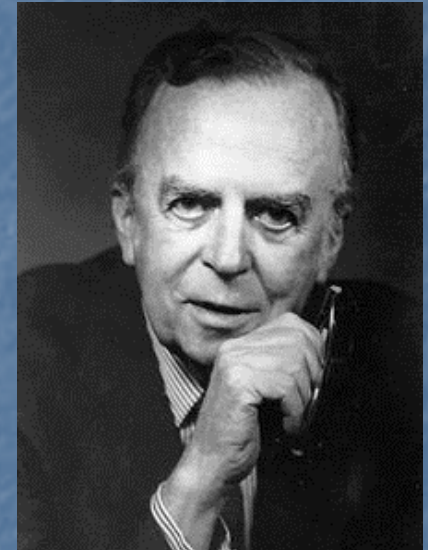
Post-Memex

- After WWII, Bush continued to push for analogue computers (and against digital).
- Which just goes to show that even people with great ideas don't get it right all the time...

J.C.R. Licklider

1915-1990

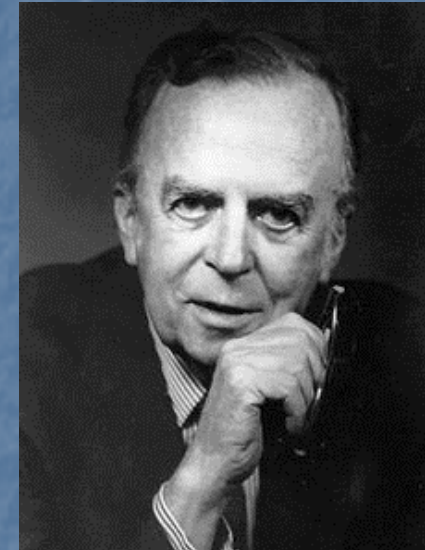
- Ph.D. 1942 Rochester, Psychologist
- Started "Human Engineering group" at MIT's Lincoln labs in 1951
- Tried to evolve psych. into a department within MIT's Electrical Engineering
- ARPA created in 1958 in response to Sputnik, "Lick" became director of CS research in 1962.
- With ARPA sponsorship, the first CS programs were created:
 - MIT, CMU, Berkeley, Stanford



J.C.R. Licklider

1915-1990

- At ARPA, Licklider promoted computing research and sponsored:
 - Time-sharing
 - Networking
 - Engelbart's and Sutherland's online computing work
- Controversial at the time, why?



Networks, Time-sharing

- Much of Licklider's sponsored research was unpopular in the engineering community:
- "Time-sharing is a waste of valuable computer time"
- "Why are we doing this?"
 - BBN engineer about the first computer network

Timesharing

- Computers too expensive for individuals
 - increased accessibility
 - interactive systems, not jobs
 - text processing, editing
 - email, shared file system





J.C.R. Licklider, Key Publications



- Man-computer symbiosis – 1960
- Libraries of the future – 1965
- The computer as communication device - 1968

Man-Computer Symbiosis - 1960

- Did self-observation of his daily work.
 - Observed that much work was mundane and related to accessing and organizing information
- Proposed:
 - Digital libraries
 - Display screens with pen input and character recognition
 - Wall displays for collaborative work
 - Speech recognition and production for HCI

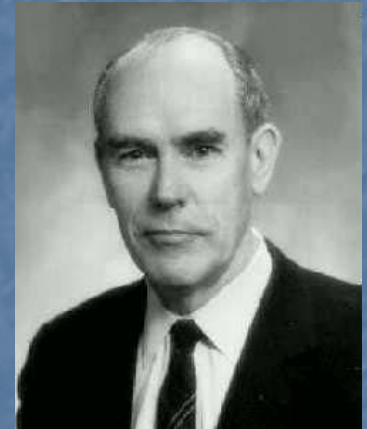
The Computer as a Communication Device - 1968

- Cooperative work with shared and individual screens
- Pen chat
- Online communities
- Agents – OLIVERs On-Line Vicarious Expediter and Responder

Ivan Sutherland

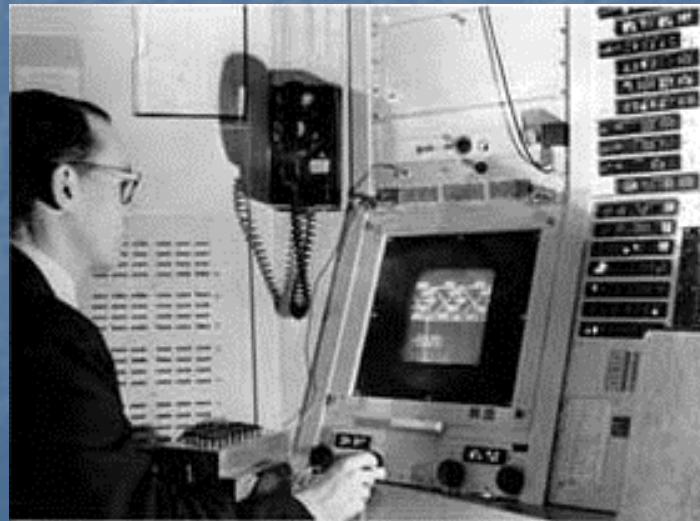
1938 -

- MIT Ph.D. in 1963
- Ph.D. work was "Sketchpad"
- Pioneered computer graphics and CAD
- Started Evans and Sutherland in 1968



Ivan Sutherland: Sketchpad

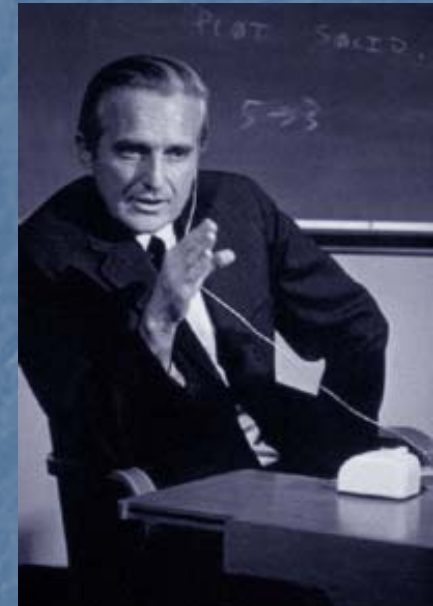
- Sketchpad was a very modern pen-based interactive system that support CAD design and 3D modeling.
- Its novelty was its interactivity (real-time computing was practically non-existent).



Doug Engelbart

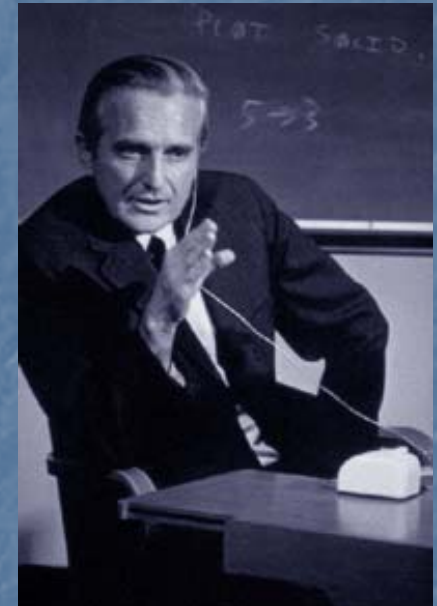
1925 -

- Ph.D. UC Berkeley (EE) in 1955
- Thesis on “plasma digital devices”
- a way into computing
- Strongly influenced by Bush’s article
- Moved to SRI, started formulating human augmentation ideas in 1959
- Funding from ARPA in 1963
- NLS (oNLine System) demo 1968



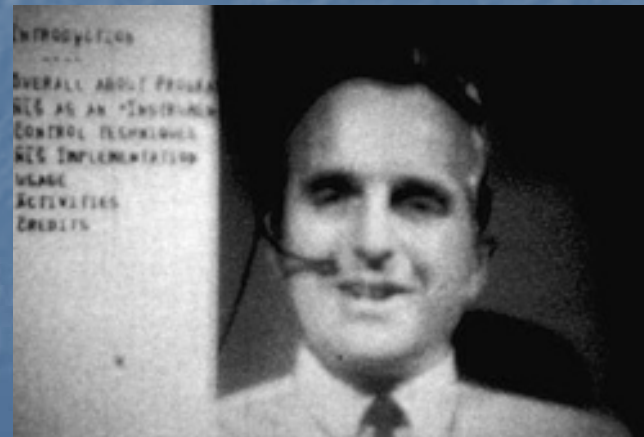
Doug Engelbart

- How would you implement Bush's Memex in 1963?



Engelbart's innovations

- NLS (1968) featured:
 - Video screen and keyboard
 - Mouse and chording keyboard
 - Videoconferencing
 - Hypertext linking
 - Word processing
 - E-mail
 - A window system
 - User testing!



The first mouse, 1964



Links across documents, in conjunction w. chorded keyboard

Engelbart's work - here

- Continued at SRI, worked on network extensions
- Funding dwindles through the 70's..., AI ↑ HCI ↓
- NLS project sold in 1977 to Tymshare
 - Half of the (~40) NLS engineers moved to Xerox PARC, others to Tymshare
 - Engelbart fired from SRI in '77, moves to Tymshare
- Migrated to McDonnell-Douglas in 1984, until 1989 pushed for open hypertext systems
- Started Bootstrap institute in 1989

Engelbart's work

- 80s and 90s: Personal computing and the web happen
- Engelbart Receives the ACM Turing award in 1997

“For an inspiring vision of the future of interactive computing and the invention of key technologies to help realize this vision”

Ted Nelson

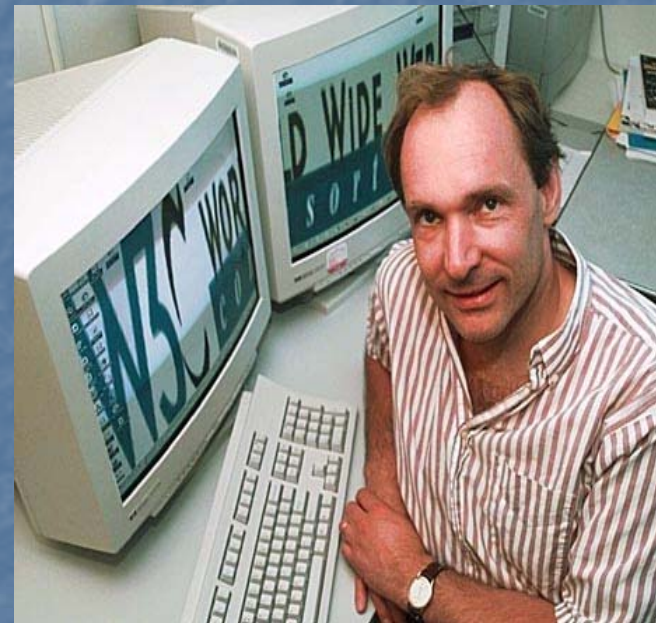
1937 -

- M.A. Sociology, Harvard '63
- Coined "hypertext" in 1960
- Worked with Van Dam at Brown on HES – 1967
- Designed Xanadu in 1981
 - Global hypertext
 - Pay-per-view
 - Not funded until 1987
- Hypertext as a more natural medium than linear text for creative writing
- "I build paradigms. I work on complex ideas and make up words for them. It is the only way."



Tim Berners-Lee/ Mark Andreessen

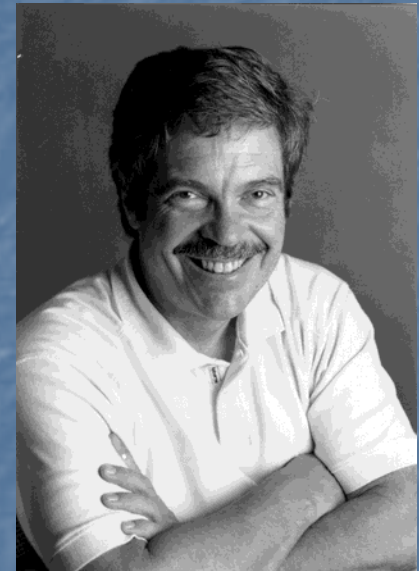
- Berners-Lee Co-developed the HTTP/HTML standard as an open standard (1991).
- Key facilitator was an active user group (Physicists) who needed hypertext.
- Mark Andreessen added the “Mosaic” browser which simplified access and opened up the “web” to anyone (1993).



Alan Kay

1940 -

- Ph.D. 1969 (Utah) Computer Graphics
- In 1968, met Seymour Papert (LOGO) in the MIT AI Lab.
 - kids can program!
- Moved to Xerox PARC in 1972
- Started developing "Smalltalk", in the Learning Research Group
- First general OO programming language
- Influenced by Simula
 - Engineers can program!



Alan Kay @ PARC

- Dynabook (first personal computer) conceived by Kay in 1968.
- What should it look like?

Alan Kay @ PARC

- Dynabook (laptop computer) conceived in 1968, well ahead of its time.
- As interim steps, Kay pushes the Xerox Alto (1972) and Star, the first real personal computers.



Xerox Alto

Alan Kay @ PARC

- The Star (1981 and begun in 1975) in particular was a very advanced machine. It had most of the “WIMP” elements we know today.
- The Star was the result of extensive user testing, and its design has stood the test of time (Liddle article).
- Many design features were better than its successors (e.g. object-oriented editing features)



The Star group

- The Star design team developed a new methodology for system design:
- Task analysis
- Wide range of users
- Usage scenarios
- Decomposition of design:
 - display and control interface
 - User's conceptual model
- Many prototyping cycles
- Desktop metaphor, direct manipulation, WYSIWYG



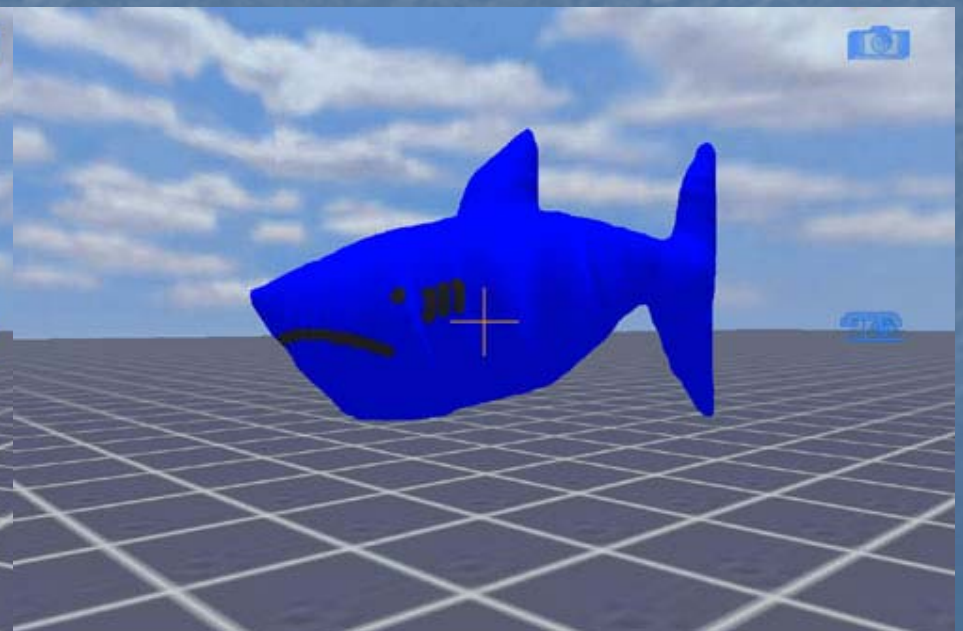
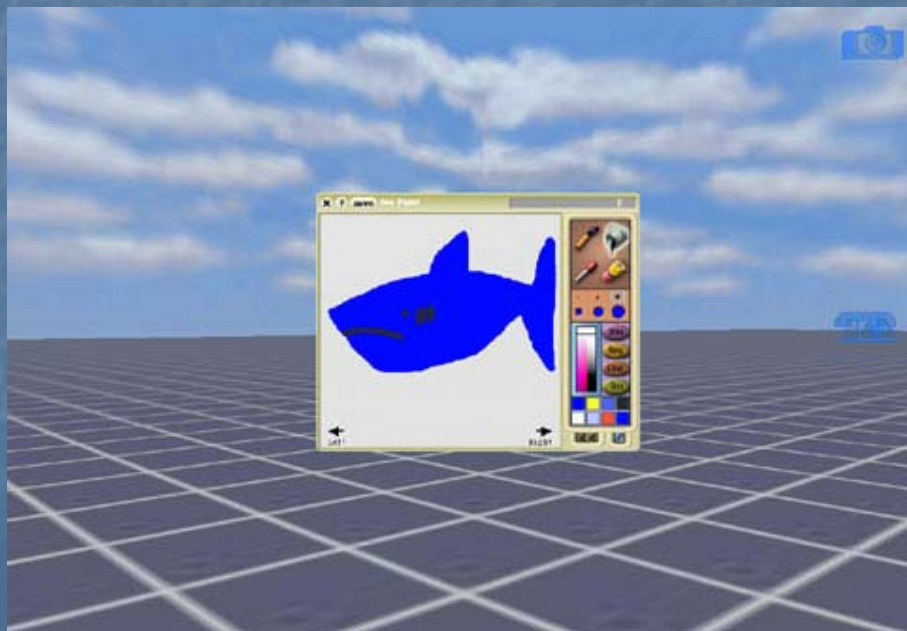
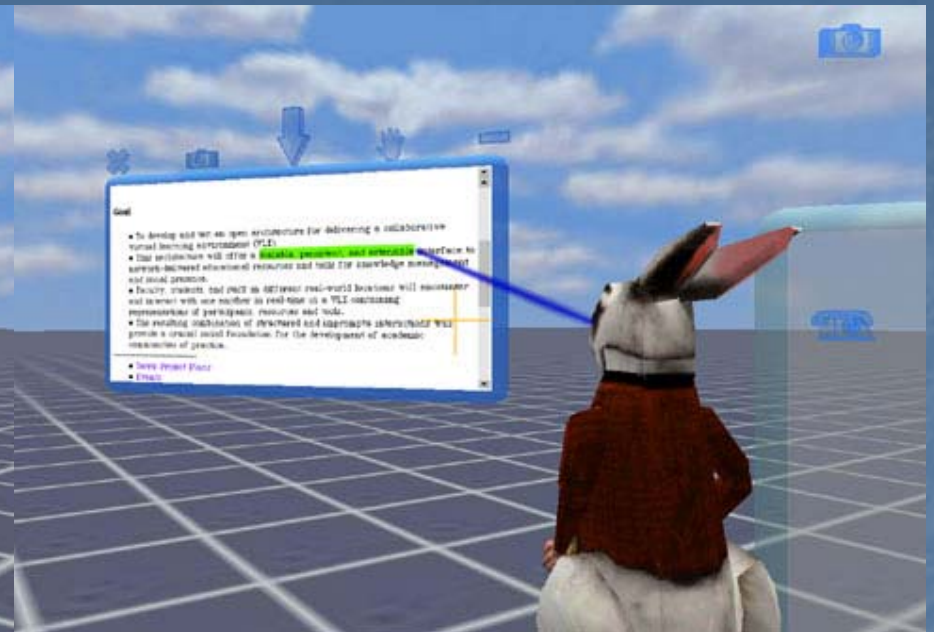
Star -> Mac

- But the Star was expensive and slow (\$25k).
- Steve Jobs and Apple engineers visited PARC in 1979, and that set the path for Apple
- 15 PARC engineers migrated to Apple
- Apple Lisa ships in 1983 at \$10,000, and fails in the marketplace
- The Apple Macintosh (Jeff Raskin) ships in 1984 at \$2500, and the personal computing market changes for good



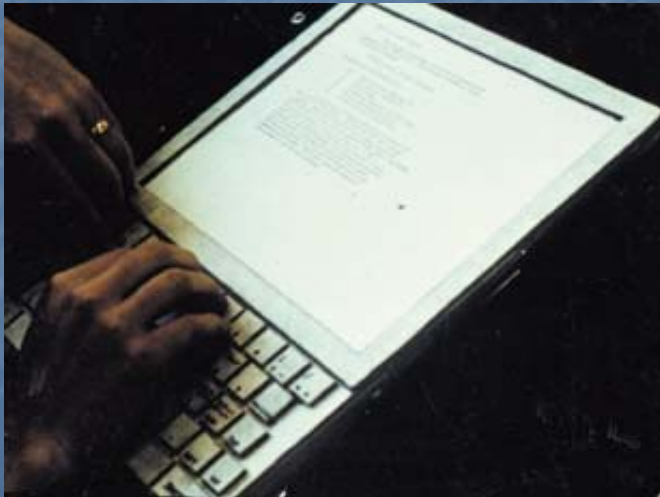
Alan Kay after PARC

- Kay worked briefly at Atari, then became an Apple fellow in 1984. Often visited the MIT Media Lab in the 80's and 90's.
- In 1996 he left for Disney to become a Disney fellow. Left Disney because of cutbacks, joined HP labs in 2002.
- Working (among other things) on Croquet
- In 2005 went on to head the Viewpoints Institute



Alan Kay quote

- "Don't worry about what anybody else is going to do... **The best way to predict the future is to invent it.** Really smart people with reasonable funding can do just about anything that doesn't violate too many of Newton's Laws!"



Small Devices

- The Apple Newton was the first “PDA” (1993) but didn’t succeed commercially.
- Still sort of popular, though long out of production.
- Has achieved a kind of cult status.



Palm Pilot

- Jeff Hawkins was an EE with an interest in cognitive science and the brain.
- Worked at GRiD.
- Wrote Ph.D. proposal at Berkeley in Biophysics in 1987 - rejected.
- Back to GRiDPad - first pen computer?
- Developed a handwriting recognizer based on his interests in the Brain.



Palm Pilot

- Next try: "Zoomer" 1993 - a failure commercially
- Intensive studies of Zoomer users began in 1994
- Decided the PDA should be a paper replacement, not a PC replacement.
- Switched to graffiti.
- Shrunk to pocket size.
- Unveiled the Palm Pilot in 1994.



Smart phones

- Qualcomm's PDQ 1999 (Jacobs) - phone with a complete Palm Pilot inside. Other models followed.
- Latest generation of phones support "applets".
- Motorola J2ME phones.
- Qualcomm's BREW (binary) environment.
- GPS will enable location-based services.



Phono-photo-orga-locallizers

- Butler Lampson (Time-sharing, Dynabook, Alto, Turing award) argues that when devices are “close enough” (e.g. factor of two) in size and cost, they collapse.
- So, cell phones, PDAs, cameras, GPS's etc. will merge into one product.
- → iPhone



Tablet PC

- Excellent writing surface, pen, digital ink.
- Compromise on:
 - Keyboard
 - Weight
 - Battery life
- Still (or again) trying to be a PC.
- Many formats, will natural selection choose a winner? - or is it headed the way of the Newton?



Multi-Touch, Surface Computing

- Multi-Touch Display (U Toronto, 1982)
- 1991 Pierre Wellner's Digital Desk
- Early 2000's: More prototypes (Fingerworks, 2005 acq. by Apple, Jeff Han's TED demos → Perceptive Pixel, Andy Wilson @ Microsoft Research)
- 2007 iPhone
- 2008 Microsoft Surface
- Will it stay around as a platform and paradigm?

From my HCI class slides (additions 2007/8):

Multi-Touch, Surface Computing



Encouraging (to me)

There actually is a new UI paradigm now (~40 years since the Alto)...

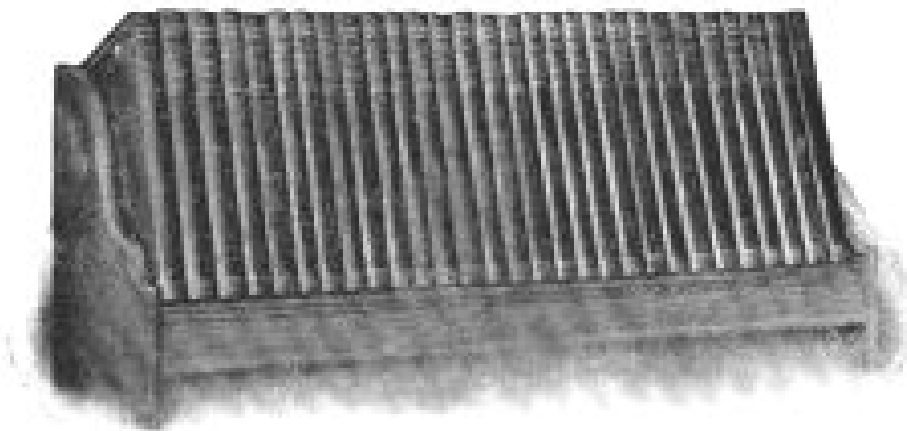


Not revolutionary,
but...



Our Knowledge Repository – 1910

WHEN IN DOUBT—"LOOK IT UP" IN The *Encyclopaedia Britannica*



(New 11th Edition) issued 1910-11 by the
CAMBRIDGE UNIVERSITY PRESS (England)

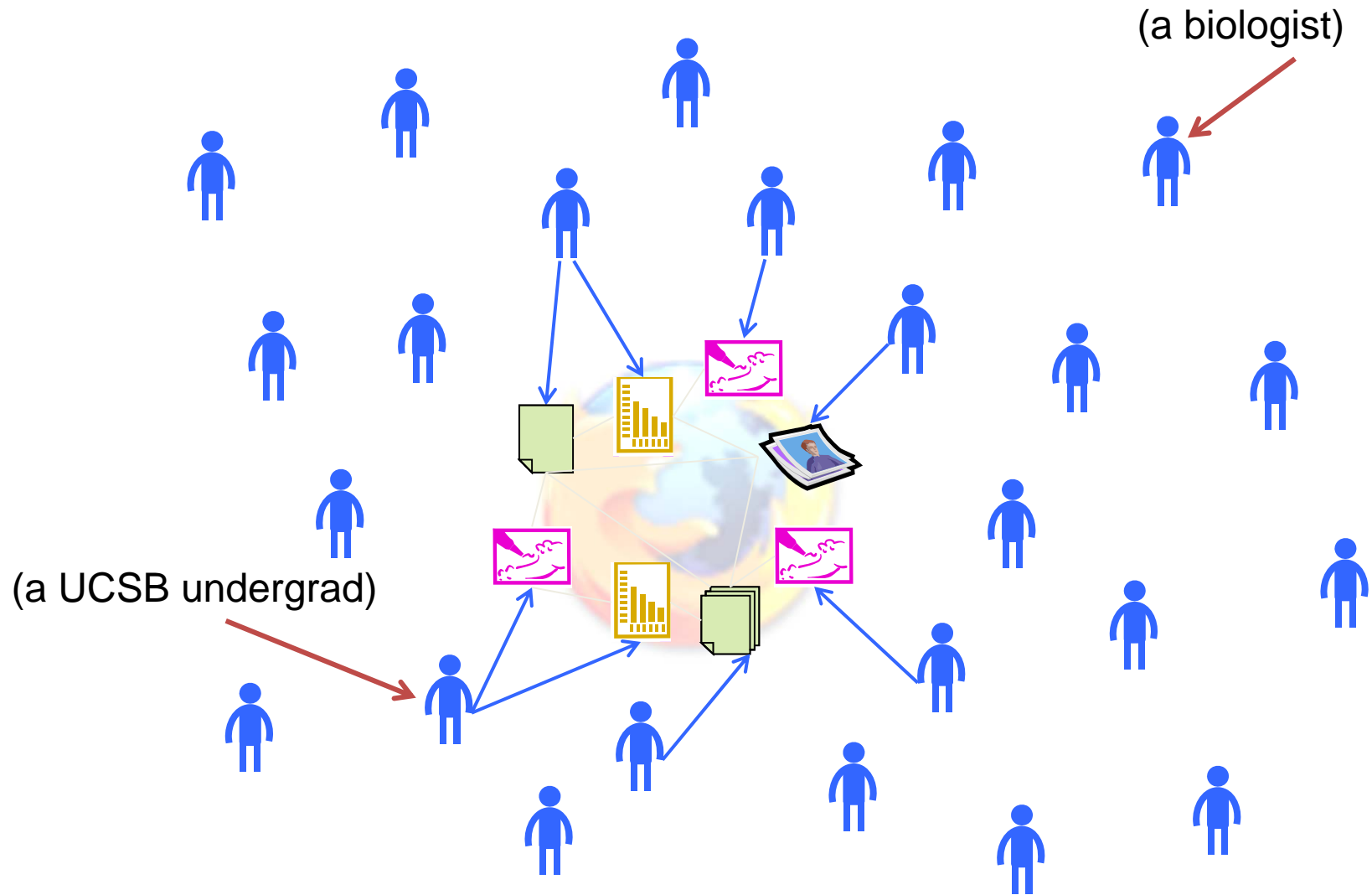
The Sum of Human Knowledge

*29 volumes, 28,150 pages,
44,000,000 words of text.
Printed on thin, but strong
opaque India paper, each
volume but one inch in
thickness.*

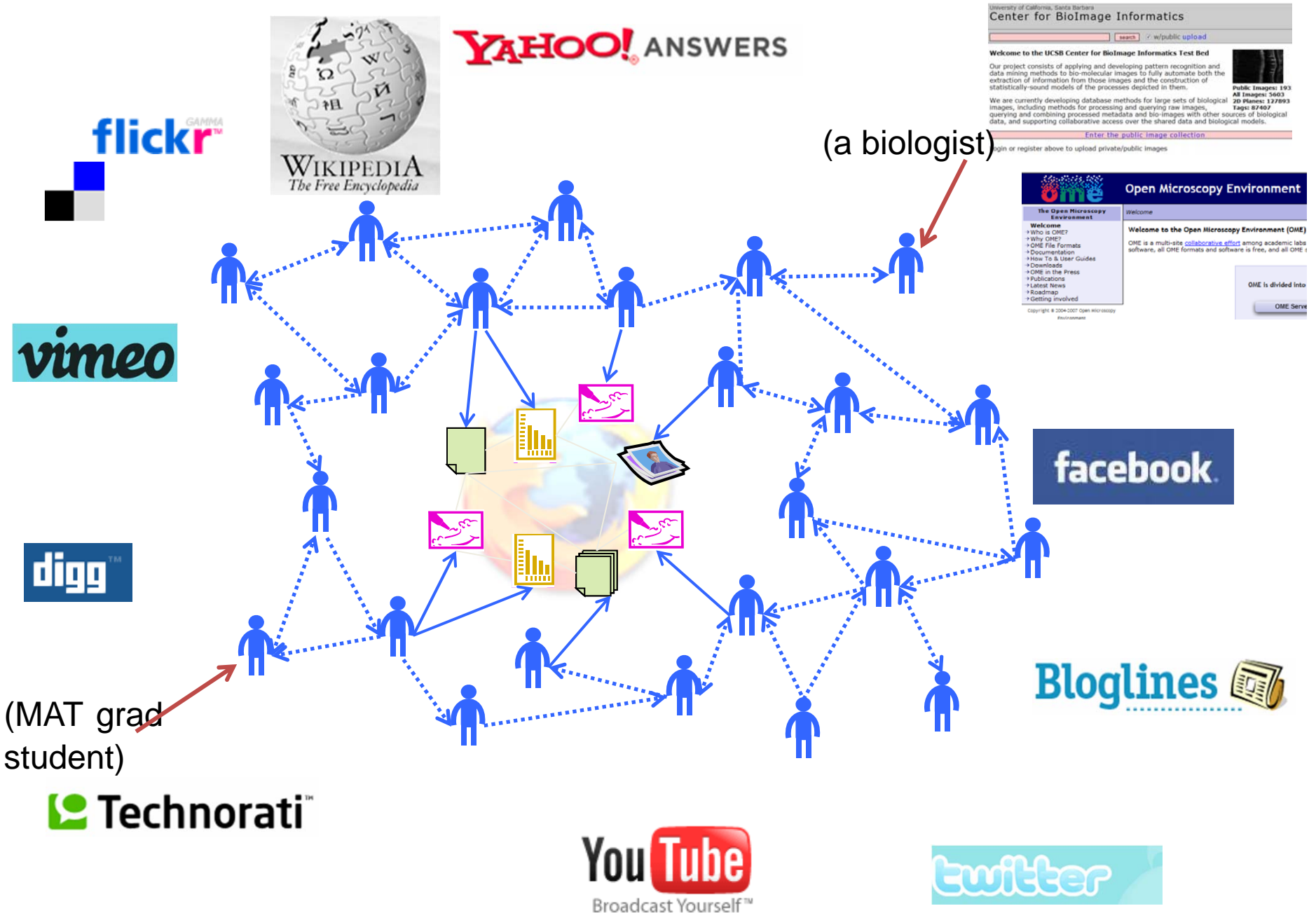
THE BOOK TO ASK QUESTIONS OF

FOR READING OR FOR STUDY

The “Traditional” Web



The "Social" Web (aka 2.0)




Virtual Reality



Henry Fuchs (UNC) thoughts on Facebook/Oculus deal (at IEEE VR 2014)

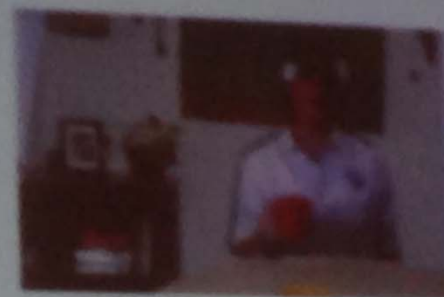
First, why did Oculus make this \$2B breakthrough?

- Started with an excellent HMD design (Mark Bolas & Ian McDowall's Fakespace Labs Wide5&follow-on) + new large screens + low-latency tracking (needed for presence) 
- Kickstarter: excitement, potential for vast # of users, attracting many app developers, a community.
- Why didn't one of the established VR companies do this?
 - Big companies: very difficult to make a big organization move quickly
 - Small companies: difficult to raise funds for long-range R&D
- Why didn't a university group develop such a good HMD & tracker?
 - May not be a dissertation in it. May not lead to a good publication. May not help get more research funding. "Too incremental"

Summary & Concluding Thoughts

- Oculus-Facebook \$2B Acquisition is a historic opportunity for VR field.
- Telepresence: idea is appealing, but unproven, & unconvincing to many, perhaps most people

Similar to state of computer animation in ~1971; only a few papers & demos; no animation house used it.



- But, progress is visible annually
- Advances in VR "presence" will come fast, and these will help Telepresence also.
- Few people have an opportunity to change the world, we in VR can,



Ubiquitous Computing

Ubiquitous computing is just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. 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 Twenty-First Century](#)", *Scientific American*, pp. 94-10, Sept. 1991]

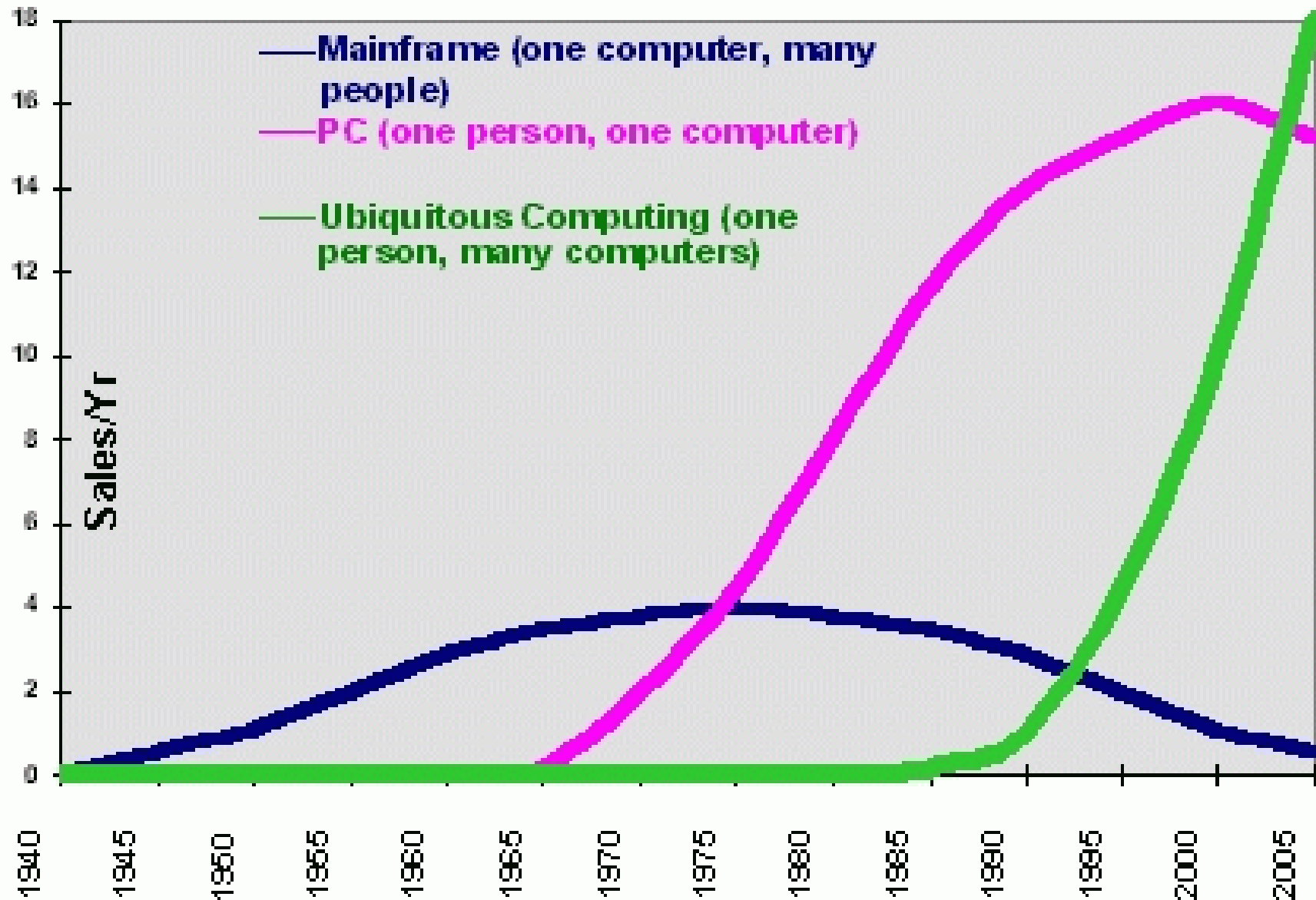


Mark Weiser (1952-1999)

What Ubiquitous Computing Isn't

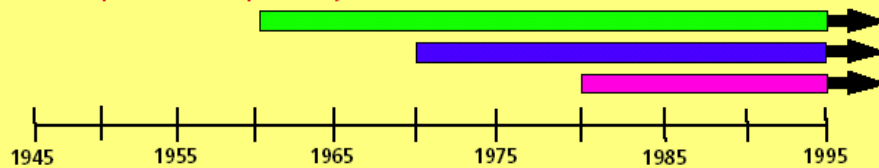
Ubiquitous computing is roughly the opposite of virtual reality. Where virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out here in the world with people. Virtual reality is primarily a horse power problem; ubiquitous computing is a very difficult integration of human factors, computer science, engineering, and social sciences.

The Major Trends in Computing

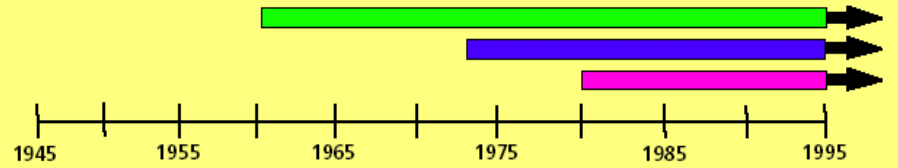


Historical Perspective (1945-1995)

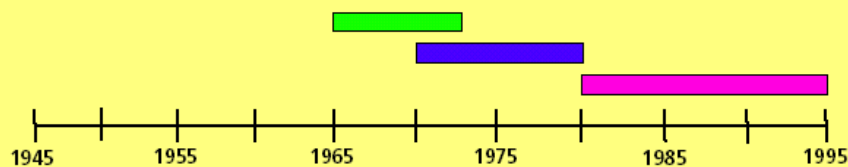
Direct Manipulation of Graphical Objects



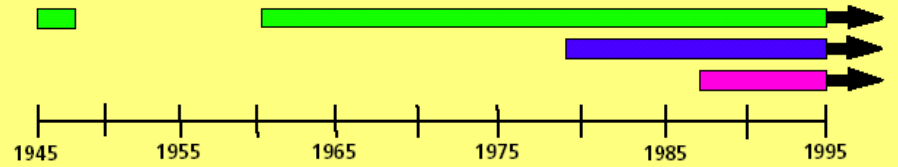
Text Editing



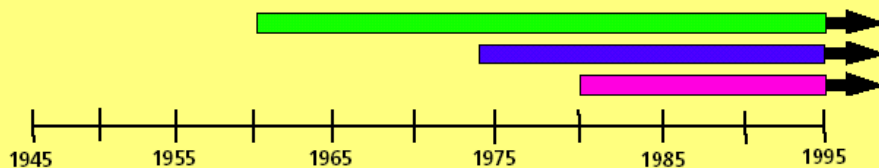
The Mouse



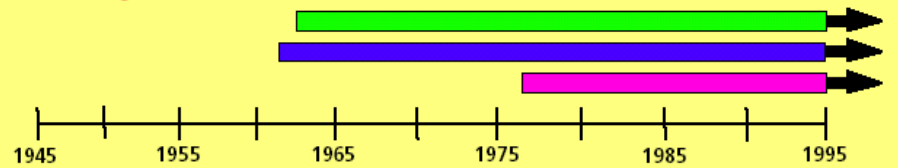
HyperText



Windows



Gesture Recognition



KEY:

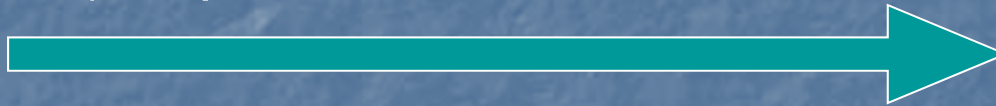
- University Research
- Corporate Research
- Commercial Products

[source: Brad A. Myers (1998).
A brief history of human-computer interaction technology.
Interactions, vol 5(2), pp. 44-54]

Putting Things in Perspective: An Analogy

mid 60's

Sutherland, Engelbart, Kay (and others) inspire the PC revolution



early 90's

Developing PC apps is (relatively) “easy” and mainstream

early 90's

Weiser, Hopper (and others) inspire ubicomp revolution



2020

Where will we be?
Are we more than
three-quarters there
yet ?

QUESTIONS ?