Historical Perspective

CS160: User Interfaces

Maneesh Agrawala

Slides based on those of John Canny, Francois Guimbretiere and James Landay

Upcoming Schedule

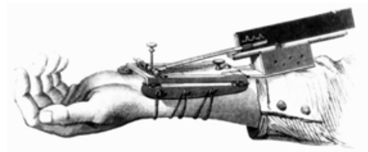
Interactive Prototype (pick up after class today)
- Mean 89.71
- Stdev 8.45

Final Presentation and Report (due Nov 27)
- Revise interface based on pilot study
- Last chance to finish implementation
- Presentations held in my office Nov 27 and 29
  - Sign up next week
- We are planning a project fair for Dec 4

Review: 3 Functions of Vis.

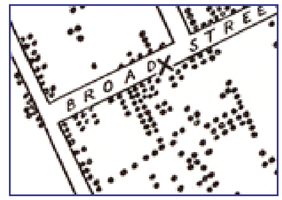
Record information

– Photographs, blueprints, …



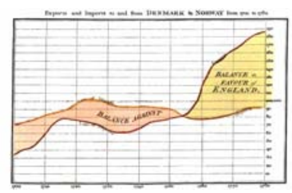
Support reasoning about information (analyze)

– Process and calculate
– Reason about data
– Feedback and interaction



Convey information to others (present)

– Share and persuade
– Collaborate and revise
– Emphasize important aspects of data



Review: Data and Image

N - Nominal (labels)

– Fruits: Apples, oranges, …

O - Ordered

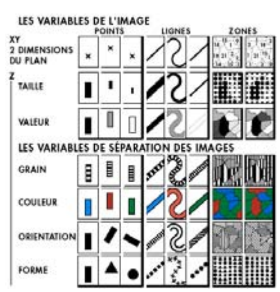
– Quality of meat: Grade A, AA, AAA

Q - Quantitative

– Ordered, with measurable distances, or amounts
– Physical measurement: Length, Mass, Temp, …

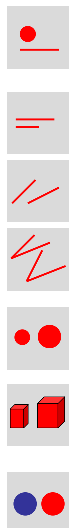
Visual Variables

– Position
– Size
– Value
– Texture
– Color
– Orientation
– Shape



Review: Magnitude Estimation

Most accurate



Position (common) scale
Position (non-aligned) scale

Length

Slope

Angle

Area

Volume

Color hue-saturation-density

Least accurate

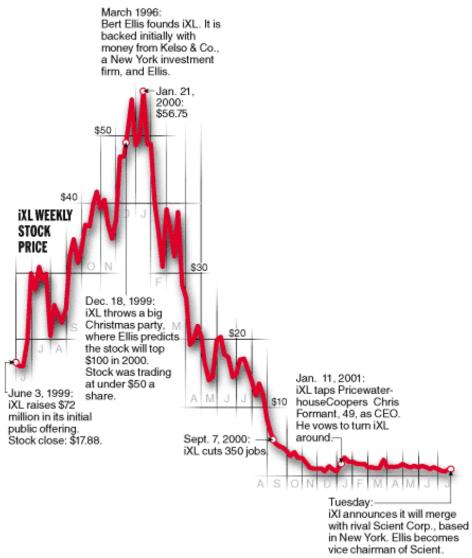
Review: Encoding Data

Position	N	O	Q
Size	N	O	Q
Value	N	O	Q
Texture	N	O	
Color	N		
Orientation	N		
Shape	N		

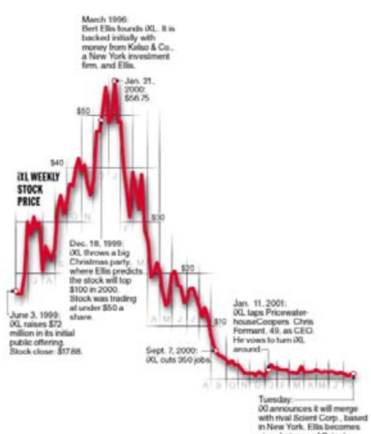
N Nominal
O Ordinal
Q Quantitative

Note: Q < O < N

Review: Deconstruction

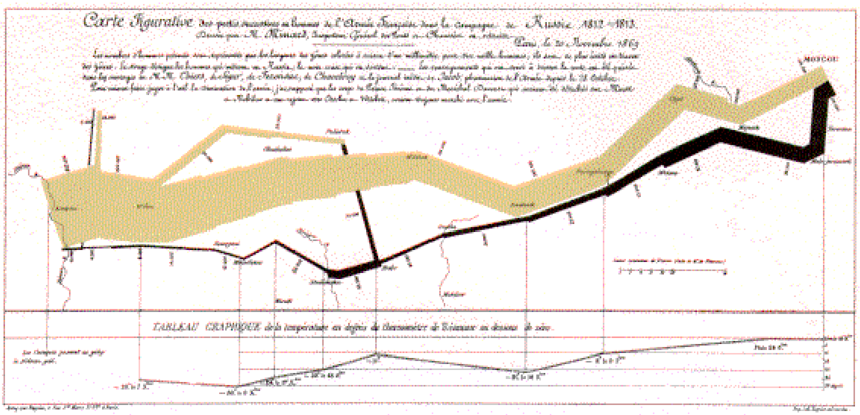


Review: Deconstruction

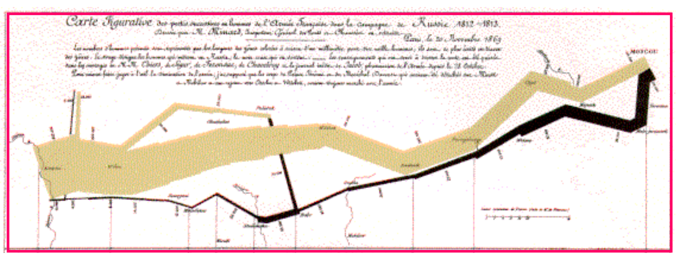


x-axis: time (Q)
y-axis: price (Q)

Napoleon's March [Minard 1869]



Single Axis Composition



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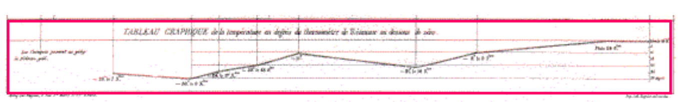


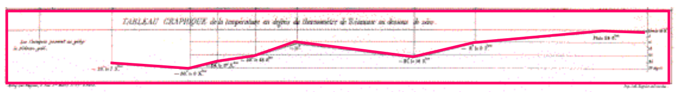
=

[based on slide from Mackinlay]

Mark Composition

y-axis: temperature (Q)

\+ x-axis: time (Q)

= 

temp over time (Q x Q)

[based on slide from Mackinlay]

Mark Composition

y-axis: longitude (Q)

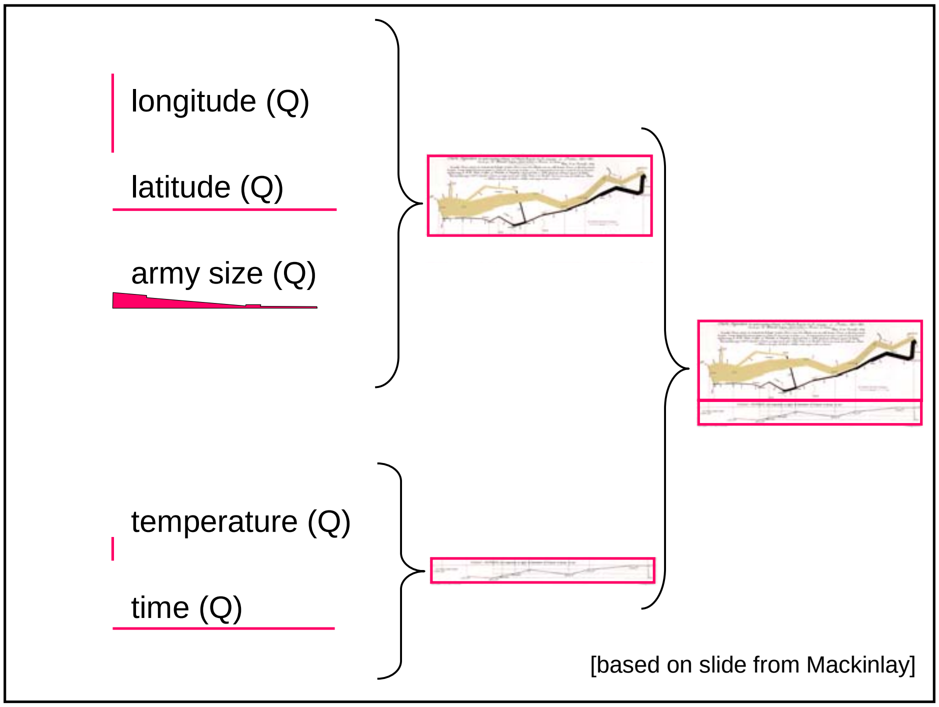
\+ x-axis: latitude (Q)

\+ width: army size (Q)

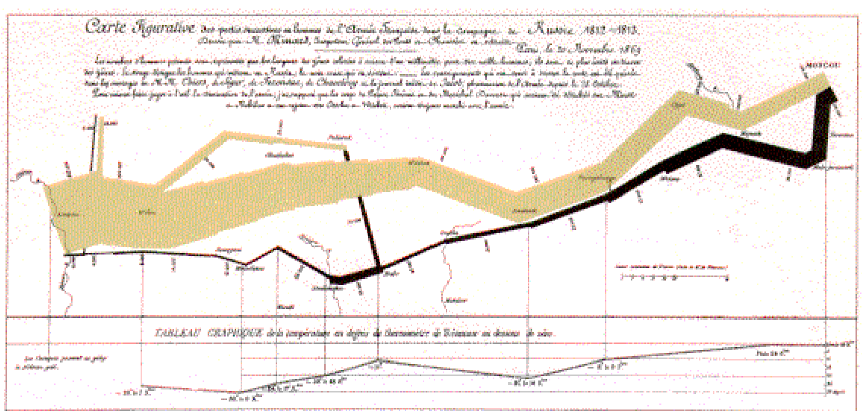
= 

army position (Q x Q) and army size (Q)

[based on slide from Mackinlay]



Napoleon’s March [Minard 1869]



- Depicts at least 5 quantitative variables
- Any others?

Summary

We create visualizations to

- Record information
- Support reasoning about the information
- Convey information to others

Choose the right mark for your data

- Position good for N, O, Q, but Hue best only for N
- …

With careful design it is possible to display many dimensions at once

Topics

- Precursors
- 1940's Early Visions
- 1960's Visionary Demos
- 1970's Personal Computing
- 1980's Graphical User Interfaces
- 1990's Mobile and Ubiquitous

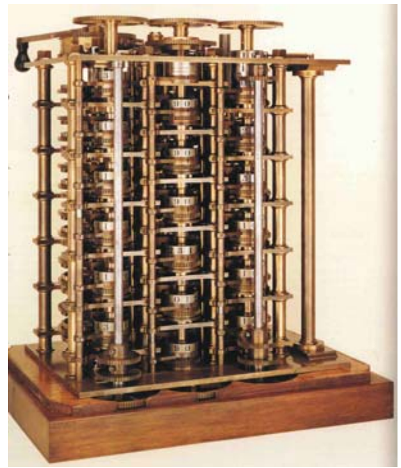
Precursors

Astrolabe (Middle Ages)

Convenient interface to complex computation

Mechanical Control & Computation

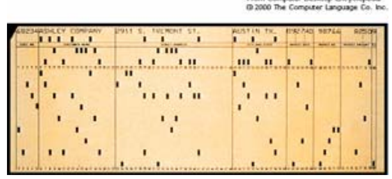
Jacquard Loom (1804)



Babbage Difference Engine (1849)

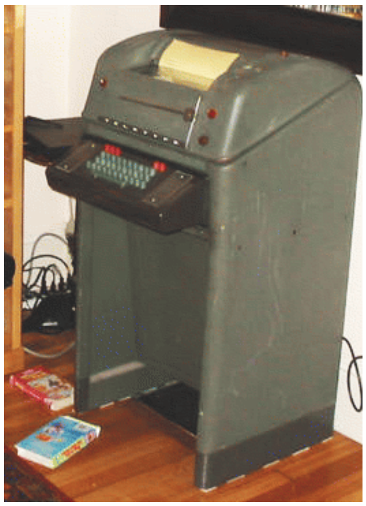
Hollerith Punch Cards (1890)

From Computer Desktop Encyclopedia
© 2000 The Computer Language Co. Inc.



Hollerith Electric Tabulator, US Census Bureau, Washington, DC, 1908,
Photograph by Waldon Fawcett. Library of Congress, LC-USZ62-45687.

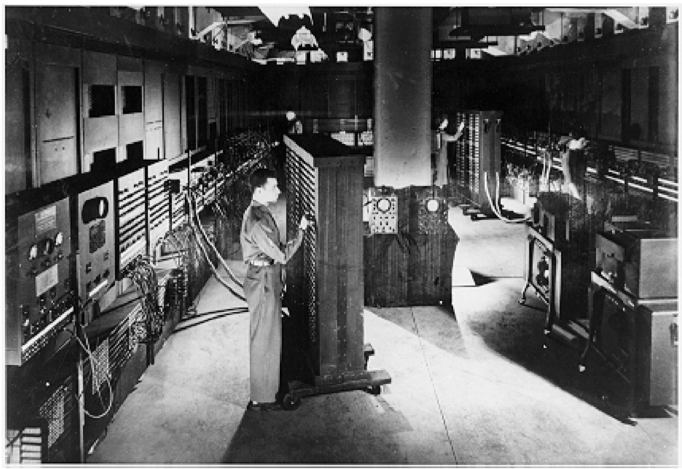
Teletype (ca. 1910)



1940's Early Visions

ENIAC (1943)

World's first numerical integrator and computer

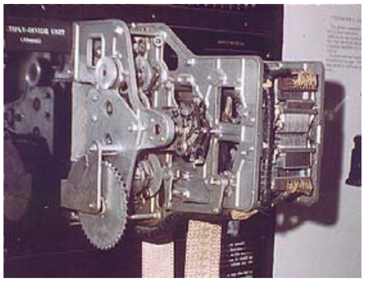


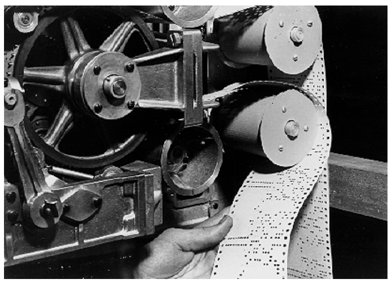
From IBM Archives.

Harvard Mark I (1944)

55 feet long, 8 feet high, 5 tons

Harvard Mark I (1944)





Hardware
- Physical switches (before microprocessors)
- Paper tape

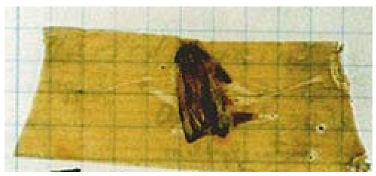
Uses
- Ballistics calculations
- Simple arithmetic & fixed calculations (before programs)
- 3 seconds to multiply

Adm. Grace Murray Hopper

First programmer of Mark I

Adm. Grace Murray Hopper

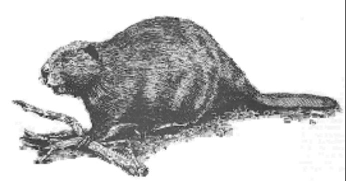
First programmer of Mark I

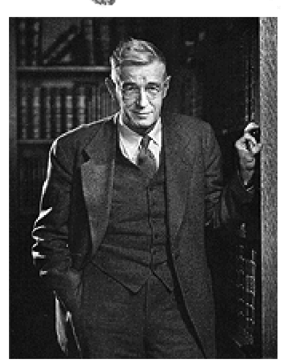


Filed first bug report

Vannevar Bush

- Name rhymes with "Beaver"
- Faculty member MIT
- Coordinated WWII effort with 6000 US scientists
- Social contract for science
  - Federal government funds universities
  - Universities do basic research
  - Research helps economy & national defense



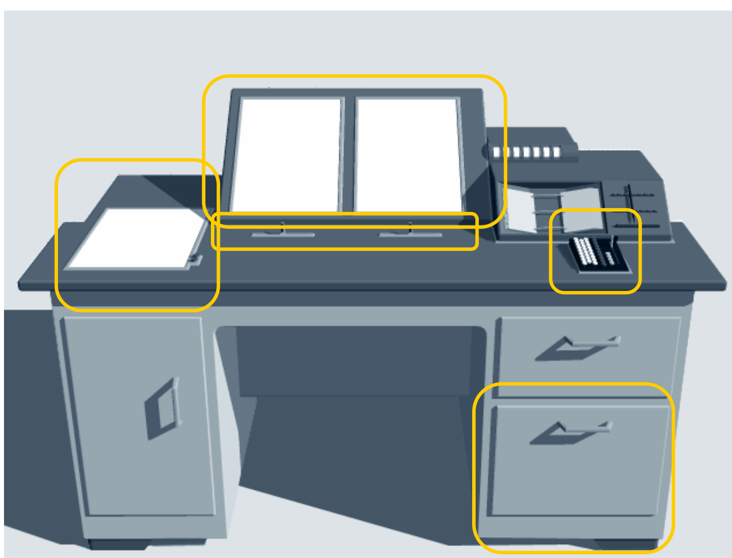


1890 - 1974

As We May Think

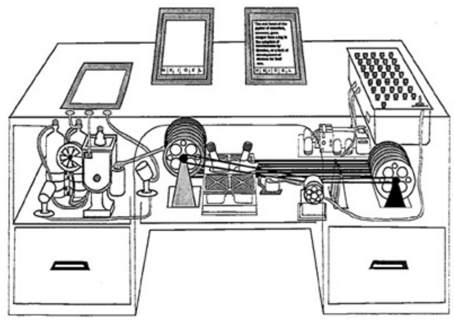
- Published in the *Atlantic Monthly* in 1945!
- What will the computer of the future look like?
  - Wearable cameras for photographic records
  - Encyclopedia Brittanica for a nickel
  - Automatic transcripts of speech
  - Memex
  - Trails of discovery
  - Direct capture of nerve impulses

Memex



Memex

- Store all personal books, records, communications
- Items retrieved 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



1960's Visionary Demos

Context - Computing in 1960s

- Transistor (1948)
- ARPA (1958)
- Timesharing (1950s)
- Terminals and keyboards

Vacuum Tube

Transistor

- Computers still primarily for scientists and engineers

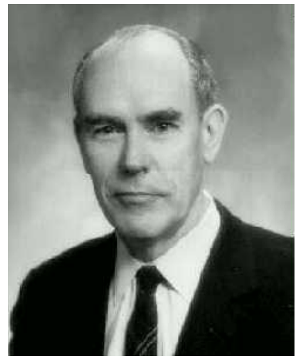
Sketchpad (1963)

- Ivan E Sutherland's PhD thesis
- Modern pen-based system supporting
  - CAD design
  - 3D modeling
- Key: Interactivity (real-time computing was non-existent)

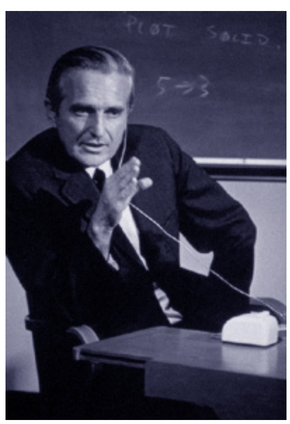
Video: 4:30

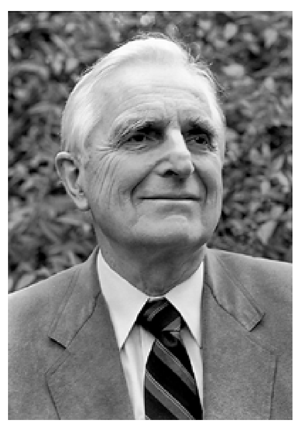
Ivan Sutherland (1938 -)

- Established Computer Graphics
- Turing award 1988
- Now a fellow at Sun and visiting Professor at Berkeley



Doug Engelbart (1925 -)

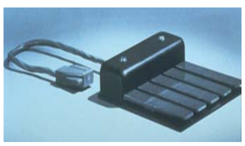




Strongly influenced by Bush
- How would you implement the Memex in 1963?

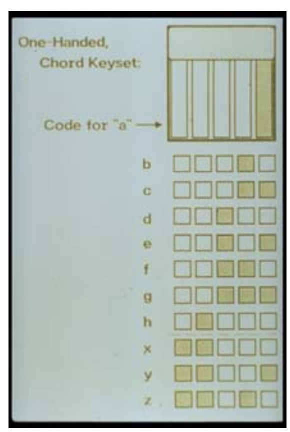
NLS: oNLine System (1968)

- 1968 Fall Joint Computer Conference (SF)
- Demonstrated NLS to1000 computer scientists
  - Video screen, chording keyboard, mouse, videoconferencing, hyperlinking, word processing, email,
  - User testing
  - Extremely influential



Video: 10:54

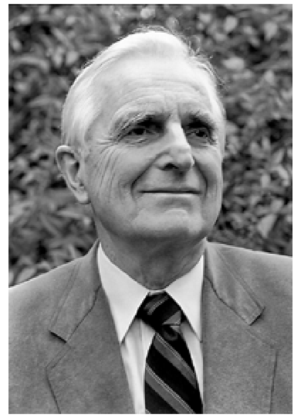
Chording Keyboard and Mouse



Advantages/Disdvantages?

Doug Engelbart (1925 -)

- Graduate of Berkeley (EE '55)
  - bi-stable gaseous plasma digital devices
- Stanford Research Institute (SRI)
  - Augmentation Research Center 1959
- ARPA funding in 1963
  - Starts work on NLS
- Funding dwindles in 70's, AI↑ HCI↓
- McDonnell-Douglas 1984-1989
  - Worked on open hypertext systems
- Started Bootstrap institute in 1989
- Turing award 1997

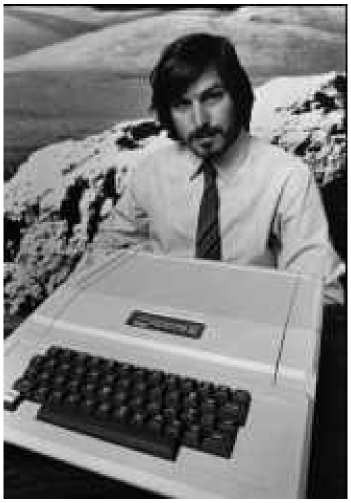


1970's Personal Computing

Altair (1975)

Apple I (1976)

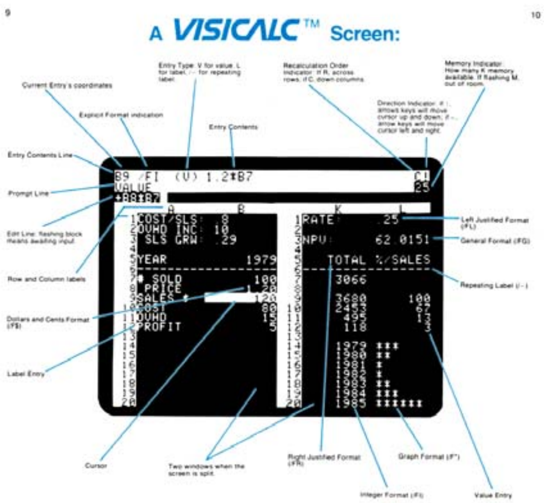
Personal Computers



Apple II 1977

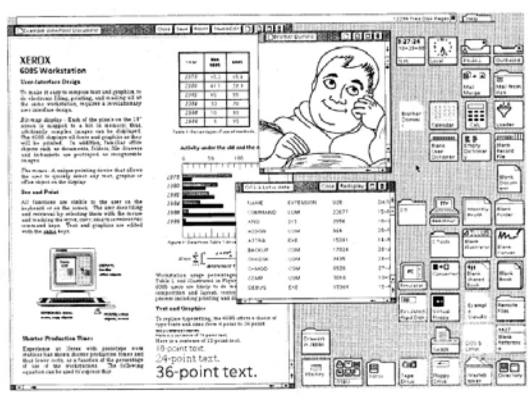
IBM PC 1981

VisiCalc (Bricklin, 1979)



1980's Graphical User Interfaces

Xerox Star (1982)



Bitmapped display, windows, icons, menus, pointer, desktop, direct manipulation, WYSIWYG …

Video: 1:11

Designing the Star

Design team developed new methodology
- Task analysis
- Wide range of users
- Usage scenarios
- Decomposition of design:
  - Display and control interface
  - User's conceptual model
- Many prototyping cycles

User centered design

Star → Mac

But the Star was expensive and slow ($25k).

Steve Jobs visits PARC in 1979
- Sees Alto (precursor to Star)
- Lisa ships in 1983 at $10,000,
  - 1-button mouse
  - Menu bar (instead of pop-up menus)
- Fails in marketplace

Macintosh ships in 1984 at $2500
- Most consistent WIMP UI
  - Look and feel guidelines
- Personal computing market changes for good

1990's Mobile & Ubiquitous

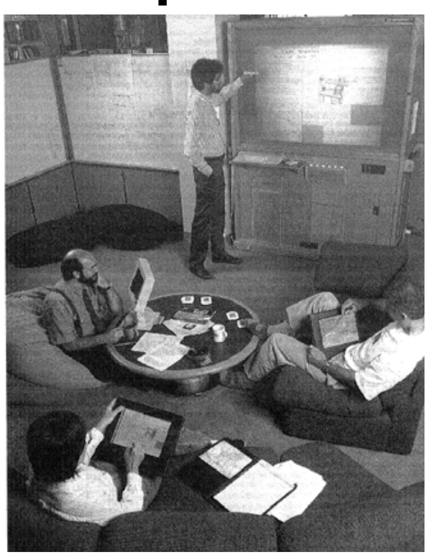
Personal Digital Assistants

Palm Pilot (1996)

Apple Newton (1993)

Mobile Devices

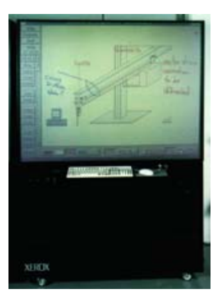
Ubiquitous Computing (1991)



Marc Weiser's vision

- 100s of computers work together
- Will disappear (invisible)

PARC tab
(Inch scale)



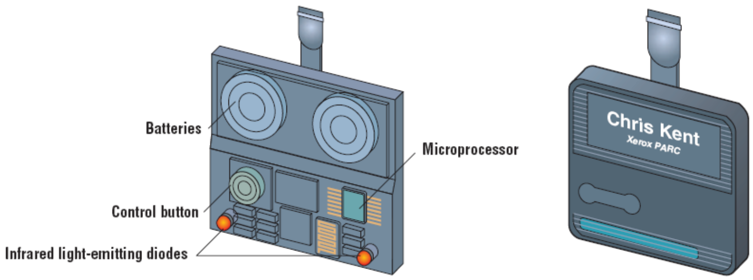
Liveboard
(Yard scale)

PARC pad
(Foot scale)

Ubiquitous Computing (1991)

Context awareness through active badges

- Privacy and security



Marc Weiser (1952 – 1999)

- Ph.D Univ. of Michigan 1979
- Prof at Univ. of Maryland 79-87
- Joined Xerox PARC 1987
  - Head of Computer Science Lab 1988

Coined term “ubiquitous computing” in 1988

What's Next?

- Smart rooms, cars & homes
- Wearable computers
- Multimodal and tangible UIs
- Context-aware and "anywhere" interfaces



Summary

- Many seminal ideas came from early years of computing
- Considering the user leads to new ideas
- Innovation happened in bursts
- A modern design process led to GUI (the Xerox Star)
  - User-centered design
- Some appealing kinds of interaction haven't taken over
  - VR
  - Speech
  - Agents
  - Beware naïve models of human behavior

Next Time

Scott Klemmer - Getting a grip on ubiquitous computing through prototyping

– Reflective physical prototyping through integrated design, test, and analysis. *UIST* 2006. Hartmann et al.