Review

- UI for programming before Von Neumann/Zuse architecture?

- Important eras: 0-D/1-D user interfaces?

- HCI innovations in
  - Memex
  - Sketchpad?
  - NLS?

- What made the Apple II a success?

Interaction Design History
of the Mouse

Engelbart's First Mouse (1964)

- Two wheels, wire is on the back, one button

- Won the test when comparing with other pointing devices at the time:
  - Light pen, tracking balls, foot-pedal, knee-operated devices, head-operated devices

NLS Mouse (1968)

- Two wheels, three button
  - Click
  - Command accept
  - Command delete (undo)

- E.g., Delete
  - Chord: d (3rd key)
  - Mouse: point at the beginning + click
  - Mouse: point at the end + click
  - Mouse: command accept

www.dougengelbart.org
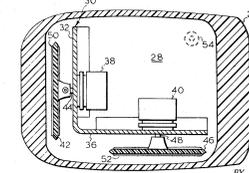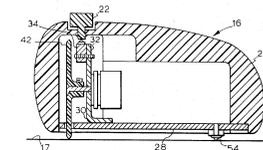
Scientific Foundations of the Mouse (1974)

- Stuart Card aimed to create scientific process that guides the design rather than only evaluation
  - Use the theory to quickly indicate that a circuit for mouse movement during Xerox Star development was too slow

- Found that Fitts's law curve of mouse have slope about 10 bits/sec
  - Close to the hand movement ⇒ mouse theoretically almost optimal

- "The science doesn't design the mouse, but provided constraints to do it"

Xerox Alto (1973) and Star (1981)

- Alto
  - Three buttons (descendant of NLS)
  - Steel ball

- Star
  - Two buttons
    - Reduce confusion over button function
 - Optical tracking

Images: www.oldmouse.com

Apple's Lisa & Macintosh (1983–4)

David Kelly   Larry Tesler

- Apple + David Kelly Design

- Single button decision
  - User study showed that it reduces selection error in text editing

- More reliable tracking mechanism
  - Two wheels that were read by LED + phototransistors
  - Tested with turntable: "Mouse miles"

- Less than 10% cost of Xerox Star mouse

Photo: Buxton Collection

Microsoft Mouse (1987)

Bill Verplank   Jane Fulton Suri   Paul Bradley

- Interdisciplinary collaboration ⇒ leads to IDEO
  - Interaction design: ID TWO
  - Industrial design: Matrix Product Design
  - Mechanical engineering: David Kelly Design

- Findings informed design
  - Move the ball forward for higher precision
  - Larger left button: people usually left click more
  - Enable holding by only fingers
 - Buttons extend to cover the entire front
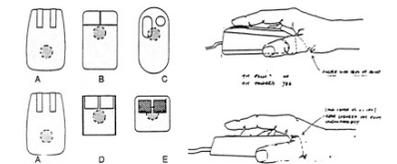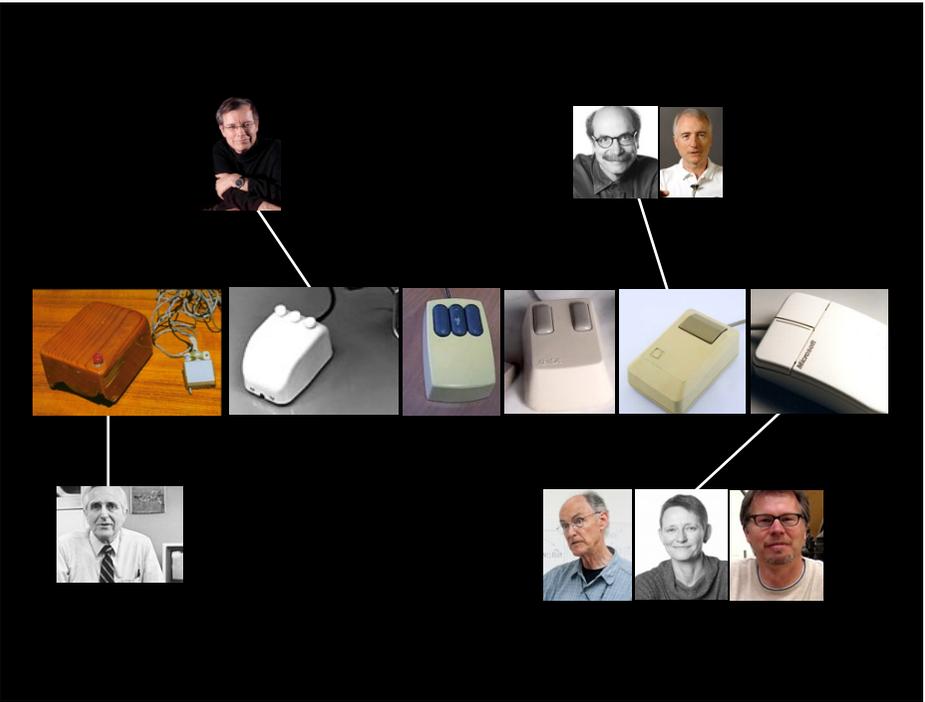
Force Shifts During Phases of the Technology Lifecycle

Enthusiast Phase (Hobby)	→	Professional Phase (Work)	→	Consumer Phase (Life)	→	Baroque Phase
"Exploit me!"		"Help me work!"		"Enjoy me!"		"Let me do it all!"

Sweet Spot

David Liddle

Enthusiast Phase (Hobby)
"Exploit me!"

↓

Professional Phase (Work)
"Help me work!"

↓

Consumer Phase (Life)
"Enjoy me!"

Sweet Spot ↓

Baroque Phase
"Let me do it all!"

Adapted from Bill Moggridge

Slide (top left)

| Enthusiast Phase (Hobby) "Exploit me!" |
| Professional Phase (Work) "Help me work!" |
| Consumer Phase (Life) "Enjoy me!" |

Sweet Spot ●

| Baroque Phase "Let me do it all!" |

Adapted from Bill Moggridge

Sweet Spot

- Simplifies your life

- Rule-changing new functionality

Baroque Phase

- Complicates your life

- Feature creep

Next Step…

- Bill Moggridge: Designing Interactions
  - Enjoyable coffee table book

- Buxton Collection
  - Input devices
  - http://research.microsoft.com/en-us/um/people/bibuxton/buxtoncollection/
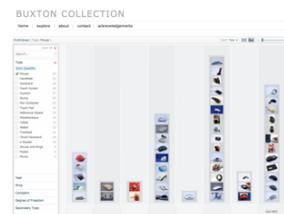
Visions of HCI

Multimodal interfaces

- Put That There (MIT, 1980)

- Key advances:
  - Recognizing human gestures
  - Combining voice with other input modes

Fig.: (Bolt, 1980)
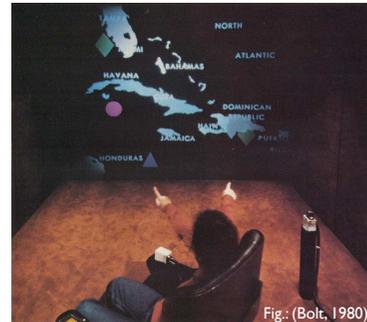
Multimodal interfaces

- Apple Knowledge Navigator (1988)
  - Vision video mockup (not implemented)
  - Key advances: Got people enticed with ideas of user agents and multimedia

Fig.: Digibarn Computer Museum

Virtual Reality

- Key advances: Producing the illusion of being in a 3-dimensional world of computer-generated objects
  - Head-Mounted Display, Ivan Sutherland, University of Utah, 1967

World-Wide Web

- Tim Berners-Lee, 1989, CERN

- Key advances: Provided quick easy ways to view both text and graphics files from remote networked sites
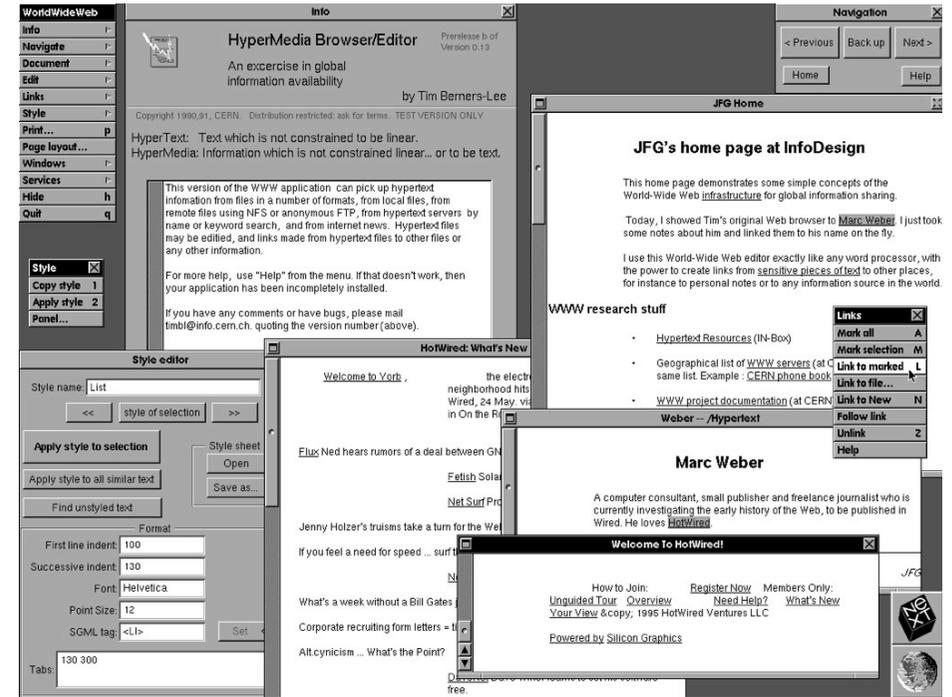
World-Wide Web

- Now getting closer to desktop-like fluid interactivity with AJAX, Web 2.0, etc.
  - Example: Google Maps

More in DIS2
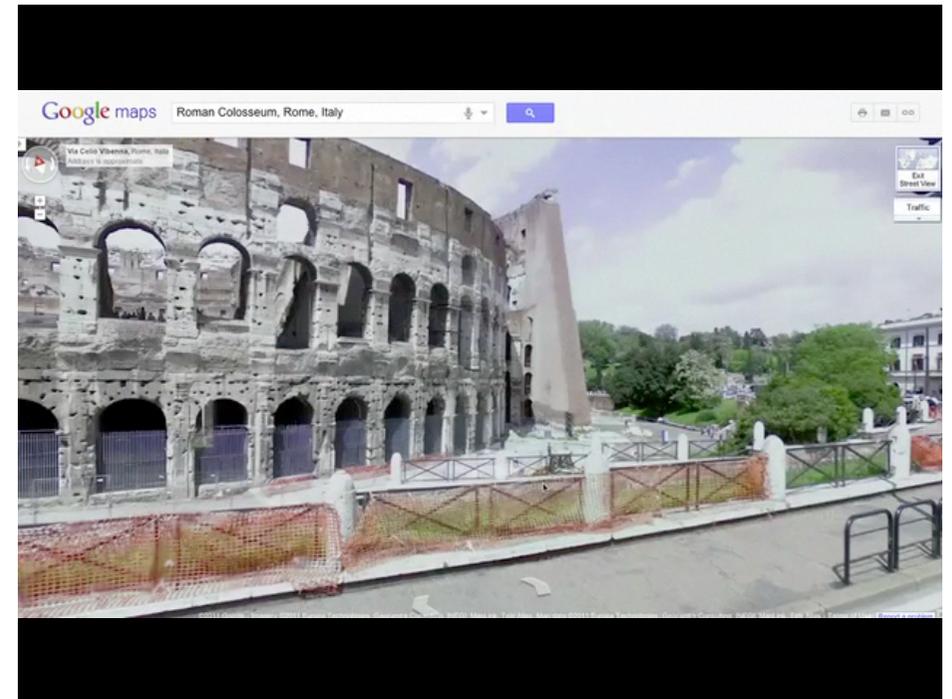
Ubiquitous Computing

- Mark Weiser, Xerox PARC †

- 1991: The Computer For The 21st Century
  - Most profound technologies disappear in fabric of everyday life

- Example: writing
  - Early scribes had to know how to make ink, bake clay,…
  - Today, writing is on candy wrappers
  - A modern world without writing?
  - In comparison, information technology is still at the "scribe" stage

- Example: motors
  - 1900: 1 engine per factory
  - Now 22 motors in your car, hard and unnecessary to notice

Reading assignment

Ubicomp vs. PC, VR

- Ubicomp = disappearing computer = augmented reality = calm computing

- Goal is to activate the world, putting computers into everything

- "PC" is just a transition towards real potential of computing, which will focus on human environment
  - Carrying a super-laptop is like owning just one very important book. Even customizing or having millions of it doesn't unleash literacy.
  - Multimedia as used today makes machines even more attention-grabbing, not disappearing
  - Psychological reasons for disappearing technology: Heidegger's hammer, compiling

- ≠VR: VR lets you explore unreachable worlds but tries to simulate infinite variety of reality instead of augmenting it.

Ubicomp: PARC Devices

- Must know where they are (crucial to human perception)
  - Knowing room it's in can make computer adapt significantly, without any AI

- Tabs/Pads/Boards: inch/foot/yard scale, 100s/dozens/1 or 2 per room
  - A tab for each book spine

The PARC Tab

- 1993, ca. 50 deployed in PARC/EuroPARC

- Activated post-it note, can animate objects
  (find mislaid book,...), voting/consensus tool in meetings

- Use as active badge, identify wearer/object

- Use to shrink windows onto tab to carry with you

- Research product: assumed constant connectivity

- What is today's Tab? What's still missing?

The PARC Pad
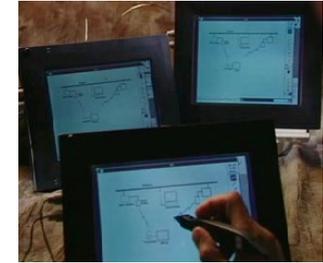
- Paper crossover with laptop

- Scrap computer (not personal to carry around with you)

- Antidote to windows: who wants 9x11" desk?

- Compare to modern Pads like the iPad: what's still missing?

The PARC Board
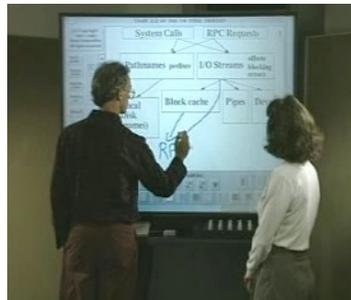
- Used as video screen

- Bulletin board (attuning to reader!)

- Whiteboard

- Flip chart

- Need different UI:
  - Keyboard awkward
  - Menubar hard to reach
  - Shared across Atlantic

Ubicomp Predictions

- Small displays, faster CPUs: correct

- Battery prediction too optimistic (days of use at 1000x800)

- Memory underestimated

- High-resolution walls (80+dpi, 10s of Mpix) not there yet

- OSs today assume fixed hardware configuration,
  but in Ubicomp, devices come and go

- Window systems assume fixed base computer

- Ubicomp diversity of input devices not being dealt with well

- Network: Bluetooth, problem of multiple connections

Ubicomp Scenarios

- Neighborhood tracks (privacy vs. "coziness")

- Paper(!) newspaper, but with electronic pen.

- Finding lost garage door opener manual

- Foreview car mirror for traffic jams and parking spots and shops

- Fresh coffee indicator.

- Collaboration via replicated/miniaturized tabs/pads, awareness, move content to board for active collaboration

- Switch effortlessly between machines, displays, and devices. Meeting review example.

Ubicomp Scenarios

- Privacy: "minority report" ads jumping at passer-by. One approach: model physical world (hard but not impossible to break in, but leaves traces).

- Human-Centered: making people more aware of other people at end of computer links. Reverse bad effect of today's email-based workplace (isolation). Enables nothing fundamentally new but takes away mental strain, making things (such as locating information) much easier (like desktop publishing did) which makes an enormous difference.

- Decline of the computer addict?

- Overcome information overload

Ubicomp Today

- HUC'99 workshop
  ➔ Ubicomp Conference

- Commercial Tabs, Pads and Boards
  - Hardware, but often still clinging to the desktop metaphor, and not "plentiful"

- One of the most intriguing current visions for the future of HCI and CS

- "As calm as a walk in the woods"

Digital Pens

Anoto Digital Pen Technology
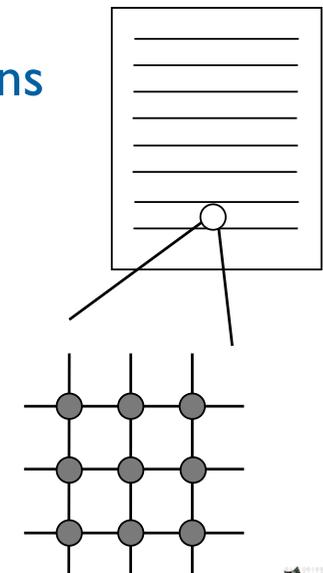
Papier Craft

(Liao et al., 2005)

- Work on paper (= the large desk) instead of small screens

- Ink gestures to execute commands
  - copy, paste, hyperlink start, hyperlink end

Operation	Command on Page 1	Command on Page 2
Excerption		
Excerption with keyword		
Excerption with cmd name	copy	paste
Hyperlink		
Stitching		
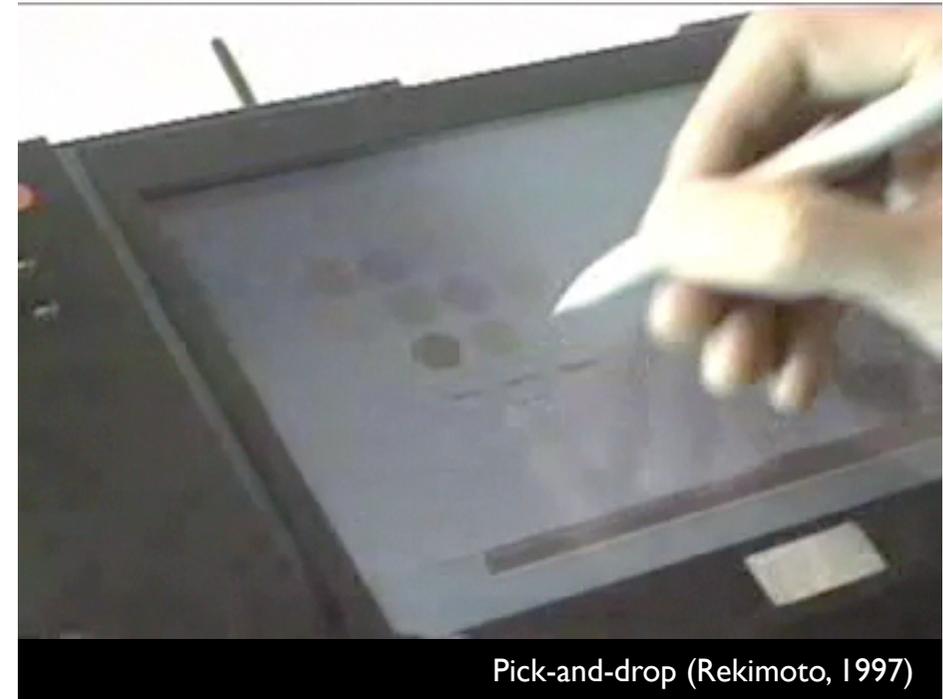
Pick-and-drop (Rekimoto, 1997)

Tangible User Interface

Hiroshi Ishii

- Coupling digital information with physical objects
  - Give immediate haptic feedback
  - Complement with intangible output

Typical HCI
GUI of desktop PC

Tangible UI
World will be interface.

e.g. building model

Input/Output

e.g. video projection of digital shadow

Output

control

tangible representation

physical

digital

intangible representation

digital information

Ishii & Ulmer, CHI '97

Slide 1
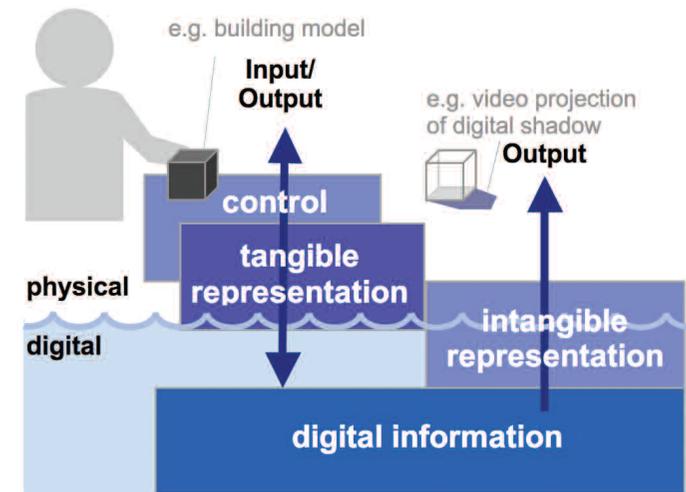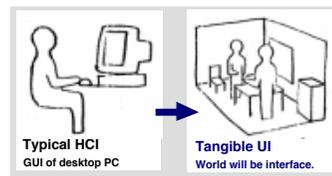
TUI:
Tangible UI

lens   phicon   tray   phandle   instrument

GUI:
Graphical UI

window   icon   menu   handle   widget

eLENS

Ishii & Ulmer, CHI '97

Slide 2
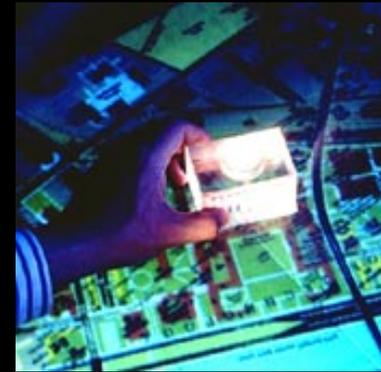
Phicon and activeLENS
Ishii & Ulmer, CHI '97

Slide 3

Light Space (Wilson & Benko, UIST '10)

Slide 4

Next Lecture: Statistics

- Bring your laptop and install programs for hands-on session
  - Install R and Deducer
  - More details on L^{2}P