chapter 4

paradigms

why study paradigms

Concerns

- how can an interactive system be developed to ensure its usability?
- how can the usability of an interactive system be demonstrated or measured?

History of interactive system design provides paradigms for usable designs

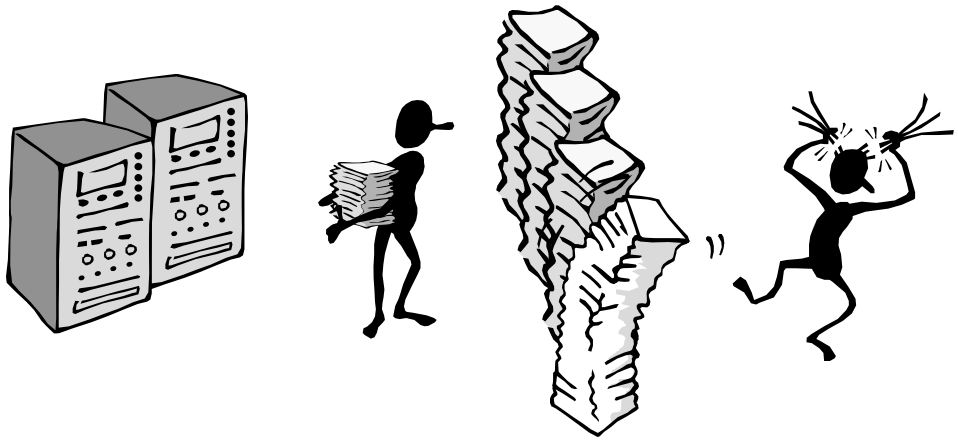
Paradigms of interaction

New computing technologies arrive, creating a new perception of the human—computer relationship.

the history of interactive technologies.

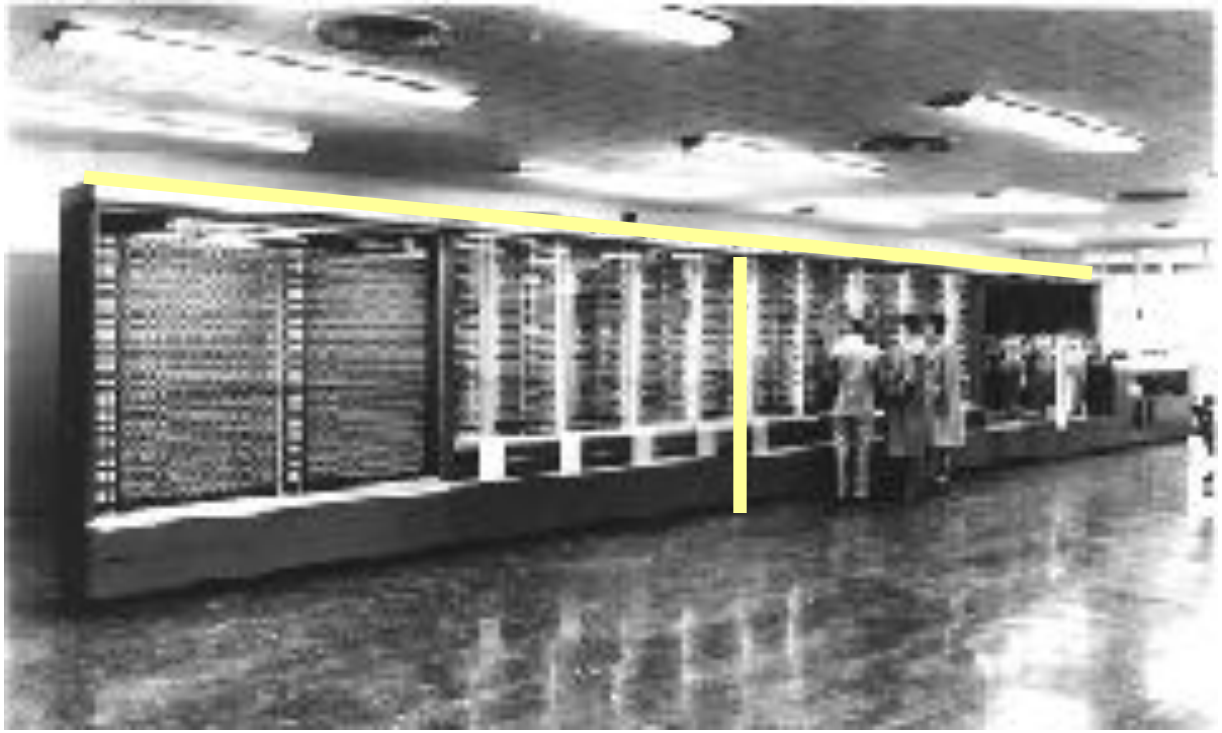
The initial paradigm

- Batch processing



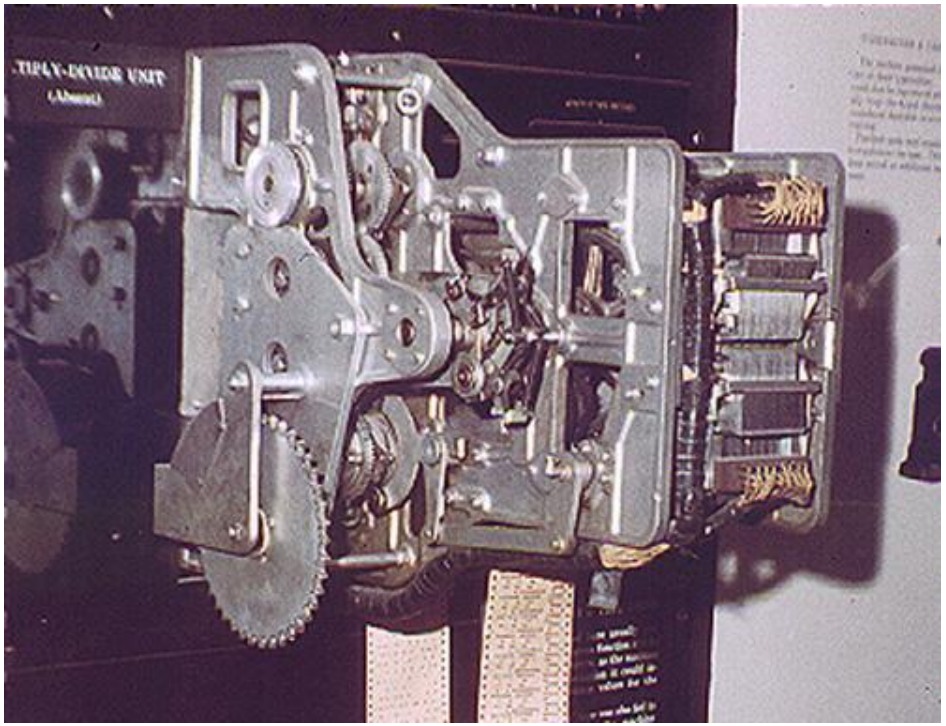
Impersonal computing

Beginnings – Computing in 1945



- Harvard Mark I
  - Picture from http://piano.dsi.uminho.pt/museuv/indexmark.htm
- 55 feet long, 8 feet high, 5 tons

Context - Computing in 1945



Picture from http://www.gmcc.ab.ca/~supy/

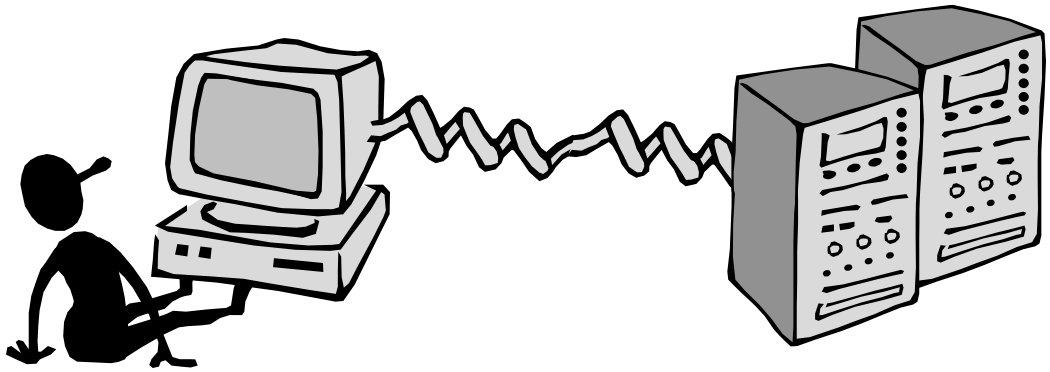
- Ballistics calculations
- Physical switches
  (before microprocessor)
- Paper tape
- Simple arithmetic & fixed calculations
  (before programs)
- 3 seconds to multiply

Batch Processing

- Computer had one task, performed sequentially
- No "interaction" between operator and computer after starting the run
- Punch cards, tapes for input
- Serial operations

Example Paradigm Shifts

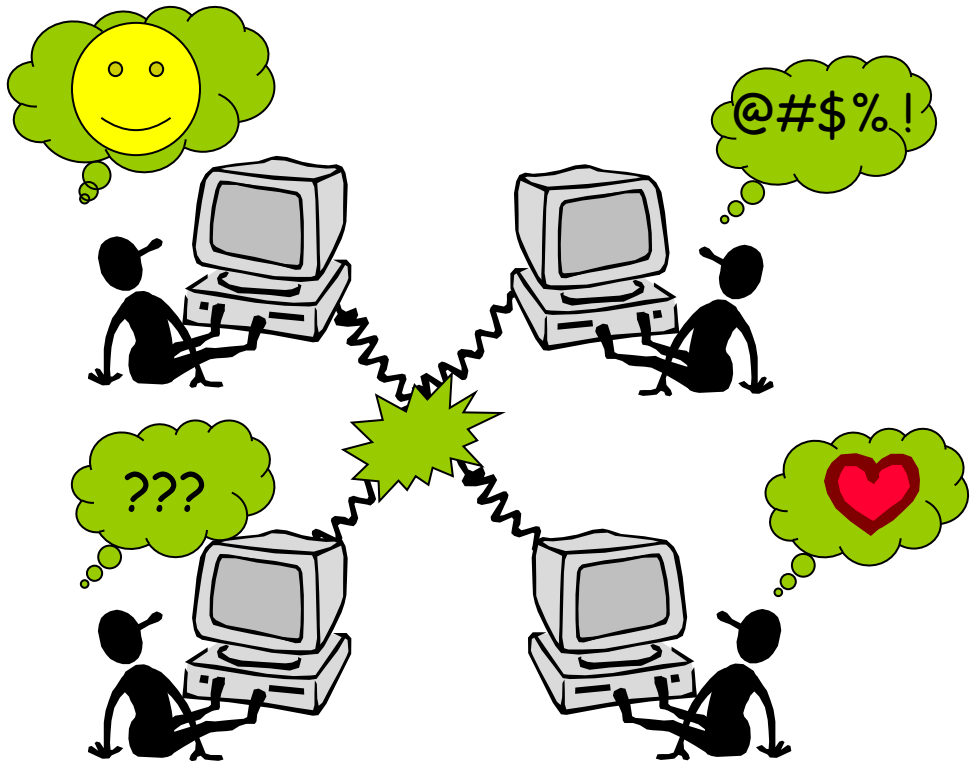
- Batch processing
- Time-sharing



Interactive computing

Example Paradigm Shifts

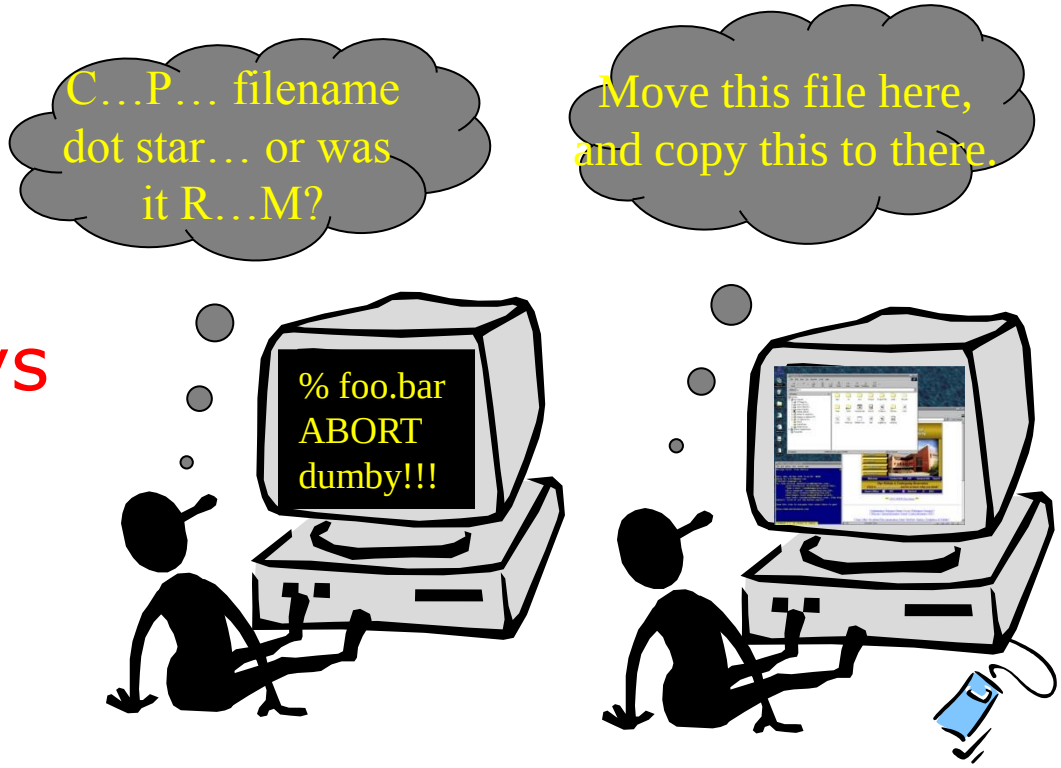
- Batch processing
- Timesharing
- Networking



Community computing

Example Paradigm Shifts

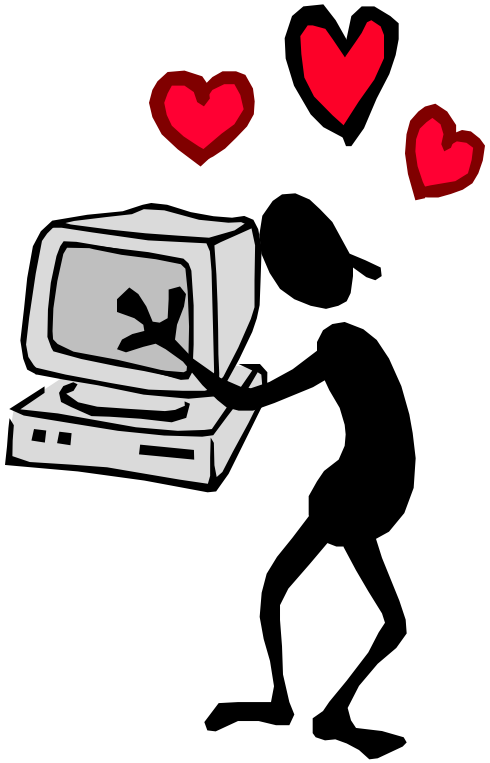
- Batch processing
- Timesharing
- Networking
- Graphical displays



Direct manipulation

Example Paradigm Shifts

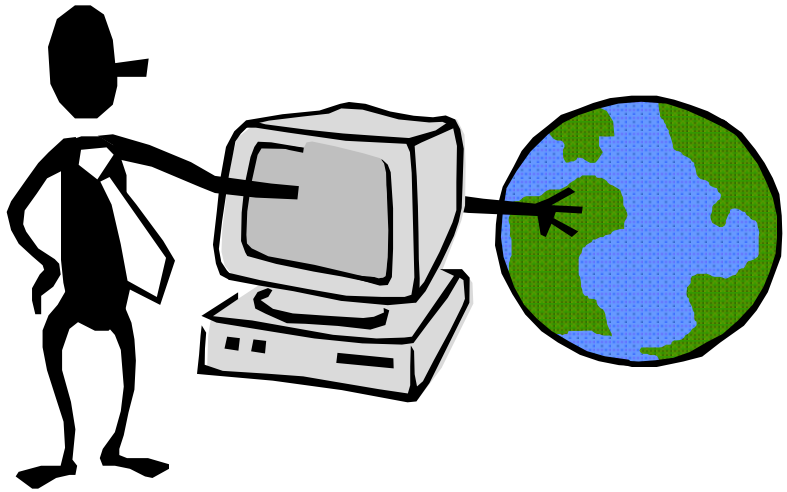
- Batch processing
- Timesharing
- Networking
- Graphical display
- Microprocessor



Personal computing

Example Paradigm Shifts

- Batch processing
- Timesharing
- Networking
- Graphical display
- Microprocessor
- WWW

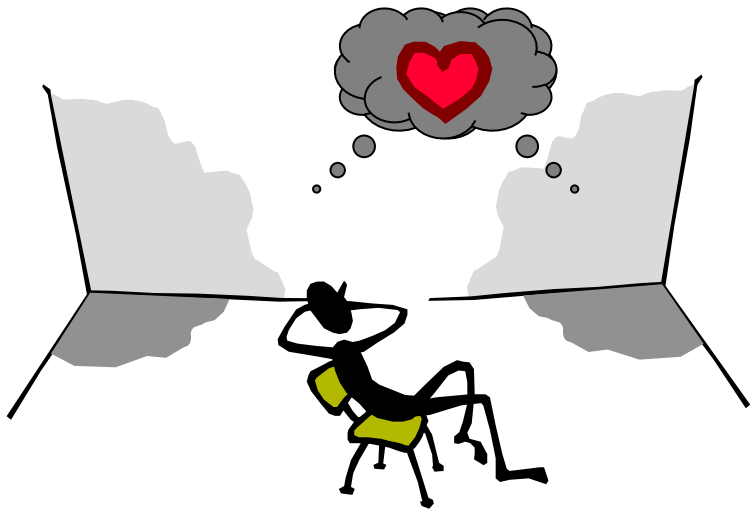


Global information

Example Paradigm Shifts

- Batch processing
- Timesharing
- Networking
- Graphical display
- Microprocessor
- WWW
- Ubiquitous Computing

- A symbiosis of physical and electronic worlds in service of everyday activities.



Time-sharing

- 1940s and 1950s – explosive technological growth
- 1960s – need to channel the power
- J.C.R. Licklider at ARPA
- single computer supporting multiple users

Innovator: J. R. Licklider

- 1960 - Postulated "man-computer symbiosis"
- Couple human brains and computing machines tightly to revolutionize information handling

Video Display Units

- more suitable medium than paper
- 1962 – **Sutherland's Sketchpad**
- computers for visualizing and manipulating data
- one person's contribution could drastically change the history of computing

Innovator: Ivan Sutherland

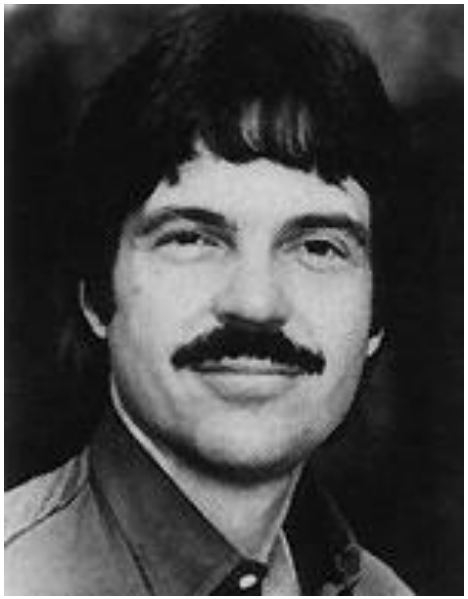
- **SketchPad** - 1963 PhD thesis at MIT
  - Hierarchy - pictures & subpictures
  - Master picture with instances (ie, OOP)
  - Constraints
  - Icons
  - Copying
  - Light pen input device
  - Recursive operations

Personal computing

- 1970s – Papert's LOGO language for simple graphics programming by children
- A system is more powerful as it becomes easier to user
- Future of computing in small, powerful machines dedicated to the individual
- Kay at Xerox PARC – the Dynabook as the ultimate personal computer

Innovator: *Alan Kay*

- Dynabook - Notebook sized computer loaded with multimedia and can store everything
- @PARC
- Personal computing
- Desktop interface
- Overlapping windows



Window systems and the WIMP interface

- humans can pursue more than one task at a time
- windows used for dialogue partitioning, to "change the topic"
- 1981 – Xerox Star first commercial windowing system
- windows, icons, menus and pointers now familiar interaction mechanisms

Direct manipulation

- 1982 – Shneiderman describes appeal of graphically-based interaction
  - visibility of objects
  - incremental action and rapid feedback
  - reversibility encourages exploration
  - syntactic correctness of all actions
  - replace language with action

- 1984 – Apple Macintosh
- the model-world metaphor
- What You See Is What You Get (WYSIWYG)

Language versus Action

- actions do not always speak louder than words!
- DM – interface replaces underlying system
- language paradigm
- interface as mediator
- interface acts as intelligent agent
- programming by example is both action and language

Hypertext

- 1945 – Vannevar Bush and the memex
- key to success in managing explosion of information
- mid 1960s – Nelson describes hypertext as non-linear browsing structure
- hypermedia and multimedia
- Nelson's Xanadu project

Innovator: Vannevar Bush

- **Memex** device
  - Stores *all* records/articles/communications
  - Items retrieved by indexing, keywords, cross references (now called hyperlinks)
  - (Envisioned as microfilm, not computer)

- 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

Innovator: Ted Nelson

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

Multimodality

- a mode is a human communication channel
- emphasis on simultaneous use of multiple channels for input and output

Computer Supported Cooperative Work (CSCW)

- CSCW removes bias of single user / single computer system
- Can no longer neglect the social aspects
- Electronic mail is most prominent success

The World Wide Web

- Hypertext, as originally realized, was a closed system
- Simple, universal protocols (e.g. HTTP) and mark-up languages (e.g. HTML) made publishing and accessing easy
- Critical mass of users lead to a complete transformation of our information economy.

Agent-based Interfaces

- Original interfaces
  - Commands given to computer
  - Language-based
- Direct Manipulation/WIMP
  - Commands performed on "world" representation
  - Action based
- Agents - return to language by instilling proactivity and "intelligence" in command processor
  - Avatars, natural language processing

Ubiquitous Computing

"The most profound technologies are those that disappear."

Mark Weiser, 1991

Late 1980's: computer was very apparent

How to make it disappear?

- Shrink and embed/distribute it in the physical world
- Design interactions that don't demand our intention

Innovator: Mark Weiser

- Introduced notion of *Ubiquitous Computing* and *Calm Technology*
  - It's everywhere, but recedes quietly into background
- CTO of Xerox PARC

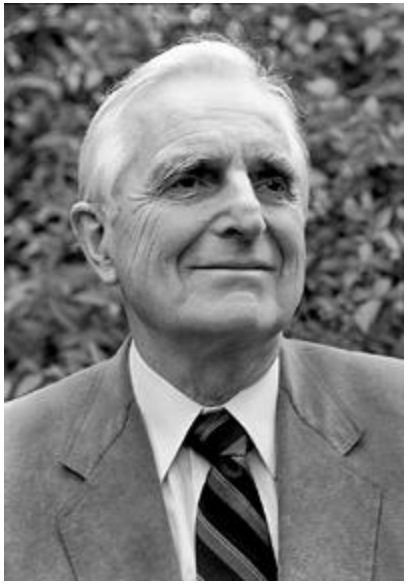
Sensor-based and Context-aware Interaction

- Humans are good at recognizing the "context" of a situation and reacting appropriately
- Automatically sensing physical phenomena (e.g., light, temp, location, identity) becoming easier
- How can we go from sensed physical measures to interactions that behave as if made "aware" of the surroundings?

Innovator: Douglas Englebart

- Landmark system/demo:
  - hierarchical hypertext, multimedia, mouse, high-res display, windows, shared files, electronic messaging, CSCW, teleconferencing, ...

Inventor
of mouse



Innovator: Nicholas Negroponte

- MIT Architecture Machine Group
  - '69-'80s - prior to Media Lab
- Ideas
  - wall-sized displays, video disks, AI in interfaces (agents), speech recognition, multimedia with hypertext
  - Put That There (Video)