IPM 15/16 – T1.1
Introduction to HCI

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Acknowledgements: Most of this course is based on the excellent course offered by Prof. Kellogg Booth at the British Columbia University, Vancouver, Canada. Please acknowledge the original source when reusing these slides for academic purposes.

U.PORTO FC

Summary

- Introduction to HCI
- Getting started: How do interfaces fail?
- Brief history of HCI

Topic: Introduction to HCI

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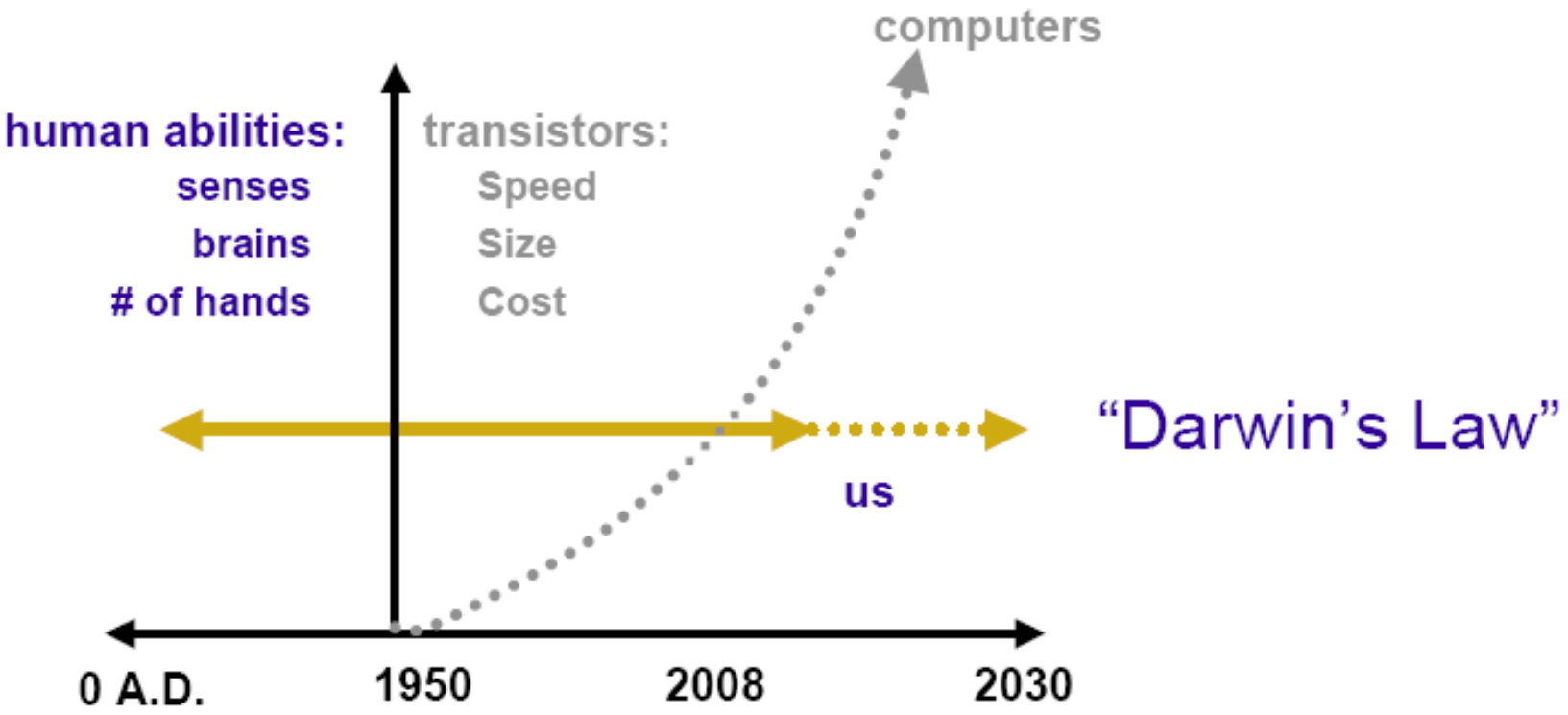
The World in 2014

- “Did You Know 3.0” (Updated for 2012)
- http://youtu.be/YmwwrGV_aiE
- What about 2014? “Did you Know 2014”
- https://youtu.be/PcZg51Il9no

Why HCI?

Moore's Law:

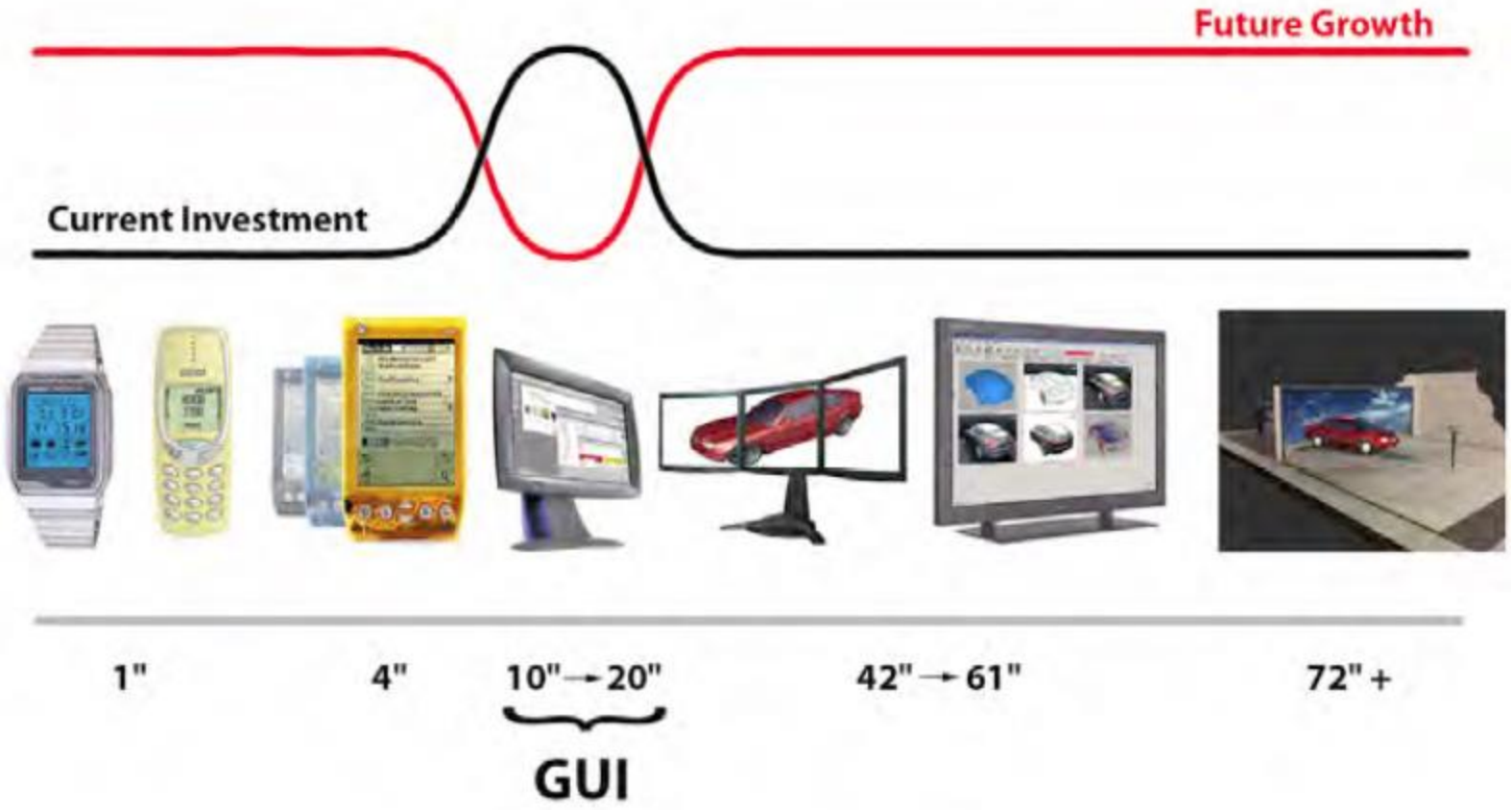


Computers are changing very quickly

“Computers”: New interaction paradigms

“Computers”: Novel integration with sensors

Investment in HCI

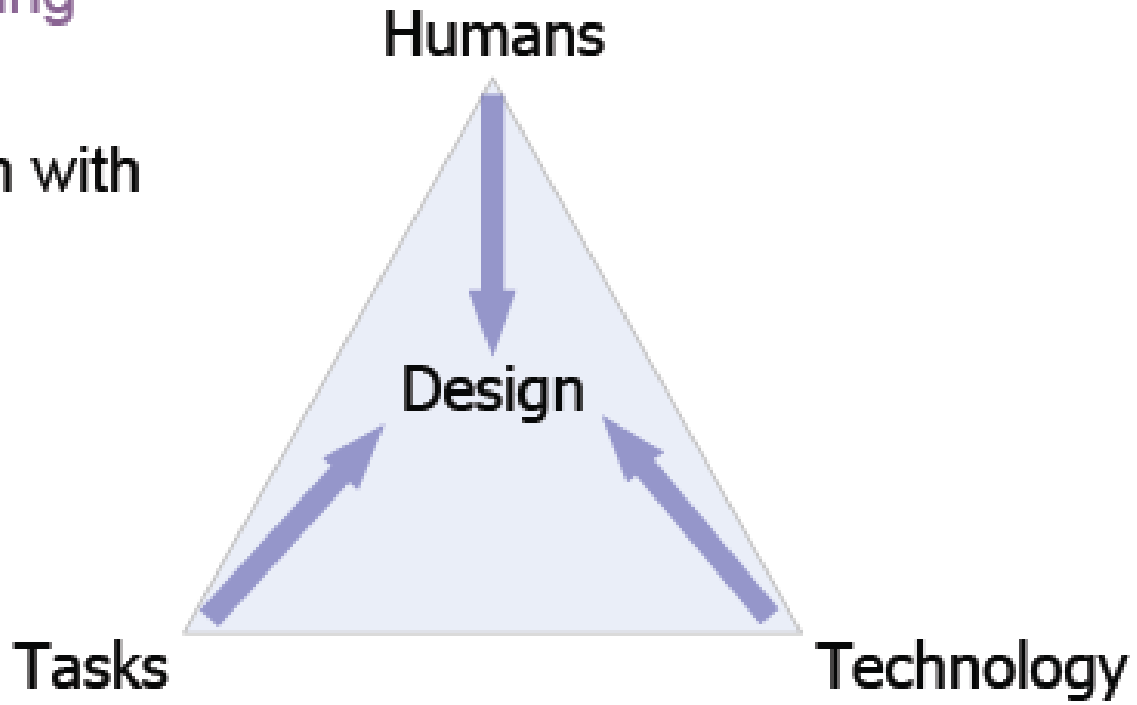


What is user interface design?

methods and theories for iteratively

designing
implementing
evaluating

human interaction with
a computer



Some landmark HCI innovations

- Mouse [Englebart, 1965]
- Direct manipulation [Sutherland, 1963]
- Desktop metaphor [Xerox Star, 1981]
- Spreadsheet [VisiCalc, Frankston & Bricklin, 1977]
- ...
- iPhone [2007]
- iPad [2010]
- Kinect ?? [2010]

Who does HCI?

- On the purely machine side:
  - Computer graphics
  - Operating systems
  - Programming languages
  - Development environments
  - Networking
  - Software engineering
- And increasingly...
  - Industrial & product design
  - Digital media processing
  - robotics

Who does HCI?

- On the human side:
  - Psychology and kinesiology
    - Cognitive, perceptual and motor behavior
    - Human capabilities to use and learn machines
  - Sociology and anthropology
    - Group and cultural behavior
  - Art and graphic + tactile design
    - Aesthetics (layout, color, icon selection, feel…)

What makes it HCI?

- Where they come together:
  - The joint performance of tasks by humans and machines
  - Structure of communication between humans / machine and humans mediated by machines
- Design methods:
  - The process of specification, design and implementation of interfaces
  - Design trade-offs

Topic: How do interfaces fail?

- Introduction to HCI
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Psychology of everyday things

- Lesson 1: the myth of human error
  - Most failures of human-machine system are due to poor designs that don't recognize peoples' capabilities and fallibilities.
  - This leads to apparent machine misuse and "human error".
- Lesson 2
  - good design accounts for human limitations.

Psychopathology of everyday things

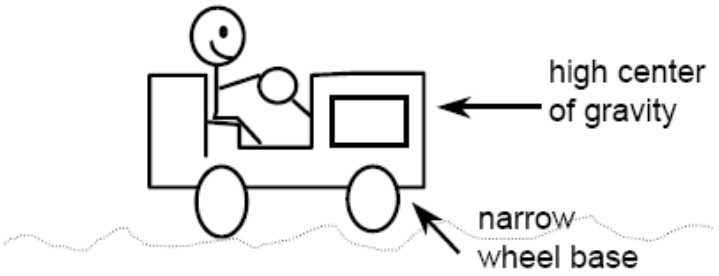
- Typical frustrations
  - An engineer can't figure out how to heat a cup of coffee in the company's microwave oven.
- How many of you can program or use all aspects of your:
  - VCR / DVD player
  - Sewing machine
  - Washer and dryer
  - Stereo system (home or car)
  - Unfamiliar water faucets
  - ???

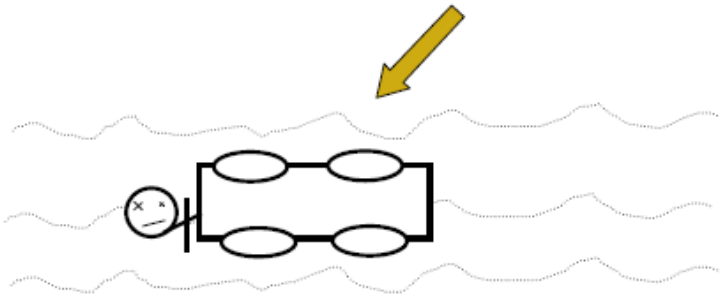
Early tractors

typical terrain:
un-surfaced
rough
hilly

original design:

early tractors





used to be called "Driver's Error" …

but, accidents became infrequent when designs changed to low center of gravity & wider wheel bases

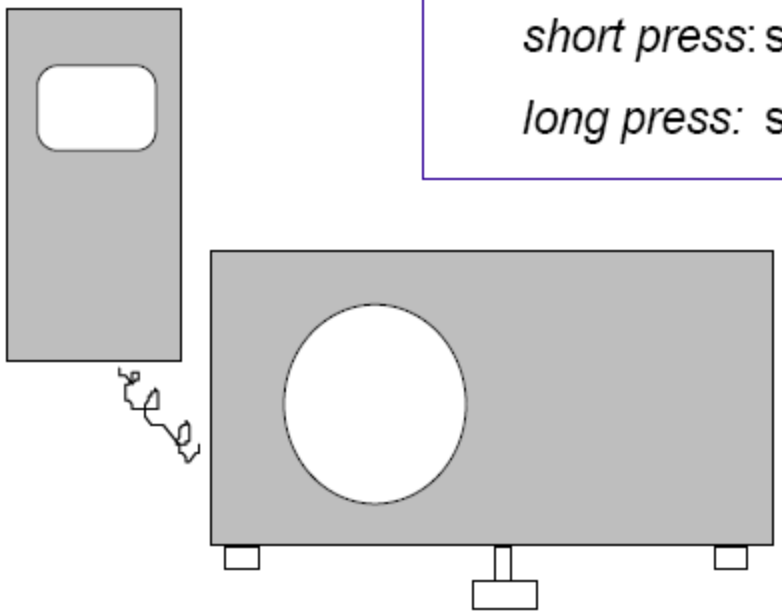
Remote control from the Leitz slide projector

how do you go forward/reverse?

instruction manual:

short press: slide change forward

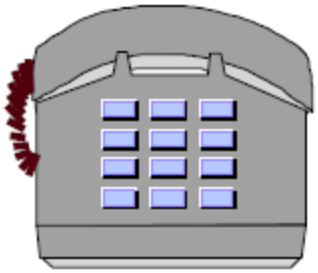
long press: slide change backward



Modern telephone systems

modern telephone systems

- standard number pad
- two additional buttons * and #



problems

- many hidden functions
- operations and outcome completely invisible – e.g.:
  - *72+number = call forward
    - can I remember that combination?
    - if I enter it, how do I know it caught?
    - how can I remember that I left my phone forwarded?
  - Ok, I'll read the manual
    - but what does "call park" mean? what's a link?
    - where is that manual anyway?

Good design

Images obtained from http://wii.com/

Psychology of everyday things

- Many so-called human errors and "machine misuse" are actually errors in design.
- Designers help things work by providing a good conceptual model.
- Designers decide on a range of users as the design audience.
- But design is difficult for a variety of reasons that go beyond design!

Topic: Brief history of HCI

- Introduction to HCI
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A brief history of human computer interaction

- Where did HCI innovations and philosophy come from?
- Who were the major personalities?
- What were the important systems?
- How did ideas move from the laboratory to the market?

Input / output devices

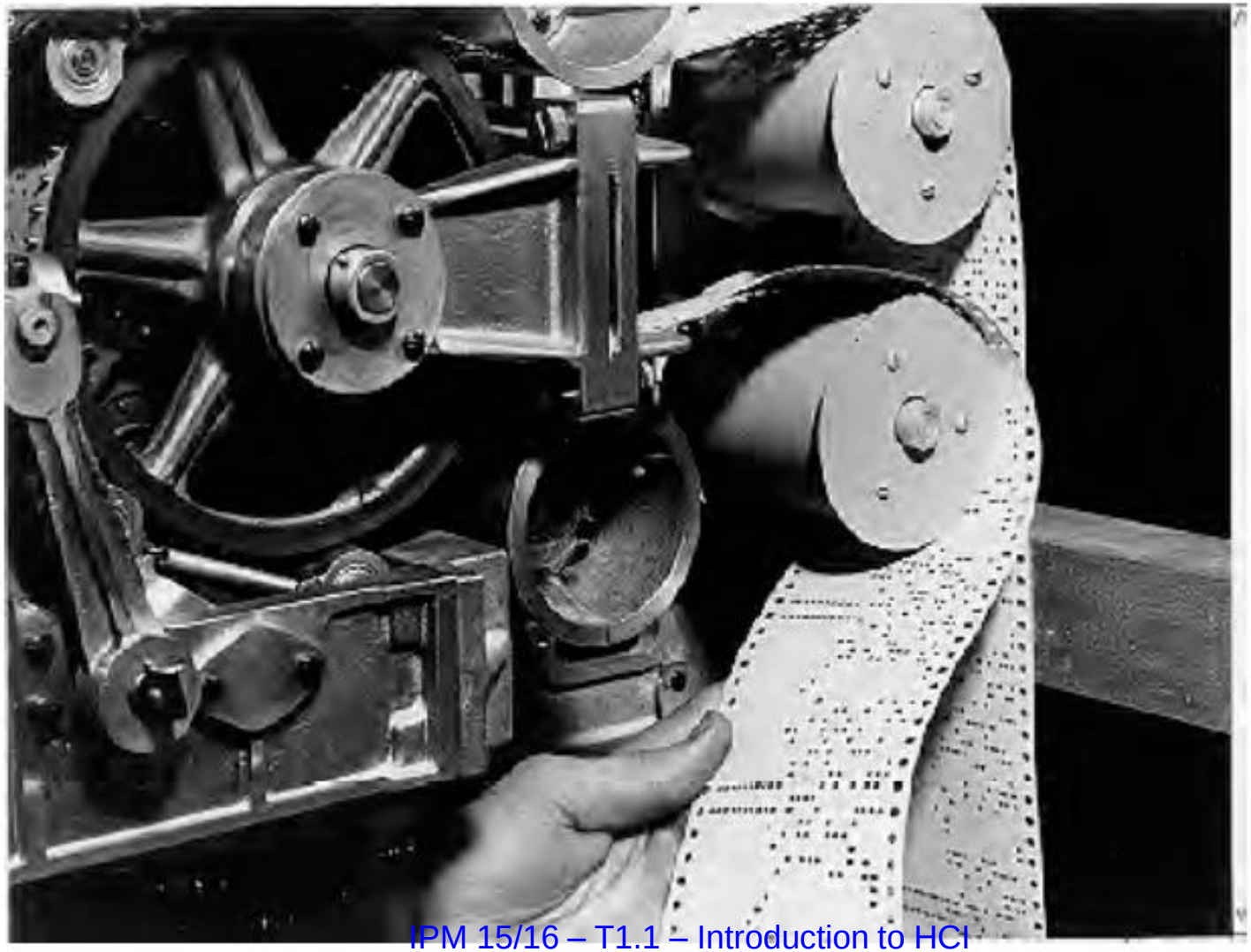
	Input	Output
Early days	Connecting wires Paper tape Punch cards Keyboard	Lights on display Paper Teletype
Today	Keyboard + cursor keys + mouse + microphone	Scrolling glass teletype Character terminal Bit-mapped screen Audio
Soon?	Data gloves / suits Computer jewelry Natural language	Head-mounted displays Ubiquitous computing Autonomous agents

The lesson:

- Keyboards & terminals are artifacts of today's technologies
- New I/O devices will change the way we interact with computers

Mark I (1944)

1st 'digital' computer (mechanical / analog)
invented by Howard Aiken and Grace Hopper



50 feet long

8 feet tall

5 tons

760,000 parts

paper tape reader

switches
relays
rotating shafts
clutches

3-5 seconds for a multiply

from Harvard University Cruft Photo Laboratory

ENIAC (1946): world's first all - Electronic Numerical Integrator and Computer

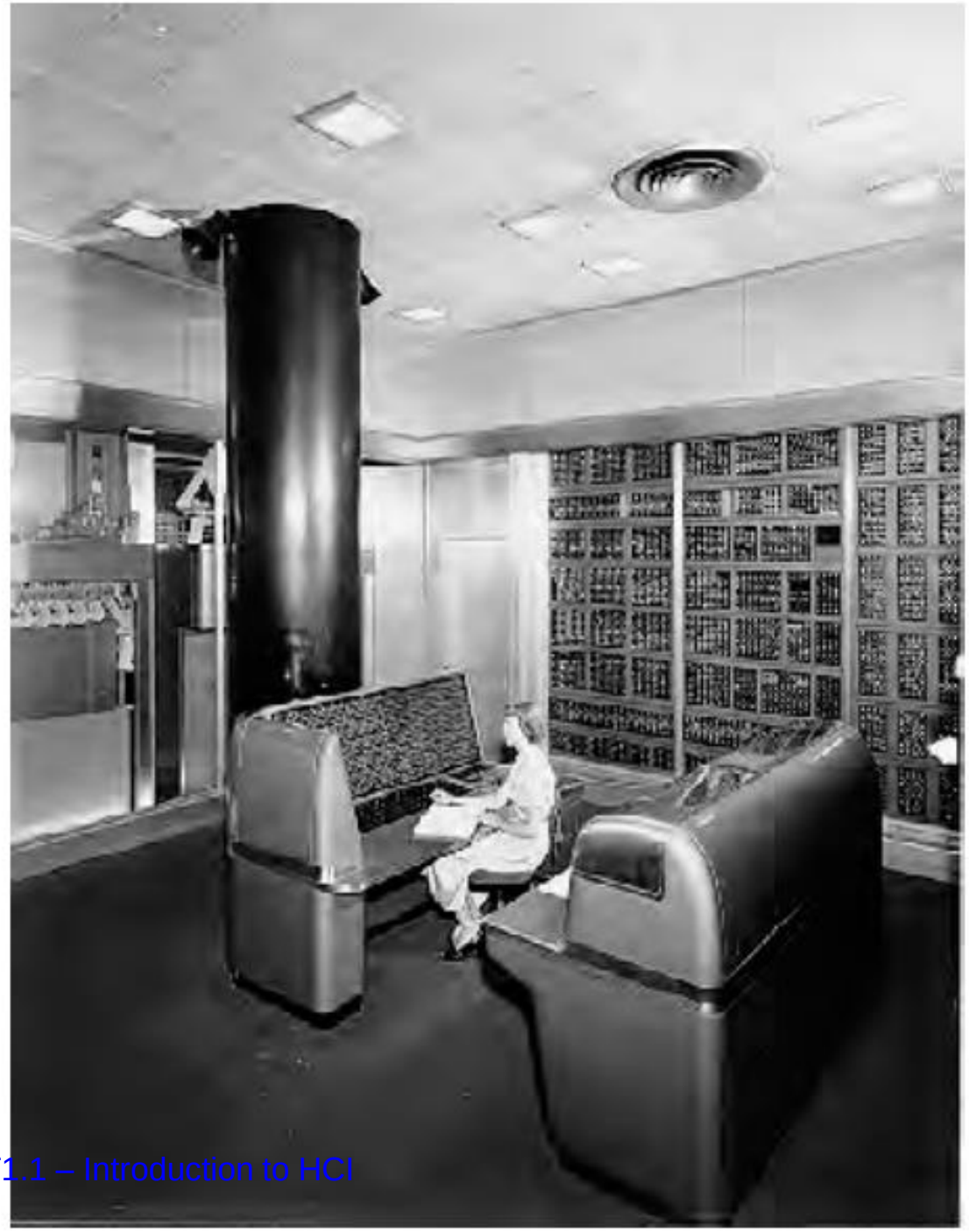
from IBM Archives

triggered by ballistics work, WWII

IBM SSEC: Selective Sequence Electronic Calculator (1948)

electronic computation + stored program

(first???)



from IBM Archives

Stretch (1961):

close-up of the Stretch control panel

random access disk drives

advanced pipelining and memory

from IBM Archives

Intellectual & historical foundations

Vannevar Bush - president of MIT

- "As we may think" article in Atlantic Monthly (1945)
- Identified the information storage and retrieval problem:
  - New knowledge does not reach the people who could benefit from it
- "Publication has been extended far beyond our present ability to make real use of the record"

today: inklings of the WWW*?*

Bush saw a unique opportunity for science to progress and assist humankind

Simultaneously, these things were happening:

1. Technology had advanced
   Large jumps in capabilities for photography, printing, and manufacturing processes
2. His stakeholders (scientists) were evolving new needs and practices
   Who needed to understand and synthesize the record of scientific advances; and to capture (and later access) ongoing data
3. Nature of the human mind and body had not changed!
   e.g. the associative and ephemeral nature of human memory.

Bush's Memex

- Conceived Hypertext and the World Wide Web
  - A device where individuals store all personal books, records, communications etc
  - Items retrieved rapidly through indexing, keywords, cross references,...
  - Can annotate text with margin notes, comments...
  - Can construct a trail (a chain of links) through the material and save it
  - Acts as an external memory!
- Bush's Memex device based on microfilm records, not computers!
  - But not implemented

J.C.R. Licklider (1960)

- Began worrying about human-computer interfaces in the 1950s
- In charge of first human factors group at MIT, 1953
- Began his career as a **behavioral psychologist**
  - Throughout the period I examined, in short, my "thinking" time was devoted mainly to activities that were essentially clerical or mechanical”
- Outlined “man-computer symbiosis”:
  - “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.”

From Man-Computer Symbiosis (1960)

- Licklidder describes time use in his workday:

"About 85 per cent of my "thinking" time was spent getting into a position to think …When the graphs were finished, the relations were obvious at once. …

Throughout the period I examined, in short, **my "thinking" time was devoted mainly to activities that were essentially clerical or mechanical:** searching, calculating, plotting, transforming, determining the logical or dynamic consequences of a set of assumptions or hypotheses, preparing the way for a decision or an insight.” .

J.C.R. Licklider (cont.)

Stated goals pre-requisite to “man-computer symbiosis”:

- Immediate:
  - Time sharing of computers among many users
  - Electronic i/o for communication of symbolic, pictorial info
  - Interactive real time system for info processing & programming
  - Large scale information storage and retrieval
- Mid-term:
  - Facilitation of human cooperation in design & programming of large systems
- Long term visions:
  - Natural language understanding (syntax, semantics, pragmatics)
  - Speech recognition of arbitrary computer users
  - Heuristic programming

Significant technical advances: 1960-80

- Mid ‘60s: computers too expensive for a single person
- Time-sharing
  - Gives each user illusion of own personal machine

  -> Need to support human-computer interaction
    - Dramatically increased accessibility of machines
    - Afforded interactive systems and languages, rather than “jobs”
    - Community as a whole communicated through computer (and eventually through networks) via email, shared files, etc.

Ivan Sutherland's SketchPad (1963 PhD Thesis)

- **Sophisticated drawing package**: introduced many new ideas/ concepts now found in today's interfaces
  - *Hierarchical structures:* defined pictures and sub-pictures
  - *Object-oriented programming*: master picture with instances
  - *Constraints:* specify details which the system maintains through changes
  - *Icons:* small pictures that represented more complex items
  - *Copying:* both pictures and constraints
  - *Input techniques*: efficient use of light pen
  - *World coordinates:* separation of screen from drawing coordinates
  - *Recursive operations:* applied to children of hierarchical objects

SketchPad, cont.

- Parallel developments in hardware:
  - "Low-cost" graphics terminals
  - Input devices such as data tablets (1964)
  - Display processors capable of real-time manipulation of images (1968)

Douglas Engelbart (early 50's)

"...The world is getting more complex, and problems are getting more urgent. These must be dealt with collectively. However,human abilities to deal collectively with complex / urgent problems are not increasing as fast as these problems.

If you could do something to improve human capability to deal with these problems, then you'd really contribute something basic."

...Doug Engelbart

Douglas Engelbart

"…I had the image of sitting at a big CRT screen with all kinds of symbols, new and different symbols, not restricted to our old ones. The computer could be manipulated, and you could be operating all kinds of things to drive the computer

... I also had a clear picture that one's colleagues could be sitting in other rooms with similar work stations, tied to the same computer complex, and could be sharing and working and collaborating very closely. And also the assumption that there'd be a lot of new skills, new ways of thinking that would evolve "

Douglas Engelbart

“A Conceptual Framework for Augmenting Human Intellect” (SRI Report, 1962)

"By *augmenting man's intellect* we mean increasing the capability of a man to approach a complex problem situation, gain comprehension to suit his particular needs, and to derive solutions to problems.

One objective is to develop new techniques, procedures, and systems that will better adapt people's basic information-handling capabilities to the needs, problems, and progress of society."

Hypermedia-groupware system 1968 --- NLS (oNLine System)

Many current interface concepts were introduced in Engelbart's NLS system

- Document processing
  - Modern word processing & outline processing
  - Hypermedia
- Input / Output
  - The mouse & one-handed corded keyboard
  - High resolution displays
  - Multiple windows, specially designed furniture
- Shared work
  - Shared files and personal annotations
  - Electronic messaging
  - Shared displays with multiple pointers, audio/video conferencing
  - Ideas of an Internet
- User testing, training

Just one: The first mouse (1964)

Engelbart
Xerox PARC

The Personal Computer

Alan Kay (1969) Dynabook: vision of a notebook computer

> "Imagine having your own self-contained knowledge manipulator in a portable package the size and shape of an ordinary notebook. Suppose it had enough power to out-race your senses of sight and hearing, enough capacity to store for later retrieval thousands of page-equivalents of reference materials, poems, letters, recipes, records, drawings, animations, musical scores..."

Ted Nelson (1974)

- 1974: "Computer Lib/Dream Machines"
- Popular book describing what computers can do for people (instead of business!)

The Personal Computer, cont.

- Xerox PARC, mid-'70s
  - Alto computer, a personal workstation
    - Local processor, bit-mapped display, mouse
  - Modern graphical interfaces
    - Text and drawing editing, electronic mail
    - Windows, menus, scroll bars, mouse selection, etc
  - Local area networks (Ethernet) for personal workstations
    - Could make use of shared resources
- ALTAIR 8800 (1975)
  - Popular Mechanics published article that showed people how to build a computer for under $400

Commercial machines: Xerox Star (1981)

- Designed for “business professionals”
- GUI used many ideas developed at Xerox PARC:
  - Familiar conceptual model (simulated desktop)
  - Promoted recognizing/pointing rather than remembering/typing
  - Property sheets to specify appearance / behavior of objects
  - What you see is what you get (WYSIWYG)
  - Small set of generic commands used throughout system
  - Consistency and simplicity
  - Modeless interaction
  - Limited amount of user tailorability

Xerox Star (cont.)

- 1st system based upon usability engineering
  - Inspired design
  - Extensive paper prototyping and usage analysis
  - Usability testing with potential users
  - Iterative refinement of interface
- Commercial failure
  - Cost ($15,000); IBM announced a less expensive model
  - Limited functionality - e.g., no spreadsheet
  - Closed architecture - 3rd party vendors could not add applications
  - Perceived as slow
  - Slavish adherence to direct manipulation

Commercial machines: Apple

- Apple Lisa (1983):
  - Based upon many ideas in the Star
  - Somewhat cheaper ($10,000), but also commercial failure
- Apple Macintosh (1984) - “old ideas” but well done!
- Succeeded because:
  - Aggressive pricing ($2500)
  - Did not need to trailblaze: mature ideas + market ready
  - Developer’s toolkit encouraged 3rd party non-Apple software
  - Interface guidelines encouraged consistency between applications
  - Affordable laser printer + excellent graphics

    -> domination in desktop publishing

Other events

- MIT Architecture Machine Group: N. Negroponte (1969-80s)
- Many innovative inventions, including
  - Wall sized displays
  - Use of video disks
  - Use of artificial intelligence in interfaces (idea of agents)
  - Speech recognition merged with pointing
  - Speech production
  - Multimedia hypertext
- ACM SIGCHI (1982)
  - Special interest group on computer-human interaction
- Specific HCI Journals since 1969 (“man-machine”)

Summary – current HCI prominence arises from:

- Cheaper/available computers

  -> People more important than machines
- Interface ideas modeled after human needs instead of system needs (user centered design)
- Evolution of ideas into products through several generations
  - *Pioneer* systems developed innovative designs, but often commercially unviable
  - *Settler* systems incorporated well-researched designs