# *Introduction to Human-Computer Interaction*

## Designing Interactive Systems

Lecture 1

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with acknowledgements to:
Petra Isenberg, Anastasia Bezerianos, Anthony Tang, Nic Marquardt, Tobias Isenberg, Raimund Dachselt



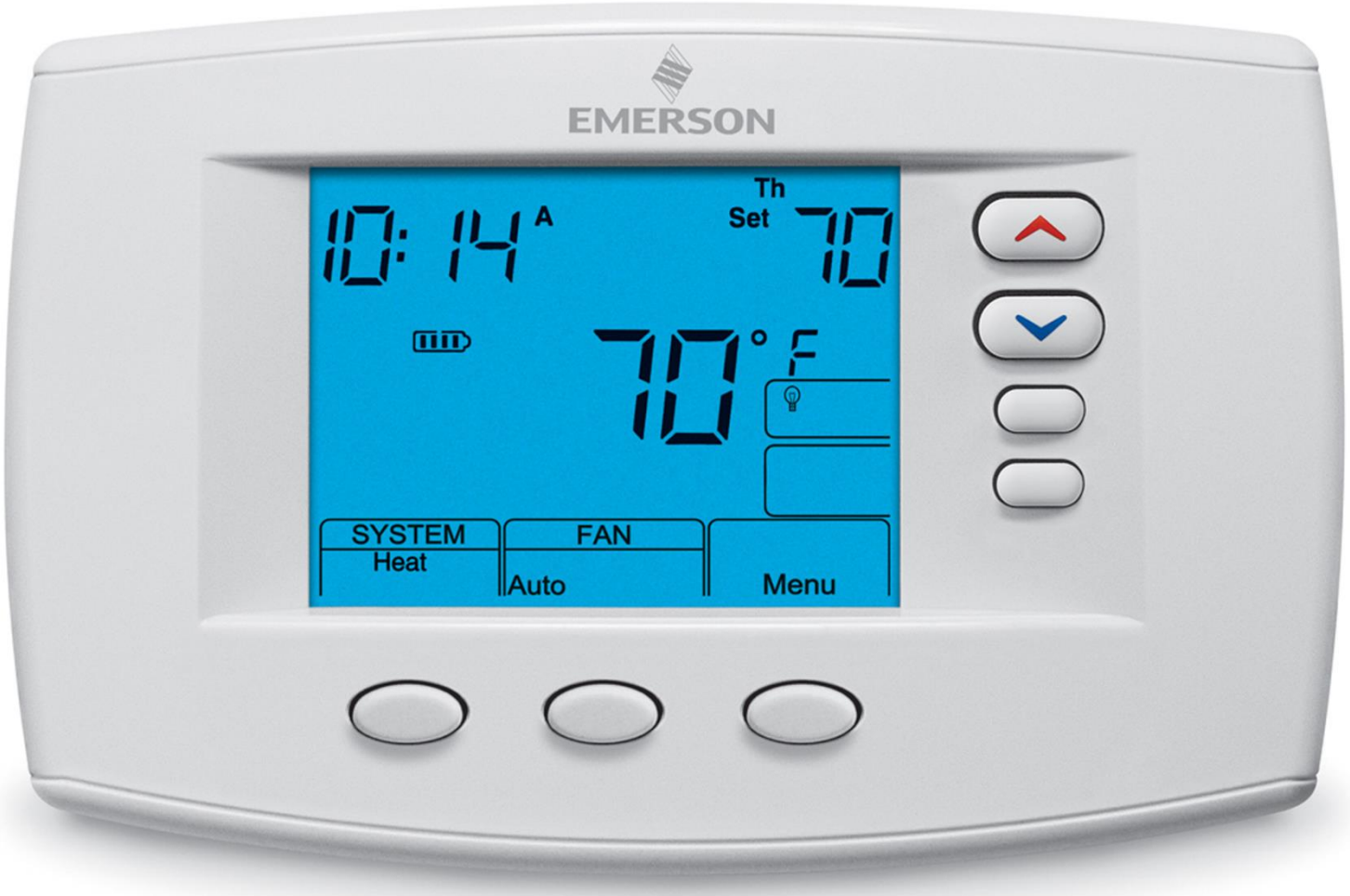

Photograph courtesy of Penelope Sanderson

# *bad interaction design is everywhere*

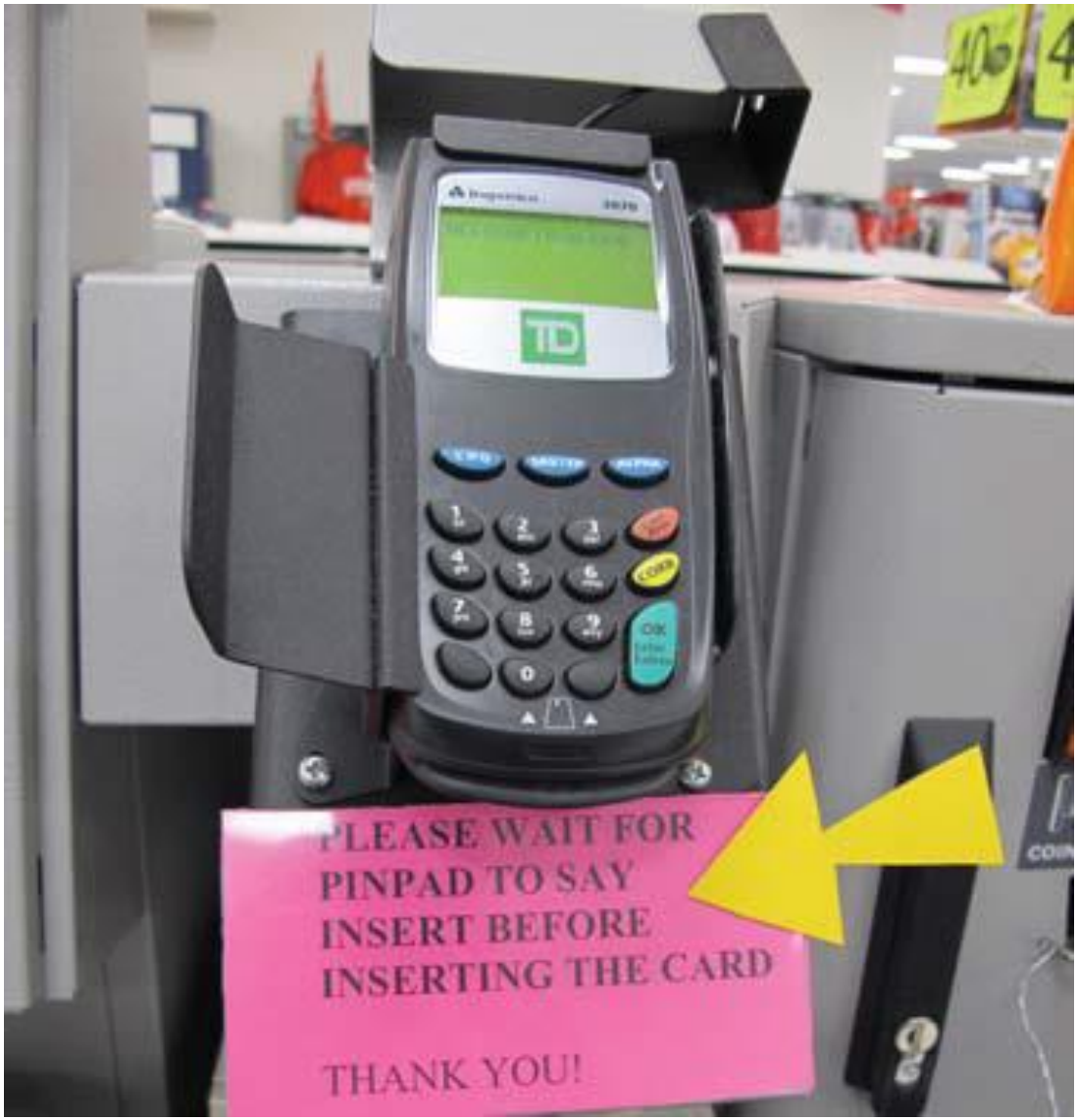


Photographs courtesy of Penelope Sanderson

# *bad interaction design is everywhere*



# *bad interaction design is everywhere*



# *bad interaction design is everywhere*


*“This Is What Happens When You Let Developers Create UI”*

Jeff Atwood (Co-Founder StackOverflow)

# *bad interaction design can be harmful*

in harmless cases just to your general sense of well-being



http://www.rigaut.com/benoit/CERN/badday/

# *bad interaction design can be harmful*

Money

- A $200 withdrawal turns into $20000
- Bad font choice ➔ "," looks like "."

# *bad interaction design can be harmful*

Lives: Therac-25 Radiation Machine

- Massive doses of radiation led to several deaths
- The system noticed that something was wrong and halted the X-ray beam, but merely displayed the word "MALFUNCTION" followed by a number from 1 to 64. The user manual did not explain or even address the error codes, so the operator pressed the P key to override the warning and proceed anyway.

**Therac 25 user interface** [1]

```
PATIENT NAME   : JOHN DOE
TREATMENT MODE : FIX     BEAM TYPE: X     ENERGY (MeV): 25

                          ACTUAL     PRESCRIBED
    UNIT RATE/MINUTE          0           200
    MONITOR UNITS           50  50        200
    TIME (MIN)              0.27         1.00

GANTRY ROTATION (DEG)       0.0            0     VERIFIED
COLLIMATOR ROTATION (DEG) 359.2          359     VERIFIED
COLLIMATOR X (CM)          14.2         14.3     VERIFIED
COLLIMATOR Y (CM)          27.2         27.3     VERIFIED
WEDGE NUMBER                  1            1     VERIFIED
ACCESSORY NUMBER              0            0     VERIFIED

DATE   : 84-OCT-26   SYSTEM : BEAM READY   OP.MODE: TREAT AUTO
TIME   : 12:55. 8    TREAT  : TREAT PAUSE           X-RAY 173777
OPR ID : T25V02-RO3  REASON : OPERATOR     COMMAND:
```

# *"but, I wouldn't make those mistakes!"*

maybe, but you're not the only one working on most projects. Your team might still make that mistake.

here's the problem:

- **you are typically not the user.**
- **you have your own biases.**

# *summary*

- interaction design is everywhere
- good interaction design is hard
- poorly designed things have big consequences
- good design practices can help
- you're going to be a good designer

# *course objectives*

- learn ways to address interaction design problems
- learn how to understand users
- learn how to develop design representations
- work as part of an interaction design team

*involves hands-on experience with multiple design methods: involving users, prototyping, testing*

# *introduction: me*

- instructor: Nadia Boukhelifa
- post-doctoral researcher at INRIA
  - Ph.D. in Computer Science from University of Kent
- research in Information Visualization / HCI
- office: at Université Paris Sud / Bâtiment Claude Shannon (plateau de Saclay)
  - email me for an appointment

# *basic course information*

- website
  - http://tinyurl.com/ktt3eng
  - readings / slides
  - posted online at the main website

**09:45 – 11:15 (lecture 1-3, 5-7)**
**14:00 – 15:30 (lecture 4, Tuesday!)**
S109

**11:30 – 13:00 (lab 1-3, 5-7)**
**15:45 – 17:15 (lab 4, Tuesday!)**
S109

| Lecture | Break | Labs |
|---|---|---|

# *Course outline*

- January 15
  - Lecture: Introduction to HCI
  - Tutorial: Group formation, picking projects
- January 19
  - Lecture: User requirements analysis
  - Tutorial: Conducting a requirements analysis
  - Hand in project component I
- February 2
  - Lecture: Sketching and storyboards
  - Tutorial: Sketching and brainstorming
  - Hand in project component II
- Febuary 3
  - Lecture: Prototyping
  - Tutorial: Planning a high-fidelity prototype
- Feb 23
  - Lecture: Interaction Design
  - Tutorial: Development of high-fidelity prototype
  - Hand in project component III
- March 2
  - Lecture: Usability evaluation
  - Demo project component IV
- March 9
  - Lecture: Information Visualization
  - Tutorial: Heuristic evaluation
- March 16
  - Exam

# *assessment*

- Class participation: 10%
- Project: 40%
- Exam: 50%

# *assessment – participation (10%)*

- treat everyone with respect – be constructive
- be prepared for class
- let the instructor know if you cannot attend
- ask challenging questions, contribute with comments
- help your classmates / project team

# *assessment – project 40%*

- opportunity for you to engage in hands-on interaction design with a real project
- project teams of 3 (one group of 4)

Component I - Group Formation & Topic Choice
Component II - User Requirements
Component III - Low-Fidelity Prototype
Component IV - High-Fidelity Prototype

# *labs*

- will explain the project components
- hands-on activities towards your projects

# *Acknowledgements*


- Lecture slides include material from:
  - Anthony Tang (University of Calgary)
  - Nicolai Marquart (City University London)
  - Anastasia Bezerianos (Université Paris Sud)
  - Raimund Dachselt (University of Dresden)
  - Tobias Isenberg (INRIA)
  - Petra Isenberg (INRIA)

# *Further readings*


- Helen Sharp, Yvonne Rogers, Jenny Preece, Interaction Design: Beyond Human-Computer Interaction, Wiley, 2nd Edition, 2007, ISBN 0-47001866-6, http://www.id-book.com/
- Bill Buxton: Sketching User Experiences - Getting the Design Right and the Right Design. Morgan Kaufmann, 2007, ISBN 0-12-374037-1. Educating us in creativity and design
- [Shne05] Shneiderman, B., Plaisant, C.; Designing the User Interface; Pearson Addison-Wesley, 4th edition, 2005, ISBN 0-321-19786-0.

# Questions?

Lecture 1

# *WHAT IS HCI AND WHERE DO WE COME FROM?*

# *What is HCI?*

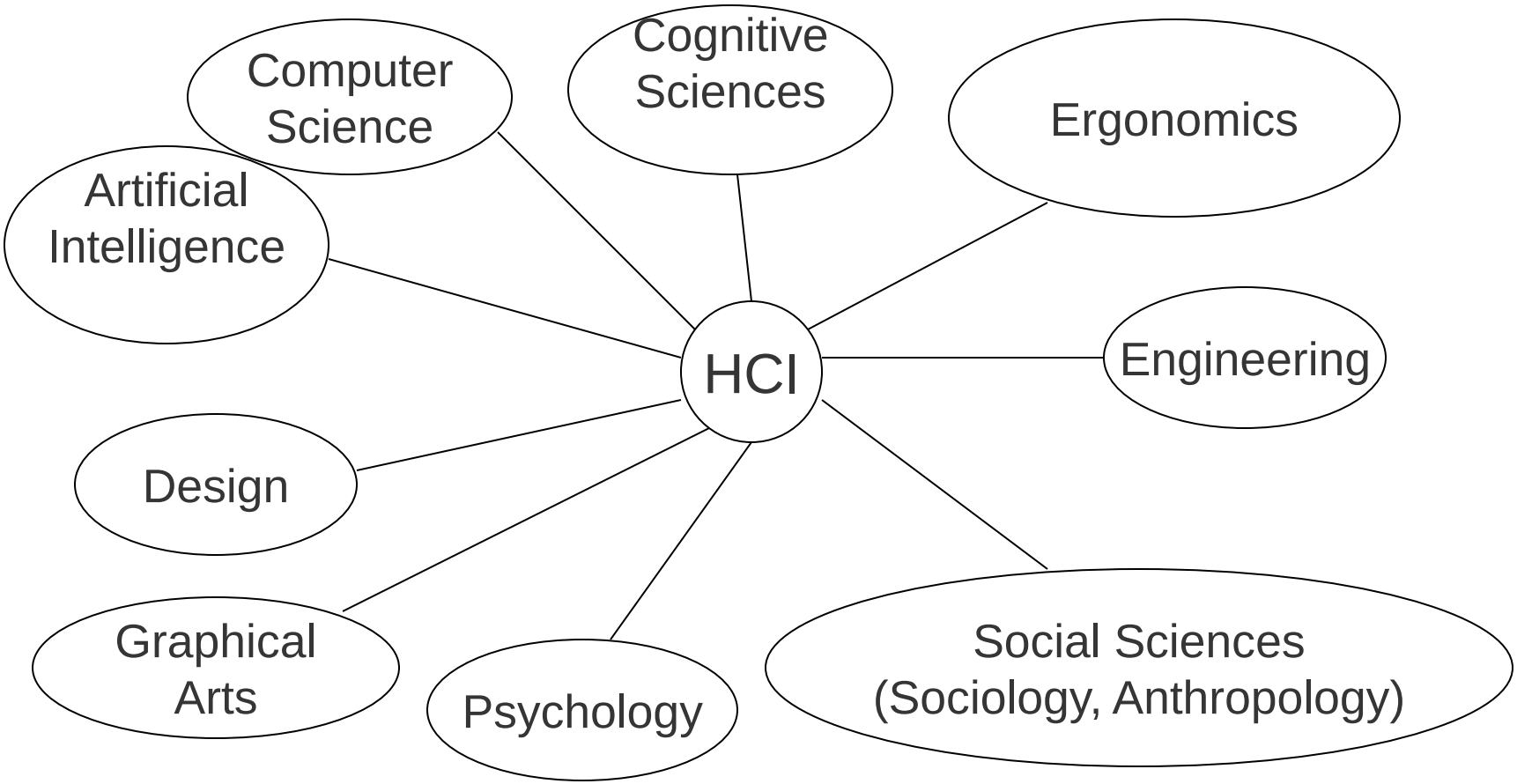
"Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" [ACM]

# *We focus on designing interactive systems*

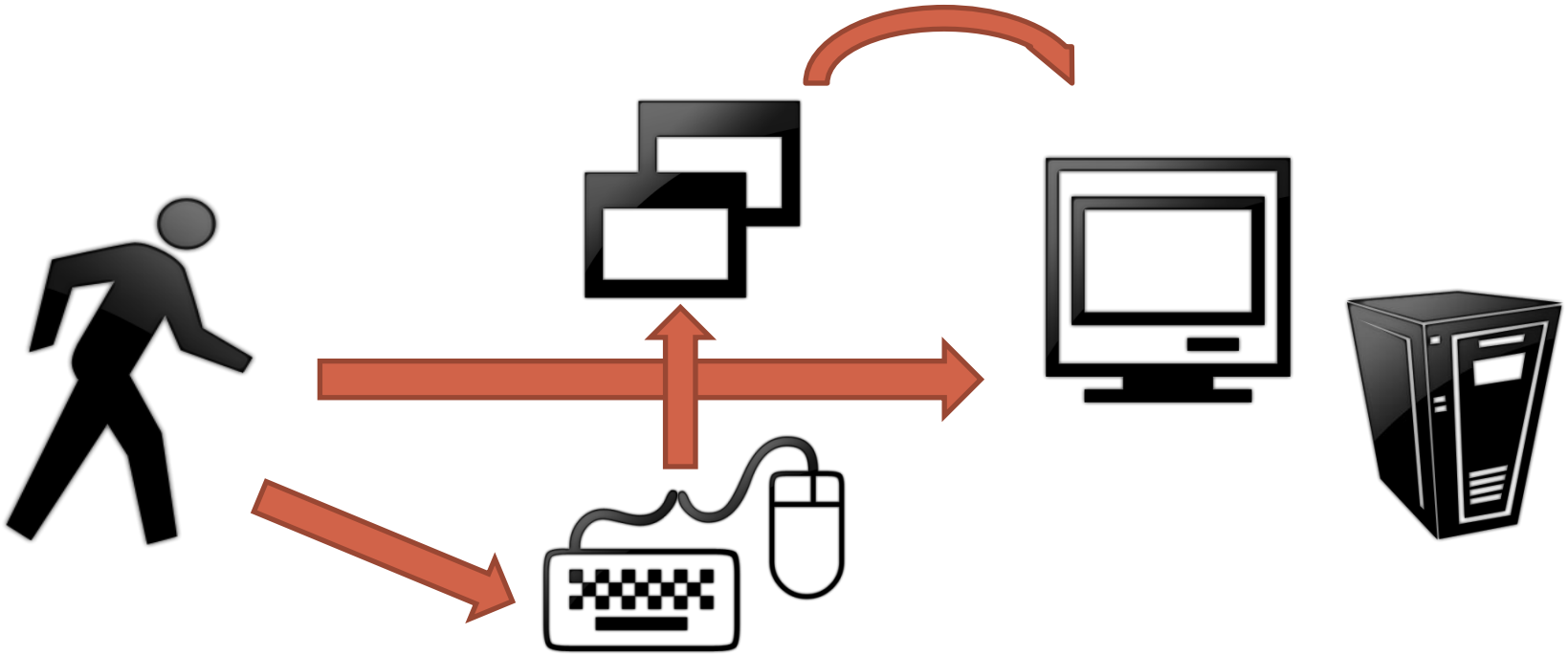
= “[…] developing interactive products that are easy, effective, and pleasurable to use” – from a user’s perspective

Rogers, Sharp, & Preece, 2011

# *hci is multidisciplinary*



# *what is an interactive system?*



- interaction devices
- user interfaces
- responsive software

# *what is a user interface (UI)?*

- part of an interactive system that:
  - represents its internal state on output peripherals
  - captures & manages input from input peripherals

- the medium through which the communication between human and computer takes place
- through the interface user actions are translated into instructions that are comprehensible for the computer
- computer outputs are coherently edited for the user so that he/she can react on them [Bowm+04]

# *user interface*


The DEC VT100, a widely emulated computer terminal

image source wikipedia

# *graphical user interface (GUI)*

interface

that uses *output* peripherals (screen, projector)

+

some *input* peripherals (mouse, pen) that provide *relative positions w.r.t.* the *output* peripherals

to

allow reference to aspects on the interface using pointing (thus linking input/output)

# *graphical user interface*

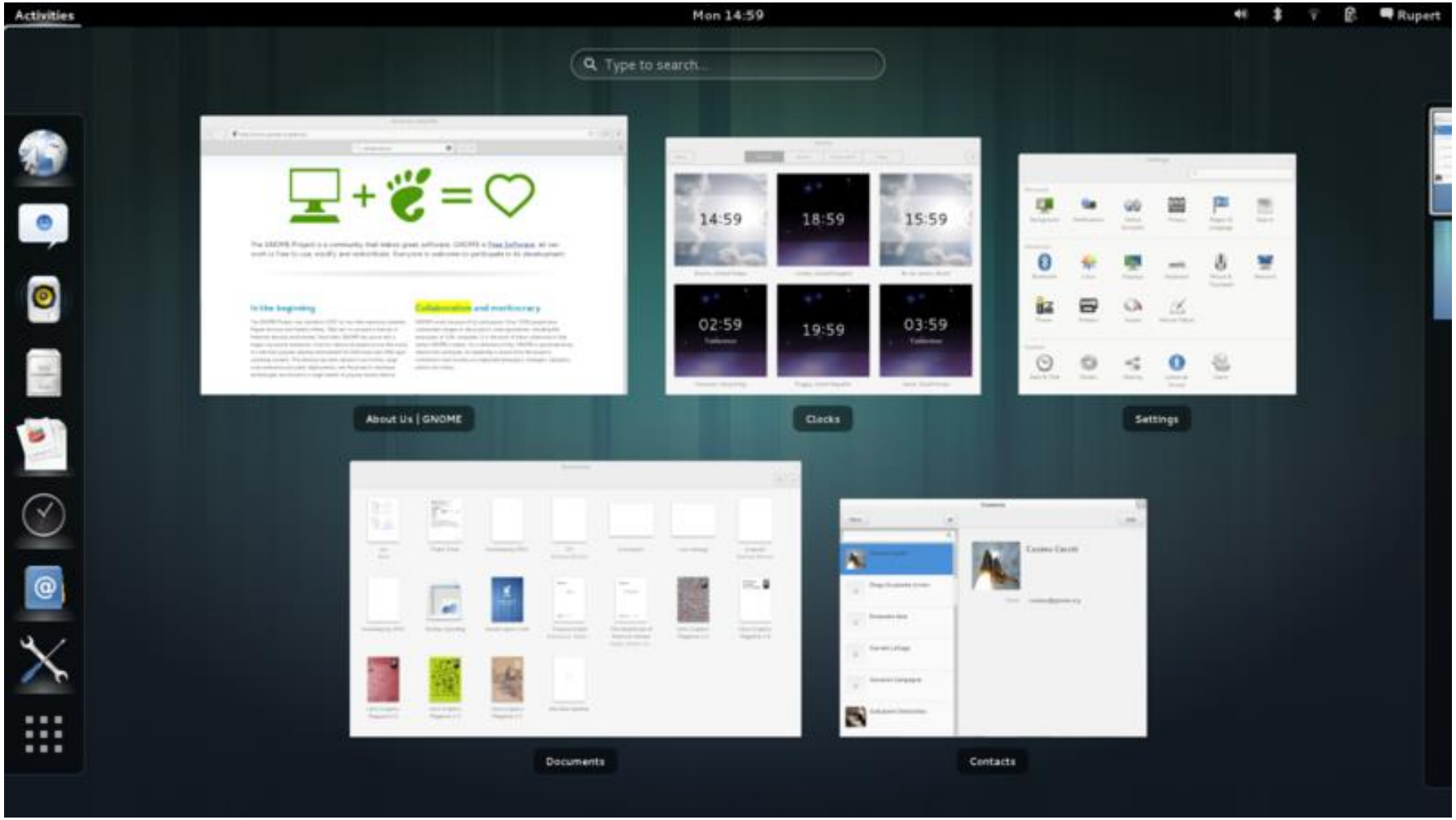



image source wikipedia

*UI is responsible for approx. 50% of the design, implementation and maintenance time + code size*

*→ important part of the software development*

# *what is an interaction technique?*

- A method which enables the user to carry out a task by means of the user interface.
- Comprises hardware and software components
  - Software component responsible for transfer of device information into actions and for the issue of (graphical, acoustic, haptic) feedback [Bowm+04].

# *drag and drop*

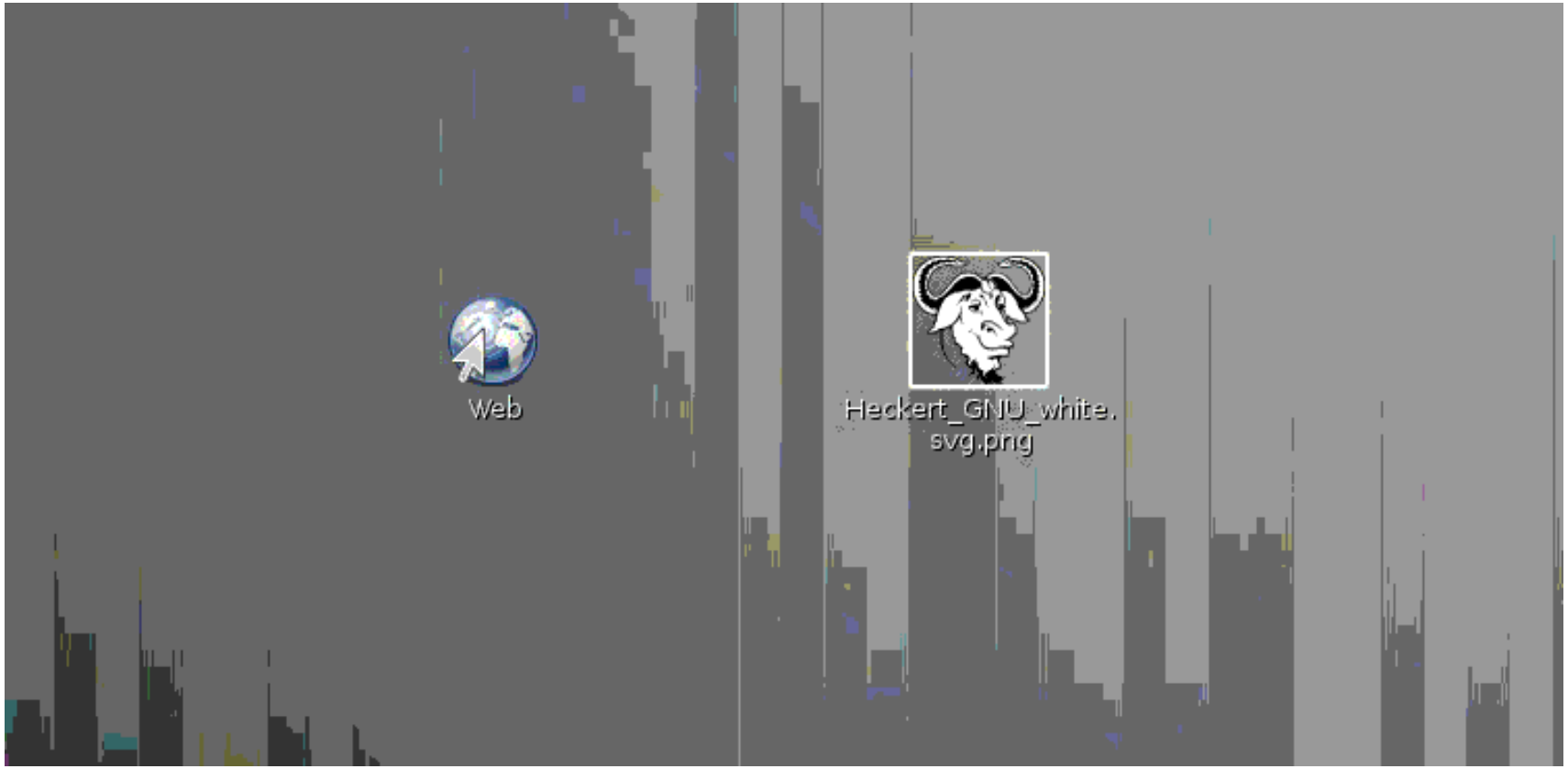



image source wikipedia

# *usability*

- aim is to make things that meet users' needs
- there are many ways to meet needs
- usability is concerned with optimizing interactions

# *usability goals*

- effective to use
- efficient to use
- safe to use
- have good utility
- easy to learn
- easy to remember how to use

# *the user experience*

- all aspects of the user's interaction with the product: how it is perceived, learned, and used
- important questions:
  - what are the important qualities of the intended experience?
  - fast and efficient vs. slow and leisurely interactions

# *in this course…*

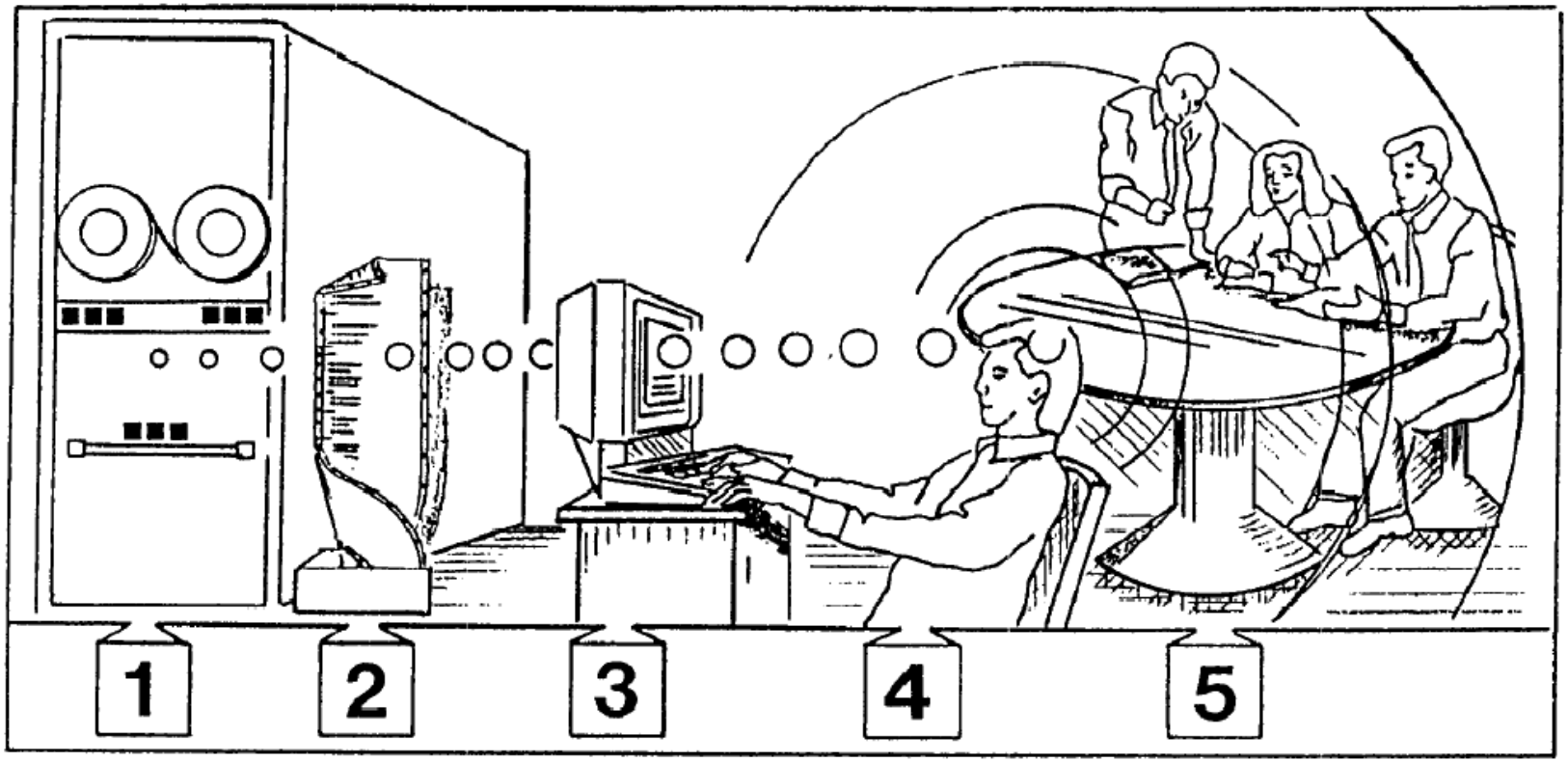
- we will be concerned with all these aspects
  - interactive systems
  - graphical user interfaces
  - interaction techniques
  - usability
  - user experience

# *but first …*

we need to learn where we're coming from

**a brief history of human-computer interfaces**

# *the history of interfaces*




Grudin (1990) The computer reaches out: The historical continuity of interface design

History of the development of UIs [vDam97]

- No predictable, steady UI improvements, like e.g. for Moore's Law
- More like a "punctuated equilibrium" (Steven Jay Gould)
  - long periods of stability, interrupted through rapid changes

# *Moore's Law*

- Gordon Moore (Intel): 1965
- "The complexity for minimum component costs has increased at a rate of roughly a factor of two per year… Certainly over the short term this rate can be expected to continue, if not to increase. Over the longer term, the rate of increase is a bit more uncertain, although there is no reason to believe it will not remain nearly constant for at least 10 years."

# *Moore's Law… bang on so far*

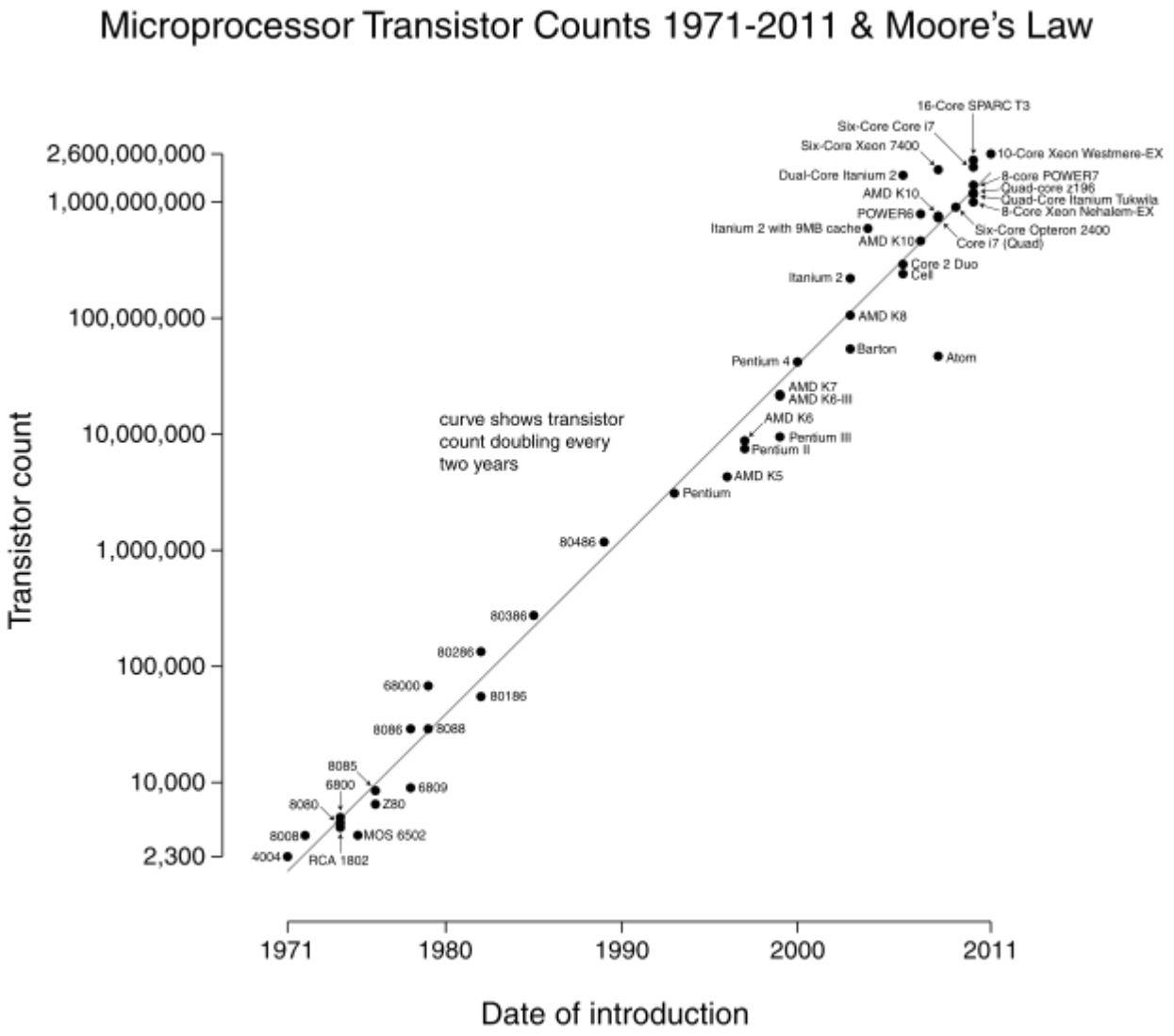
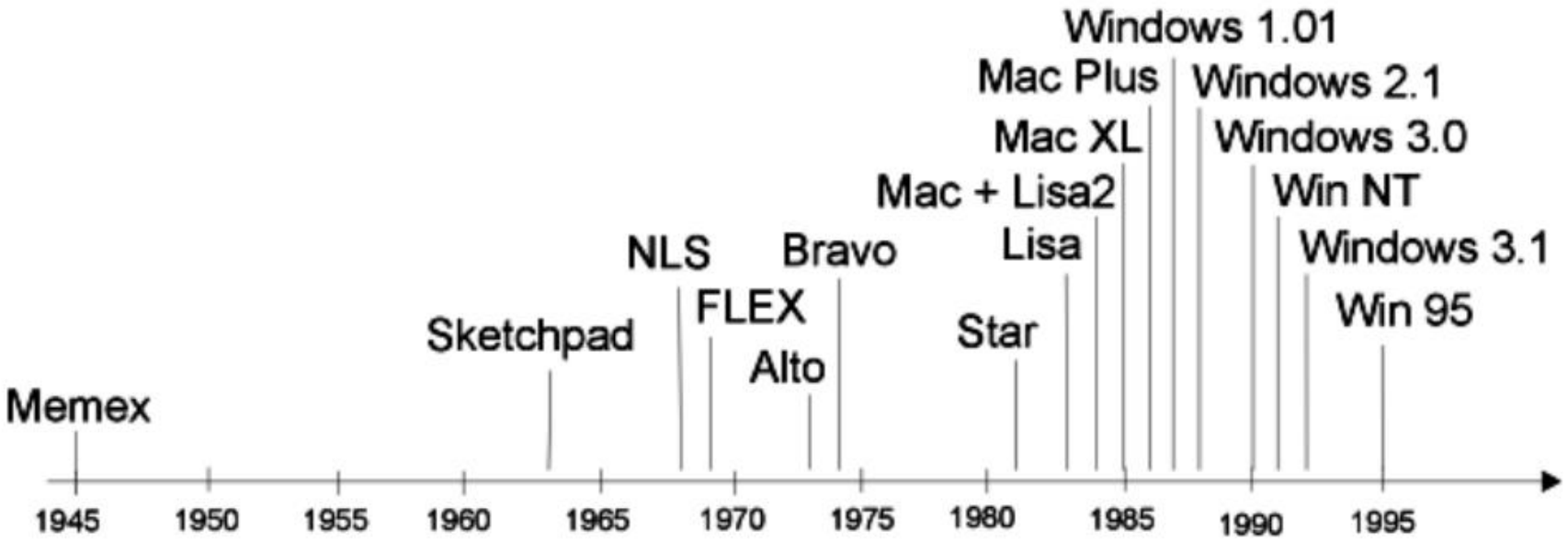



image source wikipedia

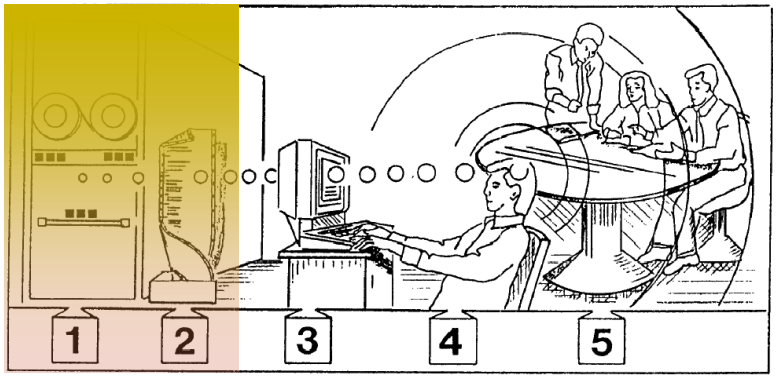
# *history of GUIs*

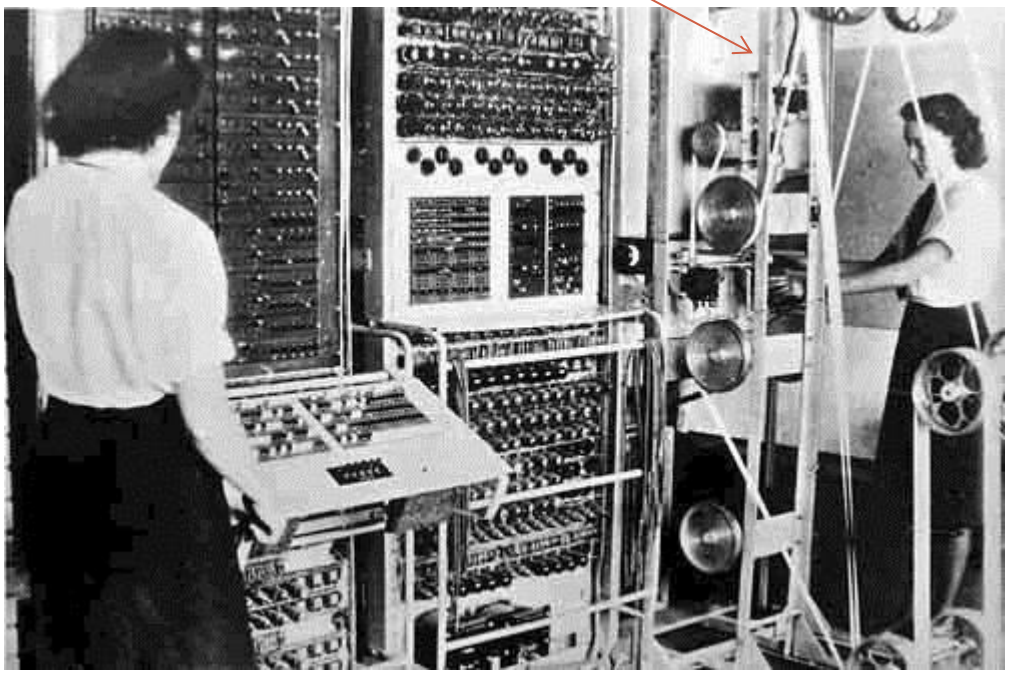


# *the history of interfaces*

Phase 1,2 interaction by programming

- 1950s – 60s
- Batch mode
- Punch cards
- Line printer
- Not interface, no menus

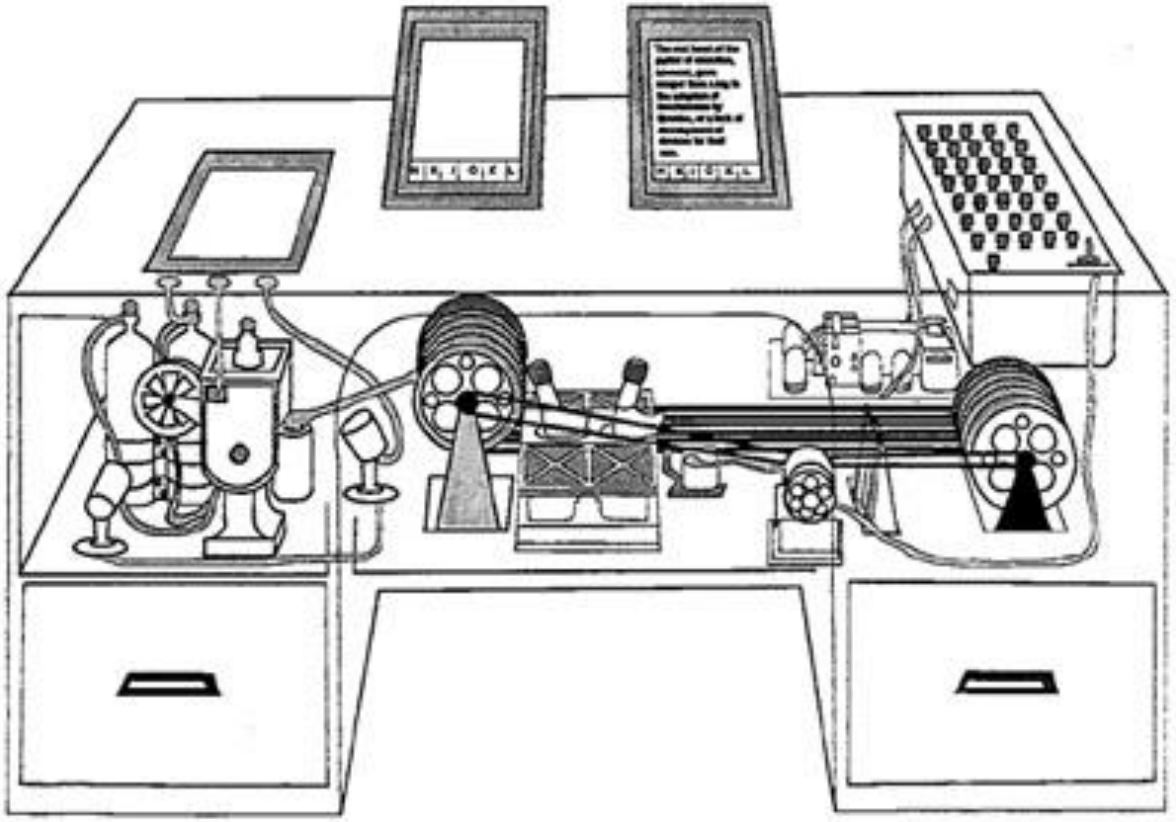


Colossus Mark 2

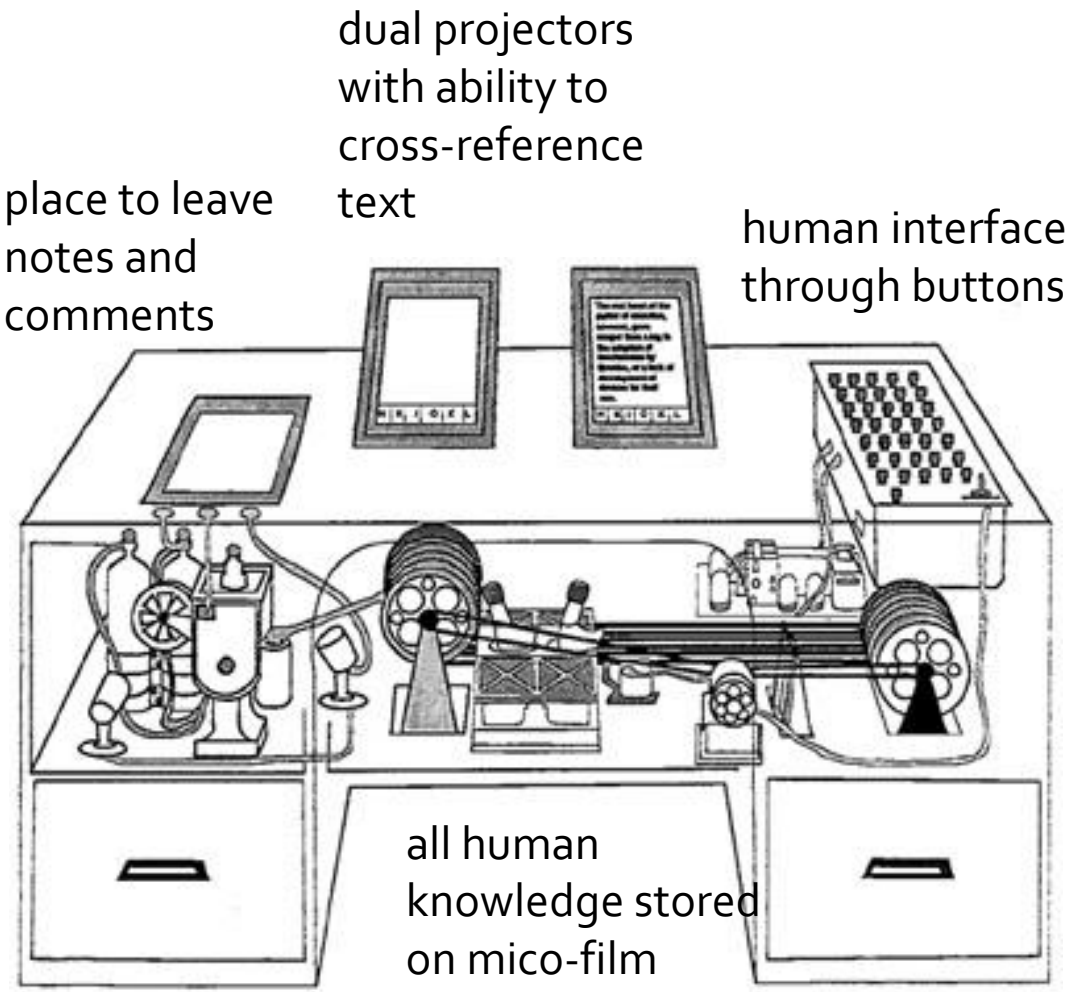
# *but there were revolutionary thinkers much earlier*

- MEMEX and Hypertext (1945)
  - Vannevar Bush: "As We May Think"



# *The Memex user interface*

- "A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility.
- User interface:
  - Translucent screens (displays)
  - A keyboard, buttons and levers
  - A camera ("analog scanner")

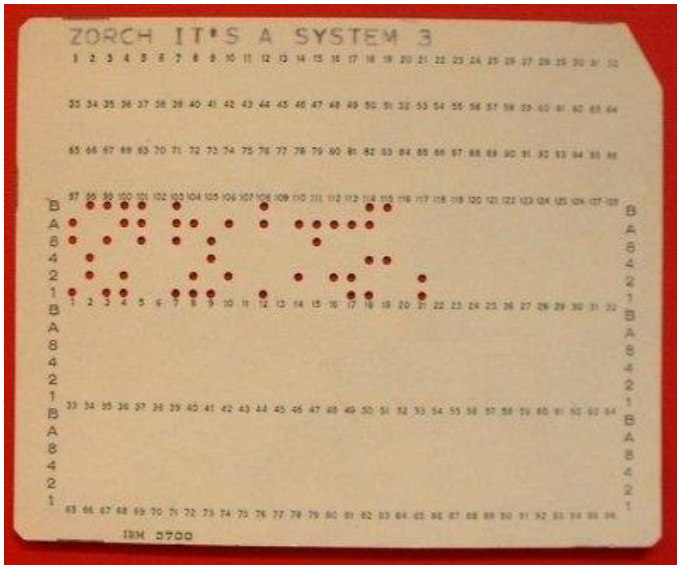


# *The Memex Legacy*

- Predicted personal computers, hypertext, the internet, the www, speech recognition, online encyclopedias
  - "Wholly new forms of encyclopedias will appear, ready-made with a mesh of associative trails running through them, ready to be dropped into the memex and there amplified."

# *Sketchpad – Ivan Sutherland (1963)*

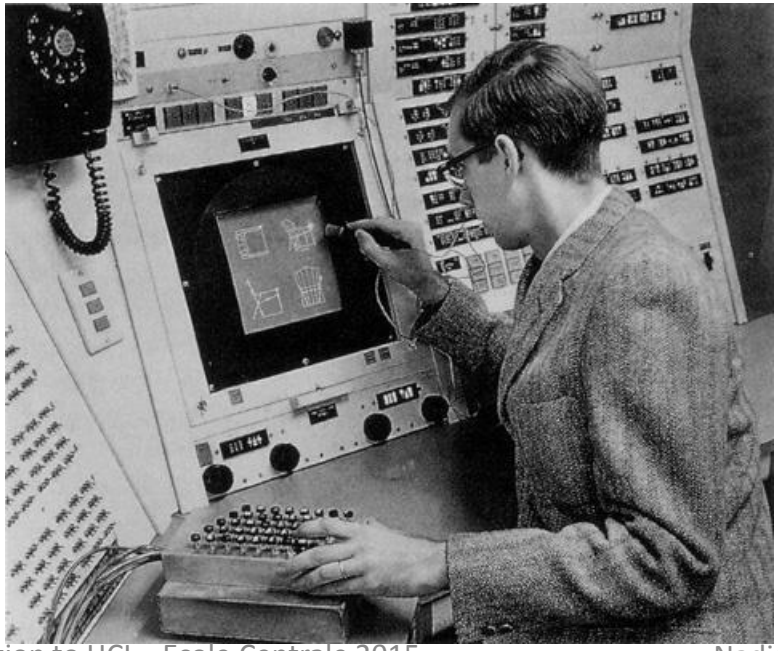
- 1960s – usually computers dealt with batches of jobs and used punched cards for input
  - exception: TX-2 computer at MIT

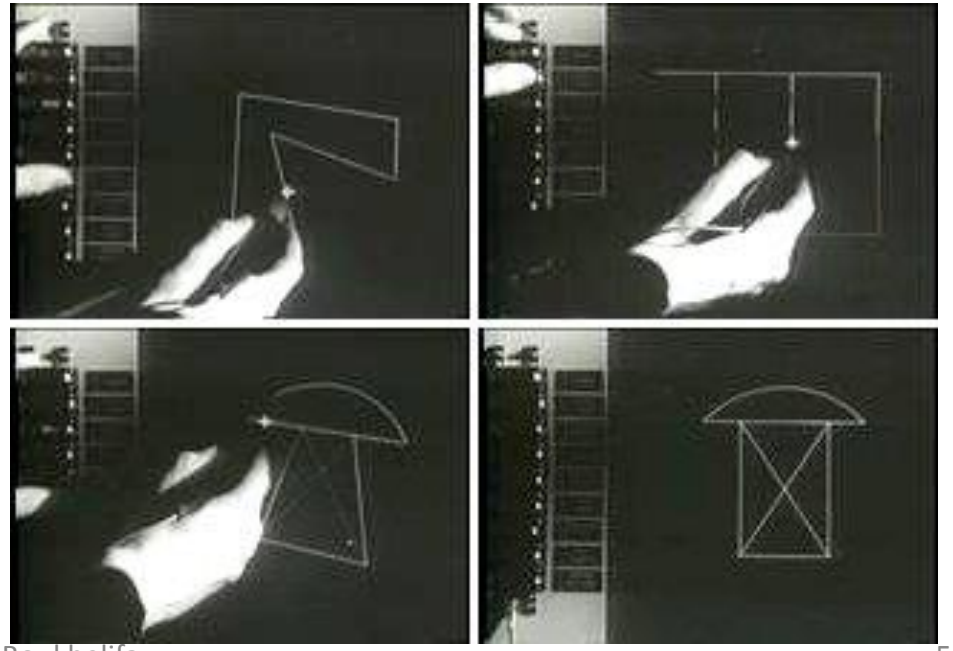



punched card

# *Sketchpad – Ivan Sutherland (1963)*

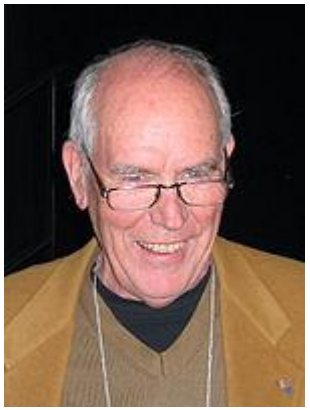
- PhD thesis at MIT
  - 1st graphical interface
  - graphical screen
  - pointing devices (optical pen) and buttons
  - design, zoom, copy-paste, icons, geometric constraints





http://www.youtube.com/watch?v=mOZqRJzE8xg

# *Sketchpad – Ivan Sutherland (1963)*

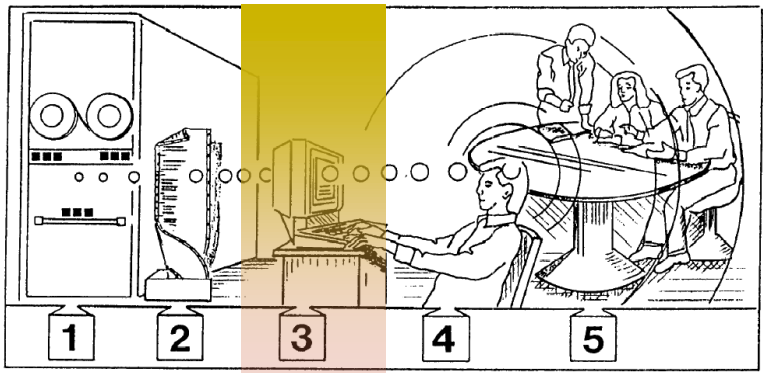


- Ivan Sutherland received for Sketchpad:
  - the ACM Turing Award (1988)
    (thought of as the Nobel prize for computing)
  - the Kyoto Prize (2012)
    (regarded as Japanese equivalent of Nobel prize)
- Sketchpad influenced:
  - CAD
  - development of computer graphics
  - GUI development
  - object oriented programming

# *the history of interfaces*

Phase 3 commands with parameters

- 1960s-1980s
- End users (time-sharing)
- Human factors, cognitive psychology, graphic design
- Time sharing creates the illusion of a personal machine
- User can afford to think "at the terminal"
- Focus on user behaviour and productivity
- Computer mediated human-human interaction (CSCW)
  - Messages / Shared file systems




# *Douglas Engelbart – NLS (1968)*

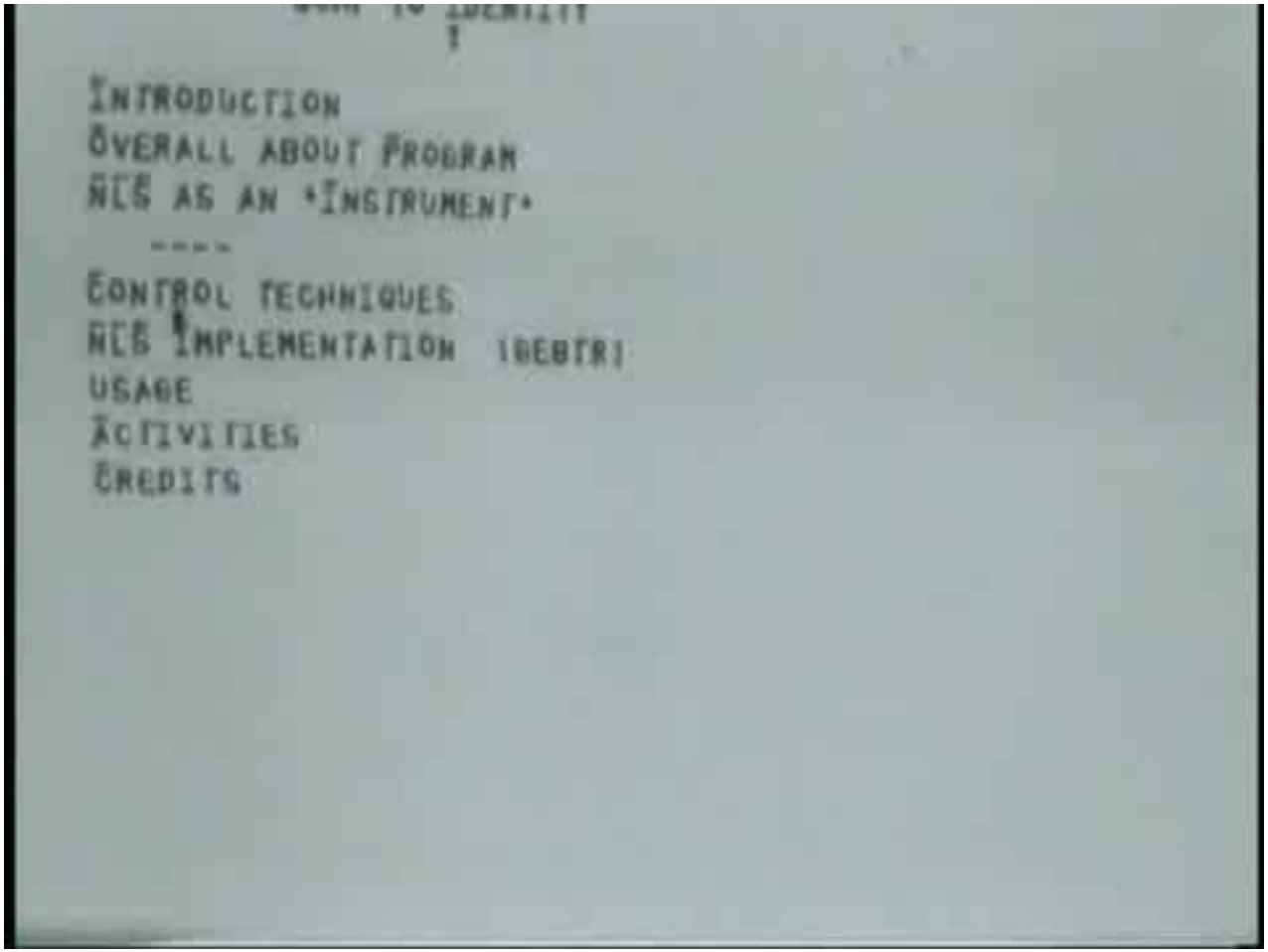
- Stanford Research Institute
  - developed system to augment human intellect and use a network, wanted to turn the idea of Memex into reality (oNLine System)
  - invention of mouse, keyboard & function buttons
  - hypertext links (remember Vannevar Bush (1945))
  - collaborative work, video-conference, document sharing

# *The Mother of All Demos*

http://en.wikipedia.org/wiki/The_Mother_of_All_Demos

- took 90 minutes
- SF convention center (~1000 attendees)
- first time an integrated system for manipulating text onscreen was presented publicly
- demonstrated with help of geographically distributed team
- Engelbart was seated next to the screen at the controls of an online workstations whose display output was projected on the screen in the convention center

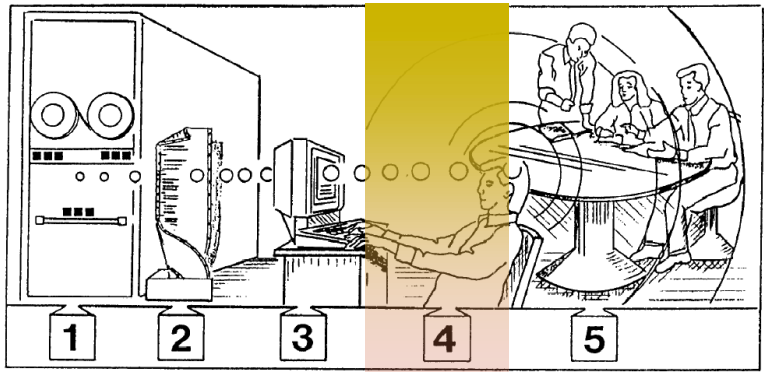
# *ffwd to discussion of the mouse*



# *the history of interfaces*

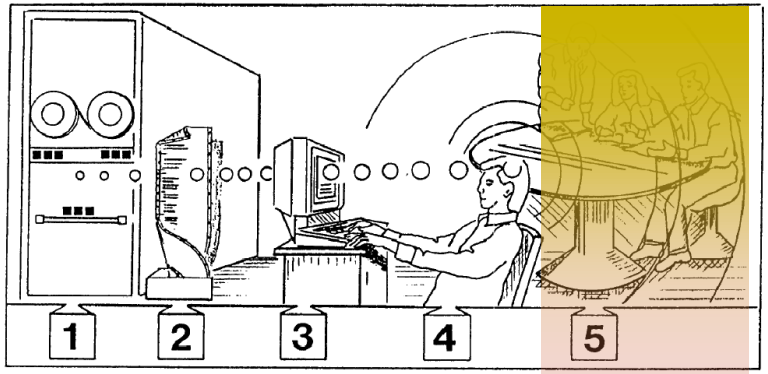
Phase 4 GUIs - WIMP

- 1980s-
- Personal computers
- Many end-users
- More cognitive psychology, graphic design
- point-and click
- WIMP = windows, icons, menus, pointers (usually mouse)

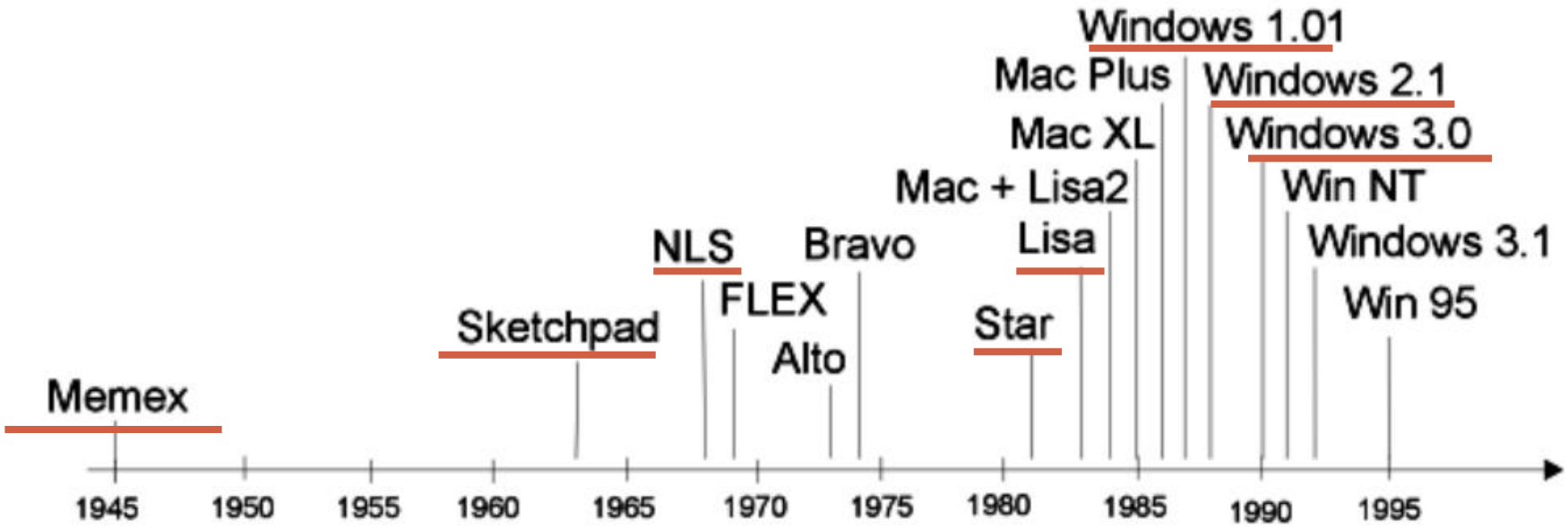



Phase 5 post-WIMP

- 1990s-
- multiple, simultaneous input and outputs
- often more than one user
- different UI styles and terms
- "beyond mouse and keyboard"



# *history of GUIs*



# *history of GUIs*

Xerox PARC = Palo Alto Research Center created in 1970

- PARC grouped divers talent, interested in photocopying but also desktop computers
- 3 researchers/engineers won a Turing award

- Known for inventing
  - OO Programming (Smalltalk)
  - Ethernet
  - Portable computers
  - Laser printers
  - WIMP : Windows, Icons, Menus & Pointers

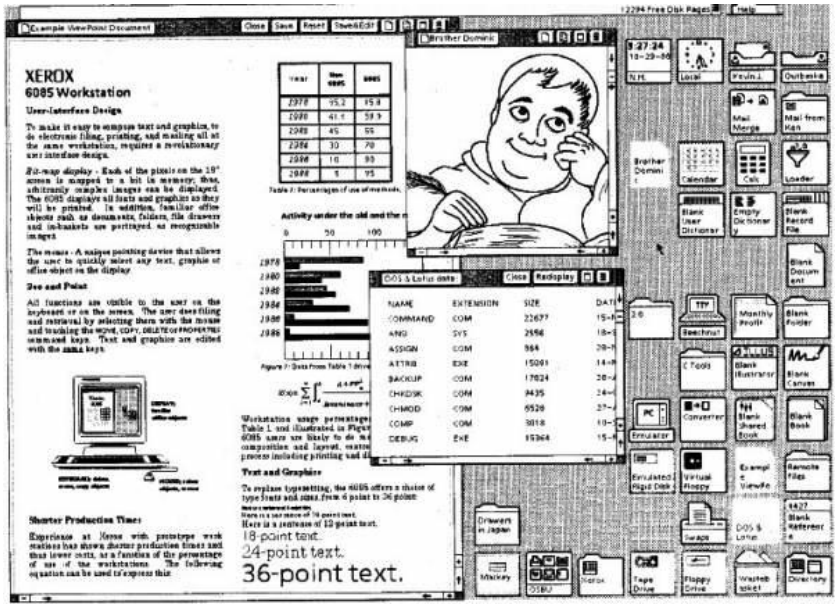
# *Xerox Alto personal computer (1973)*

- first to demonstrate desktop metaphor + GUI
- one of the first to use a mouse after sketchpad
- bitmapped screen
- not a commercial product
- GUI used windows, icons and menus (first fixed drop-down menu)
- first WYSIWYG cut & paste editor

# *Xerox Star (1981)*

followed from Alto as commercial product

$16,500



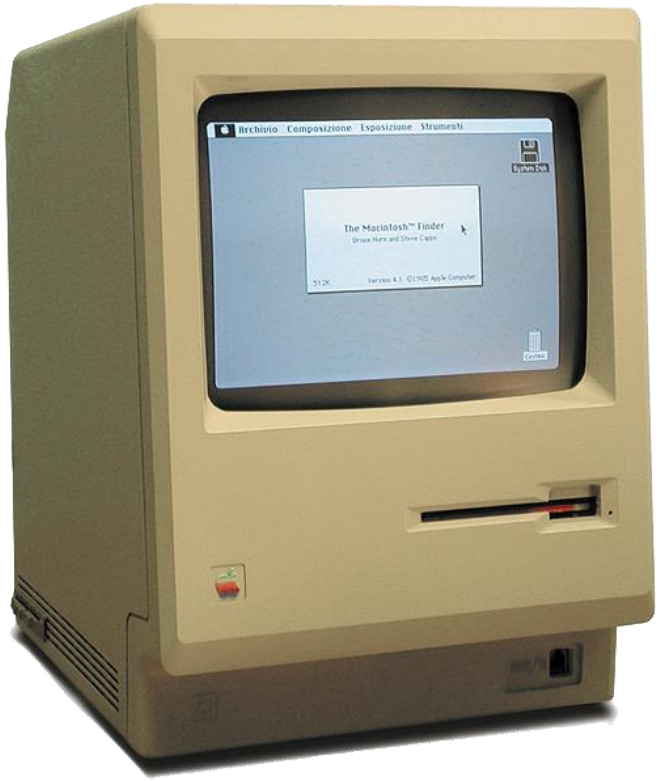

first personal computer with GUI to be sold commercially (no financial success)

# *Apple Lisa (1978, released 1983)*

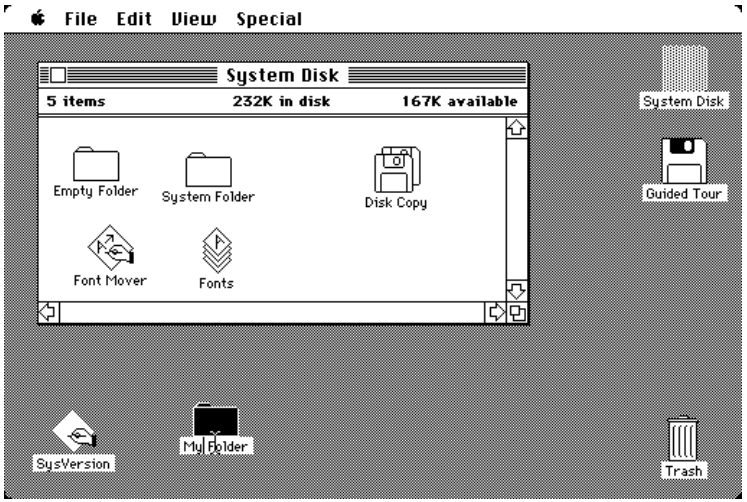
- second personal computer with GUI to be sold commercially
- drop-down menu bar, windows, multiple tasking, a hierarchical file system, the ability to copy and paste, icons, folders and a mouse

US$9,995
(approximately $23,426 in today's dollars

# *Apple Macintosh (1984)*

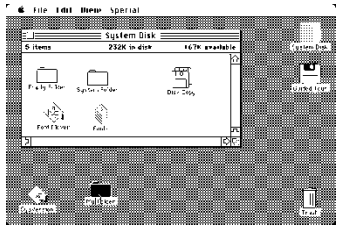


$2,495



# *Apple Macintosh (1984)*

$2,495




- commercial success, more mature
- aggressive price ($2,500) accessible to larger public
- menu bar, modal dialog boxes and visible UI toolkit to help external developers
- detailed style guides to help consistence between apps
- three key applications: Finder, MacPaint, MacWrite

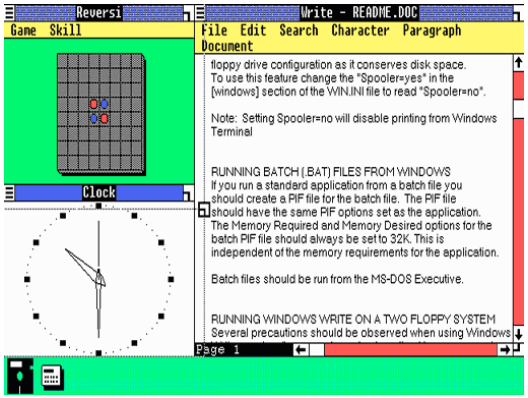
http://interaction.lille.inria.fr/~roussel/digital-library/media/1984-Macintosh.mov

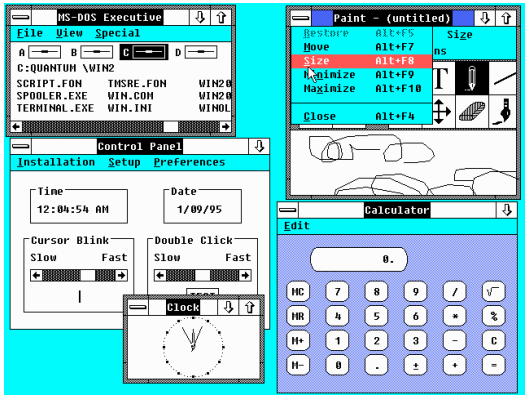
# *Apple Macintosh (1984)*

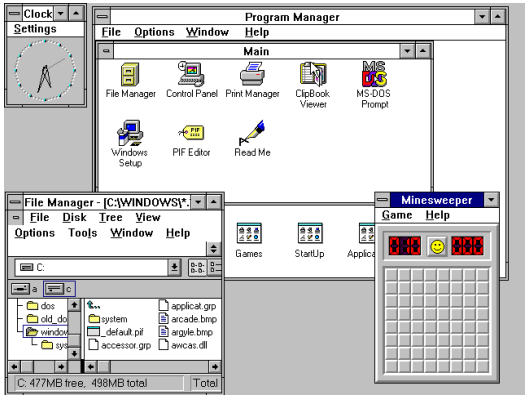
http://interaction.lille.inria.fr/~roussel/digital-library/media/1984-Macintosh.mov

# *MS Windows (1983)*

- Microsoft Windows 1.01
  - Announced in 1983 by Bill Gates (Microsoft)
  - 1987 released for IBM computers
  - Large disappointment: lack of icons, too much reliance on mouse pointing, slow, lack of tutorials
- Windows 2.03
  - 1988
  - Overlapping windows
  - Mac-like icons
  - Long court battle between Microsoft and Apple (ruled in favor of MS)
- Windows 3.1
  - Commercial success
  - 40% market share



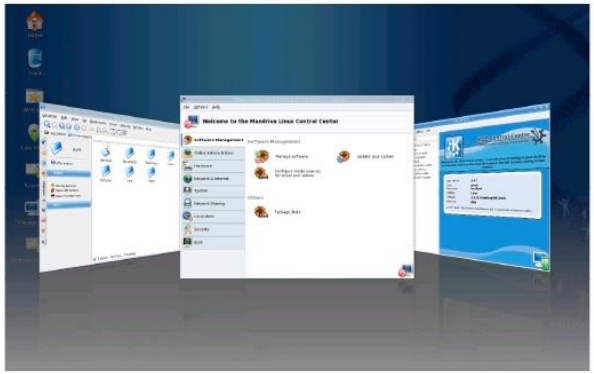



# *Desktop interface (1984 - )*

more power and new uses (network), but still lots of interfaces based on WIMP

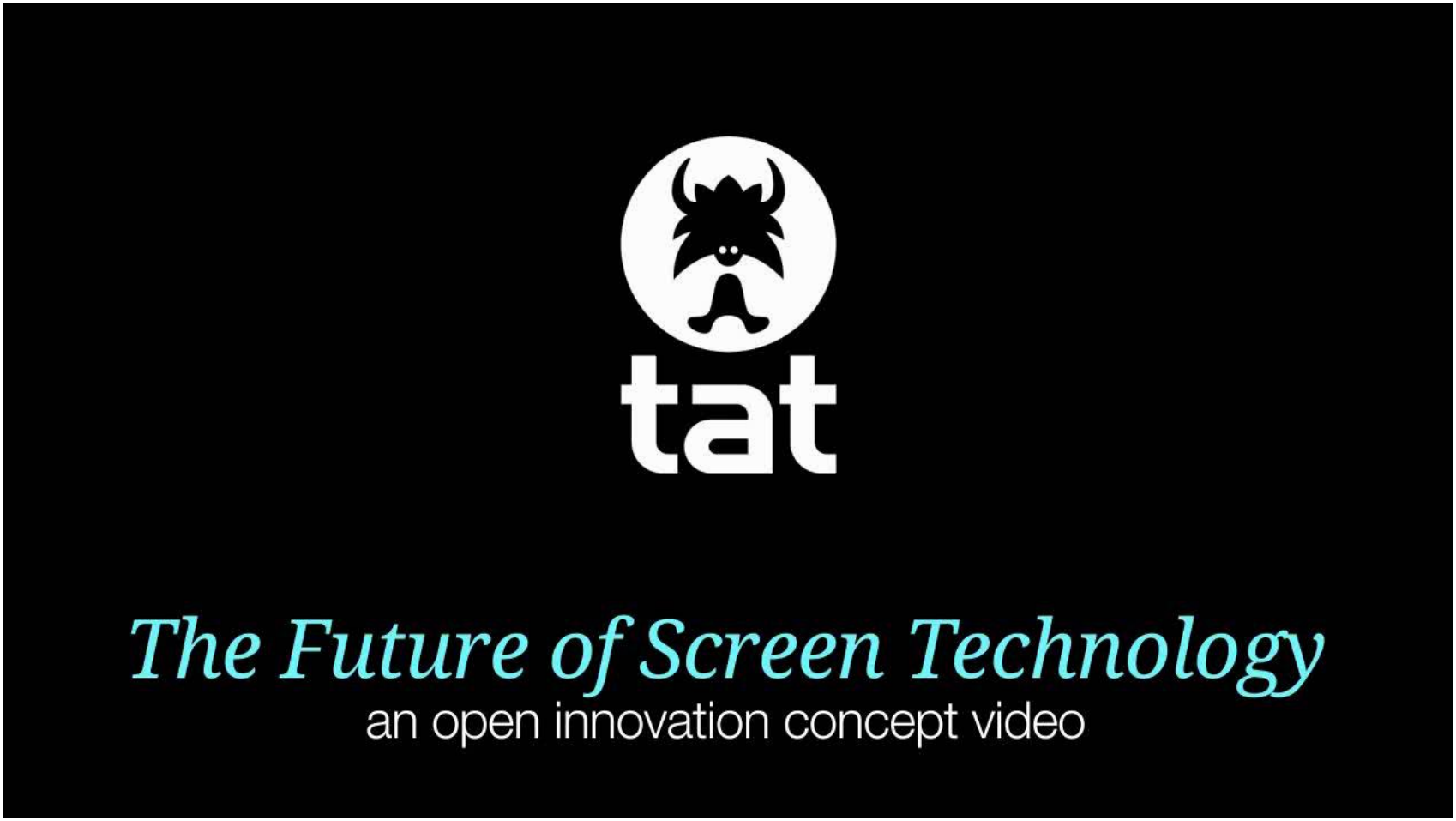

Apple OS X 10.5

Microsoft Vista



Mandriva Linux 2008

# *what do we envision next?*




from http://www.tat.se/

# *what do we envision next?*

from Minority Report, © 2002 Twentieth Century FOX and Dreamworks Pictures

# *where are we now?*

- entering post-WIMP era
  - Augmented / mixed reality
  - Wearable UIs
  - Tangible user interfaces
  - Touch UIs
  - …


The Problem

# *WHY IS IT DIFFICULT TO DESIGN GOOD UIS?*

# *Why is design hard?*

- Everyone is different
  - Age, knowledge, skill, ability, background
- People *appropriate* technology unexpectedly…
  - Designer's fallacy: that a designer can design into a technology, its purposes and uses
- Contexts of use may differ than what we expect
  - Smartphone app use in the early days, and now

# *Appropriation*

- In action…

http://appadvice.com/appnn/2012/01/ces-2012-ion-shreds-the-convention-world-with-guitar-apprentice

http://www.wired.com/gadgetlab/2010/04/sprocket-pocket-ipad-turn-signal-for-cyclists/

# *Why is design hard?*

- We've never "seen" it before
- We aren't the people using it
- We can't anticipate how people will use it

# *Why is design hard?*

- Judging/predicting which designs will be successful is difficult
  - Way more is possible than what is good
- Design involves making trade-offs
- Good designs are non-obvious

# *Why is design hard?*

- People make errors
  - slips: unintended action [motor action]
  - mistakes: incorrect action [cognitive goal]

- Exercise: classify these
  - Mistyping an email address
  - Clicking on a heading that isn't clickable
  - Clicking "Save" instead of "Open"

# *Core design skills*

- To synthesize a solution from all of the relevant constraints, understanding everything that will make a difference to the result
- To frame, or reframe, the problem and objective
- To create and envision alternatives.
- To select from those alternatives, knowing intuitively how to choose the best approach.
- To visualize and prototype the intended solution

# "*The user is not like me*"

- Familiarity with the interface problems being solved
- Confidence
- Designer's setting vs. user's setting
- Designers have different skills (perceptual, cognitive, or domain)

# Are there processes that can be followed?

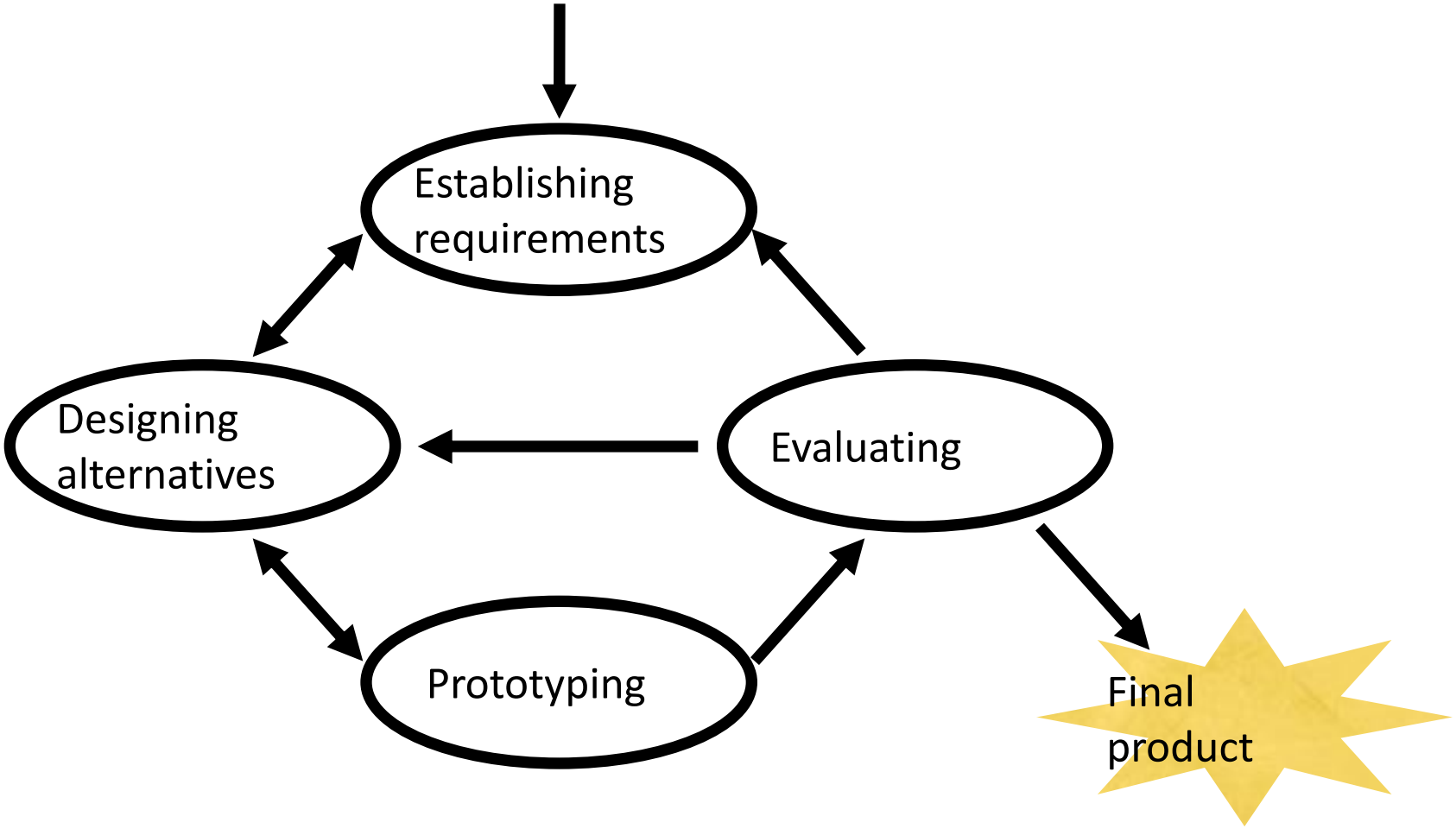
# *the user-centered approach*

- early focus on users and tasks
- empirical measurement
- iterative design

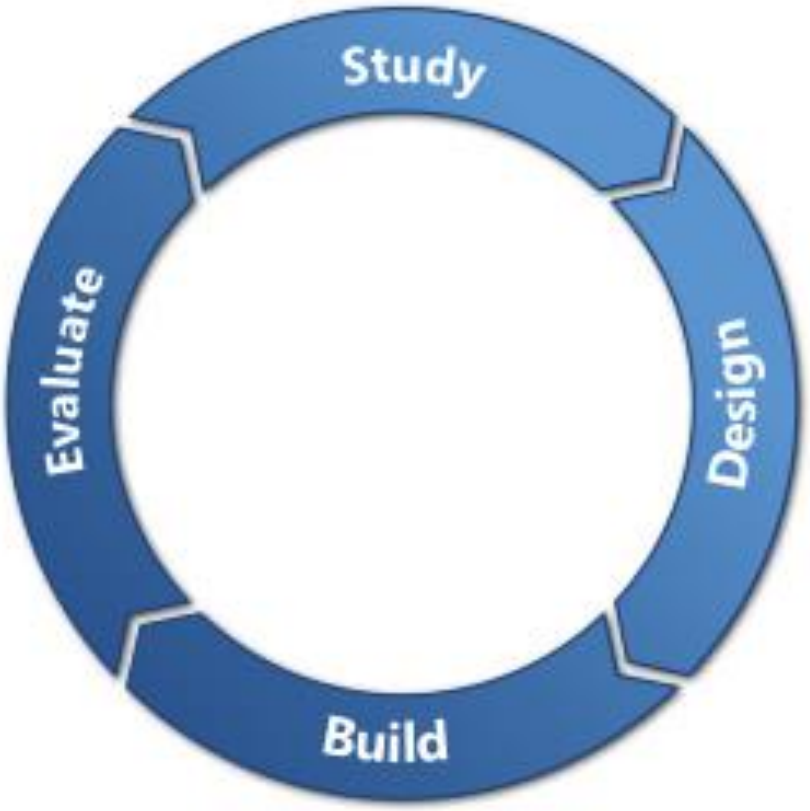
# *four basic activities*

1. establishing requirements
2. designing alternatives
3. prototyping
4. evaluating

# *the design lifecycle*



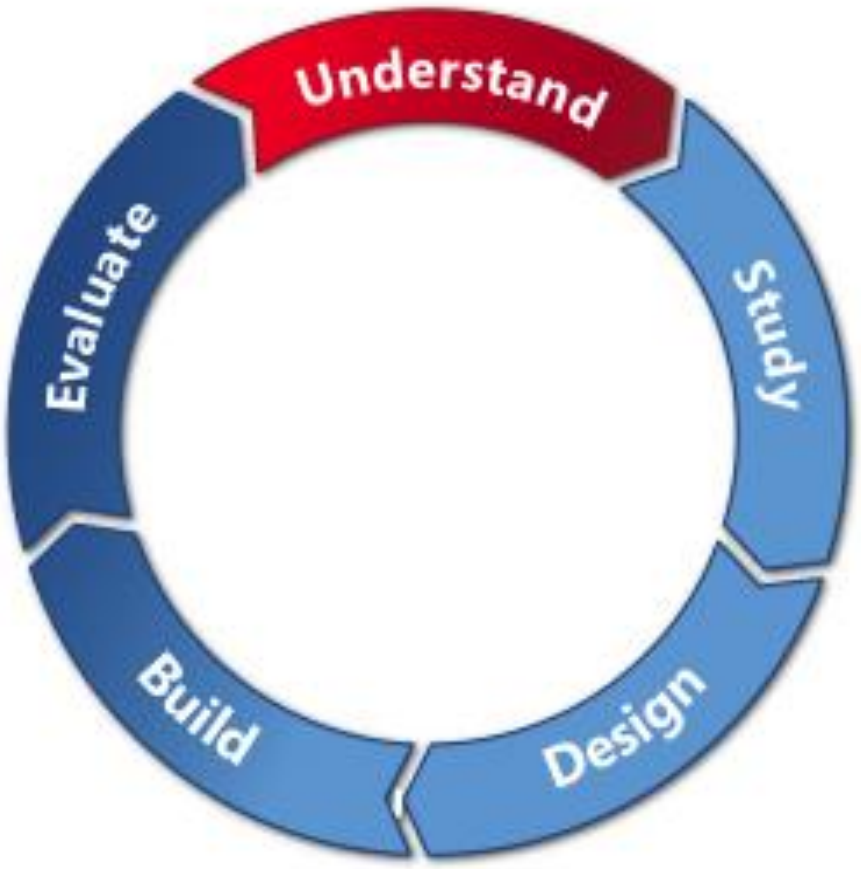
# *Iterative Process*




The conventional user-centred, four-stage design/research model

Harper et al., 2008

# *Iterative Process*




- what human values do we wish to design for?
- what are the various morale, personal, and social impacts of the proposed system?

Harper et al., 2008

# *practical issues*

- who are the users?
- what are their needs?
- how do we generate alternatives?
- how to choose among alternatives?

# *users' needs*

- **users rarely know what is possible**
- **look at existing tasks:**
  - their context
  - what information do they require?
  - who collaborates to achieve the task?
  - why is the task achieved the way it is?
- **envisioned tasks:**
  - can be rooted in existing behaviour
  - can be described as future scenarios

# *involving users*

- **member of the design team**
  - participatory design approach
  - full- or part-time members, for short- or long-term periods of the project
- **occasional consultation**
  - interview users to identify needs
  - get feedback on prototypes through user testing

# *requirements*

understand as much as possible about users, their tasks, and context of use in order to produce a stable set of requirements

# Break

Class will resume in 15 minute(s)

# Deep Dive:

## IDEO's redesign of the Shopping Cart

Idea Generation

# *LAB 1*

# *Deep Dive Discussion – 15 mins*

# *good design RARELY happens alone*

- Others are needed to help generate ideas, give feedback, etc.
- Diversity of backgrounds, skills, and experiences are needed
- Today's lab is about understanding that group process and facilitating team formation

# *breakout Session*

- Find teammates now
  - you can either self-assign
    (research does not recommend this)
  - we an do a small exercise to select groups
    (research recommends this)

# *group selection exercise – 5mins*

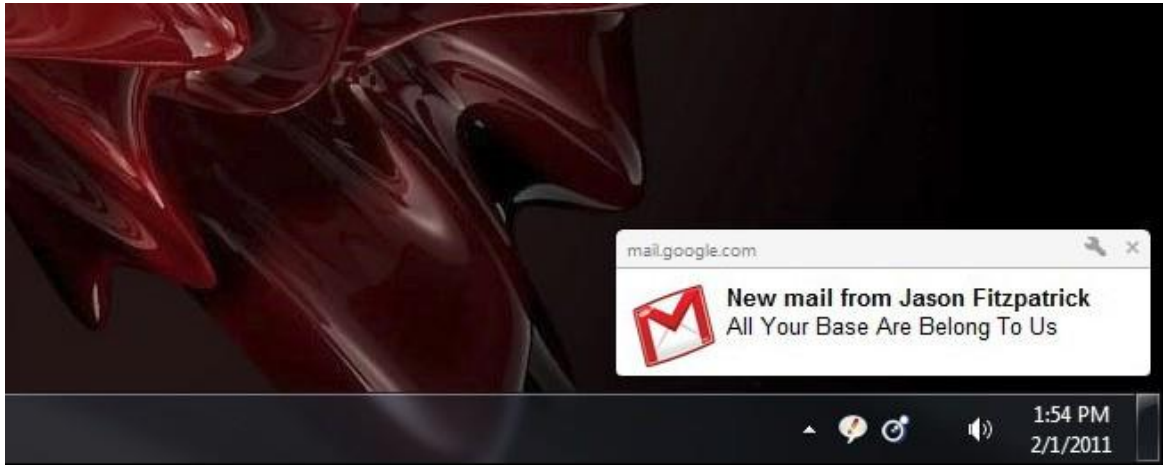
You are designing a new interface for paying a parking ticket in a parking garage. Which of the following aspects would you choose to work on:

a) finding out how people currently pay
b) building an example mockup
c) designing the hardware
d) designing the software
e) something else

write your name and answer on a piece of paper and give it to the instructor

# *project we will work on during the course*

- many people suffer from information overload
- The goal of the project is to figure out an application running on a certain device that can show us the information we need at a glance
- Currently many apps send us emails or push notifications to make us aware of information we need. This is not very creative - how can we do better?


mail.google.com
New mail from Jason Fitzpatrick
All Your Base Are Belong To Us
1:54 PM
2/1/2011


SAP
WORK/LIFE BALANCE DASHBOARD
RESOURCES
RESET
PRINT
ABOUT
Today's Date: 08/27/2010
STEP 1
Begin by filling out the information below
MY CURRENT STATE
MY IDEAL STATE
MY COMPARISON
WORK/CHORES
CURRENT
MY IDEAL
DIFFERENCE
DIFFERENCE
At Work 45 40 5 260
Commuting 5 2.5 2.5 130
Chores 7 1.5 5.5 286
Shopping 2 1 1 52
PERSONAL
With Family 21 21 0 0
Entertainment 7 7 0 0
Personal Health 7 7.5 -0.5 -26
SLEEP 49 56 -7 -364
TOTAL FREE TIME 25 31.5 -6.5 -338
The Scorecard above shows the difference between the hours in your current work week, by category, compared to your ideal week. Explore the interactive charts and gauges in the results panel on the right for a better understanding of how to optimize your work/life balance.
Review your results
STEP 2
COMPARISON CATEGORY BREAKDOWN
by hours
DETAILS
COMPARISON
Free Time 31.5 25
Personal 35.5 35
Work 45 39
Sleep 56 49
Ideal Total Hrs
Current Total Hrs
DETAILS - AT WORK
Total 168 Hour Week
45
40
Current Total Hrs
Ideal Total Hrs
Your ideal selections are always shown at 12 O'clock. The needle shows the alignment of your Current selection to Ideal. If you're more than 20% + or - the needle will be in the red. A value of 0% represents perfect alignment
2.98%
Powered By SAP Crystal Presentation Design


AT&T 3G
5:43
Monday, May 18
AP News
Breaking: Goldman Sachs, Morgan Stanley apply to repay billion in bailout money, sources say.
slide to view

# *Breakout Session – 15 mins*

- Find with your group 10 examples of situations where people have to deal with information overload
- Write down:
  - who are the people
  - what is the information they deal with

# *Breakout Session – 20 mins*

- Pick your favorite situation and create some sketches
  - What is the problem (or problems) that needs to be addressed?
  - Where would an app to solve the problem be used?
  - What is the current situation?

- What are your assumptions about this problem?
  - Assumptions are things you have not empirically backed up (e.g. security of children in a shopping cart is an issue – before you've read any studies about the topic)

- What would you need to find out?
- Who would you ask?
- How would you ask?

# *Breakout Session – 5 min talks*

- 5 minute talks – walk everyone through the charts you constructed

- 2 minute questions

# *Group Discussion – 10-15 mins*

- Place the sketches of the different project ideas around the room
- Walk around, and discuss these project ideas with others
- Use sticky notes to add a variation to that project idea
  - e.g. variations for communication system for families: (1) between homes; (2) between grandma and baby; (3) within a home
- If you would like to change groups, discuss with others

# *Project Component I - Deliverables*

- Get, buy, reuse a binder and in it put
  - a piece of paper with the names & email addresses of all team members
  - a grading sheet (download from website)
  - a description of your project idea (details see website and grading sheet)
  - a description of users and stakeholders
    - who is impacted in one way or another by your system?

Hand the binder in at the beginning of the next lab!

# *In the remaining time*

- begin with your deliverable
- flash our your project idea

**Problems to think of in this space:**
What should the device show? Email, weather, calendar, news, ...?
When should information be shown?
How important is the context of use to what is being shown?
How does the size of the screen influence what should be shown?
What would alerts look like, would they be needed?
What would the display look like for specialists in an area (e.g. if you pick musicians would John Lennon's display look different than Michael Jackson's)?

# *Acknowledgements*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