

Grundlagen der Mensch-Computer Interaktion

Niels Henze



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LET'S BE HONEST

I DON'T KNOW SHIT

memegenerator.net

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Organisatorisches

Tutorien

- Mittwoch 14-16
- Mittwoch 16-18
- Donnerstag 14-16
- Donnerstag 16-18

- Mittwoch nach der Vorlesung gehen die Übungsblätter online
- In der Regel eine Woche Bearbeitungszeit
- Voraussichtlich 10 Übungsblätter

- FlexNow Anmeldung für die Klausur ab 7. Juli
- Anmelden für die Studienleistung (Übung): 1. Juni-16.Juni
- Letztes Übungsblatt am 20. Juni

Topics of the Lecture

- Motivation
- History of HCI
- Human Abilities
- Prototyping
- Basics and Principles
- Evaluation Methods
- Controlled Experiments
- Models in HCI
- *Further selected topics*

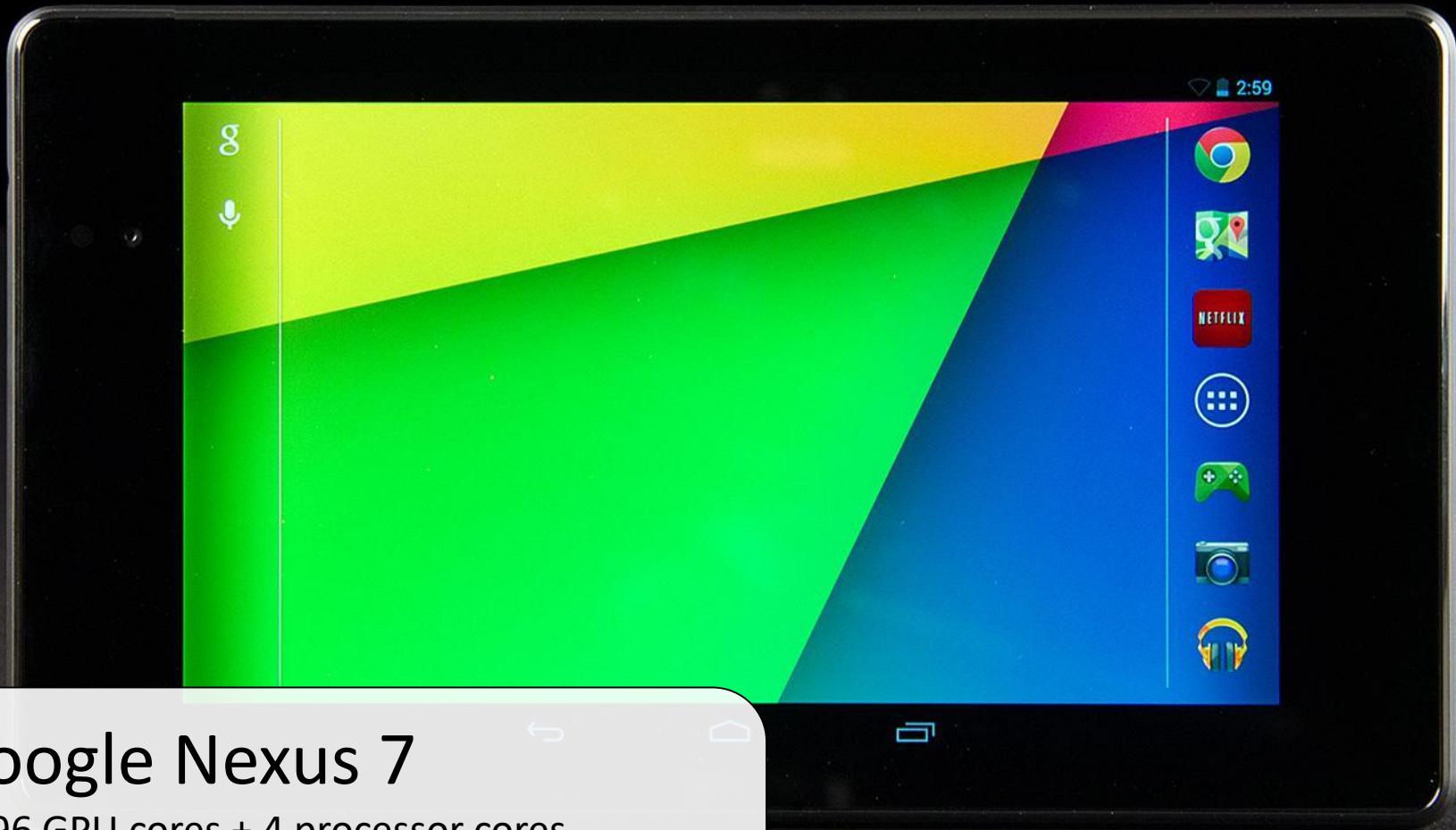
Topics of the Lecture

- **Motivation**
- **History of HCI**
- Human Abilities
- Prototyping
- Basics and Principles
- Evaluation Methods
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Intel XP/S 140 Paragon

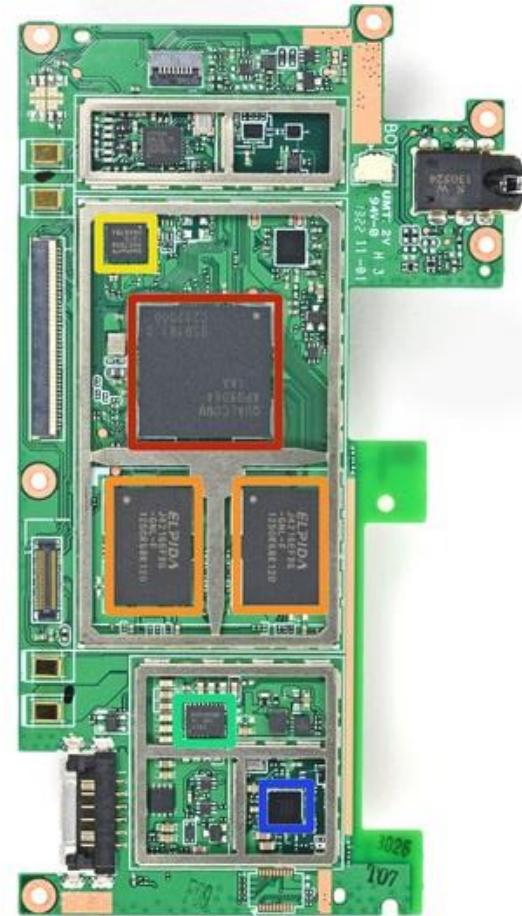
- 3,680 processor cores
- 143.40 GFLOPS
- Fastest computer in the world
(June 1994)



Google Nexus 7

- 96 GPU cores + 4 processor cores
- 96.4 GFLOPS peak performance
- Fastest computer in my hand
(March 2014)

Computer power is not the limiting factor



Images from: <http://www.ifixit.com/Teardown/Nexus+7+2nd+Generation+Teardown/16072>

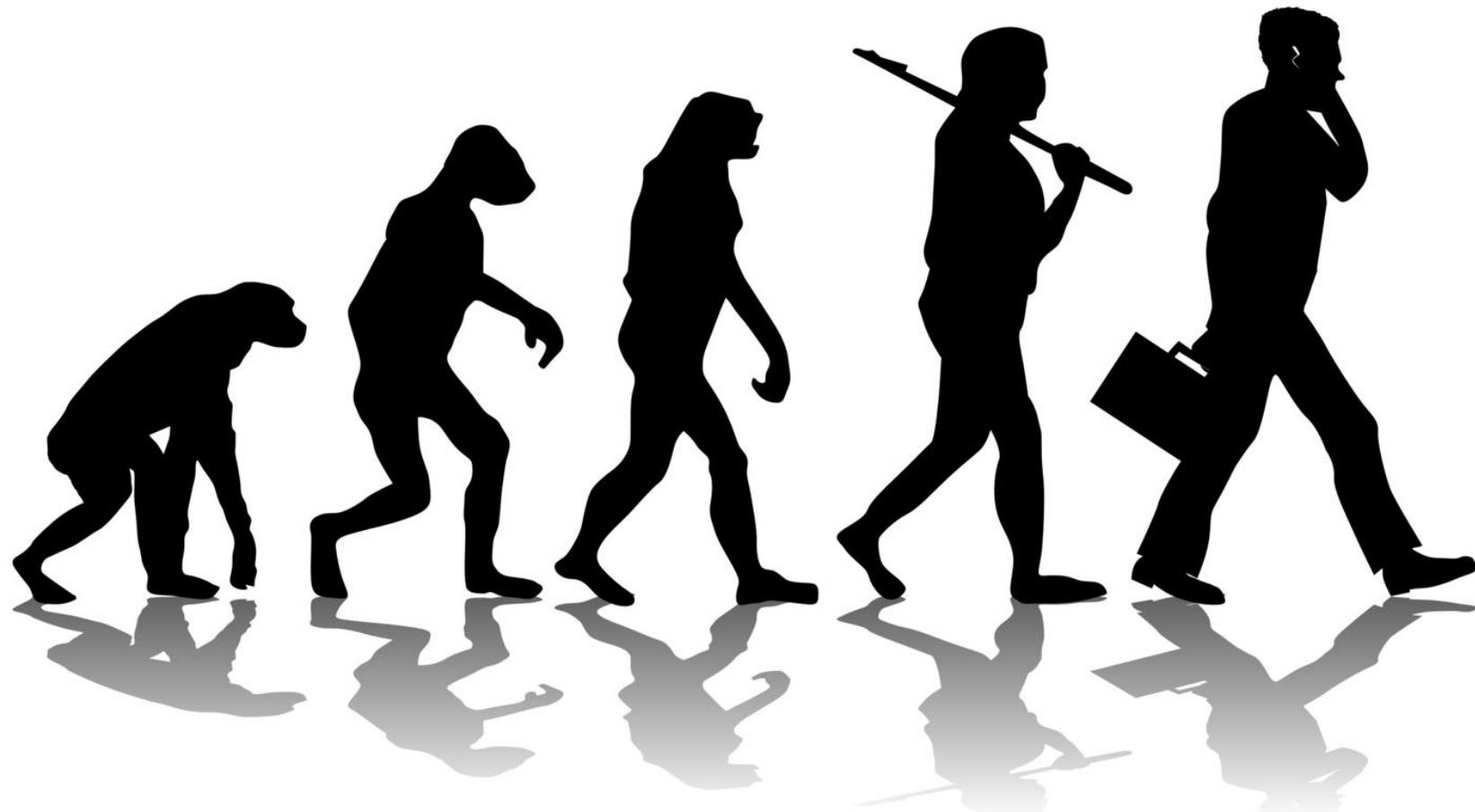


The interface determines the size



Images from: <http://www.ifixit.com/Teardown/Nexus+7+2nd+Generation+Teardown/16072>

Technical progress is fast – evolution isn't





We build tools that extend our abilities



Think for a moment...

- How many computers did you used today?

But – what is a computer?



Photos by D. Kern und A. Schmidt

Handhabung dieser Tür

1. Drücken des Tür-auf-Tasters.
2. Ca. ein bis drei Sekunden warten -
vorher nicht an der Tür ziehen!!!
3. Dann Tür öffnen.
4. Das Öffnen der Tür muss innerhalb von
fünf Sekunden erfolgen - sonst noch-
malige Betätigung des Tür-auf-Tasters.

How to operate my window

STARZ METALLBAU
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Stuttgart und Hohenheim
Pfaffenwaldring 32
70569 Stuttgart

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Ihr Zeichen, Ihre Nachricht
IK

Unser Zeichen, Unsere Nachricht
Telefon, Name
07367/9220-41 / Herr Knödler

Datum
12.06.2012

UNIVERSITÄT STUTTGART – SIM-TECH 1

Sehr geehrte Damen und Herren,

aus aktuellem Anlass übersenden wir Ihnen mit diesem Schreiben wichtige Handhabungshinweise für die motorisch betätigten Fenster an o.g. Bauvorhaben:

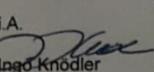
- Die Fenster sind nur über die zur Betätigung installierten Taster zu bedienen.
- Der Öffnungs- und Schließvorgang muss *immer* bis zum Erreichen der Endlage der Antriebe ausgeführt werden. Die Endlage erkennen Sie zweifelsfrei, wenn die Laufgeräusche nicht mehr zu vernehmen sind.
- Unterbrechungen des Tastendrucks während des Öffnungs- und Schließvorgangs sind unbedingt zu vermeiden.
- Mehrmaliges, kurz aufeinanderfolgendes Betätigen der Taster ist zu vermeiden. Die interne Logik der Antriebe wird dadurch gestört.

Bitte beachten Sie die Hinweise und leiten Sie diese an die Nutzer weiter. Nichtbeachtung führt zu Störungen bis hin zum Ausfall der Antriebe, auch mechanische Beschädigungen sind nicht ausgeschlossen.

Für weitere Rückfragen stehen wir Ihnen gerne zur Verfügung.

Mit freundlichen Grüßen

Starz Metallbau

i.A.

Ingo Knödler

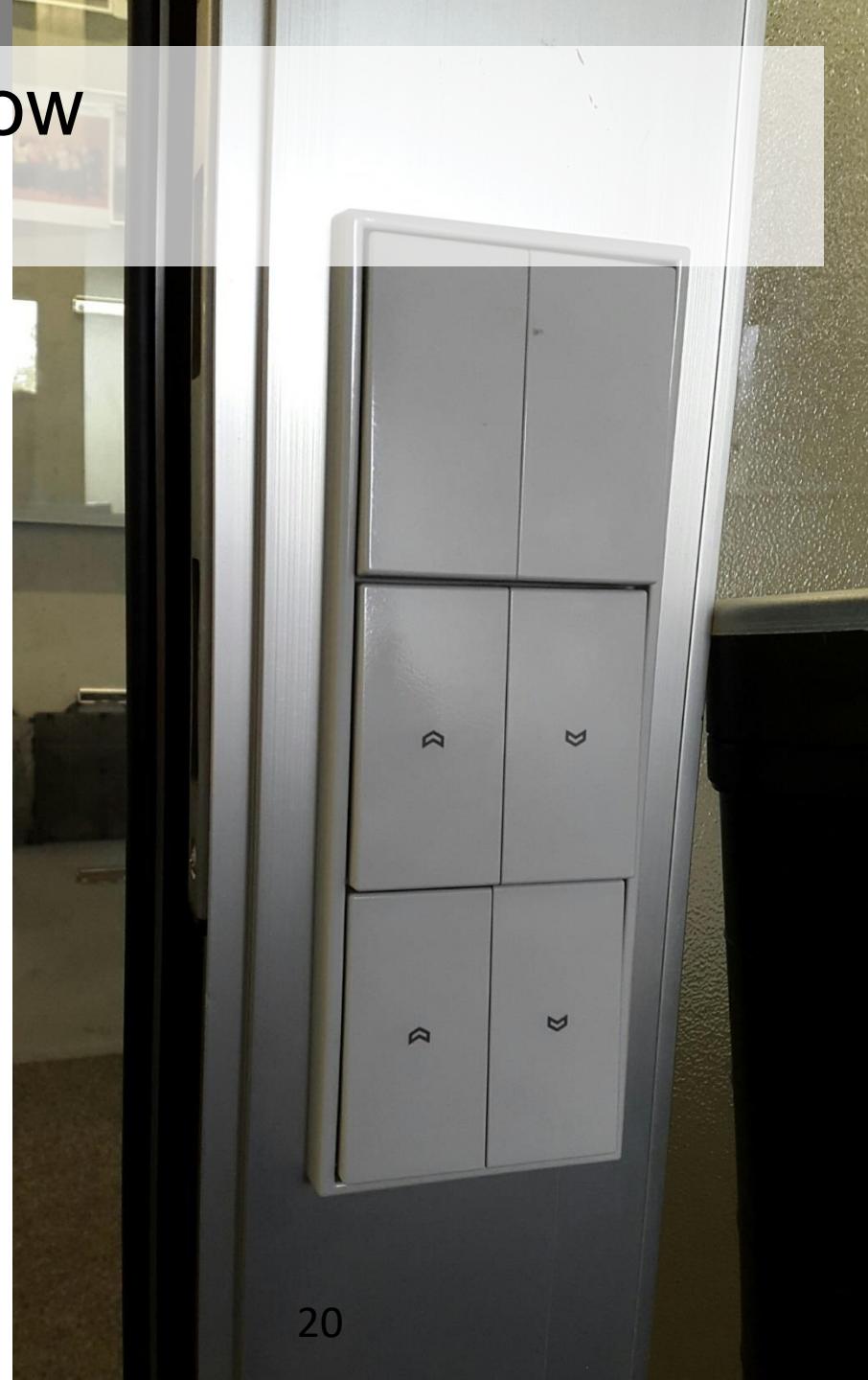
STARZ METALLBAU
kreativ und kompetent
Kreidestraße 4 - 73432 Aalen
Telefon (07367) 92 20 2
Telefax (07367) 92 20 60
info@starz-metallbau.de

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info@starz-metallbau.de

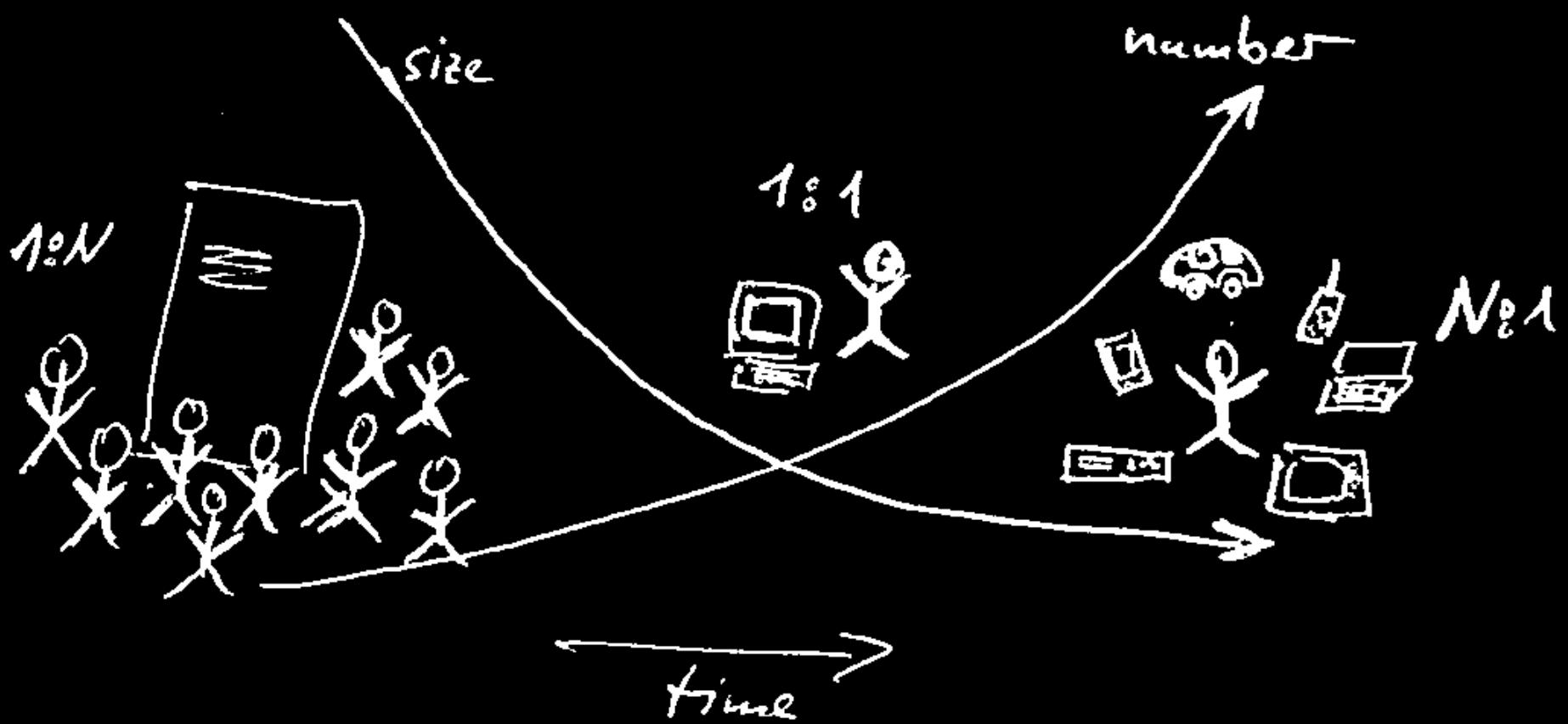
Bankverbindung
Kreissparkasse Ostalb
BLZ: 614 500 50 - KTO: 110 072 564

Finanzamt Aalen
UST-IdNr. DE 144673205

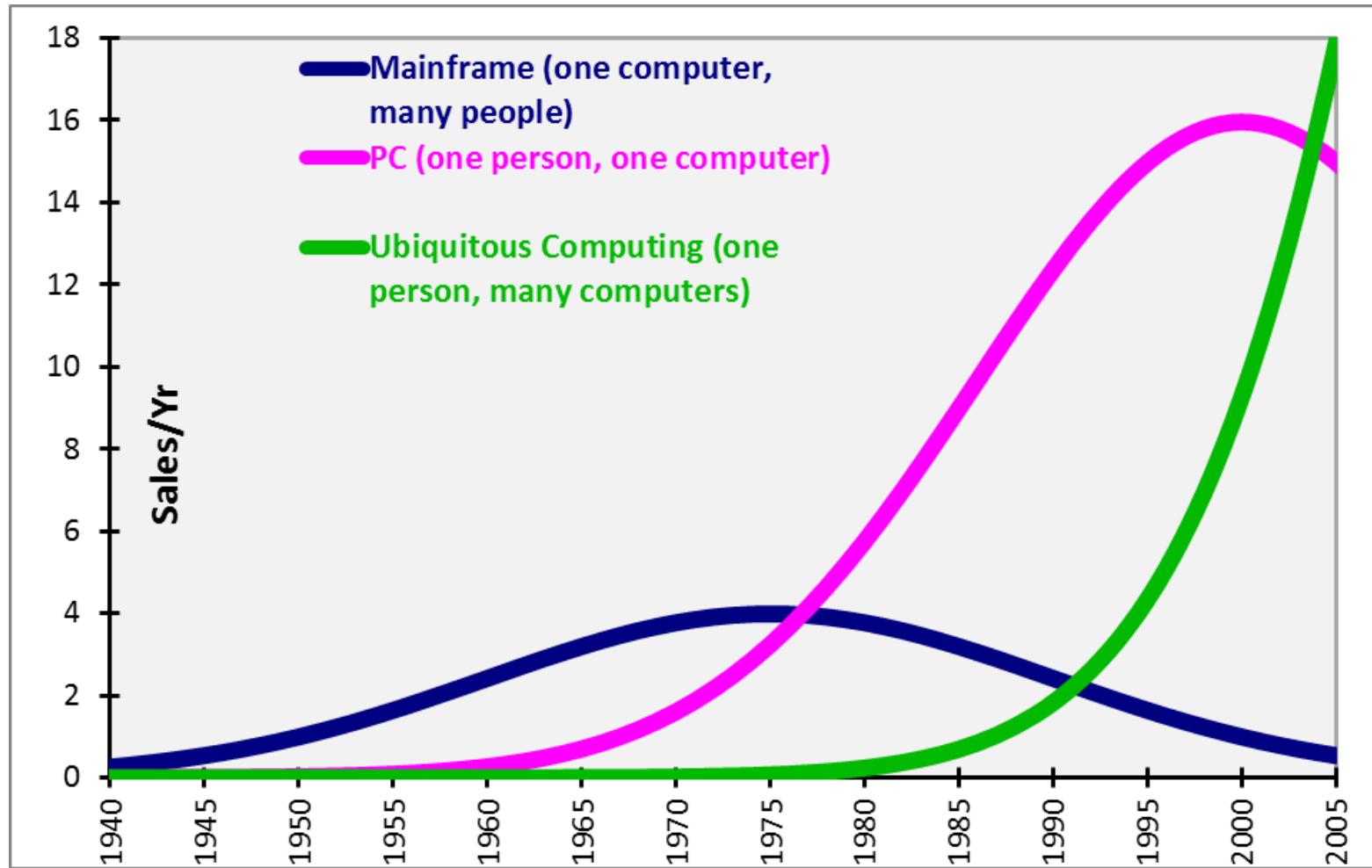


How to operate my window

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Ubiquitous Computing



Good design? Rational?



Usability is not restricted to digital system

Signs and explanations for things that are usually obvious are an indicator for a potential design problem.

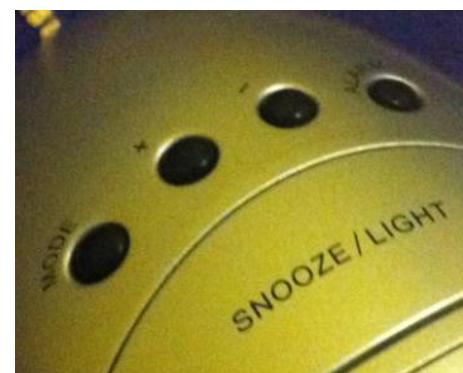


(German Rail IC-Train)

Digital vs. Mechanical

Terms

- Affordance
- Visibility



Photos by A. Schmidt

Problem of multi-functional devices

- Example: what is the semantic of the silent mode? Does it apply to phone calls only? To the alarm clock?
- Term: appliance



Photo by D-M Commons (CC BY-SA 3.0)
http://en.wikipedia.org/wiki/File:Wenger_EvoGrip_S17.JPG



Photo by N. Henze

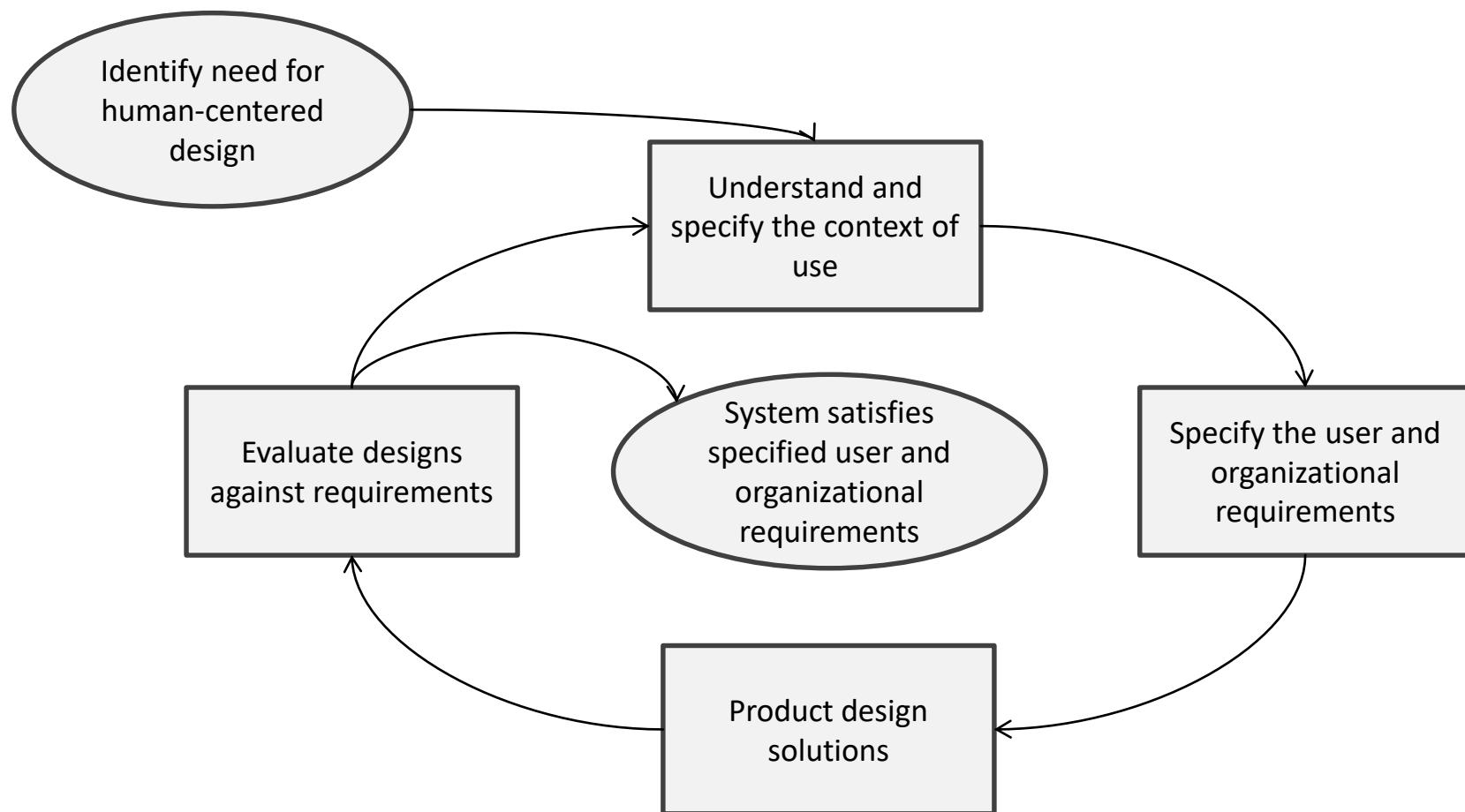


How to design a 'good' user interface?

ISO 9241-210:

Human-centered design lifecycle model

Specifies 4 human-centered design activities as being central to a system development process

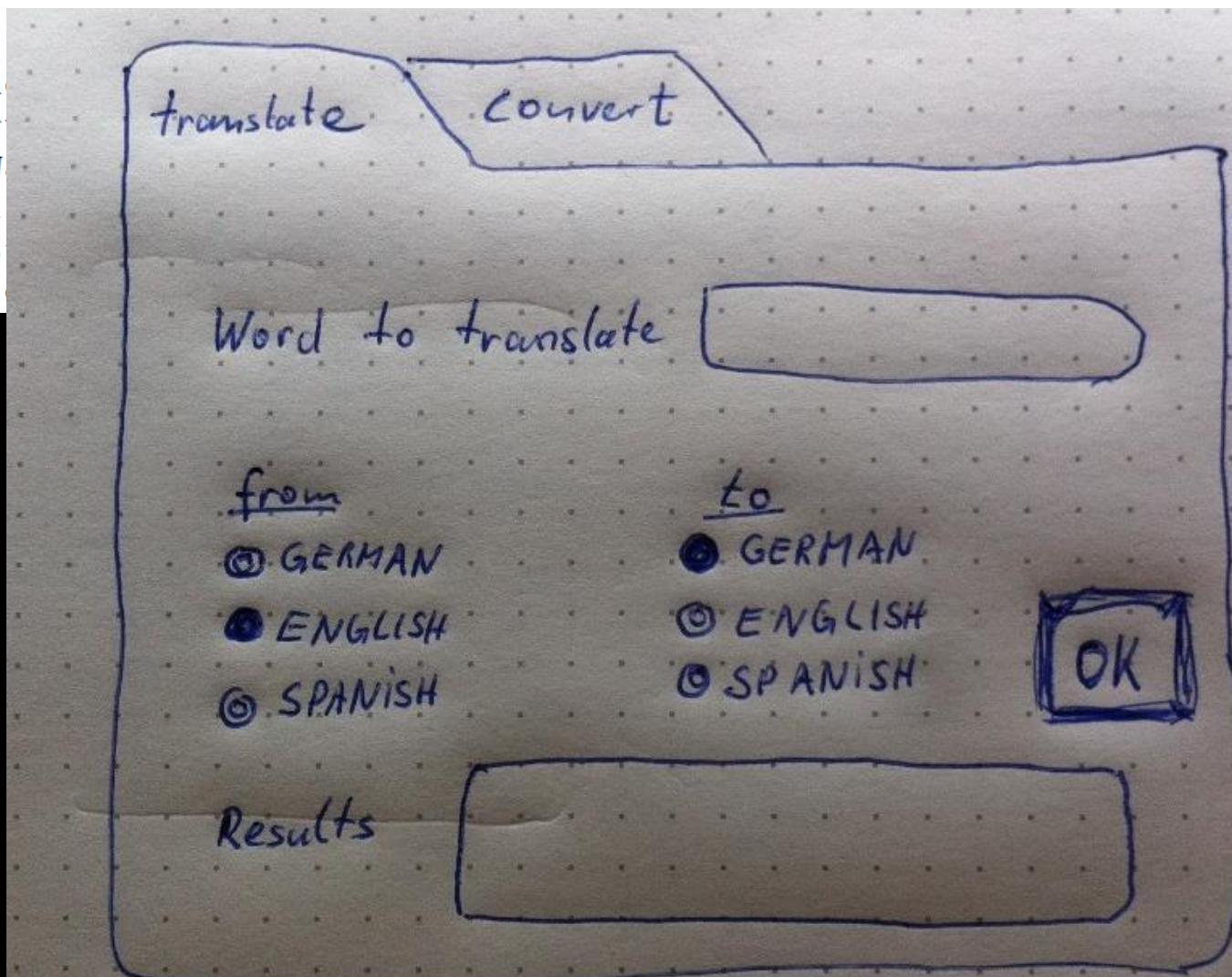


```
String translate(int fromLanguage, int toLanguage, String wordToTranslate)
// translate ist eine Funktion, die ein Wort (wordToTranslate) einer
// bestimmten Sprache (fromLanguage) in ein Wort
// einer anderen Sprache (toLanguage) umrechnet.
// Beispiel: wordInSpanish = convert(1, 3, "Haus")
// fromLanguage ist die Ausgangssprache (1=Deutsch, 2=Englisch, 3=Spanisch)
// toLanguage ist die Zielsprache (1=Deutsch, 2=Englisch, 3=Spanisch)

float convert(int fromCurrency, int toCurrency, float amount)
// convert ist eine Funktion, die eine Summe (amount) einer
// bestimmten Währung (fromCurrency) in eine Summe
// einer anderen Währung (toCurrency) umrechnet.
// Beispiel: myDollar = convert(6, 7, 19.23)
// fromCurrency ist die Ausgangswährung (6=Euro, 7=US Dollar, 8=Britisches Pfund)
// toCurrency ist die Zielwährung (6=Euro, 7=US Dollar, 8=Britisches Pfund)
```

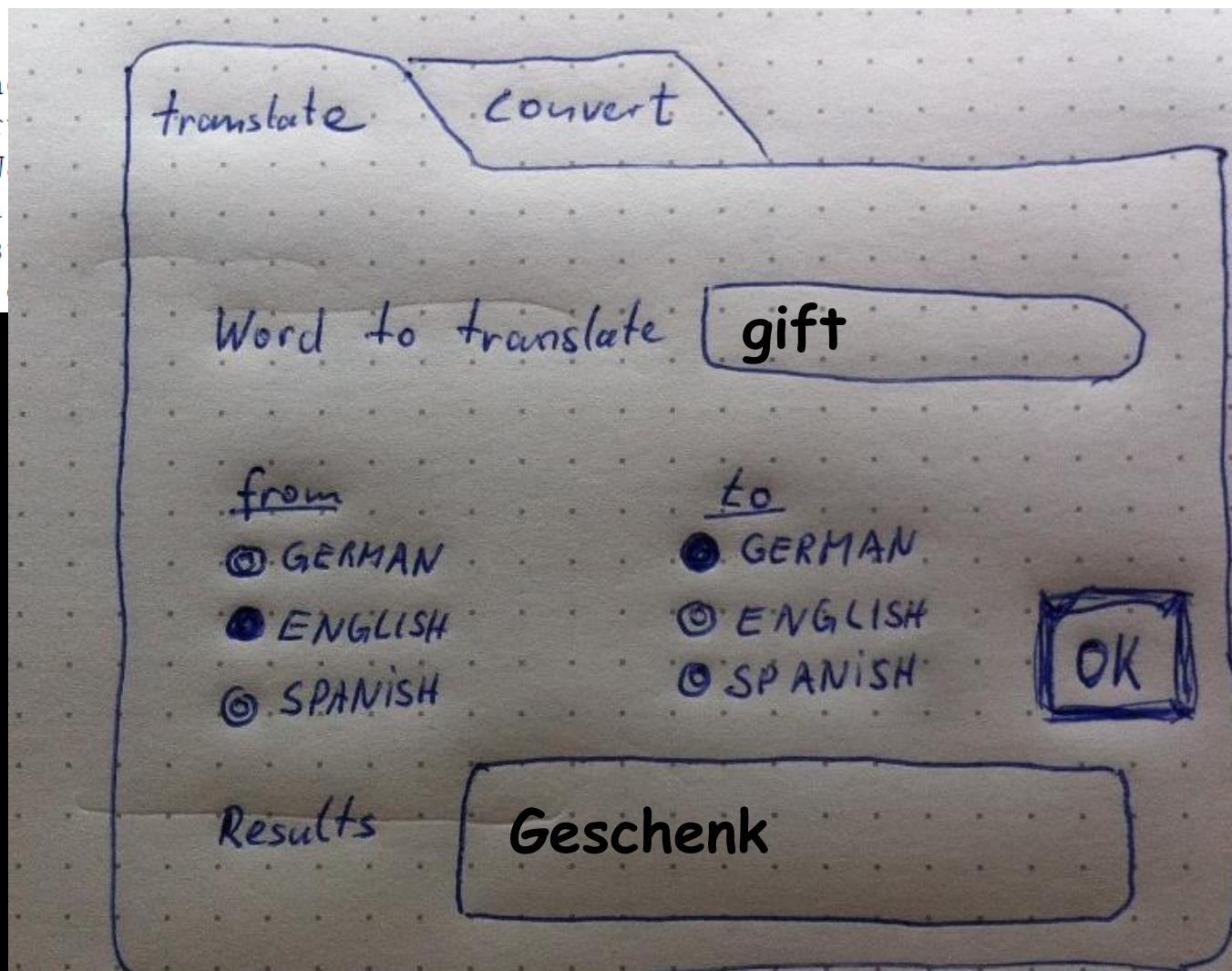
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// Beispiel: myDol
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translate & convert

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translate & convert

gift



das Geschenk
das Gift



gift
poison



el regalo
el veneno

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```

translate & convert

366



€366,00

€447,18

€277,46



£299,56

£366,00

£227,08



\$482,80

\$589,92

\$366,00



Book recommendation

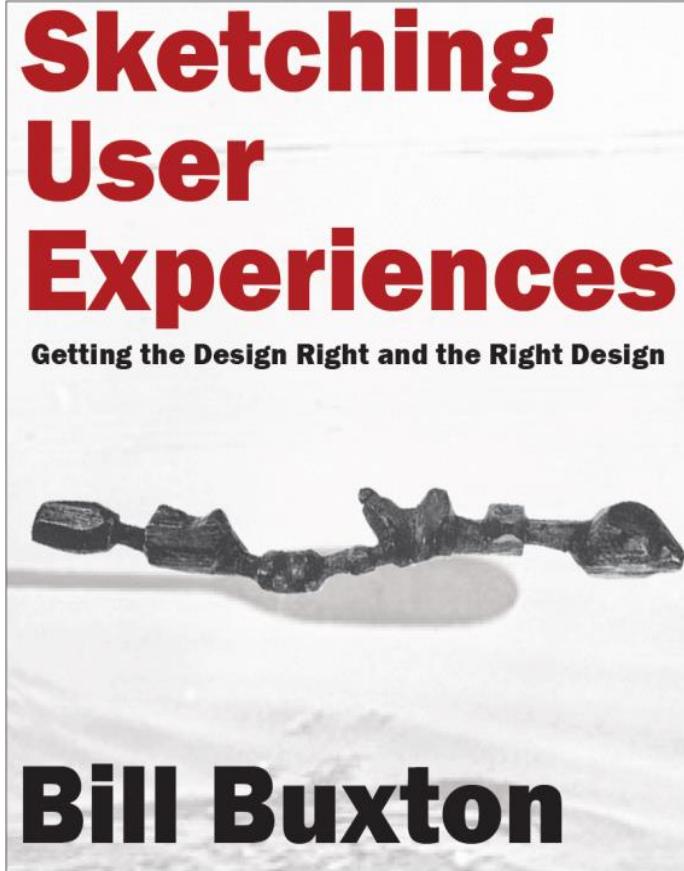


Image from: <http://www.billbuxton.com/bookFlyer.pdf>

Sketching User Experiences

Getting the Design Right and the Right Design

Bill Buxton

Microsoft Research

Redmond, Washington / Toronto, Canada

May 2007

ISBN: 0-12-374037-1

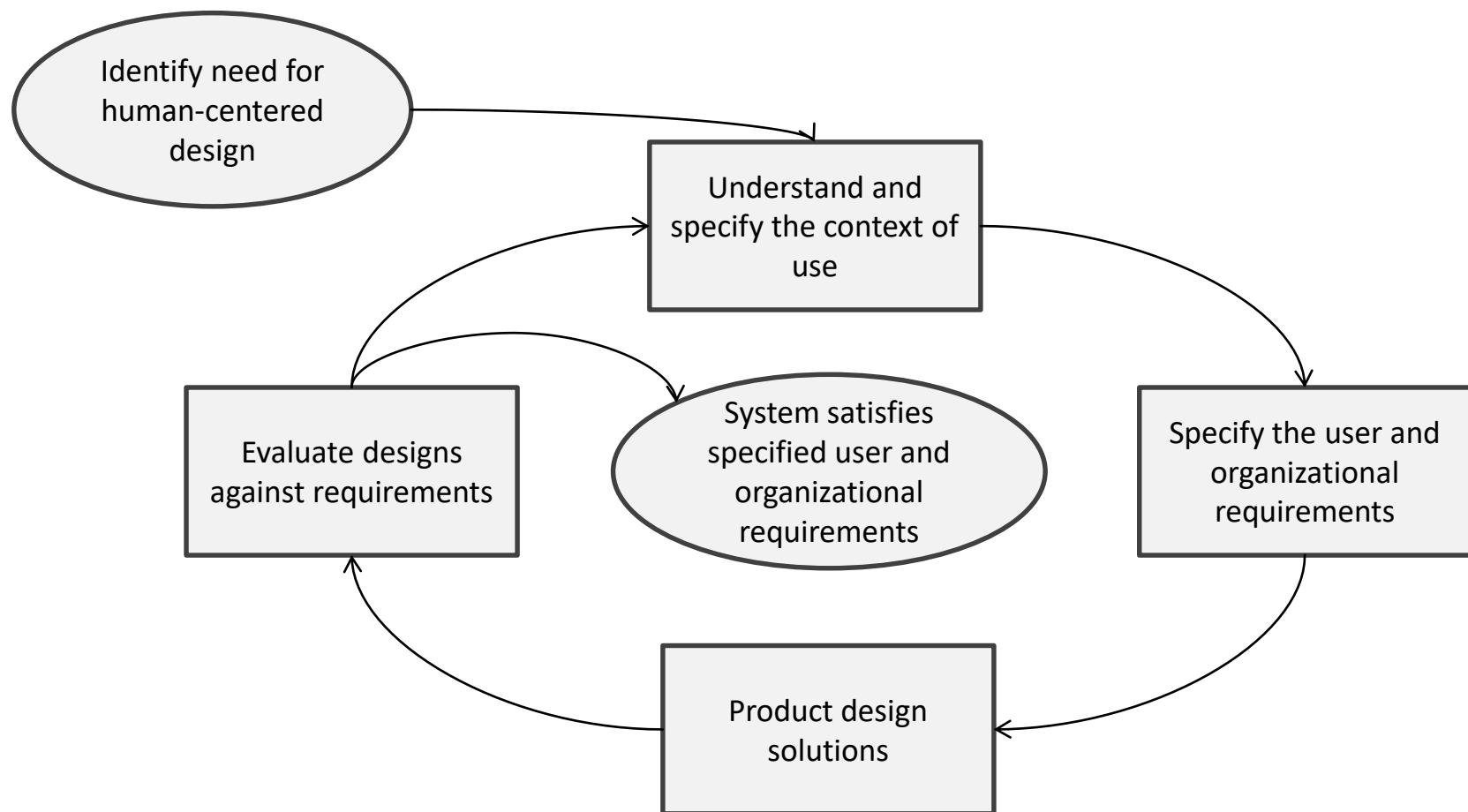
Paperback

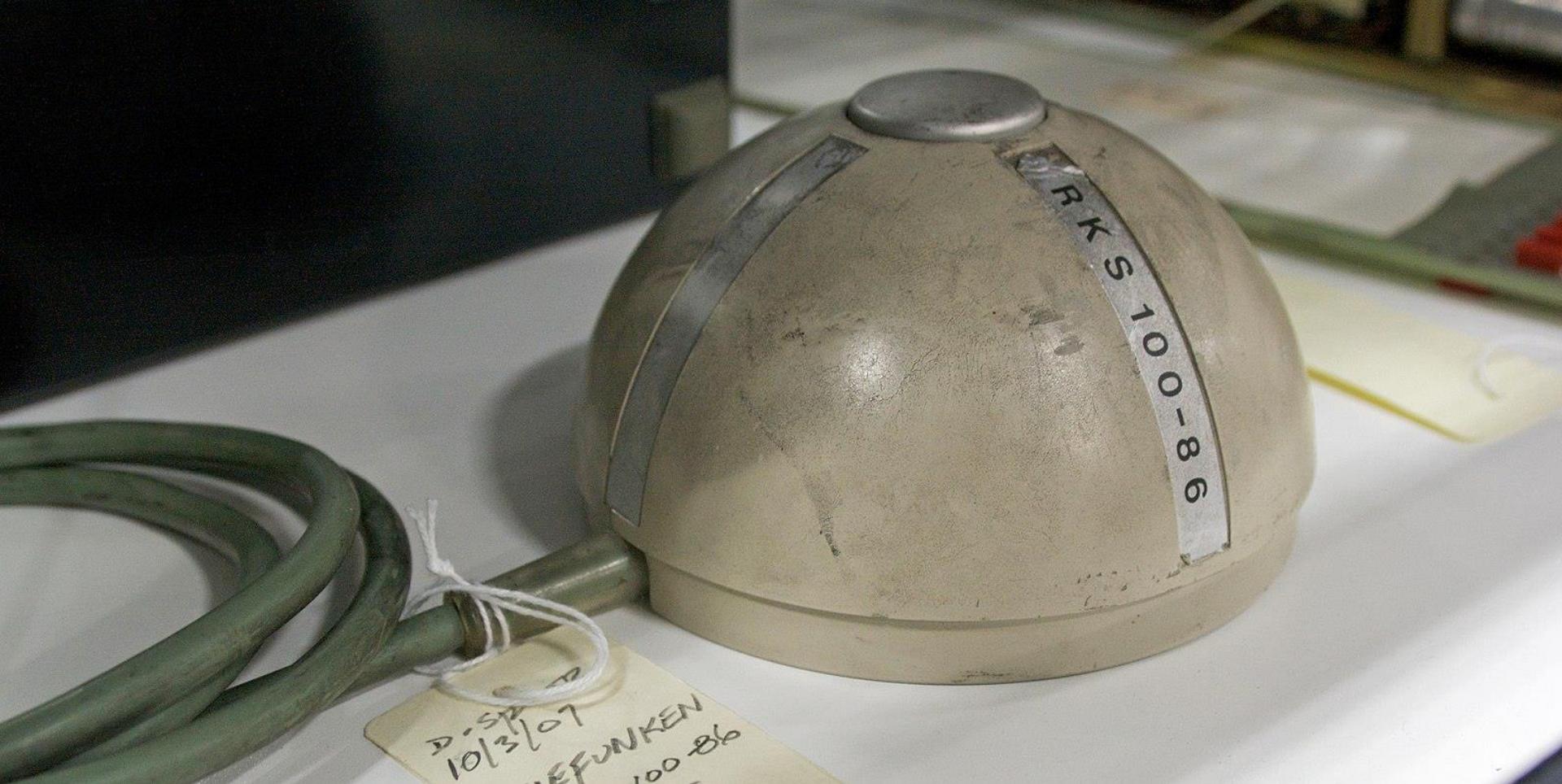
400 Pages

\$39.95

ISO 9241-210: Human-centered design lifecycle model

Specifies 4 human-centered design activities as being central to a system development process





History of HCI Niels Henze



Universität Regensburg

Topics of the Lecture

- Motivation
- **History of HCI**
- Human Abilities
- Prototyping
- Basics and Principles
- Evaluation Methods
- Controlled Experiments
- Models in HCI
- *Further selected topics*



History of Human Computer Interaction

Discussion:

What were the central innovations in Human-Computer Interaction in the last 50 years?



Timeline - technologies

- 1945: Vannevar Bush: “As We May Think”, MEMEX
- 1950: Whirlwind with cathode ray tube (CRT)
- 1955: SAGE Radar with CRT and light pen
- 1962: “Spacewar”: video game on a PDP-1 computer with joystick
- 1963: I. Sutherland’s “Sketchpad” (interactive 2D CAD system)
- 1968: D. Engelbart: computer supported cooperative work (CSCW)
- 1969: I. Sutherland: virtual reality (VR), head-mounted display (HMD)
- 1973: Xerox Alto – implementation of a graphical user interface
- 1981: Xerox Star – Fully functional graphical user interface
- 1982: Apple Lisa
- 1984: Apple Mac – first commercially successful GUI
- 1984: X Window system

Timeline – user perspective

1950: Experimental computers, specific tasks interface at the hardware level for engineers (switch panels)



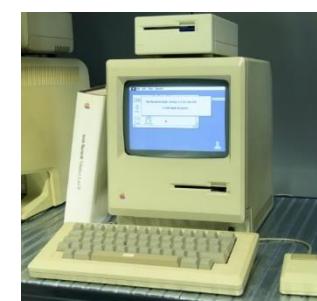
1960, 1970: Batch / offline mode; punch cards / printer interface at the programming level (COBOL, FORTRAN)



1970, 1980: Timesharing / text terminals (IBM 3270, DEC VT100) interface at the terminal level (command languages)

1980, 1990: Raster graphics / GUI on PCs / workstations interface at the interaction dialogue level (GUIs, multimedia)

2000: Multimedia: graphics, video, and audio; internet, interface at the work setting (networked systems, groupware)



2010: Mobile, Wearable, Embedded, Ubiquitous interface is pervasive, everywhere, and more and more Natural

Approaches to Human-Computer Interaction

- programming level
- command language level
- dialogue level (forms, questions & answers)
- direct manipulation of digital elements
- tangible interaction
- human-computer cooperation

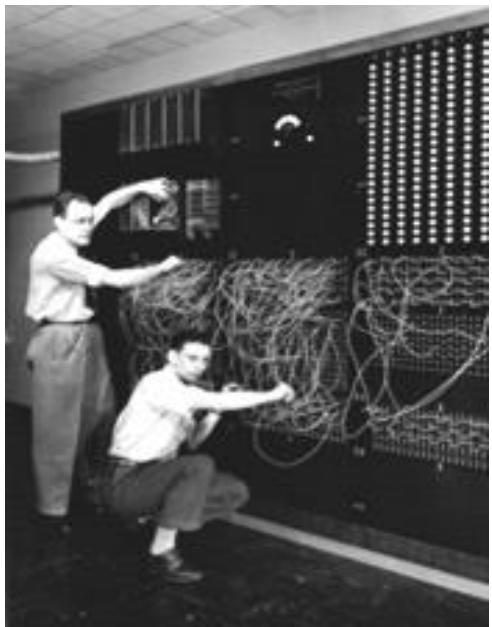


History of Human Computer Interaction

- **Interactive Computing: People and Inventions**
- VisiCalc – and Early Kill-App: Drivers of Personal Computing?
- The Evolution of Graphical User Interfaces
- (historical) Input and Output Devices



Early Computer Operators and Engineers



- From <http://www.computerhistory.org>

Foundations for Interactive Information Processing

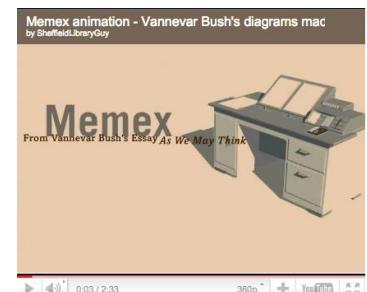
Vannevar Bush

- As we may think (1945) article in Atlantic Monthly
- Sees the Problem of storing, accessing, distributing, and annotating information
- Understands the wealth of large amounts of information and easy access to it
- Identifies organization of information as key issue



MEMEX

- Extending human memory
 - Concept of links and annotations
 - Focus on search and indexing
 - Many ideas for the WWW
- “microfilm-age” solutions not really feasible**



Video explaining the concept:

<http://www.youtube.com/watch?v=c539cK58ees>

Recommended further reading:

<http://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/3881/>

Inventing interactive computing

- Ivan Sutherland
- SketchPad (1963)

Drawing package

User interface included:

- icons,
- copying,
- light-pen input

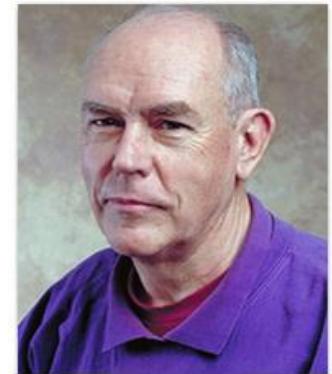
Development based on
“OO”-principles

Many ideas are still in use

- 3D Head-mounted Display (1965-1970)

3D “visualization” (very basic)

Large apparatus





Ivan Sutherland: Sketchpad Demo



Ivan Sutherland (1963) - <https://www.youtube.com/watch?v=DWAIp3t6SLU>

Ivan Sutherland: Sketchpad Demo

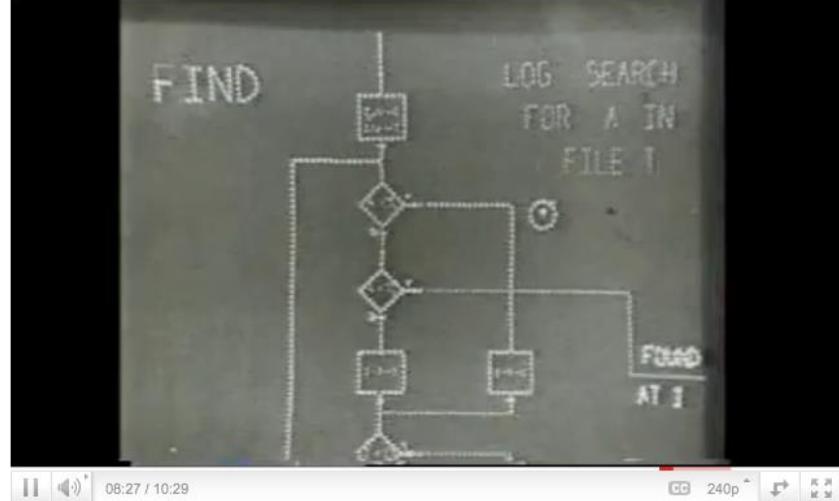


Ivan Sutherland: Sketchpad Demo



08:18 / 10:35

240p



08:27 / 10:29

CC 240p

Part 1 of 2

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

Part 2 of 2

<http://www.youtube.com/watch?v=BKM3CmRqK2o>

Sketchpad, A Man-Machine Graphical Communication System

Ivan Sutherland's Ph.D. Thesis from Massachusetts Institute of Technology 1963.

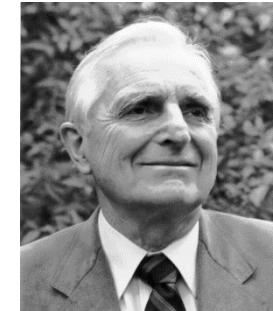
Republished by University of Cambridge in 2003 as Technical Report Number 574

<http://www.cl.cam.ac.uk/TechReports/UCAM-CL-TR-574.pdf>

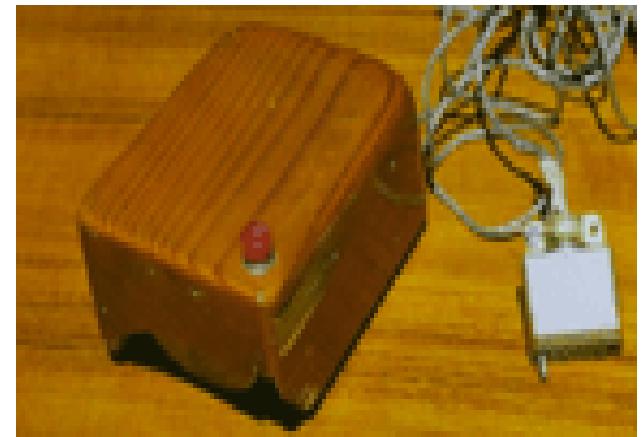
Inventing Interaction Technologies

Douglas Engelbart

- A Conceptual Framework for Augmenting Human Intellect (SRI Report, 1962)
- Understand need for collaborative (several potentially distributed people together) and immediate problem solving
- A key issue is to improve peoples abilities to make use of information



**Invention of the mouse as a pointing device
“Hi-res” video conferencing,
shared applications,
window-concept (1968)**

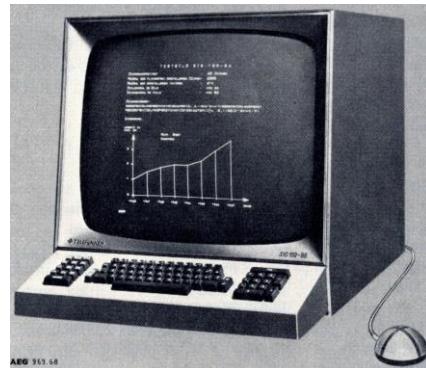


Parallel inventions (1965/1968) Pointing Devices

Rollkugel

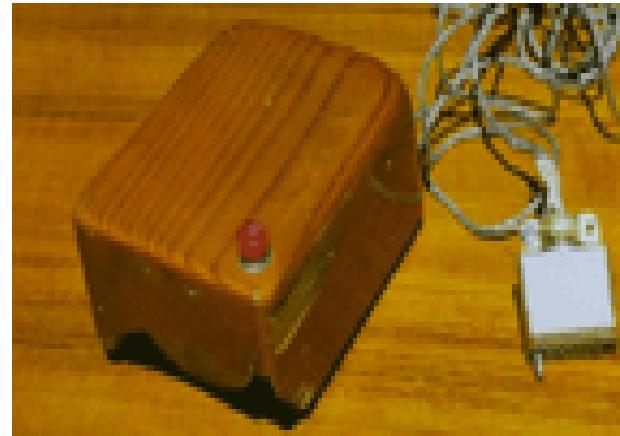


Image: Computermuseum, Fakultät Informatik, Universität Stuttgart



Der SIG-100 mit Rollkugel
Image: Computerschausammlung der FH Kiel

Engelbart's Pointing Device



<http://www.heise.de/ct/meldung/Auf-den-Spuren-der-deutschen-Computermaus-216255.html>
<http://www.heise.de/newsticker/meldung/Vor-40-Jahren-die-Maus-kreisste-und-gebar-eine-neue-Welt-187657.html>



Douglas Engelbart: The Mother of All Demos



Part 1 of 9

<http://www.youtube.com/watch?v=JflgzSoTMOs>

Further reading: Augmenting the Human Intellect

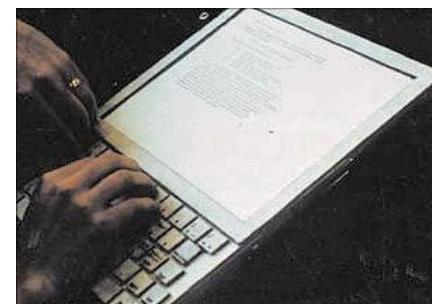
<http://douengelbart.org/pubs/augment-3906.html>

Many People shaped early HCI

- Vannevar Bush
- Douglas Engelbart
- Ivan Sutherland
- ...
- J.C.R. Licklider
 - man-computer symbiosis (1960)
 - Interactive computing
- Alan Kay
 - Vision of a notebook computer Dynabook (1969)
 - Mockup to convey the idea
 - Computing for everyone
- Many others...
- ...



<http://www.ibiblio.org/pioneers/licklider.html>





Lessons Learned from History

- Technology drives new user interface concepts and interaction metaphors
- New user interfaces create new applications
- Interaction designs and user interface concepts evolve
- You can not hide the user interface - good ideas spread out
- The first to come out with a new user interface is not necessarily the most successful



History: Please find the following videos!

- Ivan Sutherland: Sketchpad Demo

http://www.youtube.com/watch?v=USyoTHa_bA (Part 1, 10 min)
http://www.youtube.com/watch?v=USyoTHa_bA (Part 2, 10 min)

- Douglas Engelbart

Inventor of the Computer Mouse

- <http://www.youtube.com/watch?v=SQ7totFRh4g> (2 min)

Engelbart explains binary text input

- http://www.youtube.com/watch?v=DB_dLeEasL8 (1 min)

The Mother of All Demos

- <http://www.youtube.com/watch?v=JfIgzSoTMOs> (Part 1, 9 min)



History: Please find the following videos!

- Xerox Star User Interface (1982)
<http://www.youtube.com/watch?v=Cn4vC80Pv6Q> (Part 1, 9 min)
<http://www.youtube.com/watch?v=ODZBL80JPqw> (Part 2, 8 min)
- Demo of Xerox Star 8010 (CHI1998, The star was introduced 1981)
http://www.youtube.com/watch?v=8VzT_ANGeP4 (Part 1, 10 min)
- Demo of Apple Lisa (CHI 1998, the Apple Lisa was introduced 1981)
<http://www.youtube.com/watch?v=BECIVTU2sws> (Part 1, 15 min)
- Alan Kay, Dynabook (Exam relevant)
<http://www.youtube.com/watch?v=8UUkygDn2Pc> (Mock-up, 1 min)
<http://www.youtube.com/watch?v=r36NNGzNvjo> (short intro, 1 min)



History: Please find the following videos!

- Apple Newton Commercial Collection
www.youtube.com/watch?v=Ikg4EAK0Y30 (3 min)
- 1993 View of the Future by AT&T
www.youtube.com/watch?v=sYNUcFMCIzw (1min)
- IBM Simon Touch screen phone (1992)
<http://www.youtube.com/watch?v=ZGoNMSBvYUw> (4 min)
<http://www.youtube.com/watch?v=GUG7nwMmoUc> (2 min)
- Evolution of phones (based on Commercials, Part 2, 1999-2004)
http://www.youtube.com/watch?v=c2Tw4OAT_MY (10 min)



History of Human Computer Interaction

- Interactive Computing: People and Inventions
- **VisiCalc – and Early Kill-App: Drivers of Personal Computing?**
- The Evolution of Graphical User Interfaces
- (historical) Input and Output Devices

VisiCalc - Widespread use of an Interactive Application

- Version 1.0: 1979 for the Apple II
- Instantly calculating electronic spreadsheet
- Early killer app for PCs
- Significant value to non-technical users

- Video: Apple II, Visicalc and the Big Money
- <http://www.youtube.com/watch?v=DPUR-WksvKY>

PAYEE	CHECK	DEPOSIT	BALANCE
SEARS	14.22		22.31
VISA	50.75		20.99
JOES MKT	28.11		15.08
GAS CO	19.84	250.94	13.01

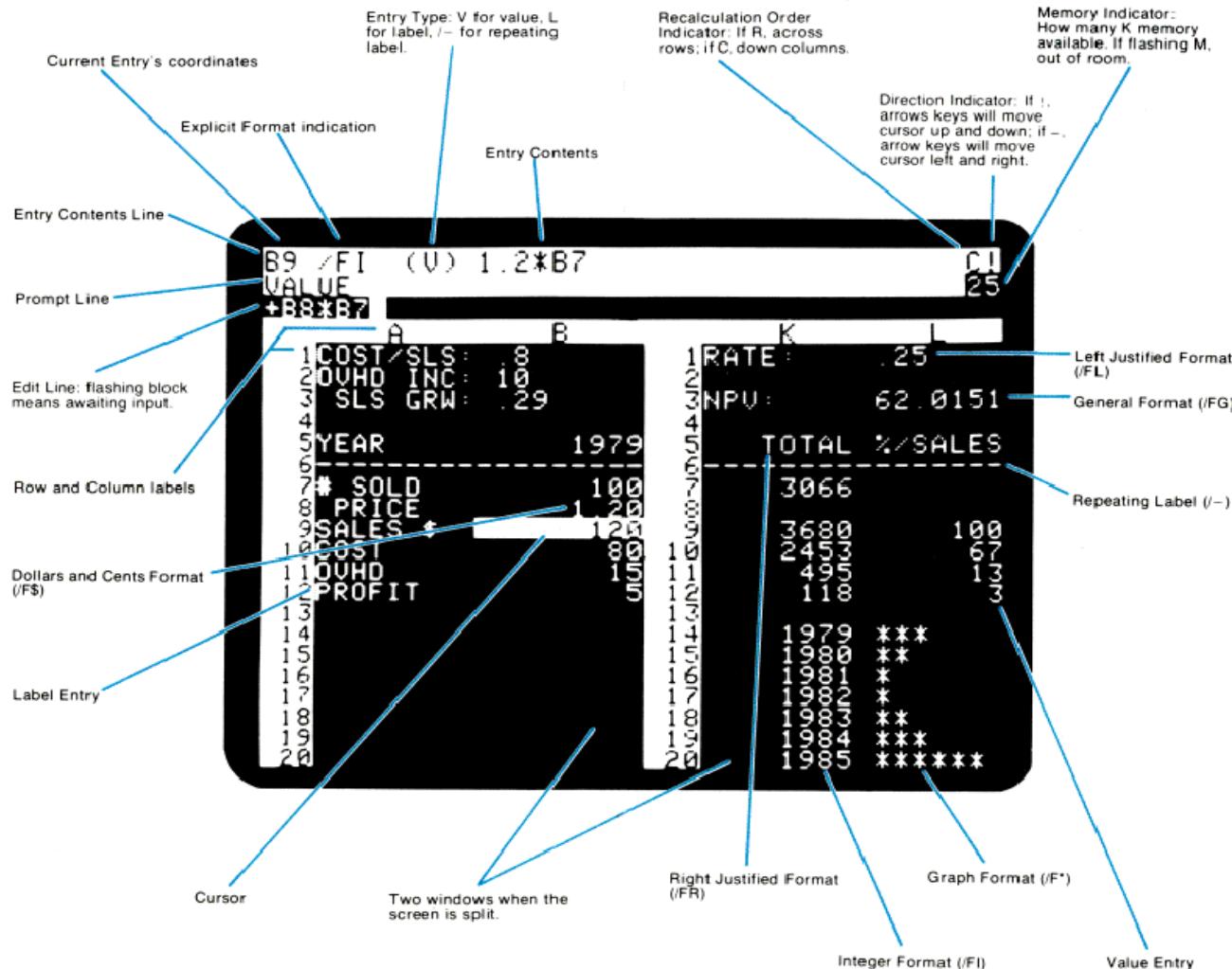
VisiCalc Screen, early Alpha 1/4/79

	HOME BUDGET, 1979	NOV	DEC	TOTAL
MONTH				
SALARY	2500.00	2500.00	30000.00	
OTHER				
INCOME	2500.00	2500.00	30000.00	
FOOD	400.00	400.00	4800.00	
RENT	350.00	350.00	4200.00	
HEAT	110.00	120.00	575.00	
REC.	100.00	100.00	1200.00	
TAXES	1000.00	1000.00	12000.00	
ENTERTAIN	100.00	100.00	1200.00	
MISC	100.00	100.00	1200.00	
CAR	300.00	300.00	3600.00	
EXPENSES	2460.00	2470.00	28775.00	
REMAINDER	40.00	30.00	1225.00	
SAVINGS	30.00	30.00	30.00	

First version of VisiCalc screenshot



A VISICALC™ Screen:





Lessons learned from Interactive Calculations

- Supporting immediate feedback is of great value
- Going beyond the input → output model is of great value to the user
- Provide freedom to the user (interactive calculations)
- Support for “what if” assessment



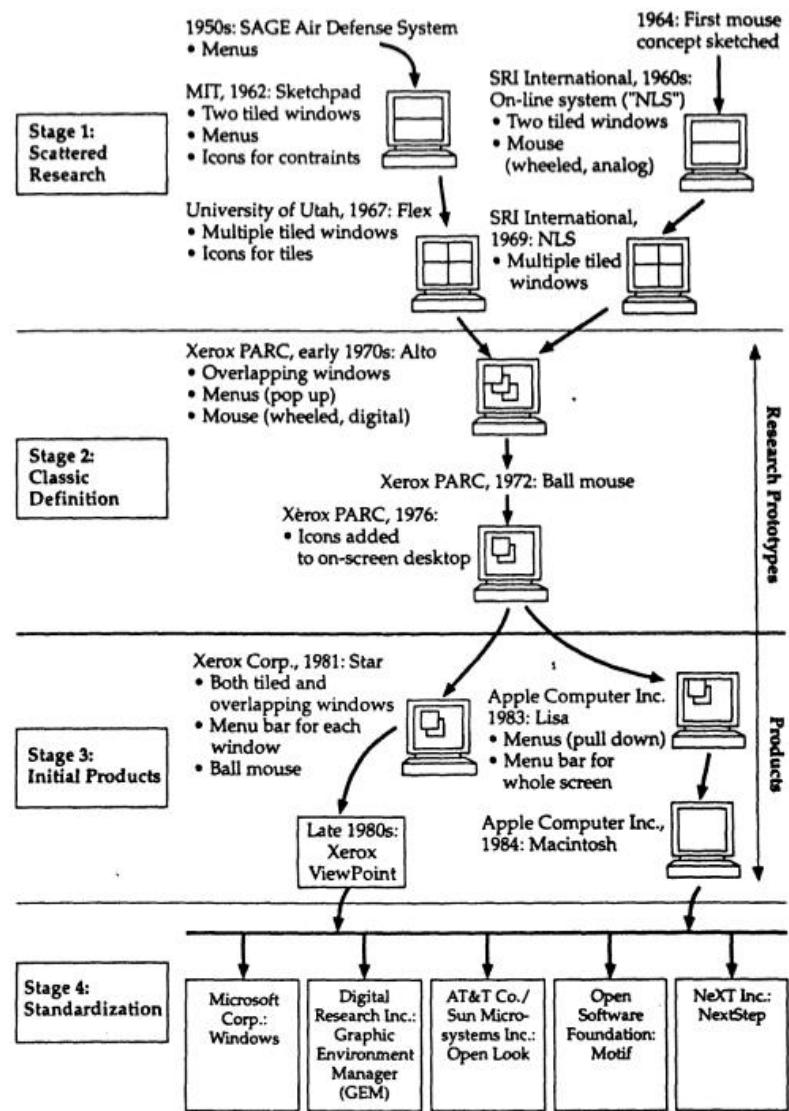
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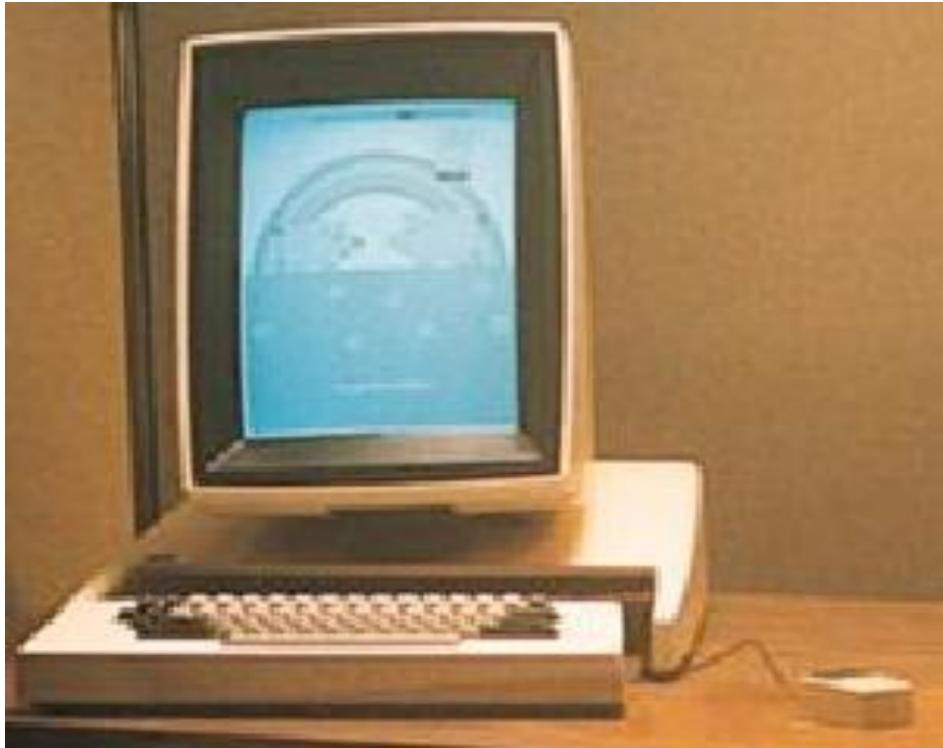
Origins of GUIs

- Card, S. K. Pioneers and settlers: methods used in successful user interface design. Human-Computer Interface Design: Success Stories, Emerging Methods and Real-World Context. San Francisco: Morgan Kaufmann; 1995; 122-169.
- <http://www2.parc.com/istl/groups/uir/publications/items/UIR-1995-16-Card-HCIDesign-Pioneers.pdf>





XEROX ALTO (1973)



Photos from

<http://members.fortunecity.com/pcmuseum/alto.html>

Ready:
Select file names with the mouse
Red-Copy, Yel-Copy/Rename, Blue-Delete
Click 'Start' to execute file name commands

Start

Pages: 832 Log

Files listed: 60 Delete: 0

Files selected: 0 Copy: 0

Copy/Rename: 0

DPO: <SysDir> *.*

-- BEGINNING --

- 1012-AstroRoids.Boot.
- Anonymous.1.
- BottleShip.er.
- BottleShip.RUN.
- BlockLock.RUN.
- BuildKal.cm.
- CalcSourcesdm.
- Calculator.RUN.
- Chess.log.
- Chess.run.
- Com.Cm.
- CompileKal.cm.
- CRTTEST.RUN.
- DMT.boot.
- EduBuild.run.
- empress.run.
- Executive.Run.
- Fly.run.
- galaxian.boot.
- Garbage.3.
- Go9.run.
- GoFont.AL.
- Invoders.Run.
- junk.
- junk.press.
- Kal.bopl.
- Kal.cm.
- Kal.A.com.
- KalMc.mu.
- Kinetic4.RUN.
- LoadKal.cm.
- MasterMind.RUN.
- maze.run.
- Mesa.TypeScript.
- Missile.run.
- NEPTUNE.RUN.
- othello.run.
- Pinball-easy.run.
- POLYGONS.RUN.

Pages: 0 Log

Files listed: 0 Delete: 0

Files selected: 0 Copy: 0

Copy/Rename: 0

No Disk: <SysDir> *.*

Quit

Clear

Type



Video: Xerox Alto History

The Xerox Alto History

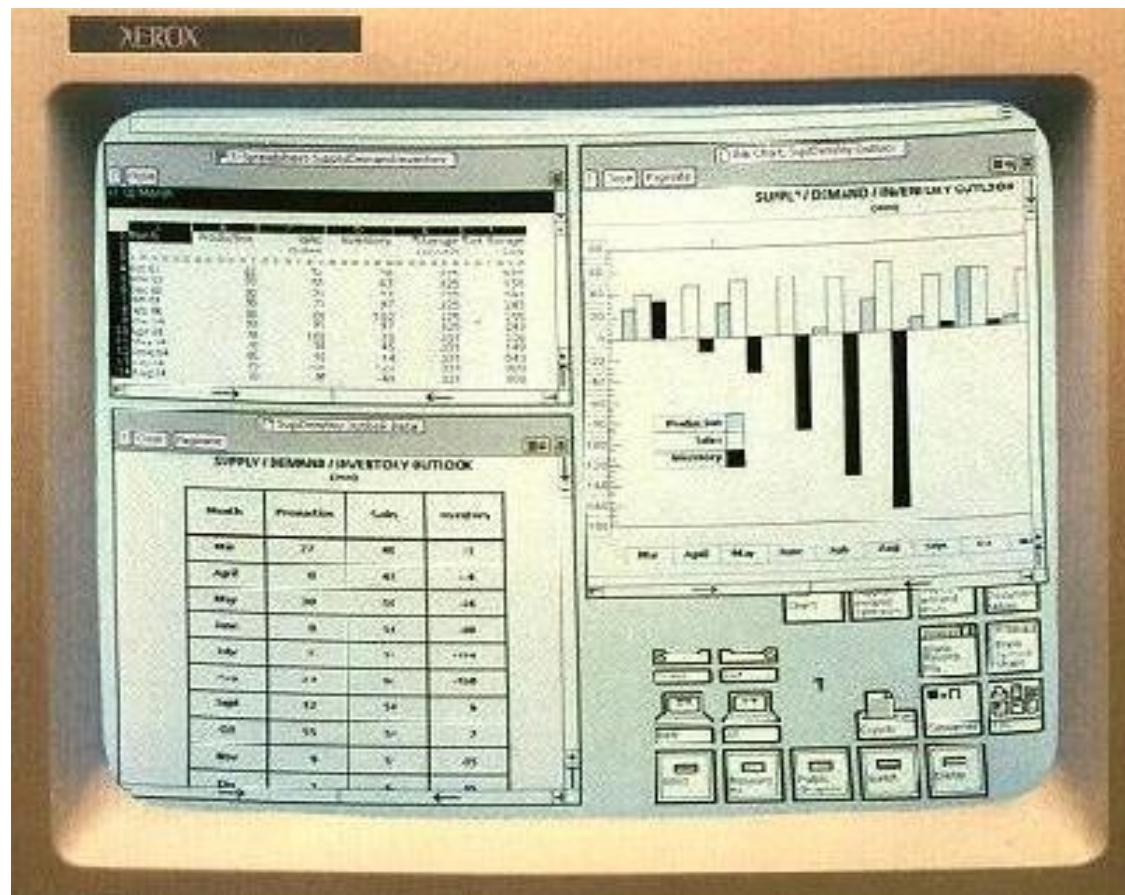
[mateusdemelo](#) 17 videos [Subscribe](#)



<http://www.youtube.com/watch?v=keSTN51PWoE>



XEROX Star (1981)



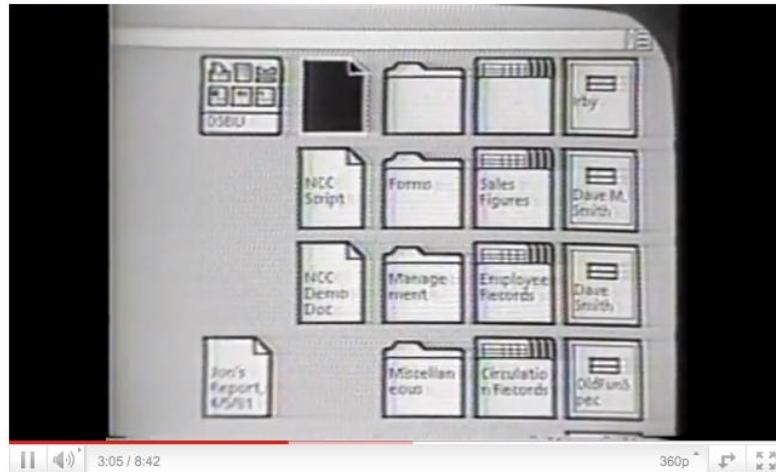
Photos from <http://members.fortunecity.com/pcmuseum/alto.html>



Videos: Xerox Star User Interface

Xerox Star User Interface (1982) 1 of 2

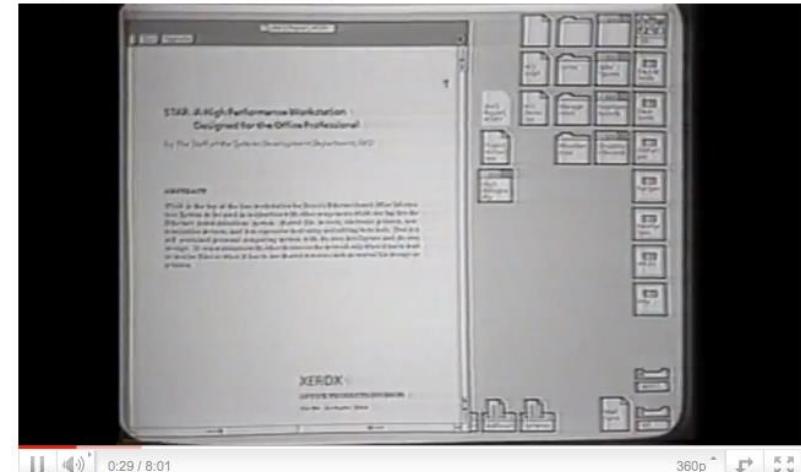
VintageCG 120 videos



<http://www.youtube.com/watch?v=Cn4vC80Pv6Q>

Xerox Star User Interface (1982) 2 of 2

VintageCG 120 videos



<http://www.youtube.com/watch?v=ODZBL80JPqw>



Video: Apple Lisa

Apple lisa Demo from 1983 Part 1

cassettiespagetie 35 videos

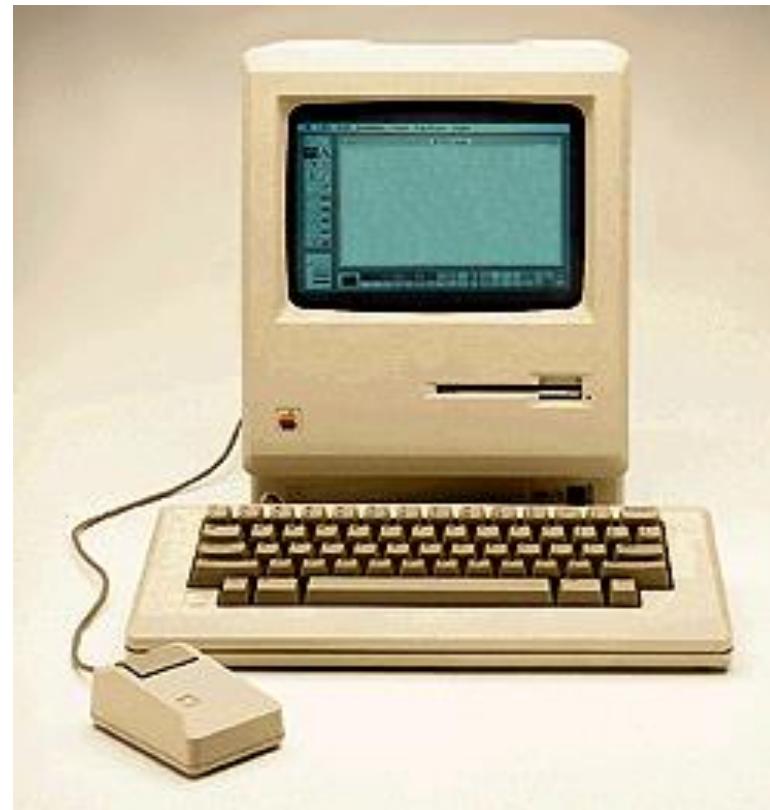
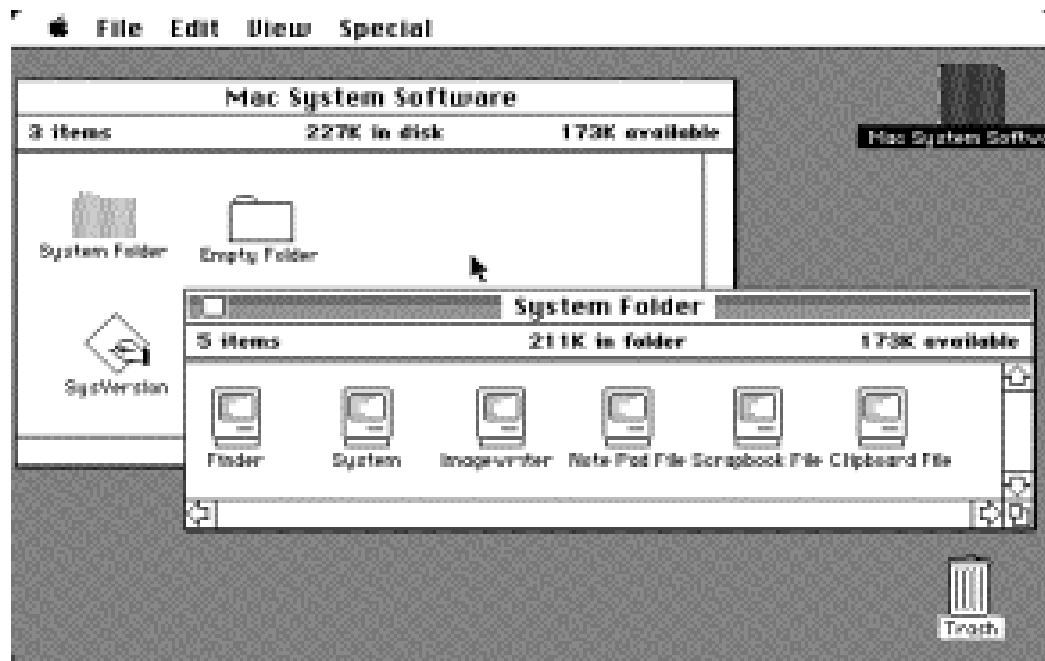


<http://www.youtube.com/watch?v=W35vpsPlwlU>



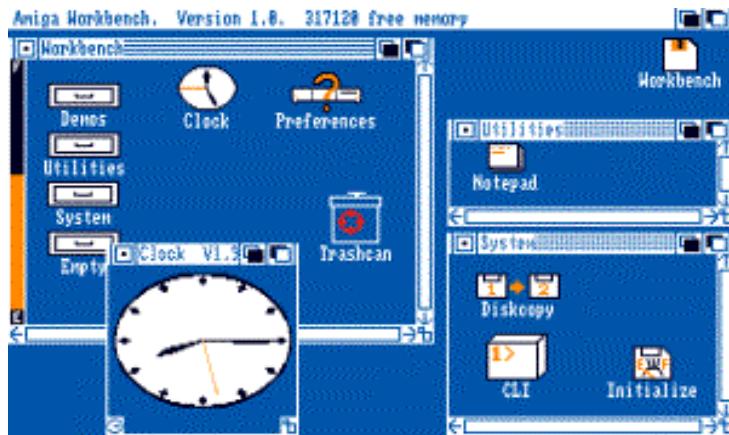
Apple Macintosh

1984 – commercially successful GUI





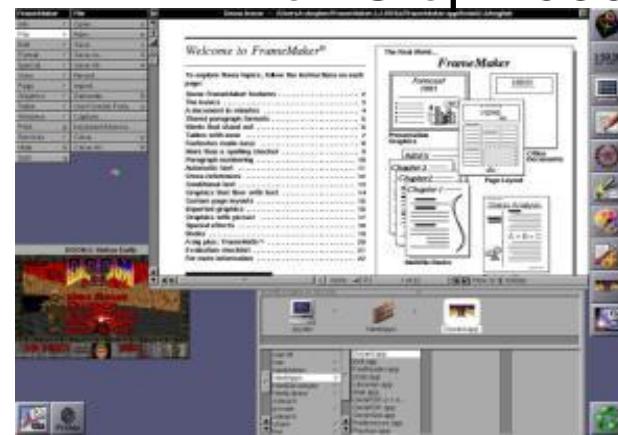
More GUIs



Amiga 1985



Win 3.11 1992



NextStep 1989



OS/2 1992



Graphical UIs - Characteristics

- Replacement of command-language
 - Direct manipulation of the objects of interest
 - Continuous visibility of objects and actions of interest
 - Graphical metaphors (desktop, trash can)
 - Windows, icons, menus and pointers
 - Rapid, reversible, incremental actions
-
- Origins of direct manipulation in a graphical user interfaces
 - Ivan Sutherland's Sketchpad, 1963, object manipulation with a light pen (grabbing, moving, resizing)
 - Douglas C. Engelbart, 1968, Mouse, NLS
 - XEROX ALTO (50 units at Universities in 1978)
 - XEROX Star (1981)
 - Apple Macintosh (1984)



Videos

- Sketchpad

http://www.youtube.com/watch?v=USyoTHa_bA
<http://www.youtube.com/watch?v=BKM3CmRqK2o>

- Engelbart

<http://www.youtube.com/watch?v=JfIgzSoTMOs>

- Xerox Star

<http://www.youtube.com/watch?v=Cn4vC80Pv6Q>
<http://www.youtube.com/watch?v=ODZBL80JPqw>



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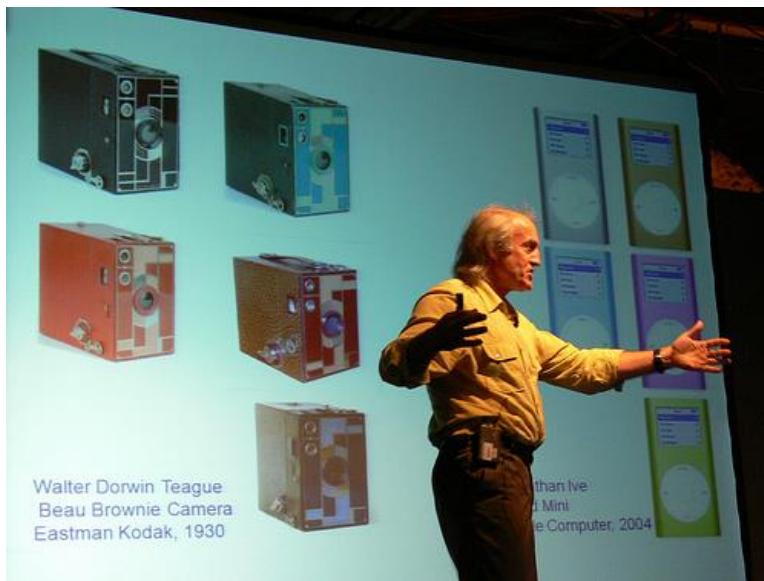


Why would you want to know about history?

Bill Buxton

Good design is often a re-mix or inspired by history

<http://research.microsoft.com/en-us/um/people/bibuxton/buxtoncollection/>



http://farm4.static.flickr.com/3081/2411871364_6ddc977031.jpg



Buxton Collection - I/O devices

<http://research.microsoft.com/en-us/um/people/bibuxton/buxtoncollection/>

BUXTON COLLECTION

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PivotViewer

Search...

Type

Sort: Quantity

Type	Quantity
Mouse	49
Handheld	31
Keyboard	28
Touch Screen	28
Joystick	27
Stylus	25
Pen Computer	23
Touch Pad	20
Reference Object	19
Miscellaneous	14
Tablet	14
Watch	12
Trackball	11
Chord Keyboard	10
e-Reader	10
Gloves and Rings	5
Pedals	4
Phone	3

Year

Price

Company

Degree of Freedom

Secondary Type

Sort: Type

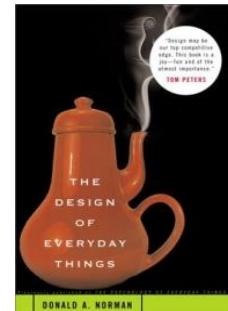
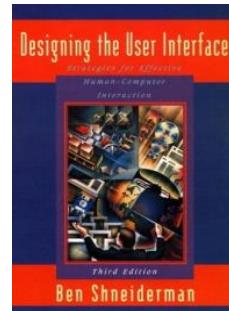
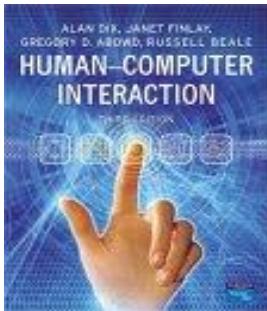
The collection includes a wide variety of input devices, such as:

- Mouse
- Handheld
- Keyboard
- Touch Screen
- Joystick
- Stylus
- Pen Computer
- Touch Pad
- Reference Object
- Miscellaneous
- Tablet
- Watch
- Trackball
- Chord Keyboard
- e-Reader
- Gloves and Rings
- Pedals
- Phone



References

- Jef Raskin, *The Humane Interface*, ACM Press 2000
- Brad A. Myers. "A Brief History of Human Computer Interaction Technology." *ACM interactions*. Vol. 5, no. 2, March, 1998. pp. 44-54.
<http://www-2.cs.cmu.edu/~amulet/papers/uistory.tr.html>
- Software Arts and VisiCalc
<http://www.bricklin.com/history/intro.htm>





Historic Visions of the Future

- Home Computer and Tele-Shopping
<http://www.youtube.com/watch?v=EC5sbdvnvQM>
- View of the Future at&t (ad)
<http://www.youtube.com/watch?v=sYNUcFMCIzw>
- Arthur C. Clarke - Predicting the Future (more general)
<http://www.youtube.com/watch?v=AOaZspeSBZU>