Interacção Humana com o Computador

Aula 4

Departamento de Informática
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Human Error

Human Error


JUST KIDDING
TO ERR IS HUMAN, GARTH!
BUT, IT'S NOT MY FAULT!
AND TO BLAME SOMEONE ELSE IS EVEN MORE HUMAN!
Copyright 2009 by Rod Maclean
www.justkiddingcartoons.com
1-11
Maclean©

Errors and Mental Models

Types of error

Slips (deslizes/falhas/faltas)

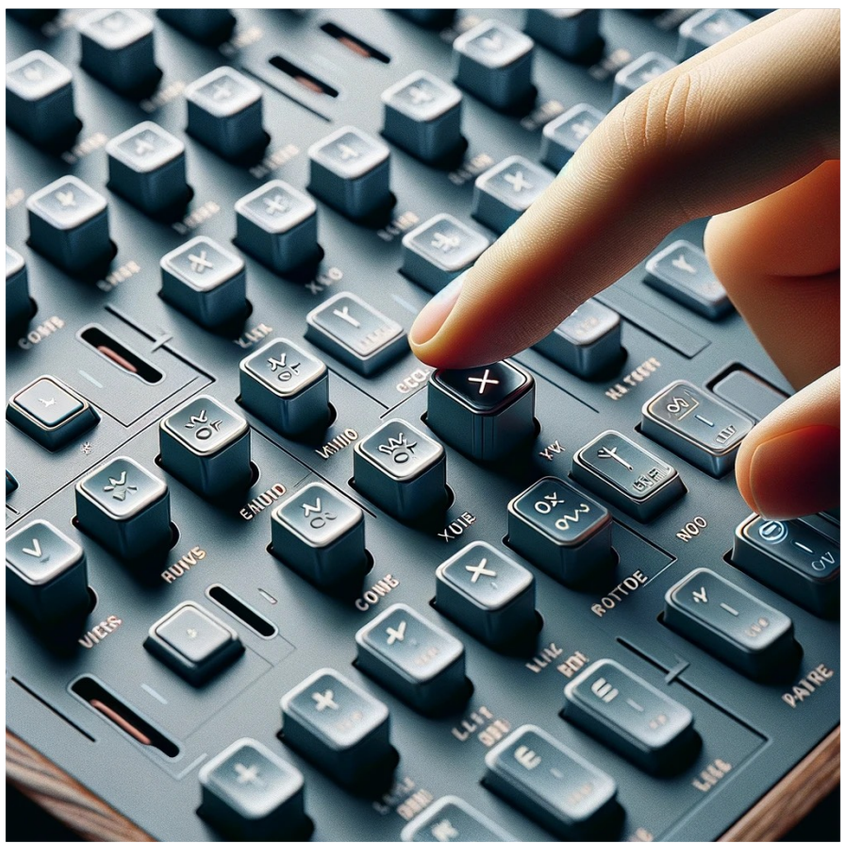
- **Right intentio**n, but failed to do it right
- **Causes**: poor physical skill, inattention, …
- Similar aspect but different functionality

Mistakes (enganos)

- **Wrong intention**
- **Cause**: incorrect understanding

  humans create mental models
  to explain behavior …

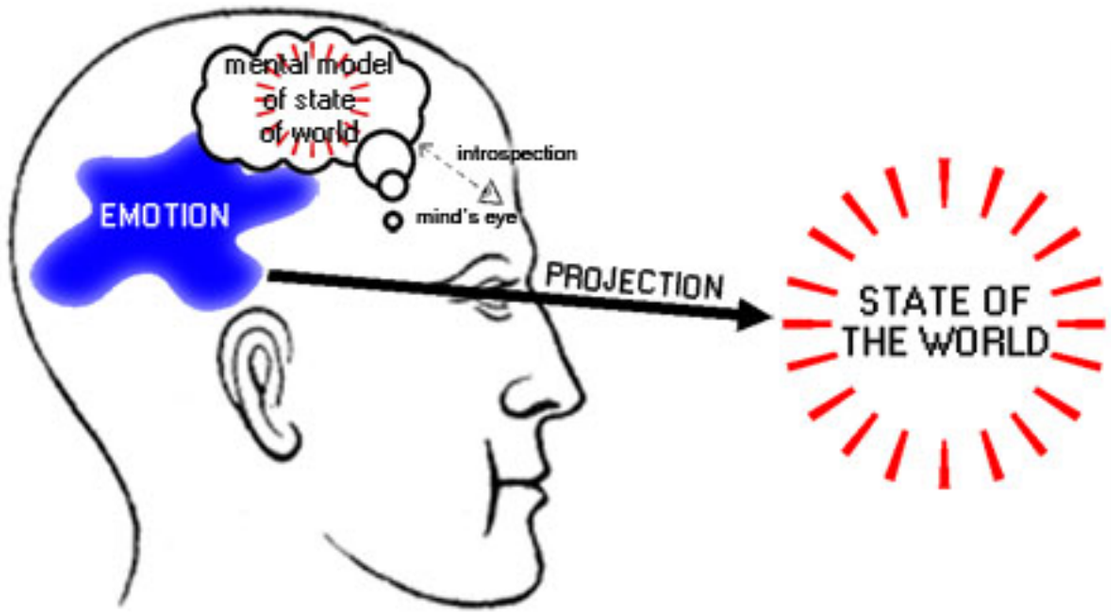
  If wrong (≠ system)
  errors will happen!



Errors and Mental Models

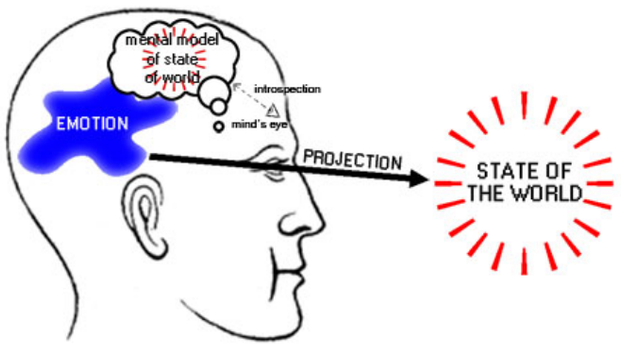
Types of error

Humans create mental models to explain behavior.
if wrong (different from actual system) errors can occur



What Norman calls the
“system image”

Errors and Mental Models



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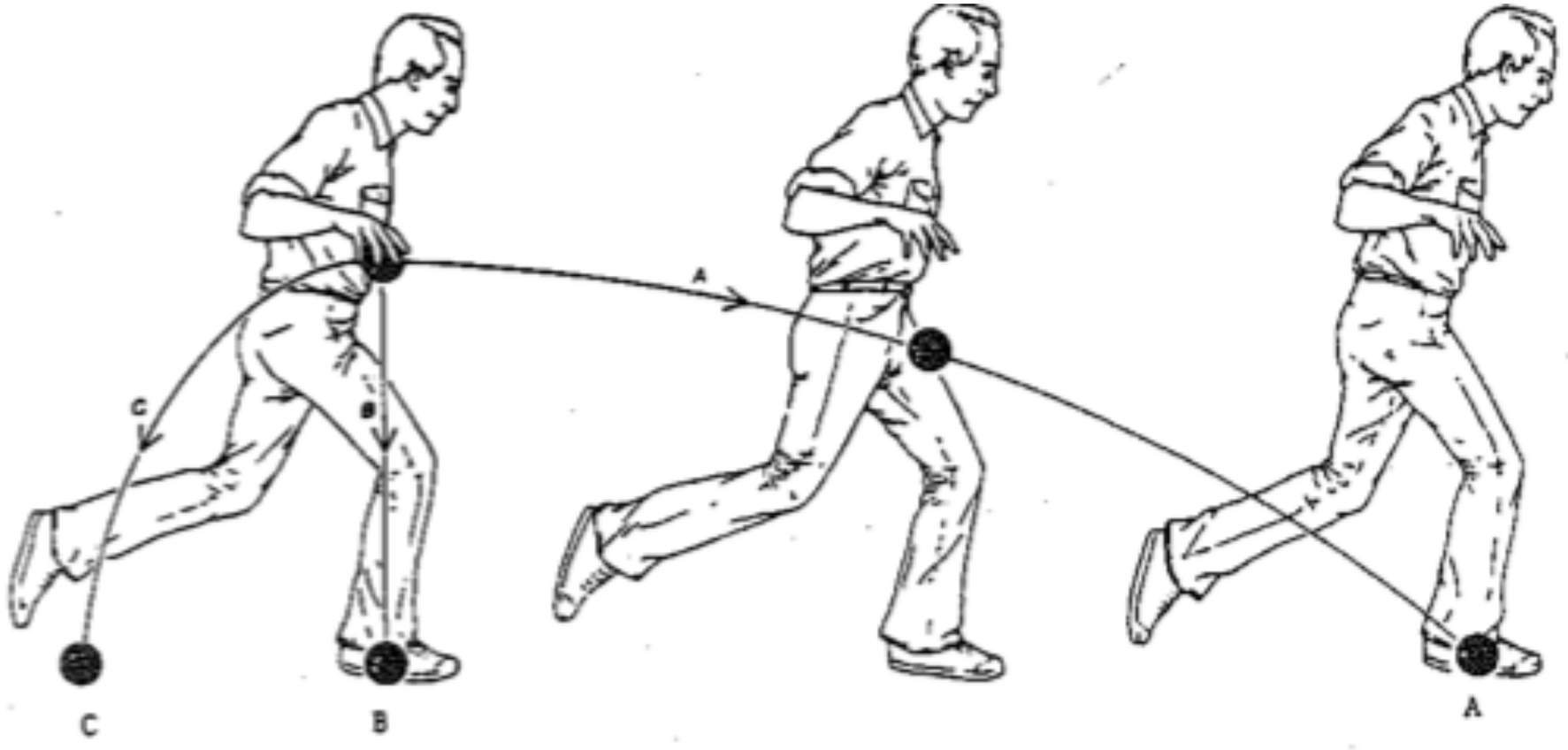
If wrong (≠ system) **errors** can occur …



Errors and Mental Models

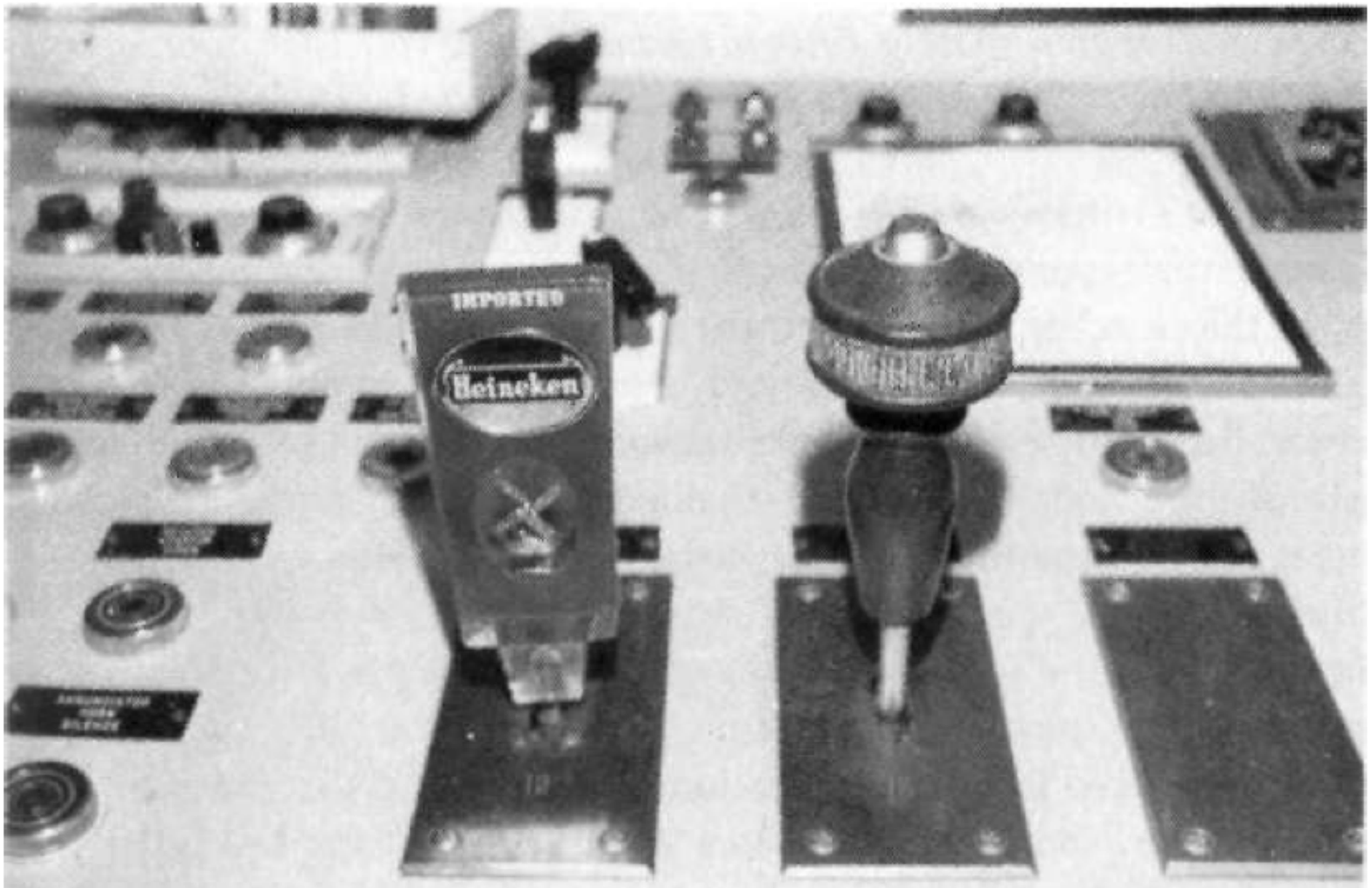
Types of error

Humans create mental models to explain behavior.
if wrong (different from actual system) errors can occur

4.5 A Clock Radio, "Human Engineered" to Simplify Operation.
Note the row of identical-looking switches!

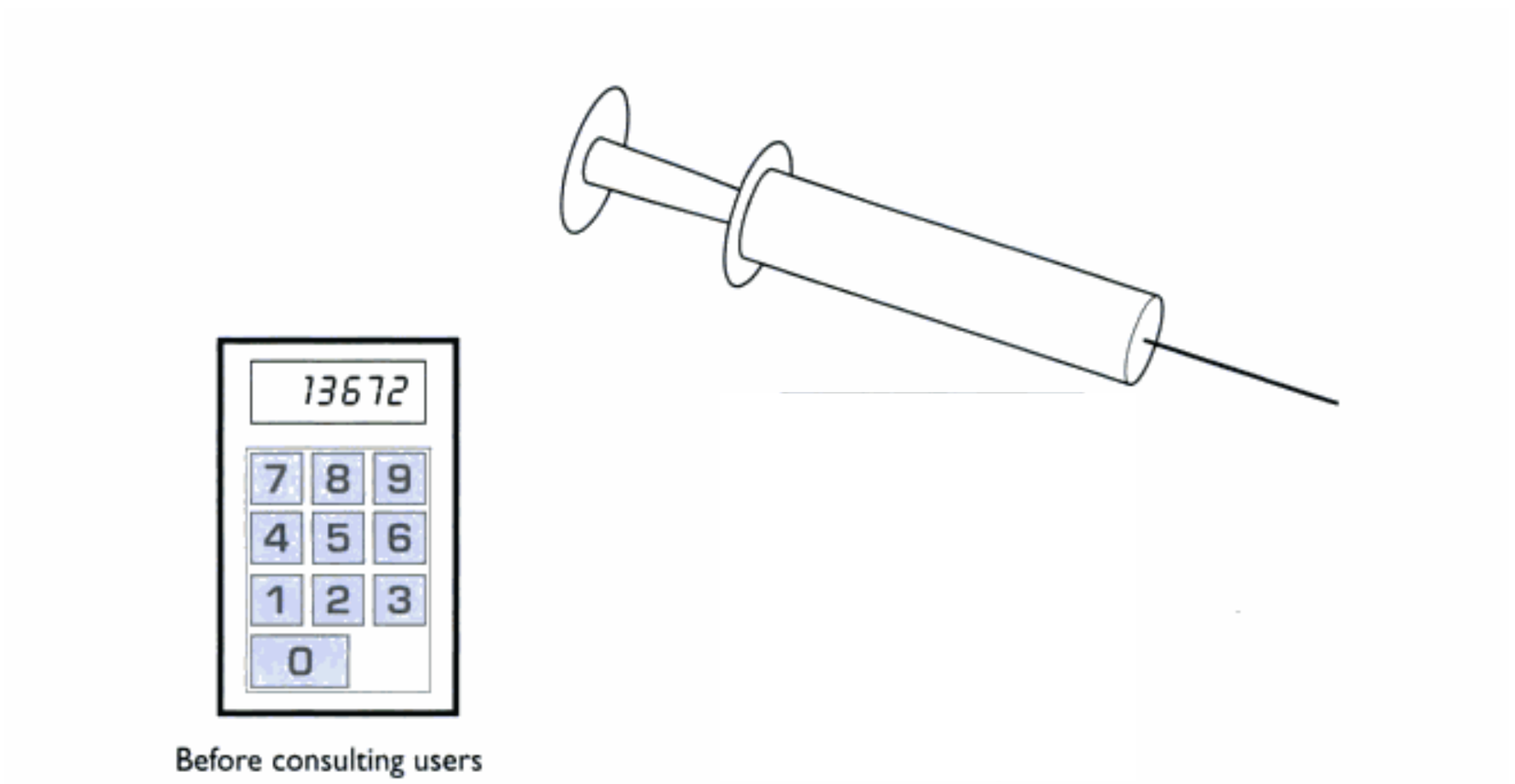
Errors and Mental Models

4.6 Make the Controls Look and Feel Different. The control-room operators in a nuclear power plant tried to overcome the problem of similar-looking knobs by placing beer-keg handles over them. This is good design, even if after the fact; the operators should be rewarded. (From Seminara, Gonzales, & Parsons, 1977. Photograph courtesy of Joseph L. Seminara.)



Errors and Mental Models

Controlling an electronic syringe



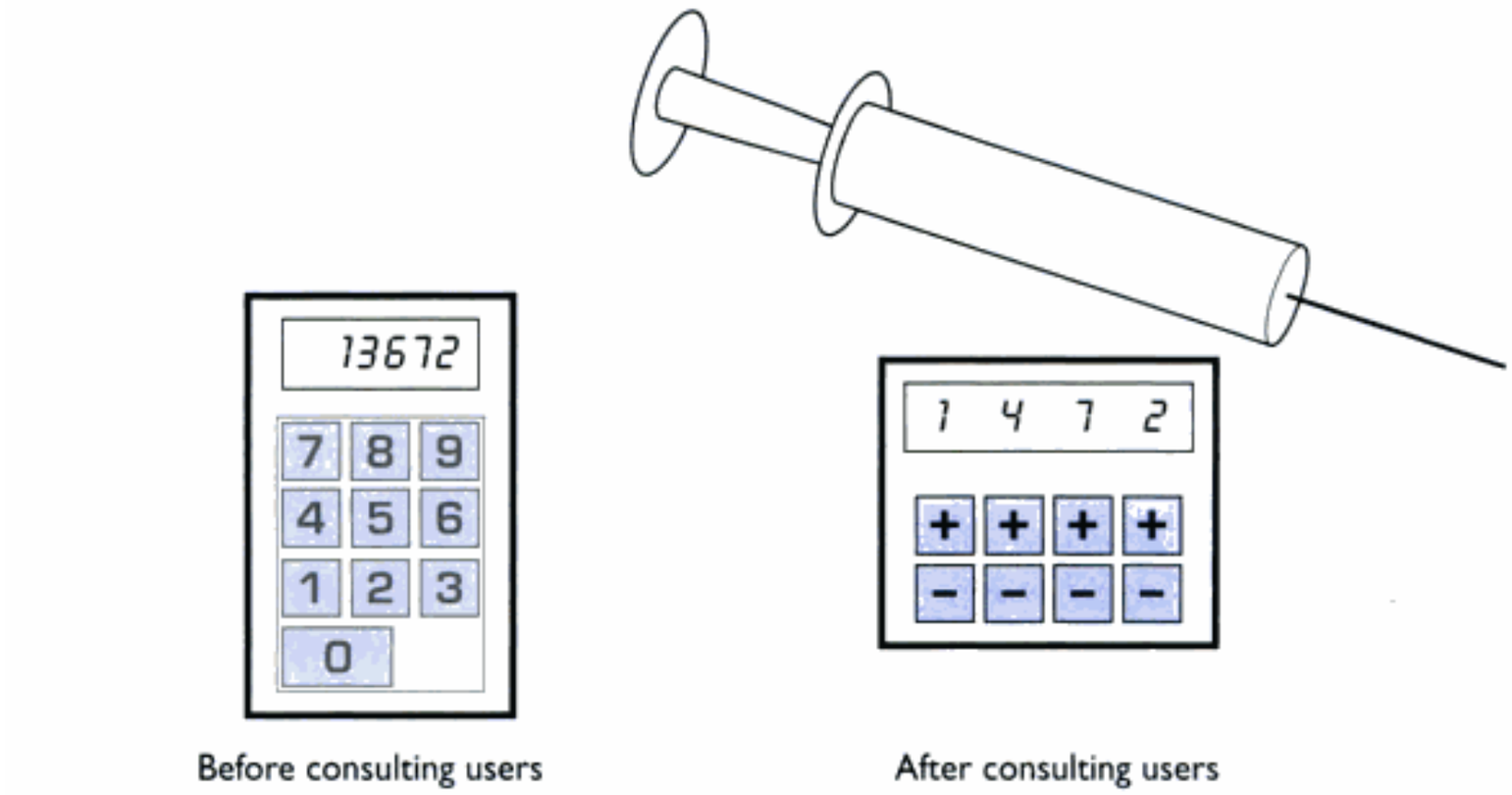
Before consulting users

Figure 0.1 Automatic syringe: setting the dose to 1372. The effect of one key slip before and after user involvement

Before **After**

Errors and Mental Models

Controlling an electronic syringe



Before consulting users

After consulting users

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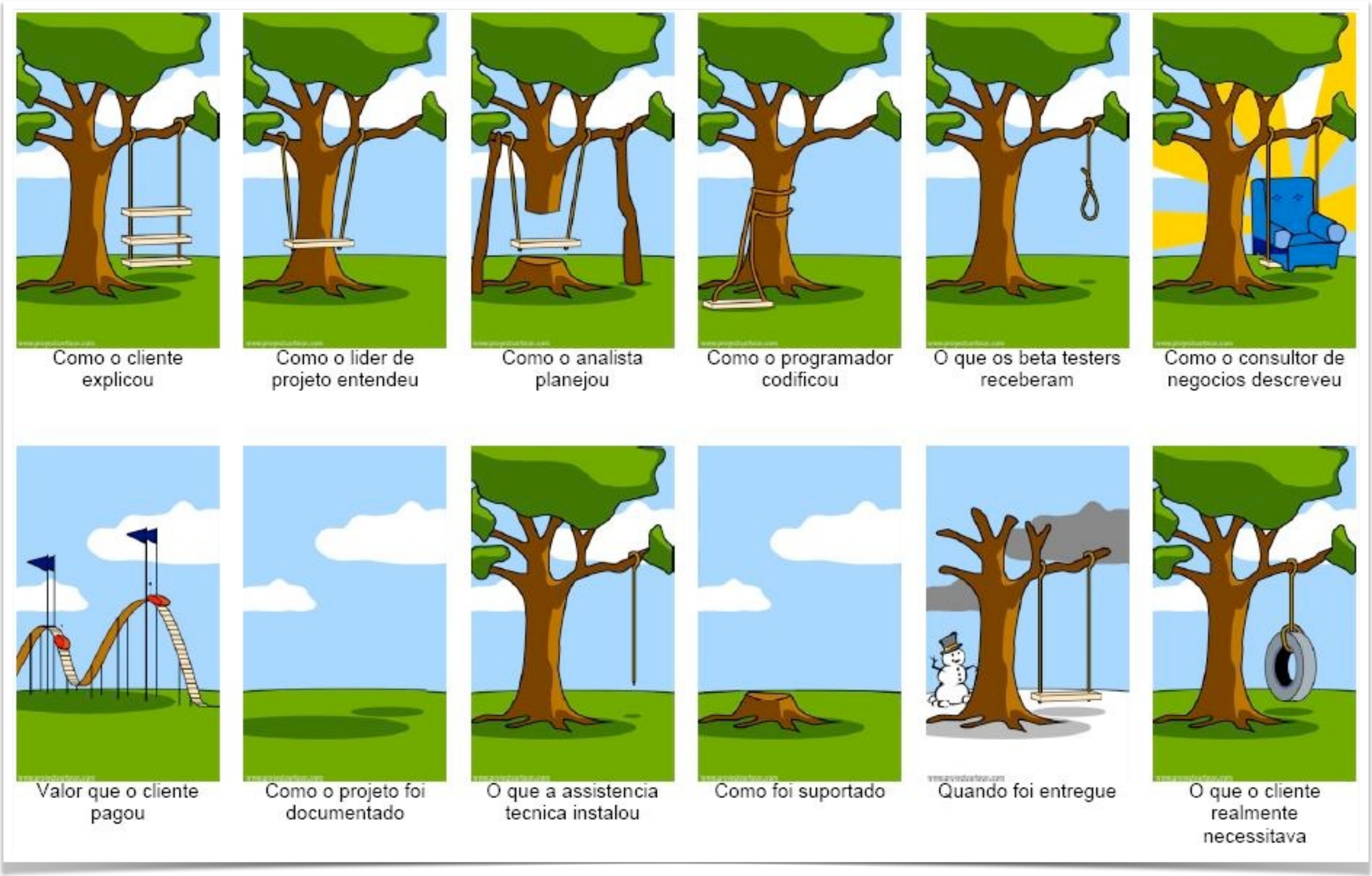
Before

After

Errors and Mental Models

Software Engineering => Fit Mental Models



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  errors will happen!

Human Emotions

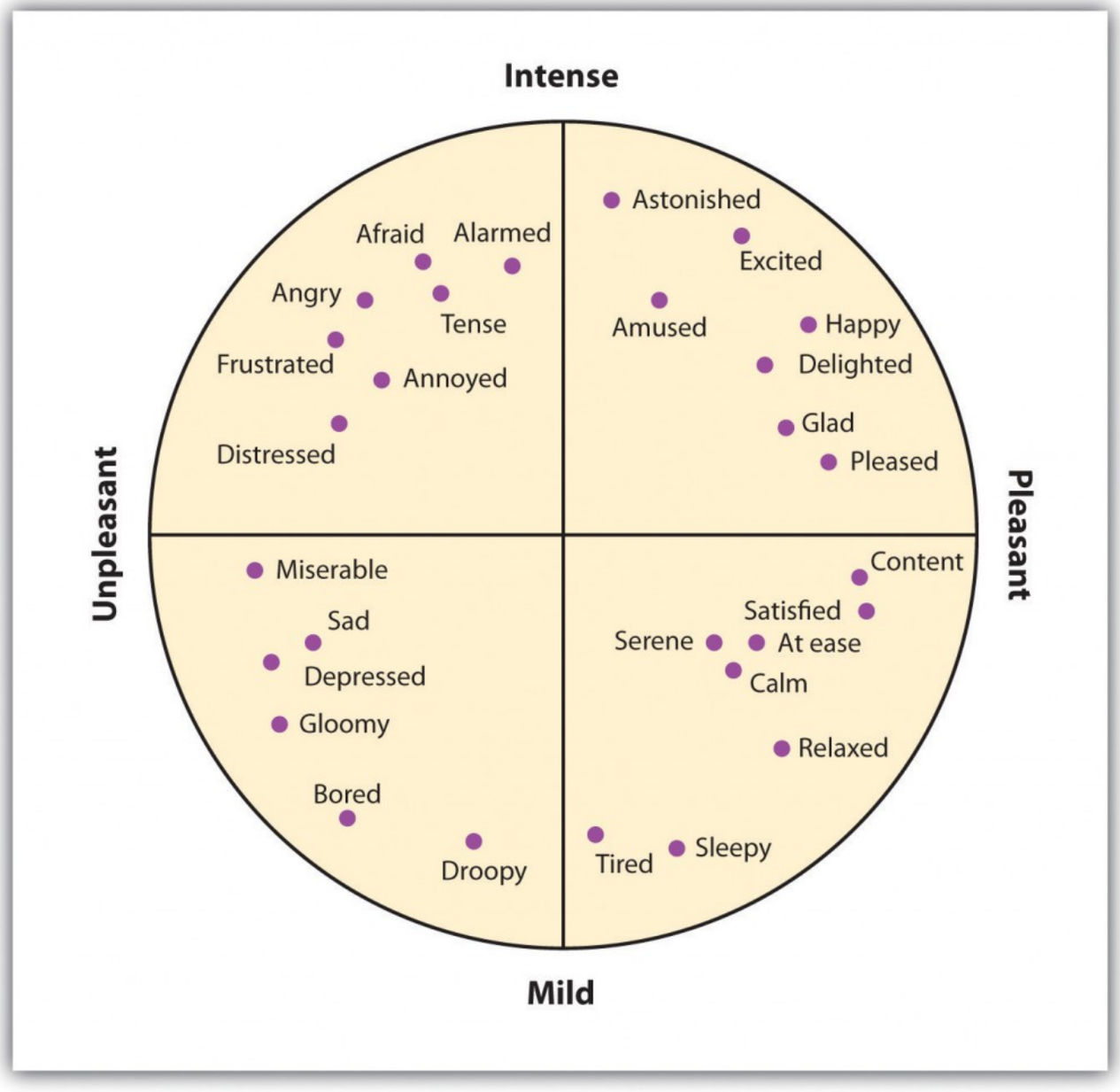
The Human — Emotions

According to psychologist **Paul Ekman**, there are **six basic emotions**, which are:

- **Joy** - Feeling of pleasure or happiness.
- **Sadness** - Feeling of pain, loss, or despair.
- Fear - Feeling of threat or danger, which can be real or perceived.
- **Anger** - Feeling of antagonism or frustration, usually in response to an obstacle or a threat.
- **Surprise** - Feeling experienced when something unexpected happens.
- **Disgust** - Feeling of aversion to something considered unpleasant or offensive.

The Human — Emotions

- **The field of *sentiment analysis***
  - Several important applications, not only in HCI
  - There are some tools: **Circumplex** model of affect



The Human — Emotions

- *The biological response to **physical** stimuli is called **affect** (afeto), which leads to an **interpretation**, as an emotion.*

James Lange

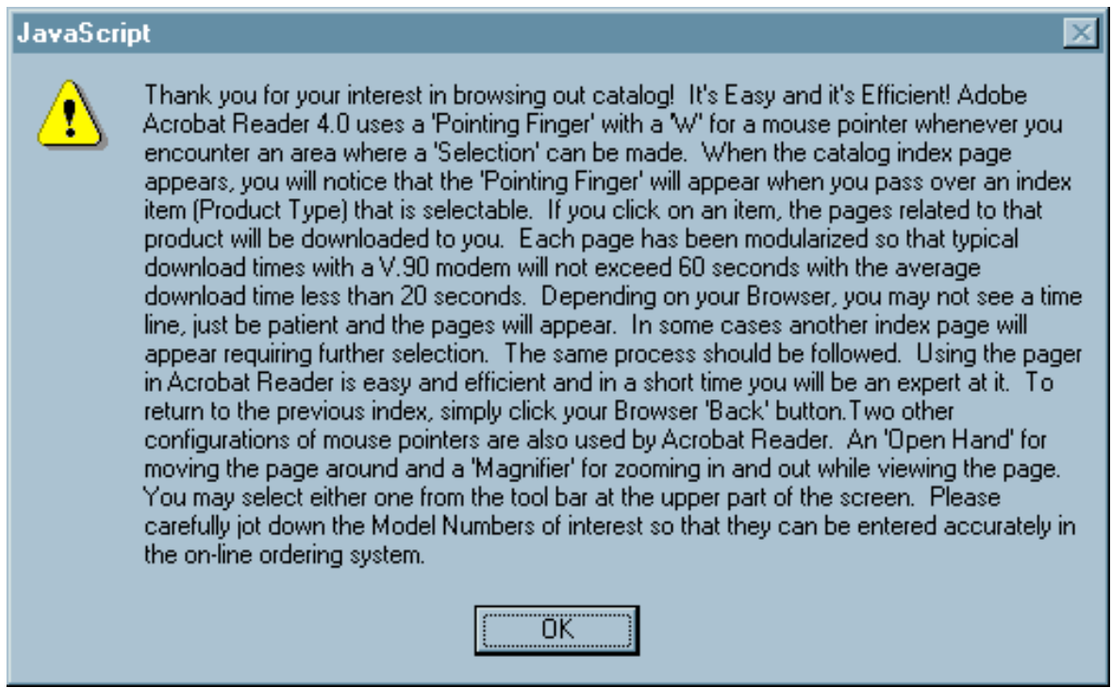
- ***Affect*** influences how we respond to situations
  - **positive** → creative problem solving
  - **negative** → narrow thinking

"***Negative** affect makes a task harder, even simple ones;*
***Positive** affect is a powerful task simplifier."*

Donald Norman

The Human — Emotions

- **Implications for interface design**
  - **Stress** increase the difficulty of problem solving
  - **Relaxed** users will be more forgiving of shortcomings in design
  - **Aesthetically** pleasing and rewarding interfaces will increase positive affect



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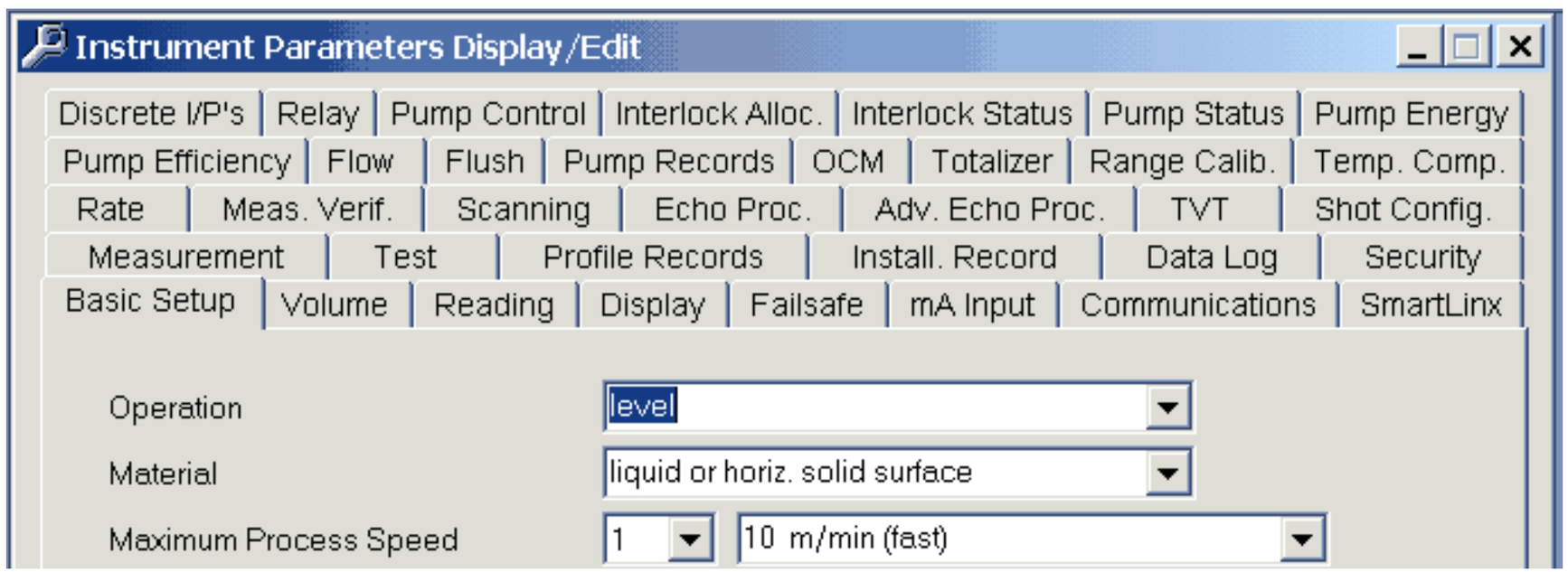

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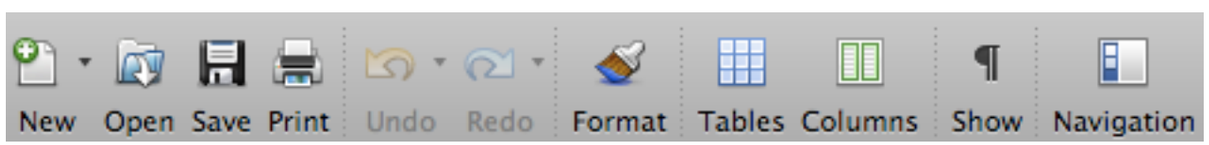
Compuserve's *WinCim 2.0*



Microsoft Office 2008

The Human — Emotions

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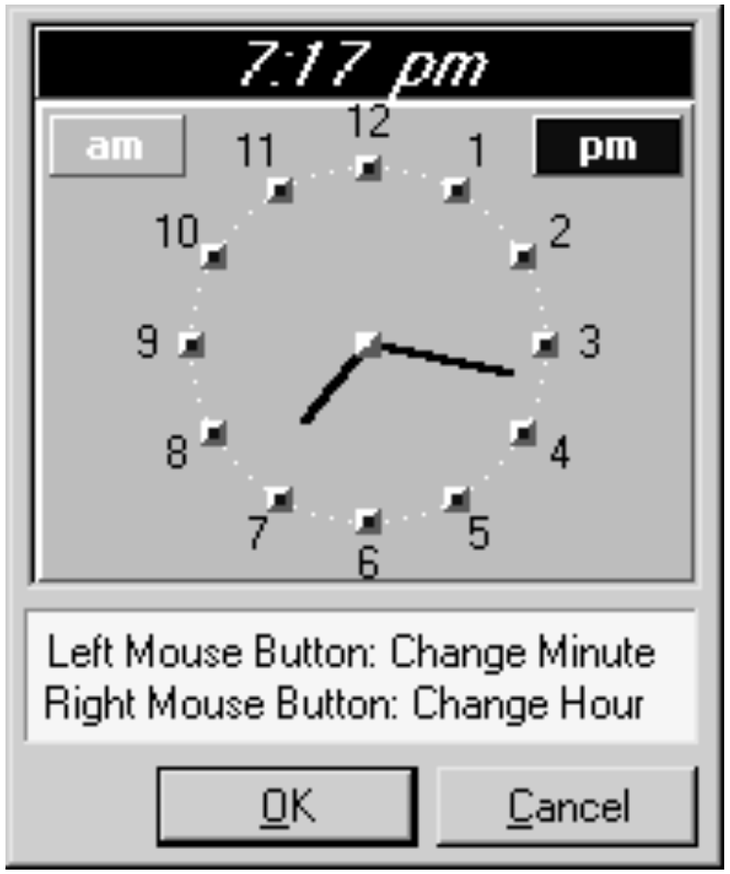
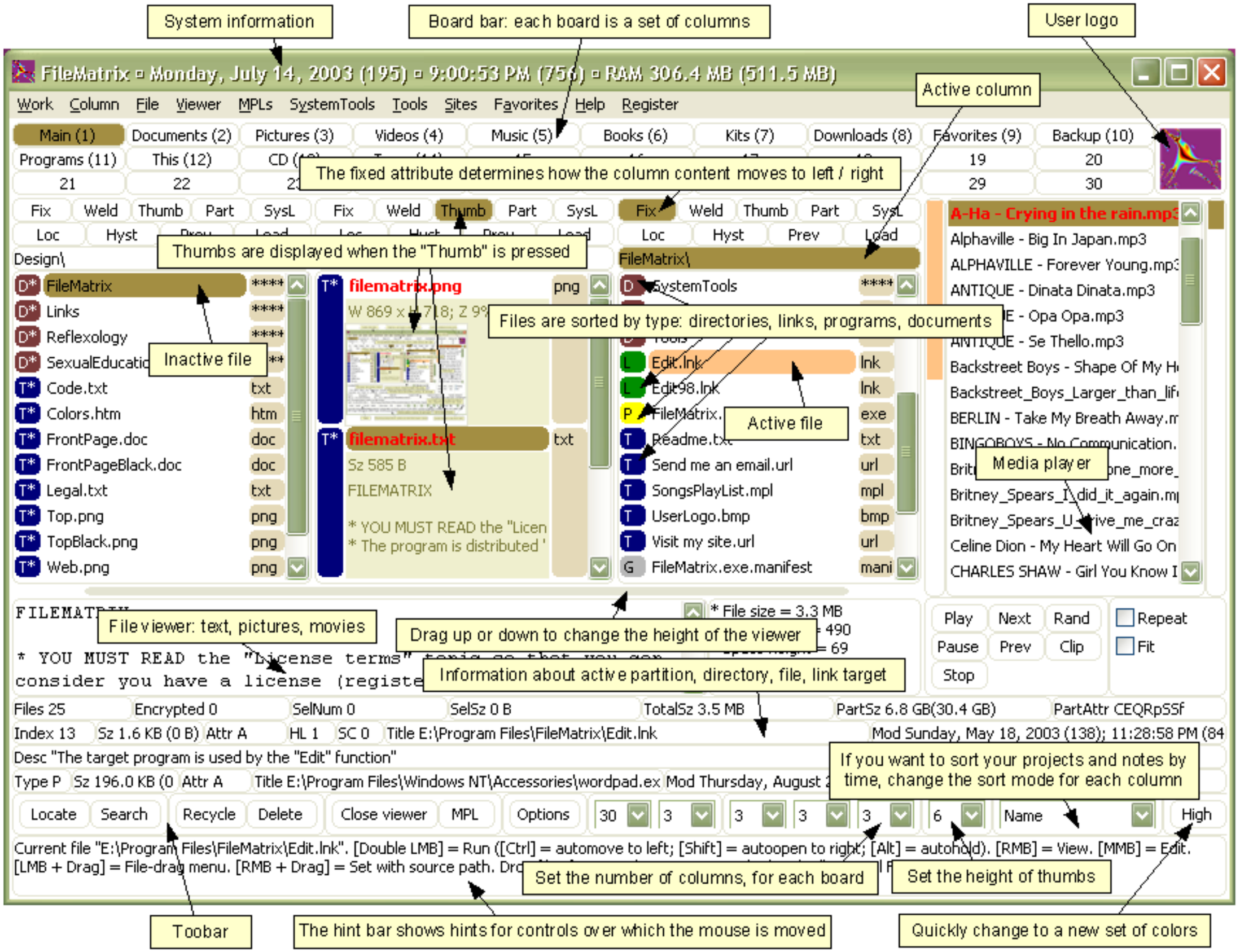

7:17 pm
am
pm
12
1
2
3
4
5
6
7
8
9
10
11
Left Mouse Button: Change Minute
Right Mouse Button: Change Hour
OK
Cancel


Microsoft Access
Wrong button!
This button doesn't work.
Solution
Try another.
OK


Select an award style...
Select an award style using the scroll bar. When you've found a style that suits you, press OKAY to create that award and open the editor.
CUSTOMER SERVICE
AWARD
CUSTOMER SERVICE AWARD
Cancel
OK



https://thedailywtf.com/articles/Enter_The_Matrix

The Human — Emotions

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Individual Differences

- **Long-term**
  - Gender, physical and intellectual abilities
- **Short-term**
  - Effect of stress or fatigue
- **Changing**
  - Age

Ask yourself:

Will design choices overlook segments of the user population?

Human-Computer Interaction

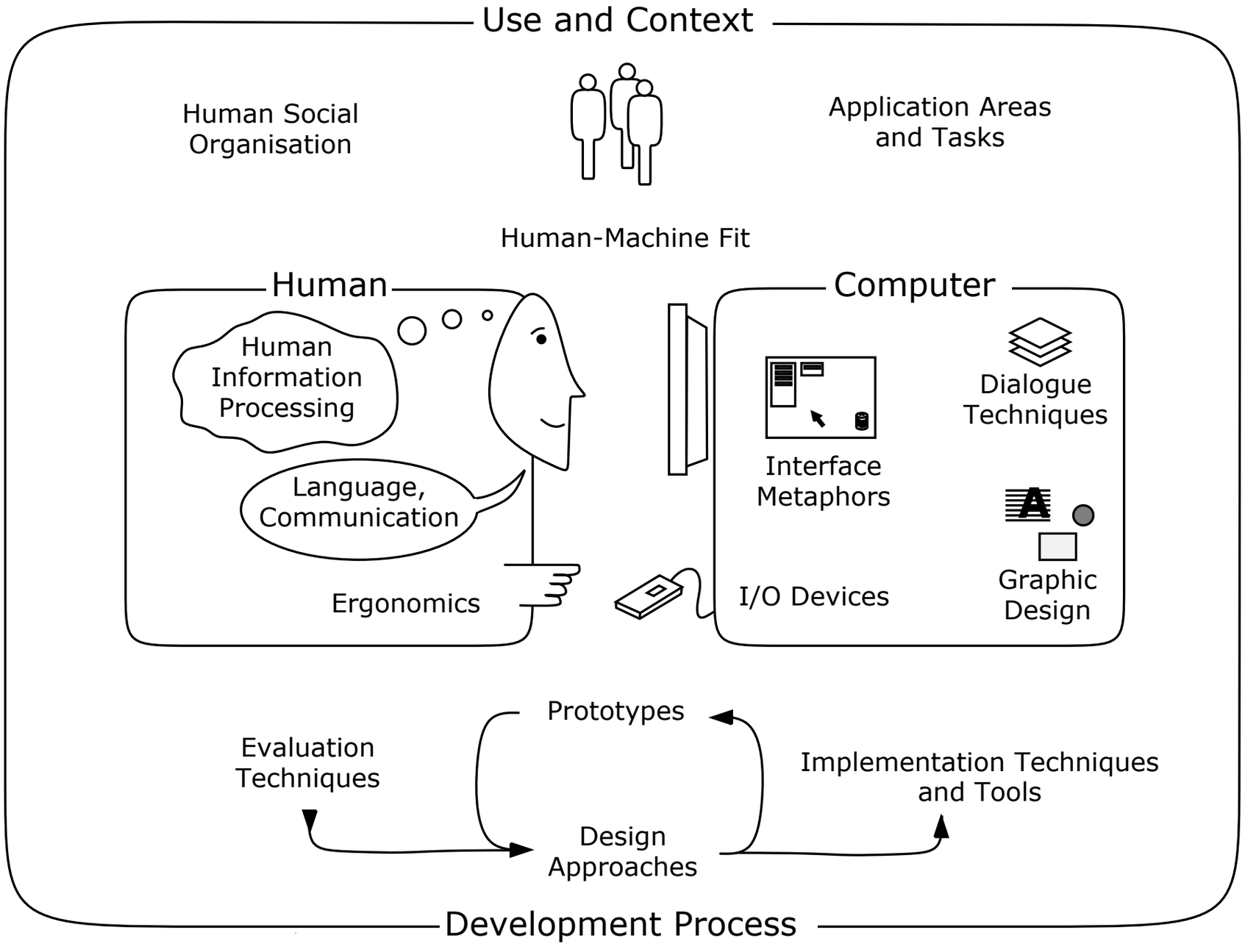


Figure 1.1: The nature of Human-Computer Interaction. Adapted from Figure 1 of the ACM SIGCHI Curricula for Human-Computer Interaction [Hewett et al., 2002]

The Computer

The Computer

A computer system is made up of various elements
each of these elements affects the interaction

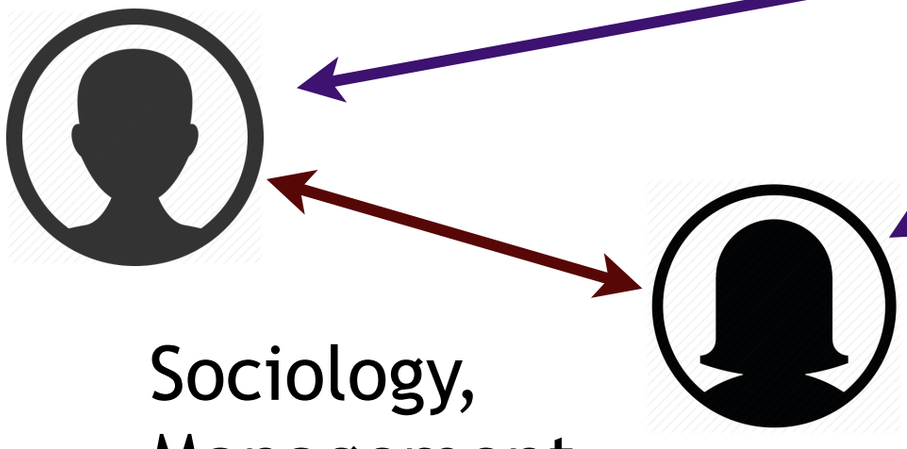
- **Input devices:** text entry and pointing.
- **Output devices:** screen (small&large), digital paper.
- **Virtual reality:** special interaction and display devices.
- **Physical interaction:** e.g., sound, haptic, bio-sensing.
- **Paper:** as output (print) and input (scan).
- **Memory:** RAM & permanent media, capacity & access.
- **Processing:** speed of processing, network access.

Interacting with computers

To understand **human-*computer*** interaction
… need to understand **computers**!

What does interaction mean?

What goes **in** and **out**
devices, paper,
sensors, etc.



Sociology,
Management,
Politics,…

What can it do?
memory, processing,
networks

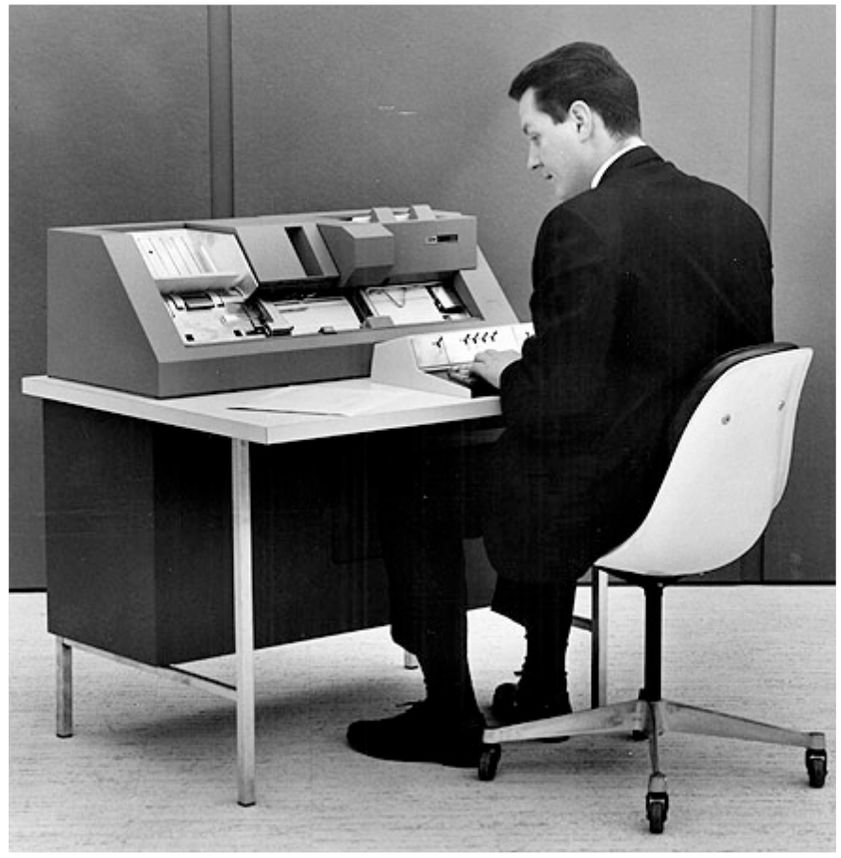
Interactivity?

"Long ago in a galaxy far away …"

***Batch* Processing**

- **Punched card** stacks or large **data files** prepared
- Long wait ….
- Line printer output

… and if it is not right …



Now, much more dynamic:

- Rapid feedback;
- The user is in control (most of the time);
- She is exploring/doing rather than thinking.

Command Line Interactivity

Unix Operating System

Unix PC, 1985

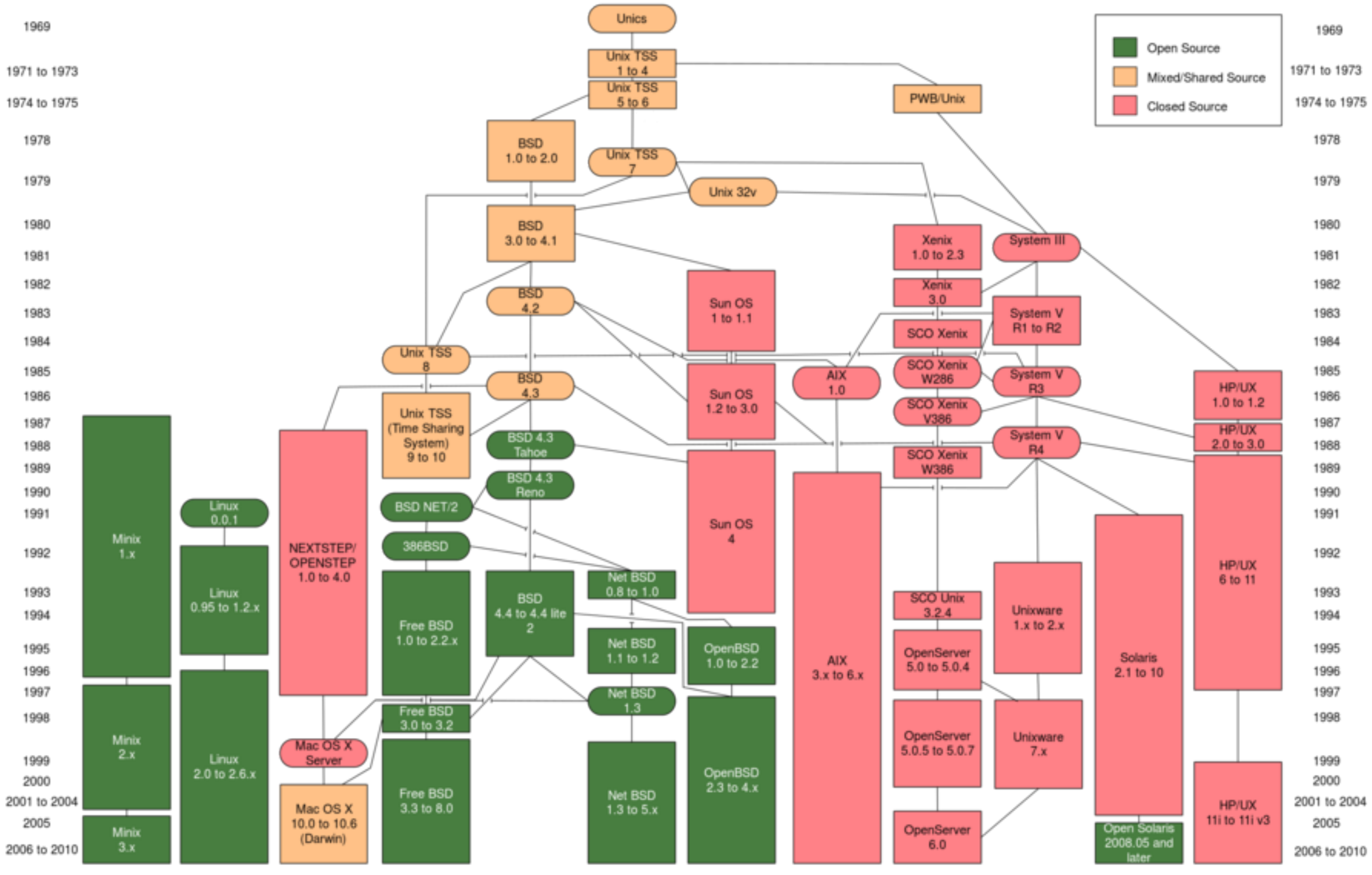
Massachusetts Institute of Technology

AT&T Bell Labs

General Electric

UNIX HISTORY

1969 – 2010



Interactivity?

PDP-11

Denis Ritchie

Ken Thompson

Interactivity?

Article | Talk | Read | Edit source | View history | Search Wikipedia

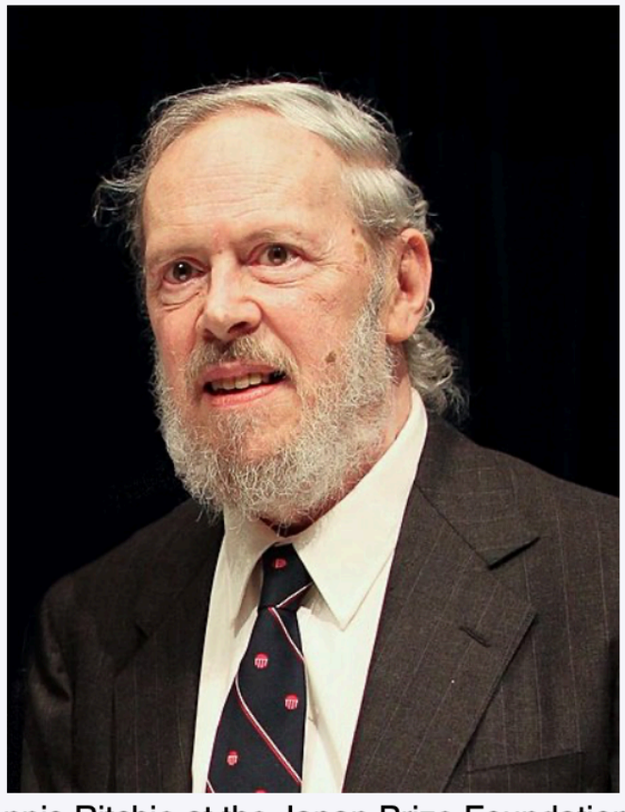
Dennis Ritchie

From Wikipedia, the free encyclopedia

Dennis MacAlistair Ritchie (September 9, 1941 – c. October 12, 2011)[2][3][4][5] was an American computer scientist.[2] He created the C programming language and, with long-time colleague Ken Thompson, the Unix operating system and B programming language.[2] Ritchie and Thompson were awarded the Turing Award from the ACM in 1983, the Hamming Medal from the IEEE in 1990 and the National Medal of Technology from President Bill Clinton in 1999. Ritchie was the head of Lucent Technologies System Software Research Department when he retired in 2007. He was the "R" in K&R C, and commonly known by his username **dmr**.

Contents [hide]

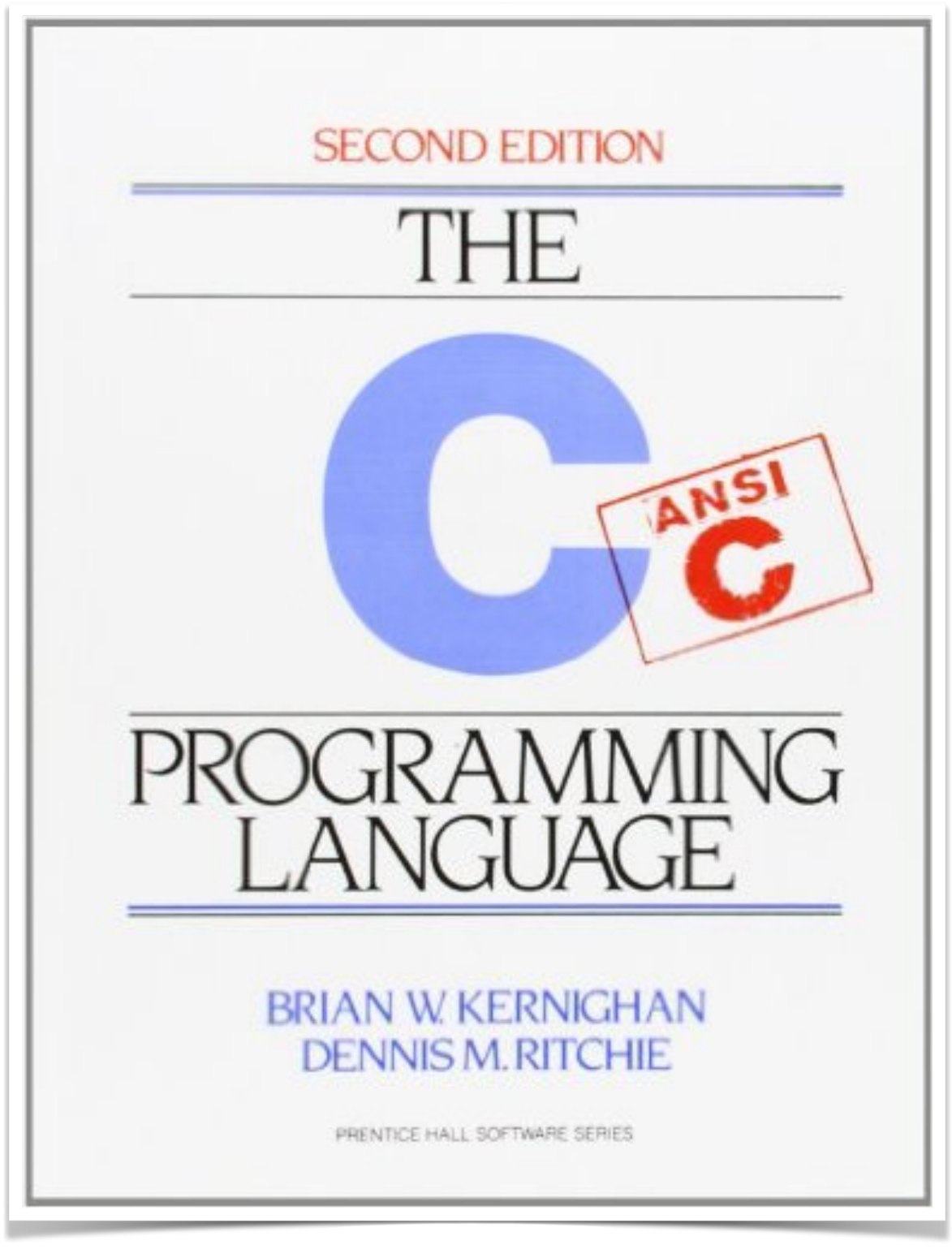
Dennis Ritchie



Dennis Ritchie at the Japan Prize Foundation in May 2011

Born	September 9, 1941 Bronxville, New York, U.S.
Died	c. October 12, 2011 (aged 70) Berkeley Heights, New Jersey, U.S.

Interactivity?



Interactivity?

Mainframes **UNIVAC, PDP-10/11** with **VAX** OS

UNIVAC

UNIVAC I Mainframe (1951)
Descendent from the ENIAC

link

PDP-10

PDP-10 is a 36-bit machine; processor KA10 ≈ 1 Mflop

Tapes; ≈ 1kb memory; Batch processing;
Time-Sharing => adopted by universities and labs.

Interactivity?

UNIVAC

PDP-10

The **DEC VT100** Terminal
1978

Interactivity?

UNIVAC

PDP-10

The **DEC VT220** Terminal
1983

Interactivity?

UNIVAC

PDP-10

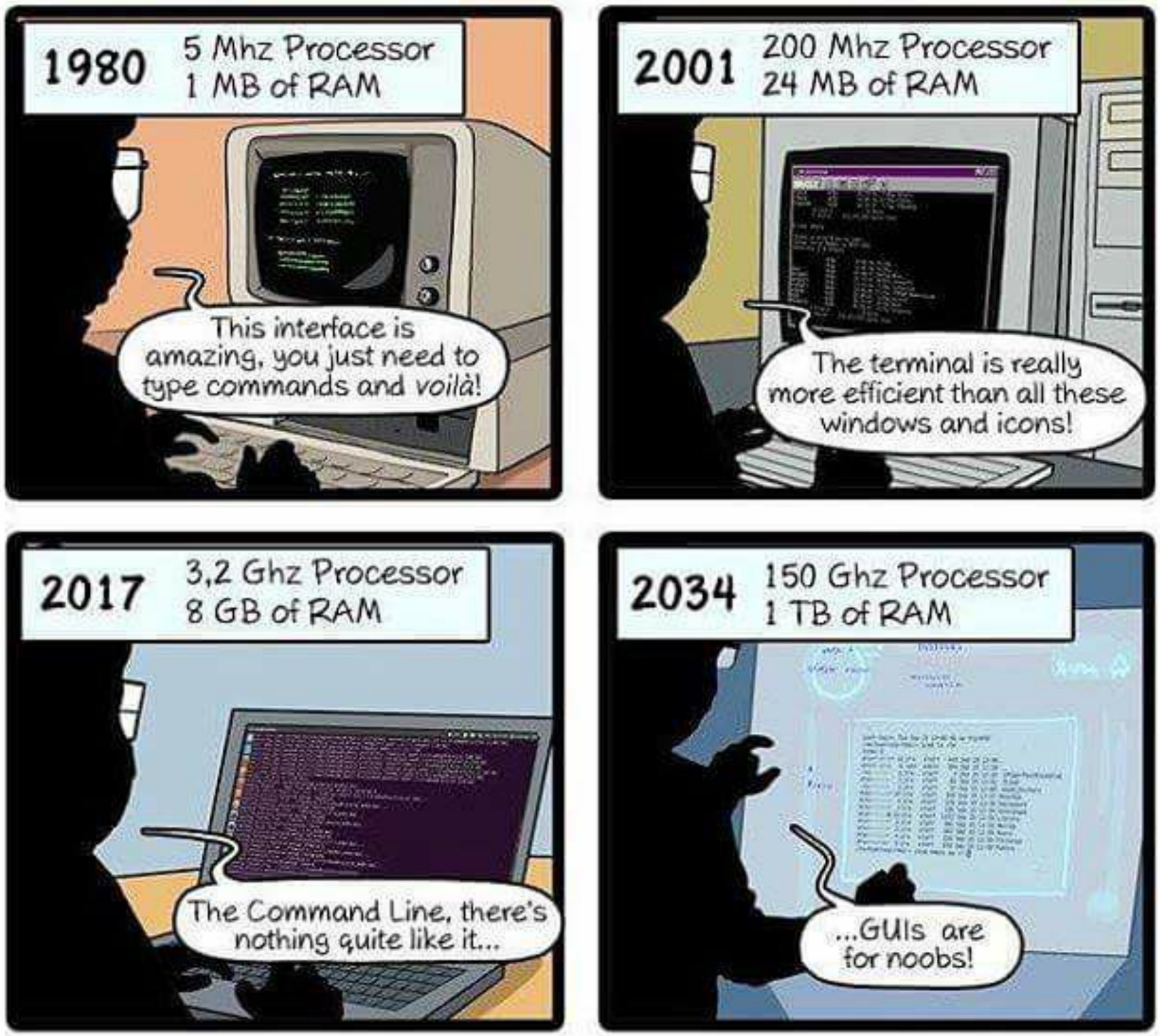
The **DEC VT320** Terminal
1983

Command Line Interactivity

```
Enter today's date (m-d-y): 08-04-81

The IBM Personal Computer DOS
Version 1.00 (C)Copyright IBM Corp 1981

A>dir *.com
IBMBIO    COM         1920  07-23-81
IBMDOS    COM         6400  08-13-81
COMMAND   COM         3231  08-04-81
FORMAT    COM         2560  08-04-81
CHKDSK    COM         1395  08-04-81
SYS       COM          896  08-04-81
DISKCOPY  COM         1216  08-04-81
DISKCOMP  COM         1124  08-04-81
COMP      COM         1620  08-04-81
DATE      COM          252  08-04-81
TIME      COM          250  08-04-81
MODE      COM          860  08-04-81
EDLIN     COM         2392  08-04-81
DEBUG     COM         6049  08-04-81
BASIC     COM        10880  08-04-81
BASICA    COM        16256  08-04-81

A>_
```

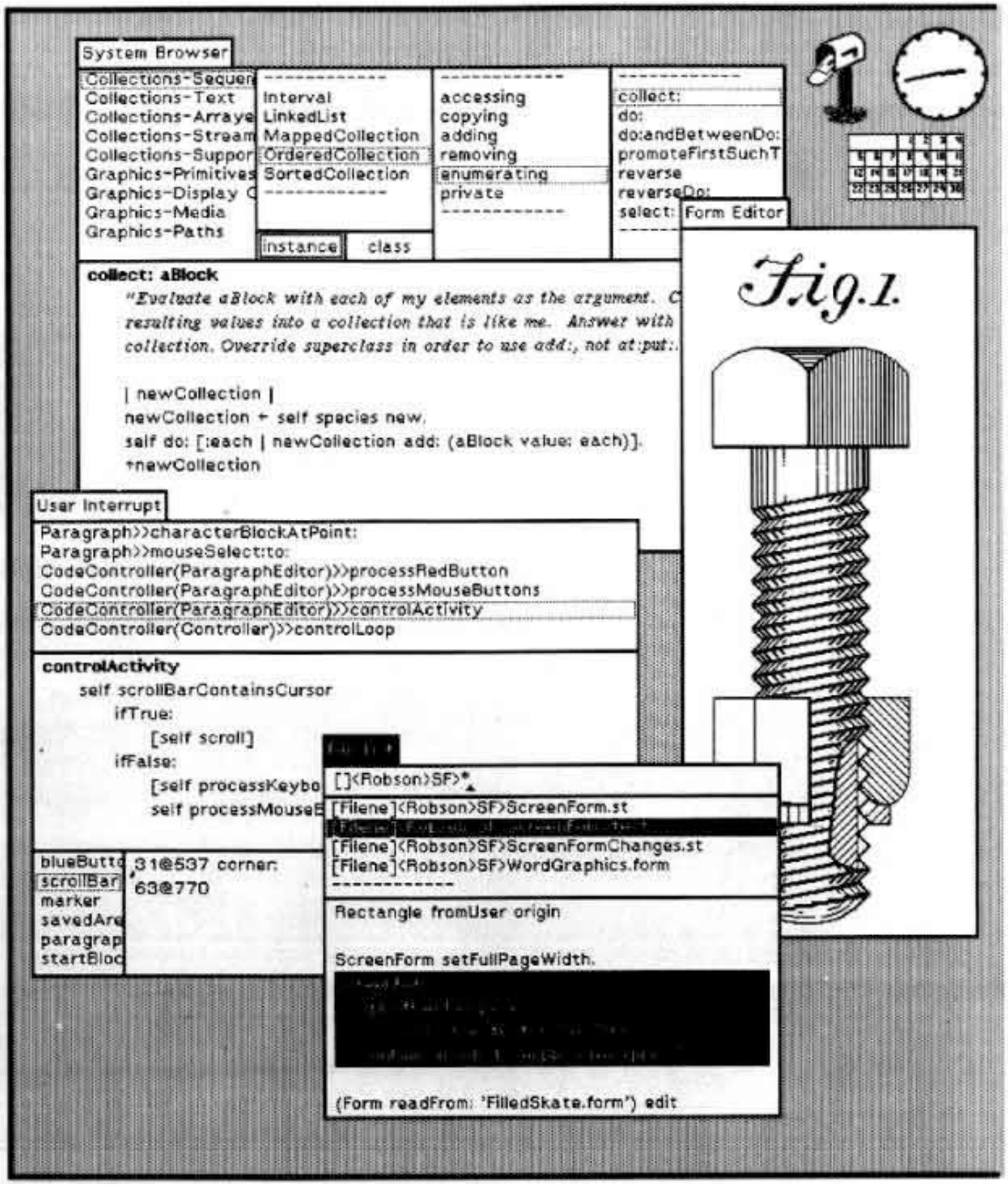
MS-DOS

The Awesome Command Line



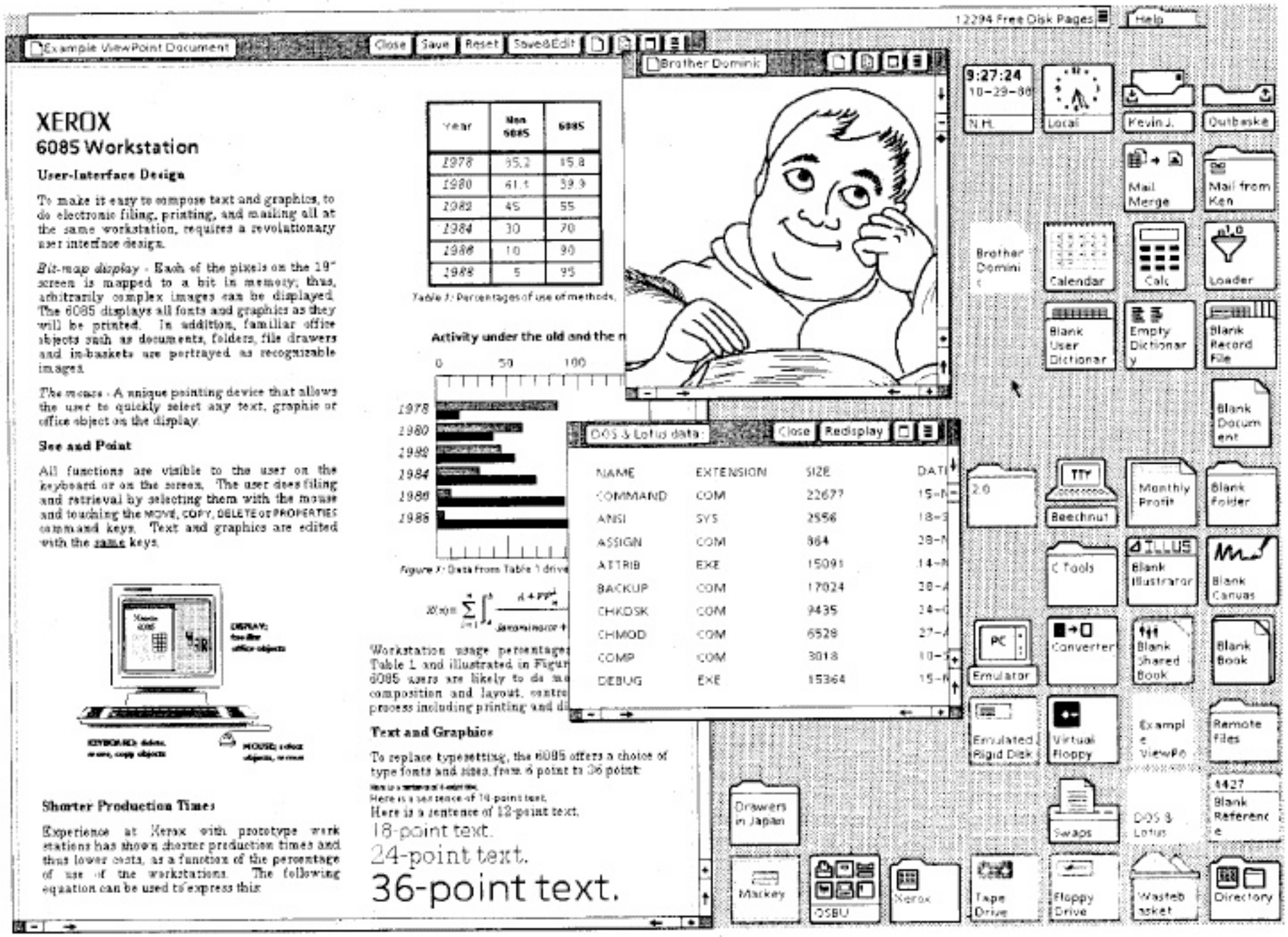
First GUI — “Xerox Alto”

March 1, 1973



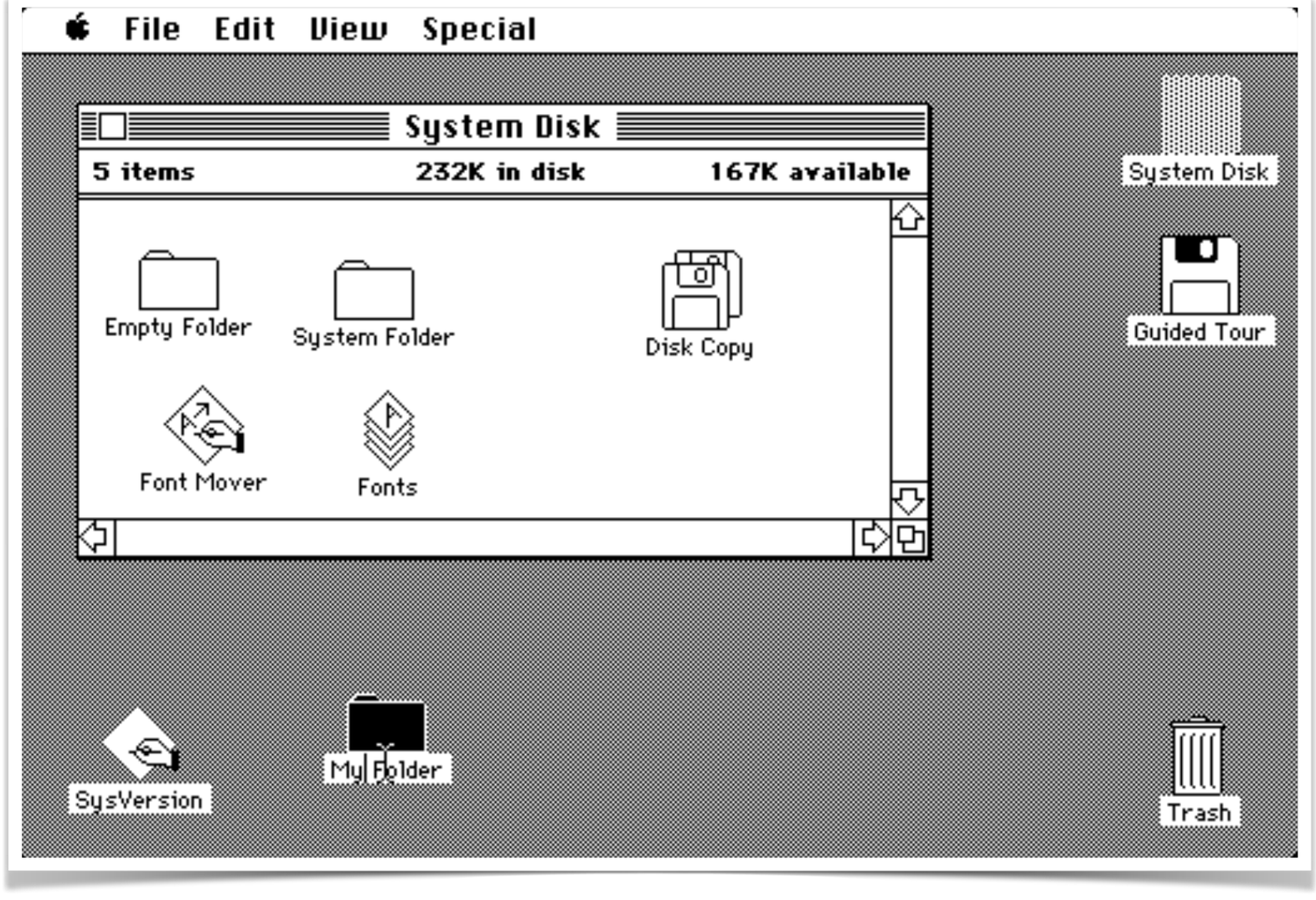
GUI — “Xerox Star”

1981



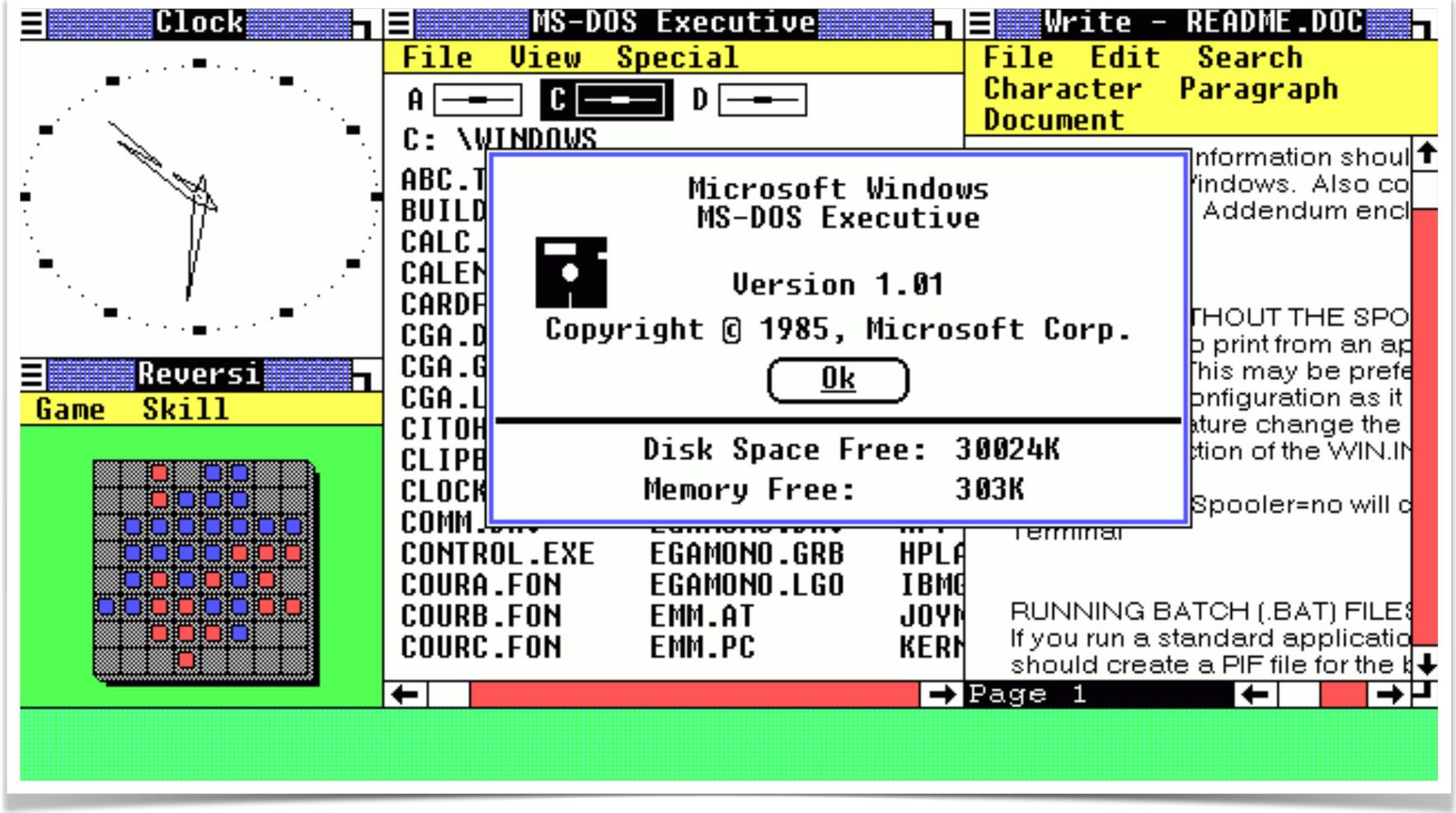
GUI — Apple Macintosh

1984

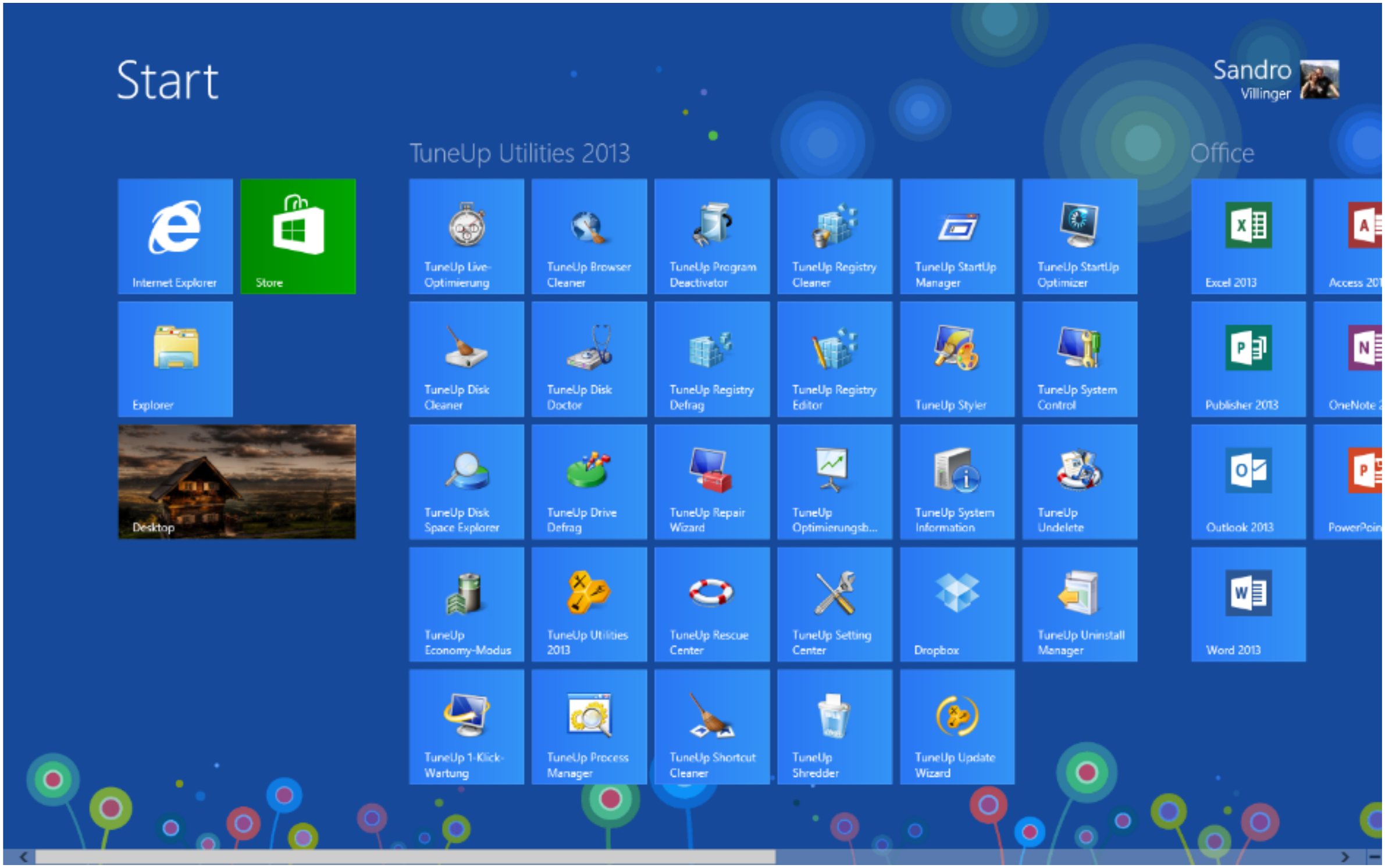


GUI — Windows 1.0

1985



Modern GUIs


Start
Sandro
Villinger
TuneUp Utilities 2013
Office
Internet Explorer
Store
Explorer
Desktop
TuneUp Live-Optimierung
TuneUp Browser Cleaner
TuneUp Program Deactivator
TuneUp Registry Cleaner
TuneUp StartUp Manager
TuneUp StartUp Optimizer
TuneUp Disk Cleaner
TuneUp Disk Doctor
TuneUp Registry Defrag
TuneUp Registry Editor
TuneUp Styler
TuneUp System Control
TuneUp Disk Space Explorer
TuneUp Drive Defrag
TuneUp Repair Wizard
TuneUp Optimierungsb...
TuneUp System Information
TuneUp Undelete
TuneUp Economy-Modus
TuneUp Utilities 2013
TuneUp Rescue Center
TuneUp Setting Center
Dropbox
TuneUp Uninstall Manager
TuneUp 1-Klick-Wartung
TuneUp Process Manager
TuneUp Shortcut Cleaner
TuneUp Shredder
TuneUp Update Wizard
Excel 2013
Publisher 2013
Outlook 2013
Word 2013

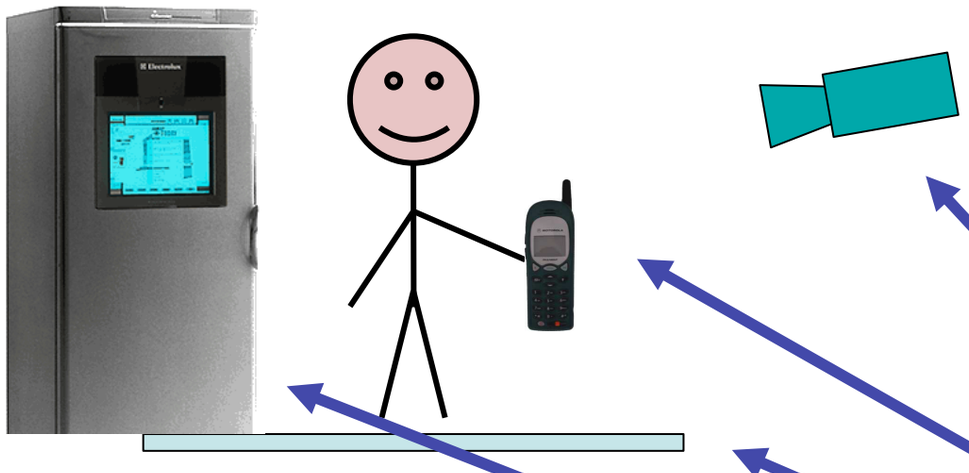
Modern GUIs

OS X

Richer interaction

Desktop computing → Ubiquitous computing

[Mark Weiser, 1988]



Sensors
and devices
everywhere

Richer interaction

Ubiquitous computing

"The most profound technologies are those that disappears"

Mark Weiser

- **Multiple smal computation devices**
  - Computers have moved out of machine room, onto the desktop and now into the pocket (Alan Dix, 2016)

IoT

Text Entry Devices

keyboards (QWERTY et al.)
chord keyboards, phone pads
handwriting, speech

Keyboards

- The **most common** text input device
- Allows **rapid** and **precise** entry of text by experienced users
- **Keypress** closes connection, causing a character code to be sent
- Usually connected by cable, but can be wireless

Layout – QWERTY

- **Standardise layout (?)**

  but …

  - non-alphanumeric keys are placed differently
  - accented symbols needed for different scripts
  - minor differences between UK and USA keyboards

- **QWERTY** arrangement **not optimal** for typing
  - layout to prevent typewriters jamming!

- Alternative designs allow faster typing but …

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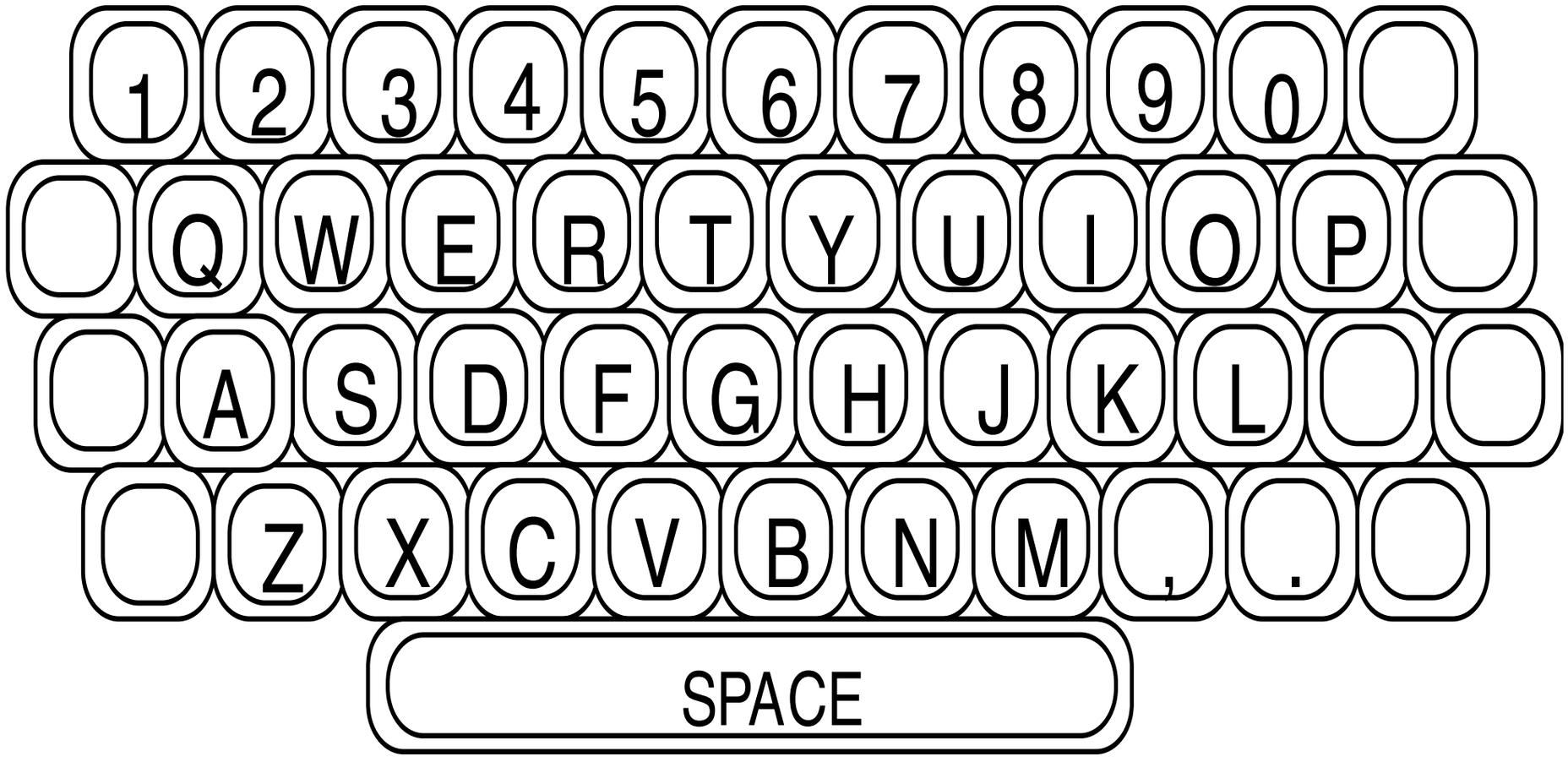
- Alternative designs allow faster typing but large social base of QWERTY typists producers are **reluctance to change.**

QWERTY



The “typewriter” history

QWERTY

The “typewriter” history

QWERTY

1954

The “typewriter” history

QWERTY

1968

The “typewriter” history

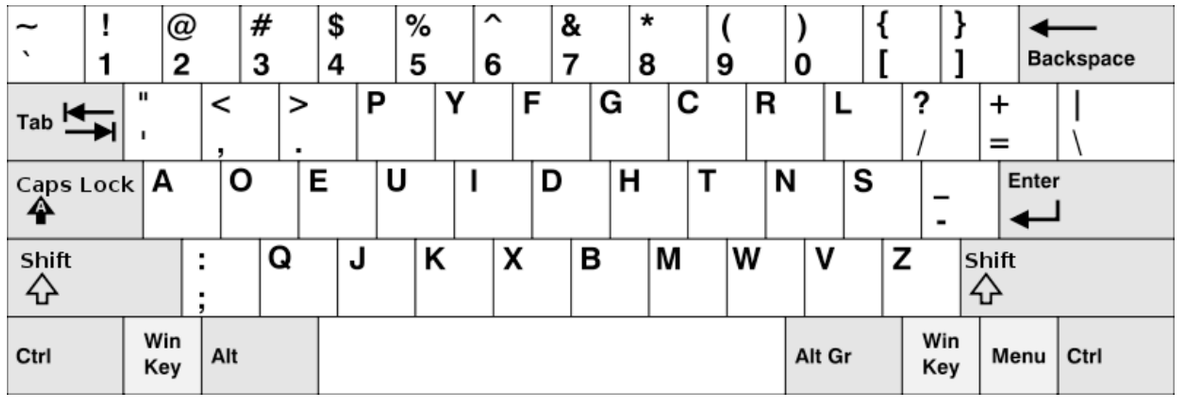
Alternative keyboard layouts

Alphabetic

- Keys arranged in alphabetic order
- Not faster for trained typists
- Not faster for beginners either!

Dvorak

- Common letters under dominant fingers
- Biased towards right hand
- Common combinations of letters alternate between hands
- **10-15% improvement** in speed and reduction in fatigue
- But - large social base of QWERTY typists produce market pressures not to change



Alternative keyboard layouts

Dvorak

~ `	! 1	@ 2	# 3	$ 4	% 5	^ 6	& 7	* 8	(9	) 0	{ [	}]	← Backspace	
Tab ⇤⇥	" '	< ,	> .	P	Y	F	G	C	R	L	? /	+ =	| \	
Caps Lock	A	O	E	U	I	D	H	T	N	S	_ -	Enter ↵		
Shift ⇧	: ;	Q	J	K	X	B	M	W	V	Z	Shift ⇧			
Ctrl	Win Key	Alt									Alt Gr	Win Key	Menu	Ctrl

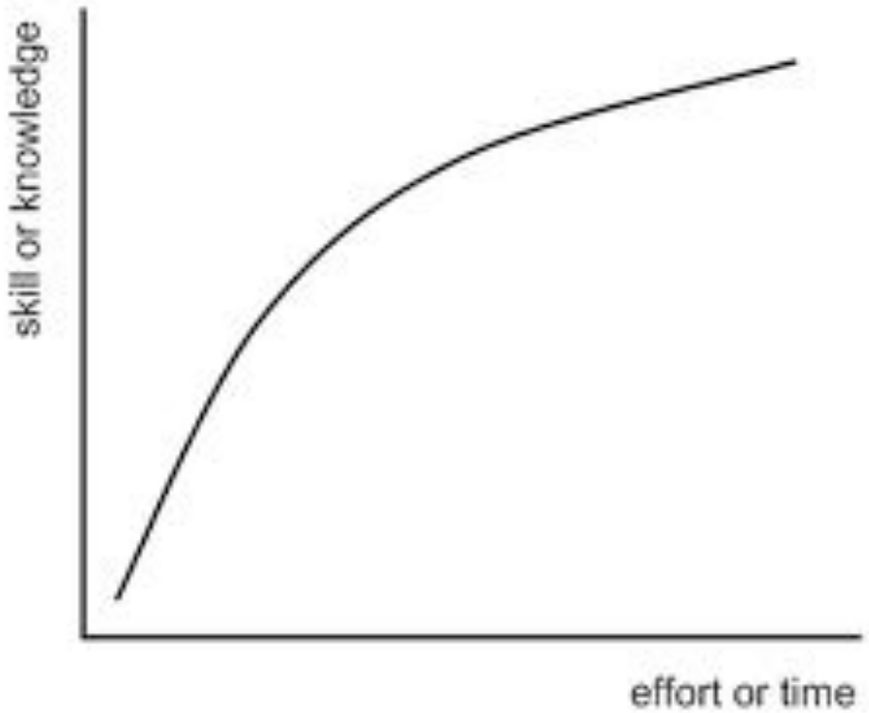
Property of Museum of History & Industry, Seattle

August Dvorak 1936

Alternative keyboard layouts

Shape Writer

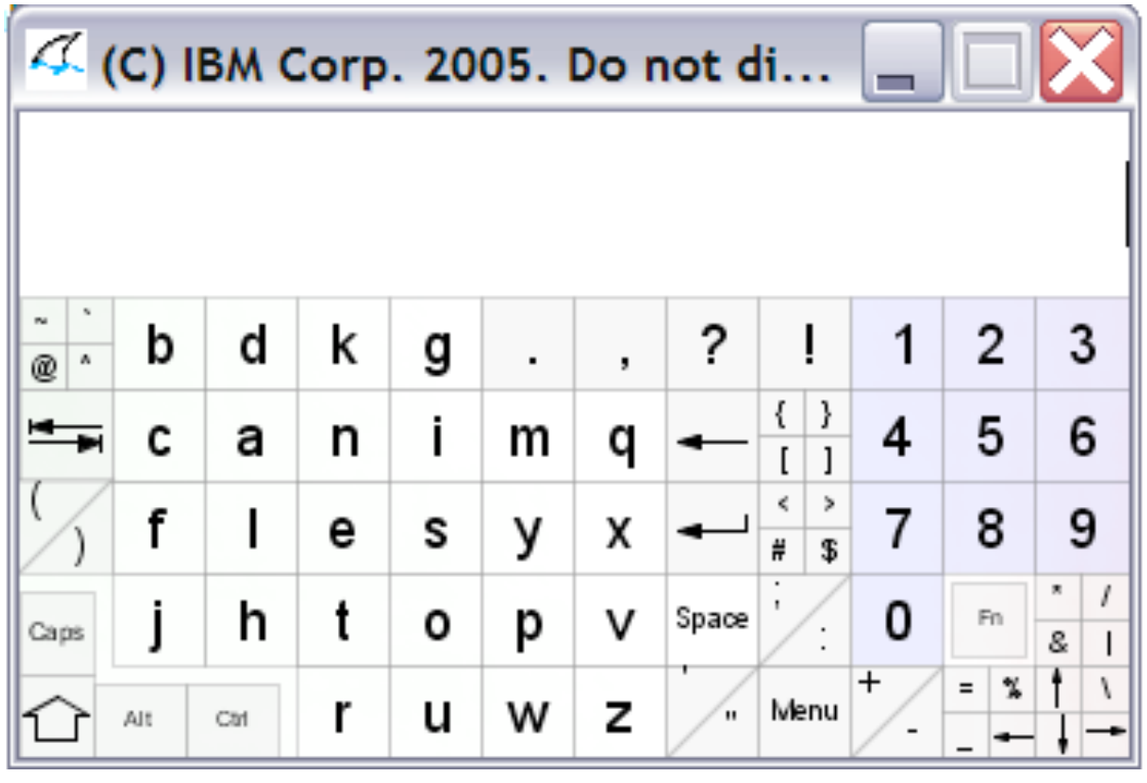
Quick learning curve



Recognise word patterns

Alternative keyboard layouts

Shape Writer



Atomic Keyboard

- Based on **Fitt's Law**

$$Mt = a + b \log_2(D/S + 1)$$

- **More Efficient**

Special keyboards for special users

- Designed to reduce fatigue for RSI
  - **RSI**: Repetitive Strain Injury
- For one handed use

  e.g. the Maltron left-handed keyboard

Special keyboards for special users

- Designed to reduce fatigue for RSI
  - **RSI**: Repetitive Strain Injury
- For one handed use

  e.g. the Maltron left-handed keyboard

Special keyboards for special users

- designs to reduce fatigue for RSI
  - **RSI**: Repetitive Strain Injury

- for impaired users in general

  e.g., the head stick keyboard

Laser Projection Keyboard

- Projects a virtual keyboard in any surface.

- User interacts with the projection.

Numeric keypads

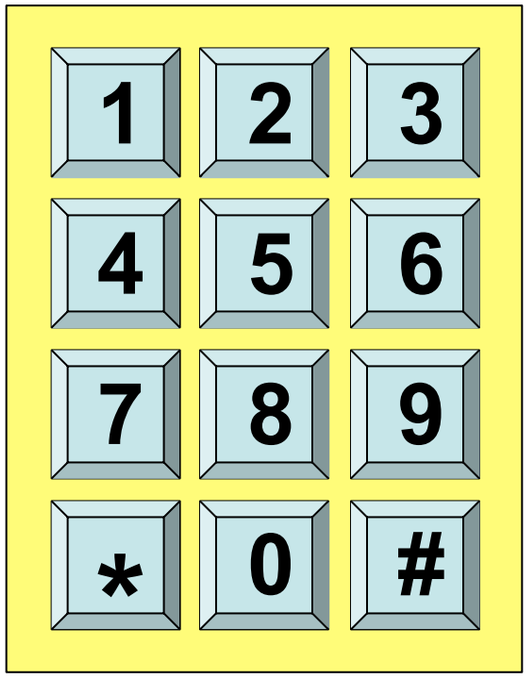
- For entering numbers quickly:
  - Calculator, PC keyboard

- For telephones

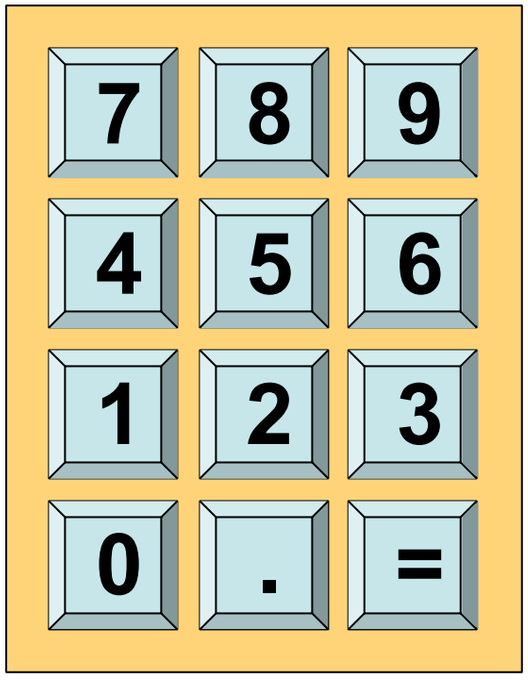
  Not the same!

  Did you noticed?

ATMs are like phones



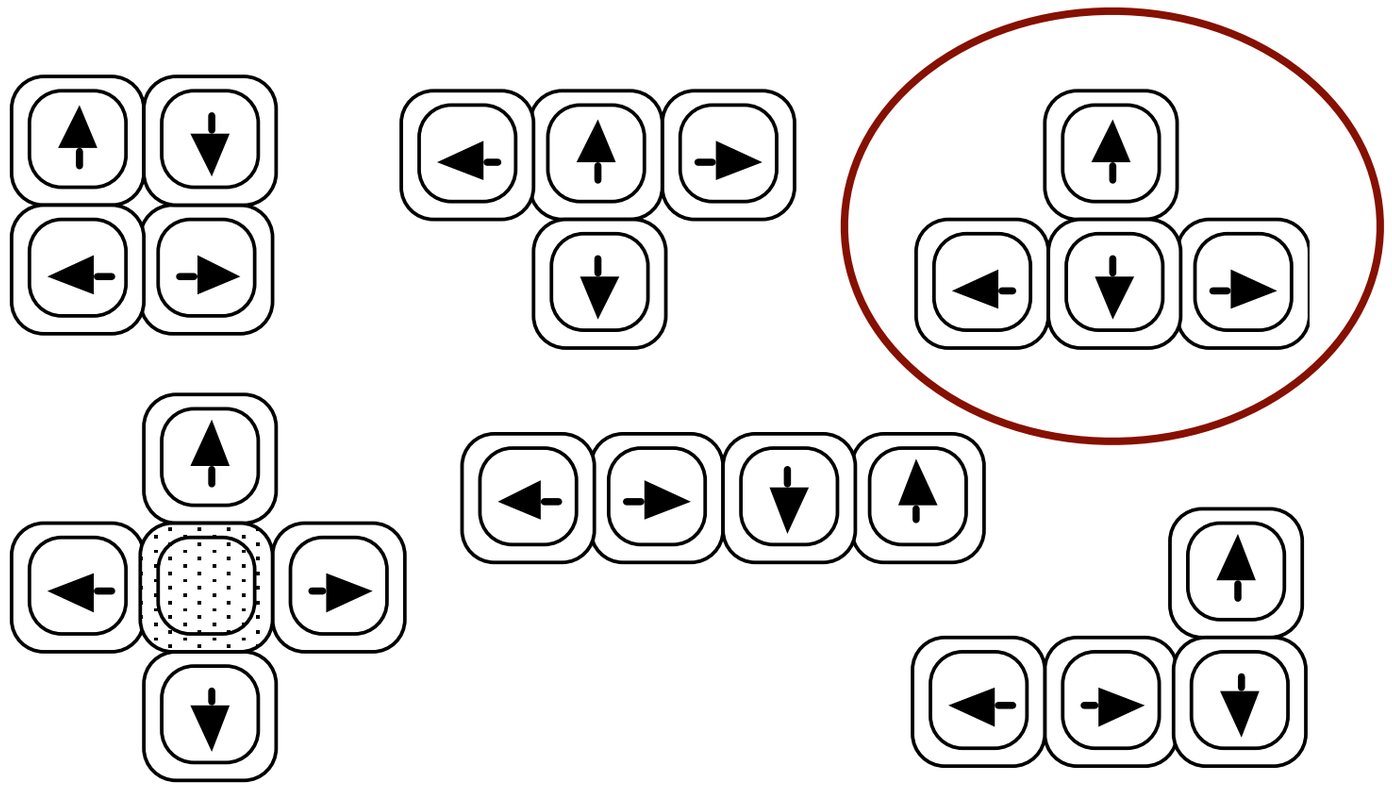
telephone



calculator

Cursor keys

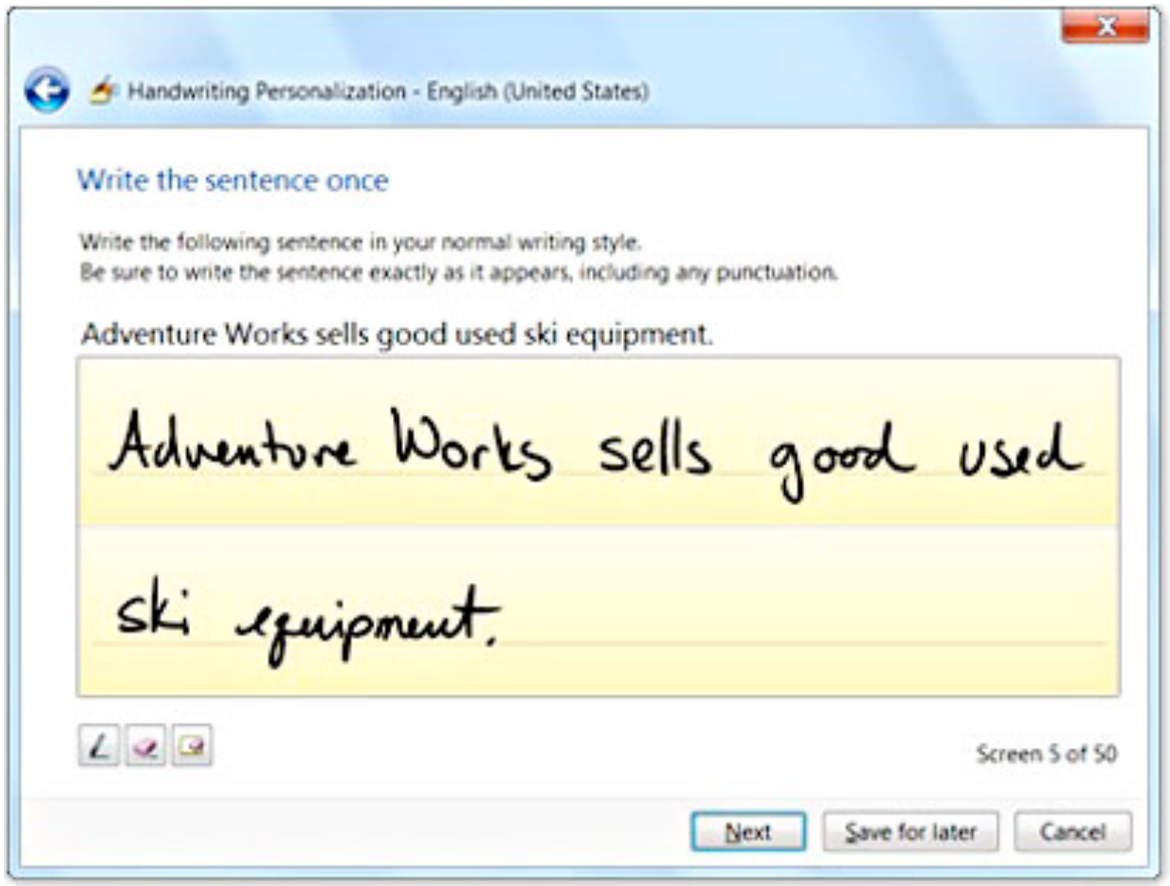
- Four keys (up, down, left, right) on keyboard.
- Very, very cheap, but slow.
- Useful for not much more than basic motion for text-editing tasks.



- No standardized layout, but inverted “T”, most common

Handwriting recognition

- **Text can be input into the computer, using a pen and a digesting tablet**
  - natural interaction



- **Technical problems:**
  - capturing all useful information - stroke path, pressure, etc. in a natural manner
  - segmenting joined up writing into individual letters
  - interpreting individual letters
  - coping with different styles of handwriting

- **But, recent improvements**

- **Used in PDAs, and tablet computers …**
  … leave the keyboard on the desk!

Apple Pencil

- **Designed to interact with the iPad Pro. Opens new interaction possibilities**

- **Key features are:**
  - Precision
  - Smoothness
  - Familiarity

Speech Recognition (NLP)

- **Improving rapidly**

- **Most successful when:**
  - Single user — with training, learns the user peculiarities;
  - Limited vocabulary systems.

- **Some challenges:**
  - External noise interference;
  - Imprecise pronunciation;
  - Large vocabularies;
  - Different speakers;
  - Accents.

For 3% error rate = 1/30 character = 1/6 words.

Apple Siri

Amazon Alexa

Natural Language Interaction

OpenAI

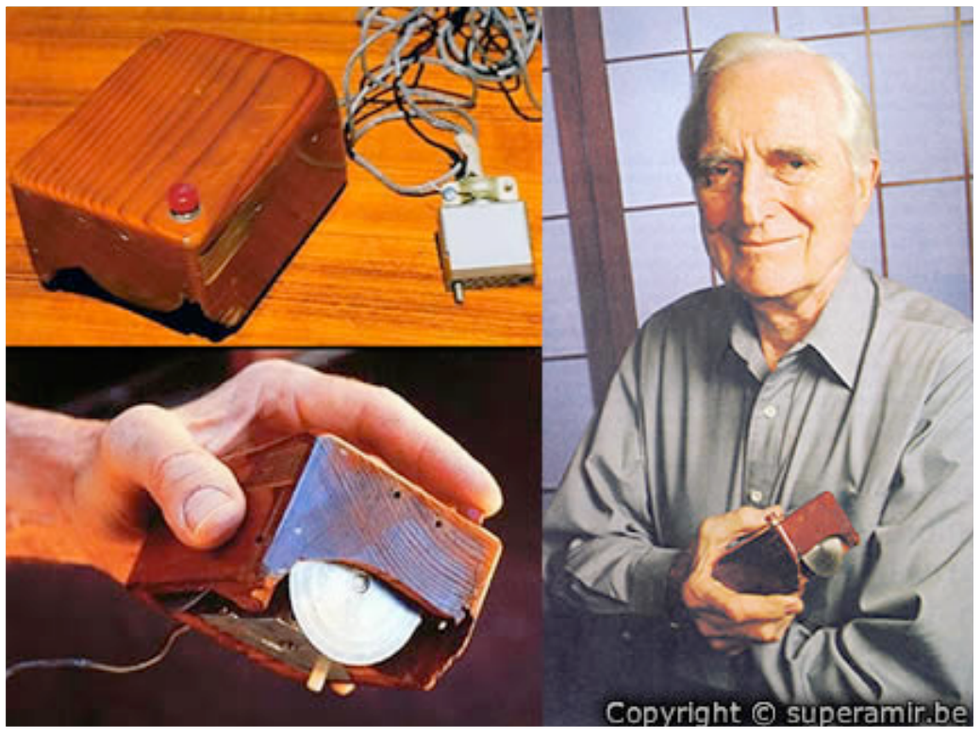
https://www.youtube.com/watch?v=GYeJC31JcM0&t=103s

Positioning, Pointing and Drawing

mouse, touchpad
trackballs, joysticks etc.
touch screens, tablets
eyegaze, cursors

The Mouse

- **Handheld pointing device**
  - very common
  - easy to use

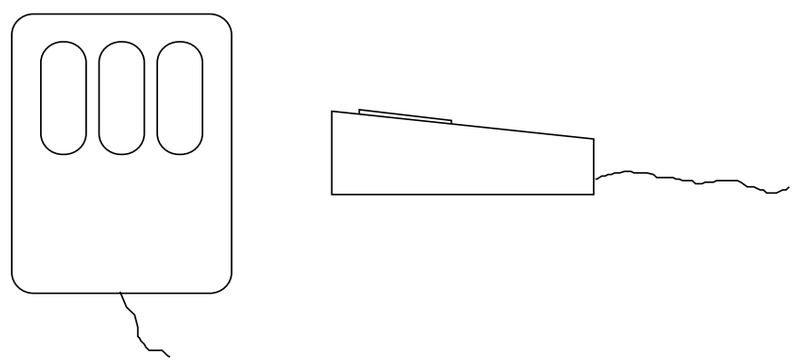


- **Two characteristics**
  - planar movement
  - buttons

    (Usually from 1 to 3 buttons on top, used for making a selection, indicating an option, or to initiate drawing etc.)

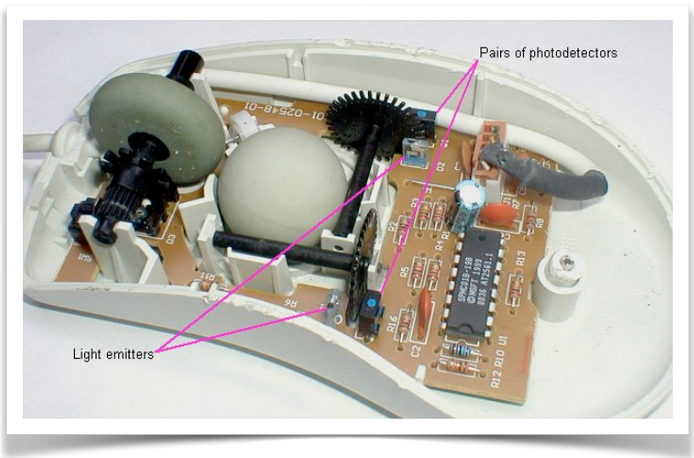
Douglas Engelbart 1964

Stanford Research Institute



How does it work?

Two methods for detecting motion

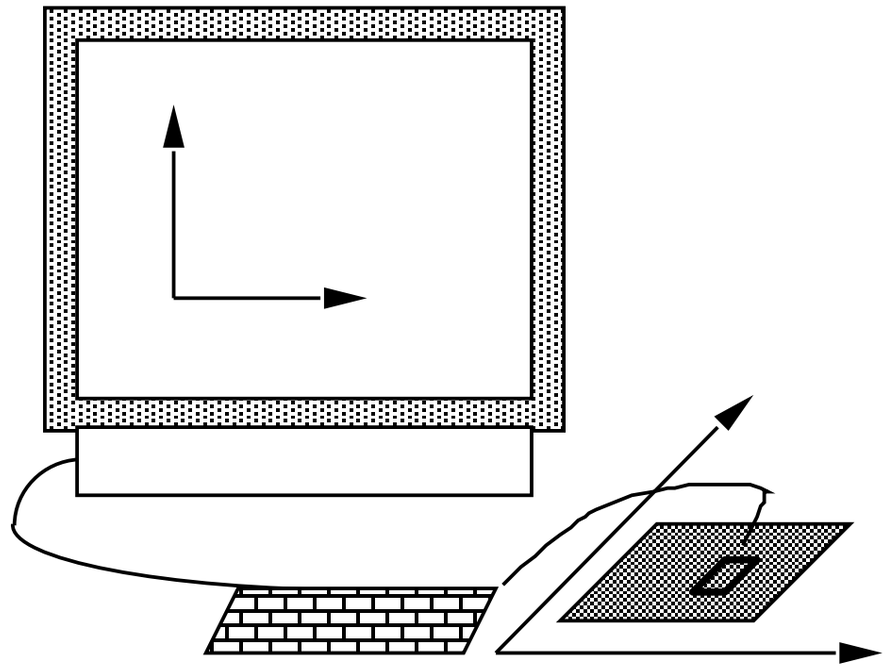


- **Mechanical**
  - Ball on underside of mouse turns as mouse is moved
  - Rotates orthogonal potentiometers
  - Can be used on almost any flat surface

- **Optical**
  - Light emitting diode on underside of mouse
  - May use special grid-like pad or just on desk
  - Less susceptible to dust and dirt
  - Detects fluctuations in reflected light intensity to calculate relative motion in (x, z) plane

The Mouse

Mouse located on desktop



- Requires physical space
- No arm fatigue

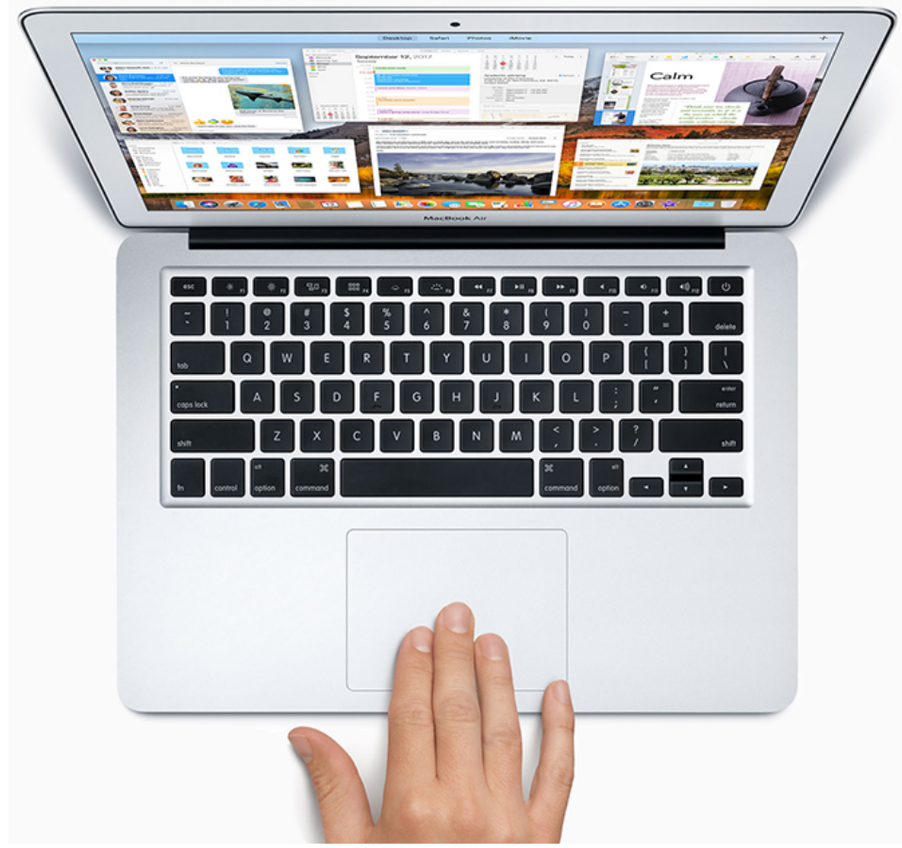
Screen cursor oriented in (x,y) plane,
mouse movement in (x,z) plane …

It is an *indirect* manipulation device.

- Device itself doesn't obscure screen, is accurate and fast.
- Hand-eye coordination problems for novice users

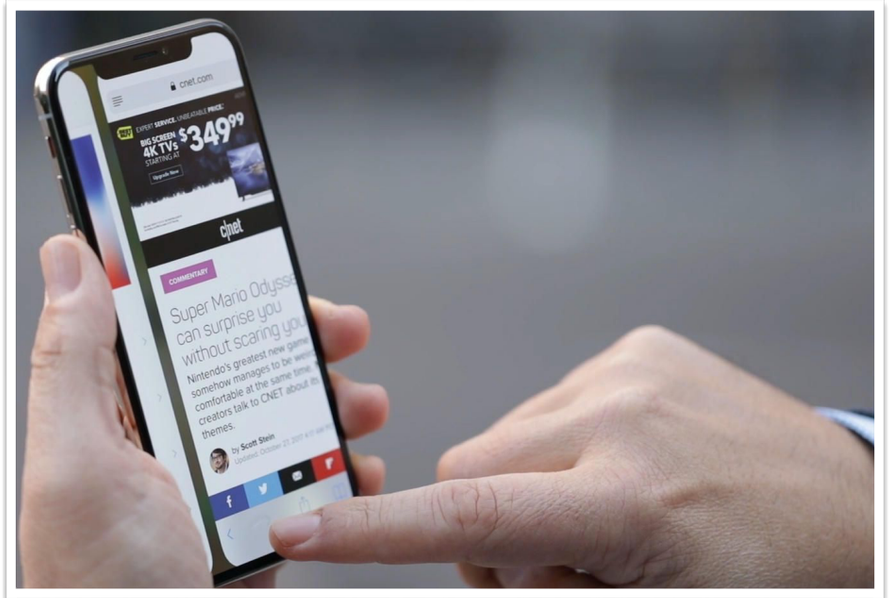
Touchpad

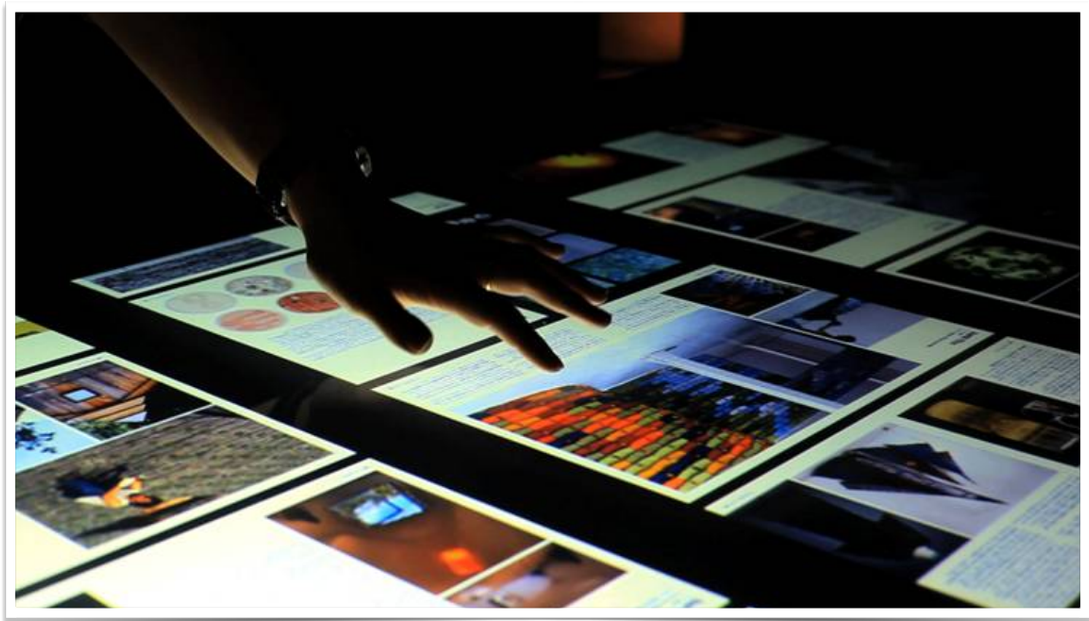
- Small touch sensitive tablets
- Stroke to move mouse pointer
- Used mainly in laptop computers
- Good “acceleration" settings are important
  - **Fast stroke**
    - lots of pixels per inch moved
    - initial movement to the target
  - **Slow stroke**
    - less pixels per inch
    - for accurate positioning
- The touch keyboard.



Direct Touch Interaction

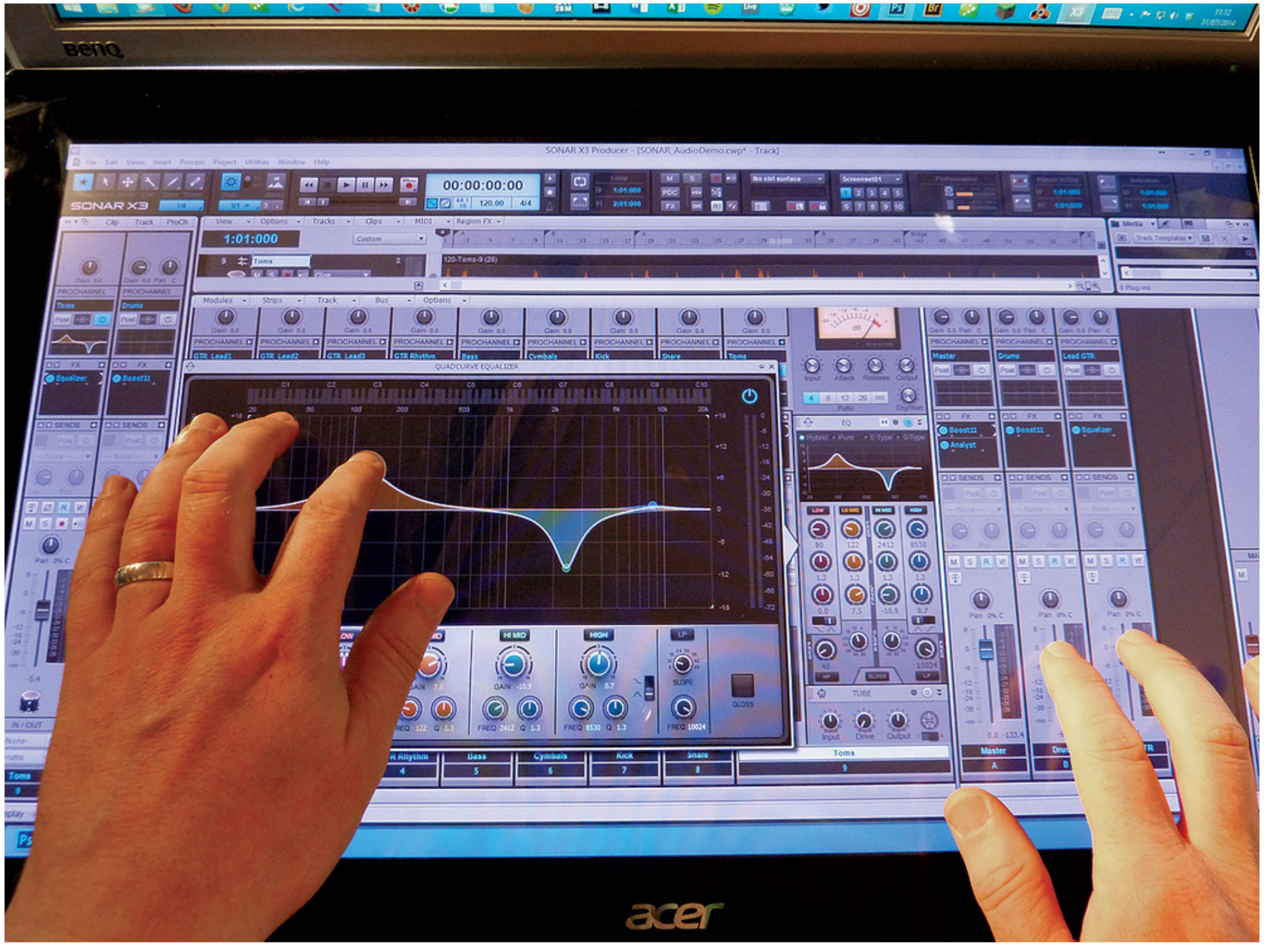
- Relatively new;
- Direct interaction;
- Multiple gestures;
- Input and output interleaved in the same space.
- Requires new interaction design: e.g. WIMP ==> PWIG





Direct Touch Interaction

Allows a complex and rich interaction



Direct Touch Interaction

Allows a complex and rich interaction

Touch-sensitive screen

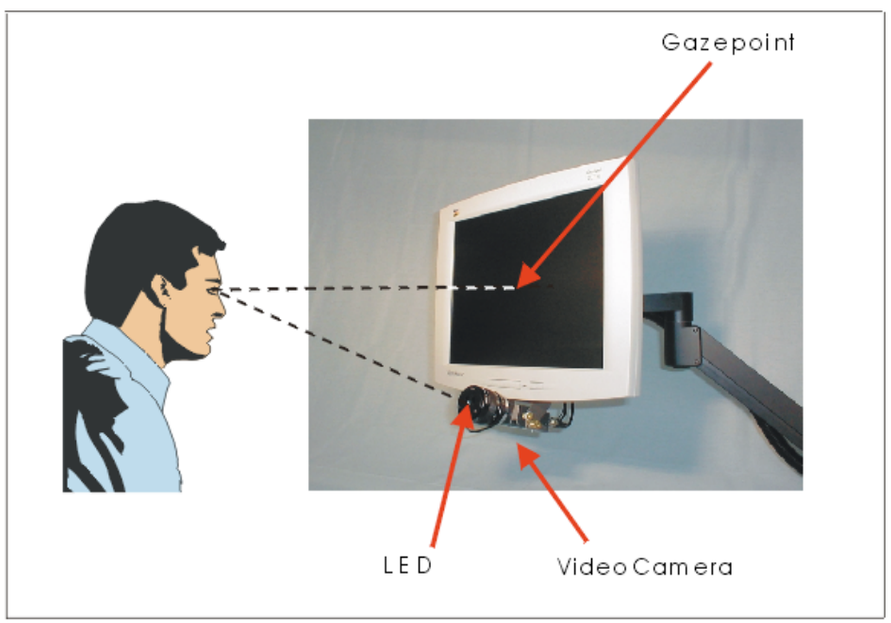
- **Detect the presence of finger or stylus on the screen.**
  - works by interrupting matrix of light beams, capacitance changes or ultrasonic reflections
  - *direct* pointing device

- **Advantages**:
  - Fast, and requires no specialised pointer
  - Good for menu selection
  - Suitable for use in hostile environment: clean and safe from damage.

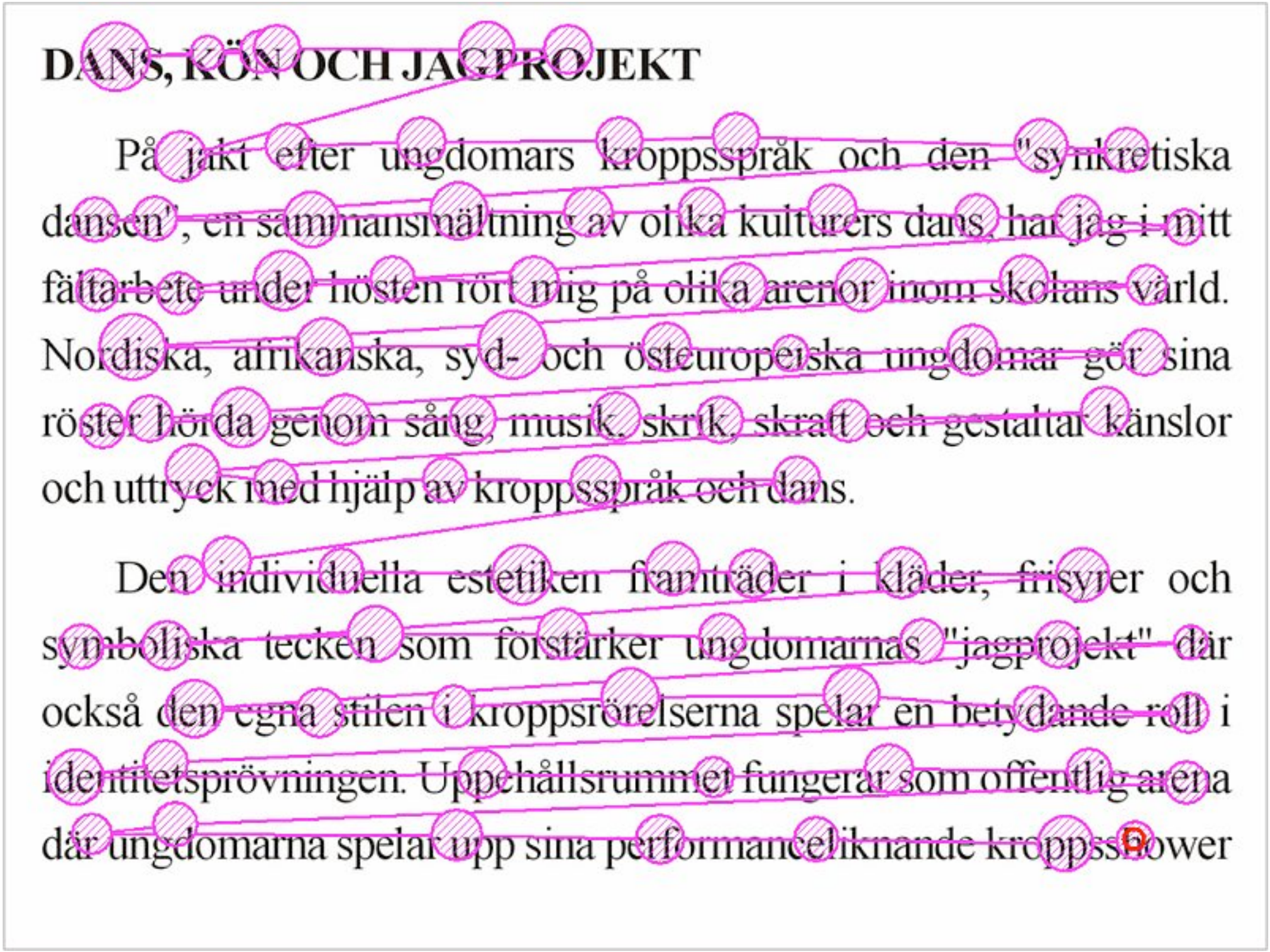
- **Disadvantages**:
  - Finger can mark screen
  - Imprecise (finger is a fairly blunt instrument!)
    - difficult to select small regions or perform accurate drawing
  - Lifting arm can be tiring

Eyegaze

- **Control interface by eye gaze direction**
  - e.g. look at a menu item to select it
- **Uses laser beam reflected off retina**
  - … a very low power laser!
- **Mainly used for evaluation**
  - potential for hands-free control
  - high accuracy requires headset
  - cheaper and lower accuracy devices available sit under the screen like a small webcam



Eyegaze



DANS, KÖN OCH JAGPROJEKT

På jakt efter ungdomars kroppsspråk och den "synkretiska dansen", en sammansmältning av olika kulturers dans, har jag i mitt fältarbete under hösten rört mig på olika arenor inom skolans värld. Nordiska, afrikanska, syd- och österuropeiska ungdomar gör sina röster hörda genom sång, musik, skrik, skratt och gestaltar känslor och uttryck med hjälp av kroppsspråk och dans.

Den individuella estetiken framträder i kläder, frisyrer och symboliska tecken som förstärker ungdomarnas "jagprojekt" där också den egna stilen i kroppsrörelserna spelar en betydande roll i identitetsprövningen. Uppehållsrummet fungerar som offentlig arena där ungdomarna spelar upp sina performanceliknande kroppsshower

Display Devices

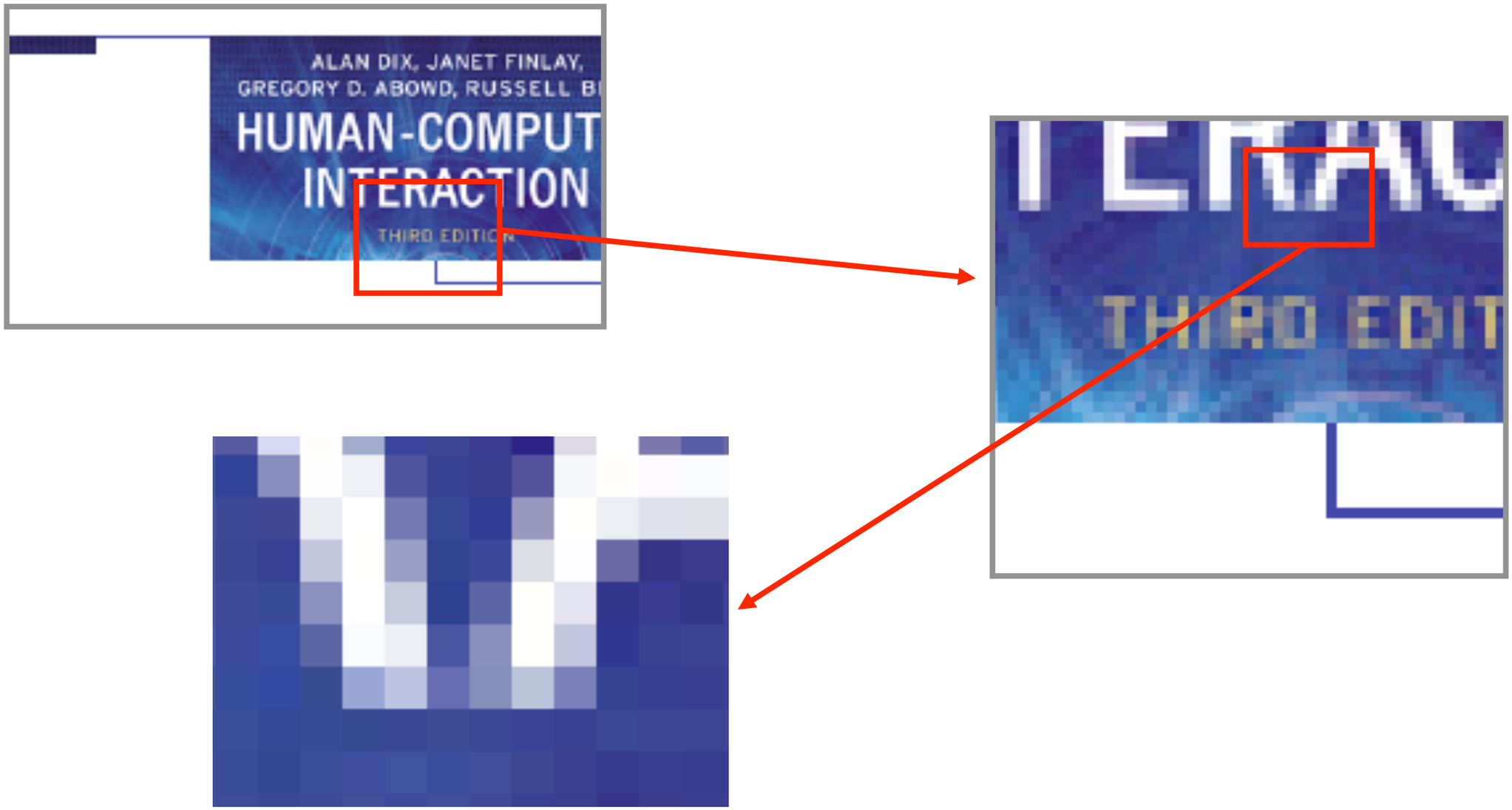
bitmap screens

large & situated displays

digital paper

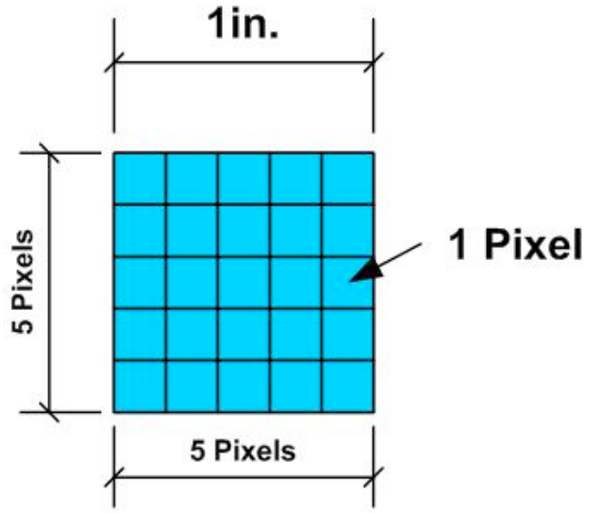
Bitmap Displays

- Screen is vast number of colored dots



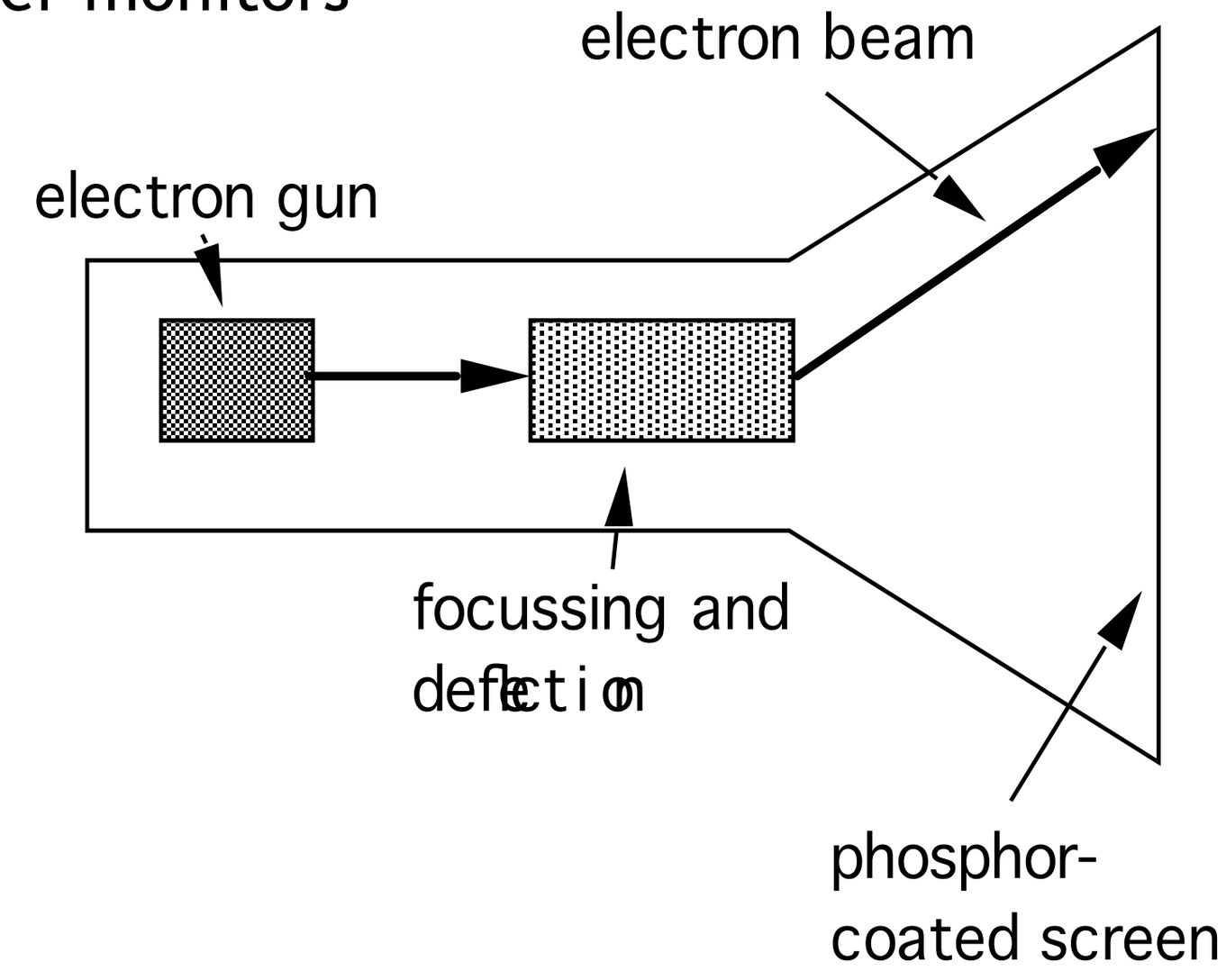
Resolution and Color Depth

- **Resolution** … used (inconsistently) for
  - **number** of pixels on screen (width x height)
    - e.g. UHD 3840 x 2160, PDA perhaps 240x400
  - **density** of pixels (in pixels or dots per inch - **dpi**)
    - typically between 72 and 96 dpi
- **Aspect ratio**
  - ration between width and height
  - 4:3 for most screens, 16:9 for wide-screen TV
- **Color depth:**
  - How many different colors for each pixel?
  - Black/white or greys only
  - 256 from a palette
  - 8 bits each for red/green/blue = millions of colors



Cathode Ray Tube (CRT)

- Stream of electrons emitted from electron gun, focused and directed by magnetic fields, hit phosphor-coated screen which glows
- Used in TVs and computer monitors



Liquid Crystal Displays (LCD)

- **Smaller, lighter, and … no radiation problems.**
- **Found on PDAs, portables and notebooks,**
  … on desktop and even for home TV
- **Also used in dedicated displays:**
  digital watches, mobile phones, HiFi controls

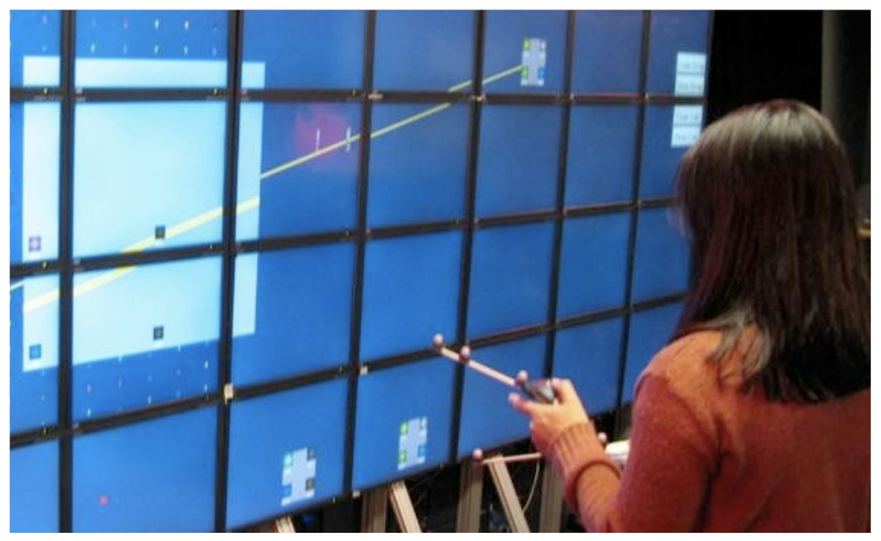
- How it works …
  - Top plate transparent and polarised, bottom plate reflecting.
  - Light passes through top plate and crystal, and reflects back to eye.
  - Voltage applied to crystal changes polarisation and hence color.
  - N.B. light reflected not emitted => less eye strain

Large Displays

- Used for meetings, lectures, etc
- **Technology:**

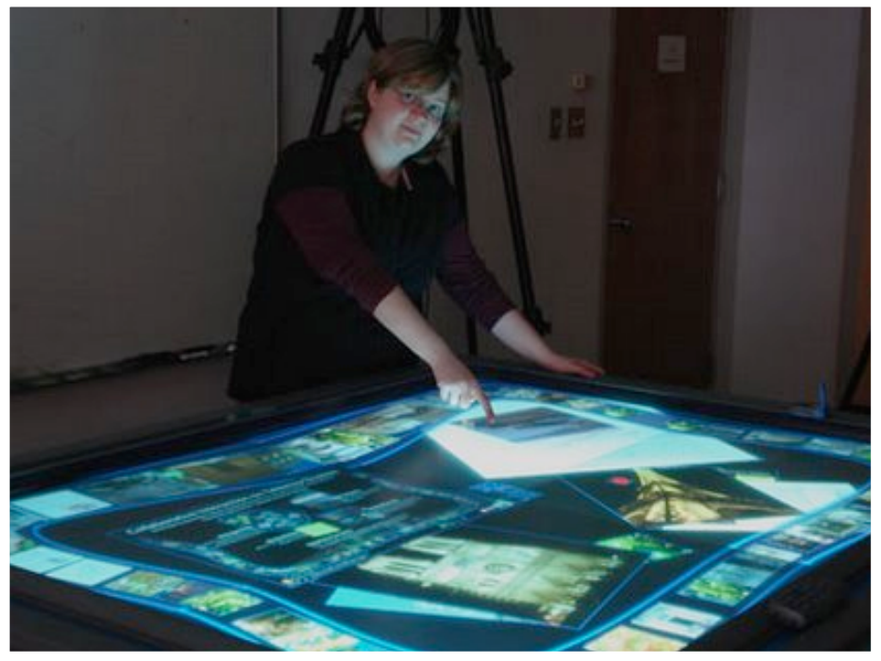
  Plasma – usually wide screen;

  Video walls – lots of small screens together



Projected – RGB lights or LCD projector

- –hand/body obscures screen
- –may be solved by 2 projectors + clever software

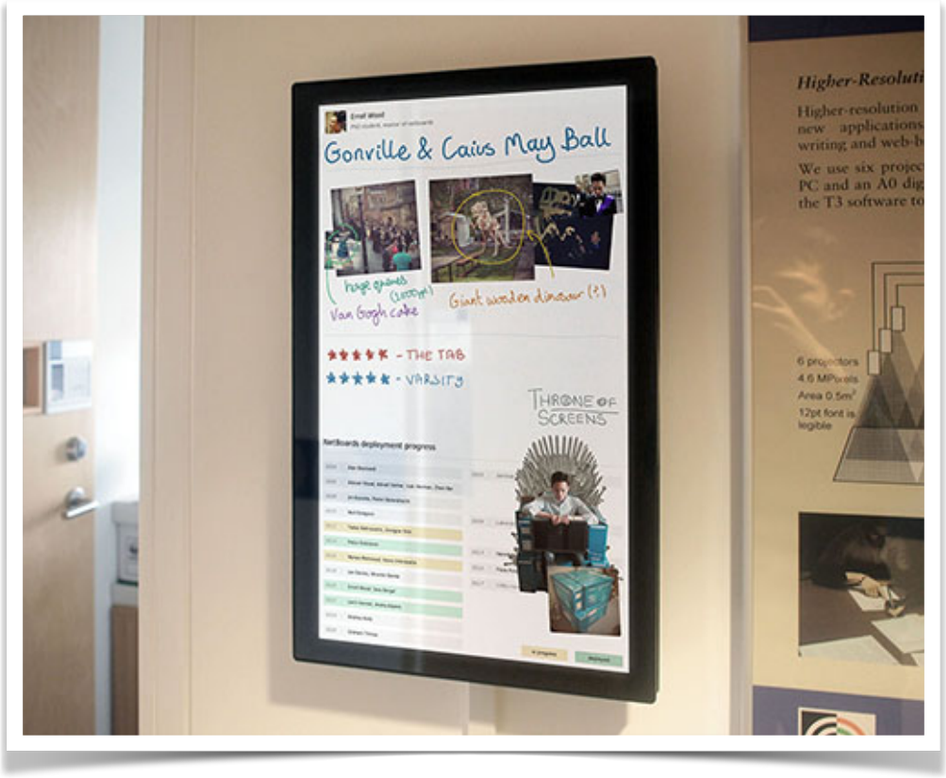


Back-projected

- –frosted glass + projector behind

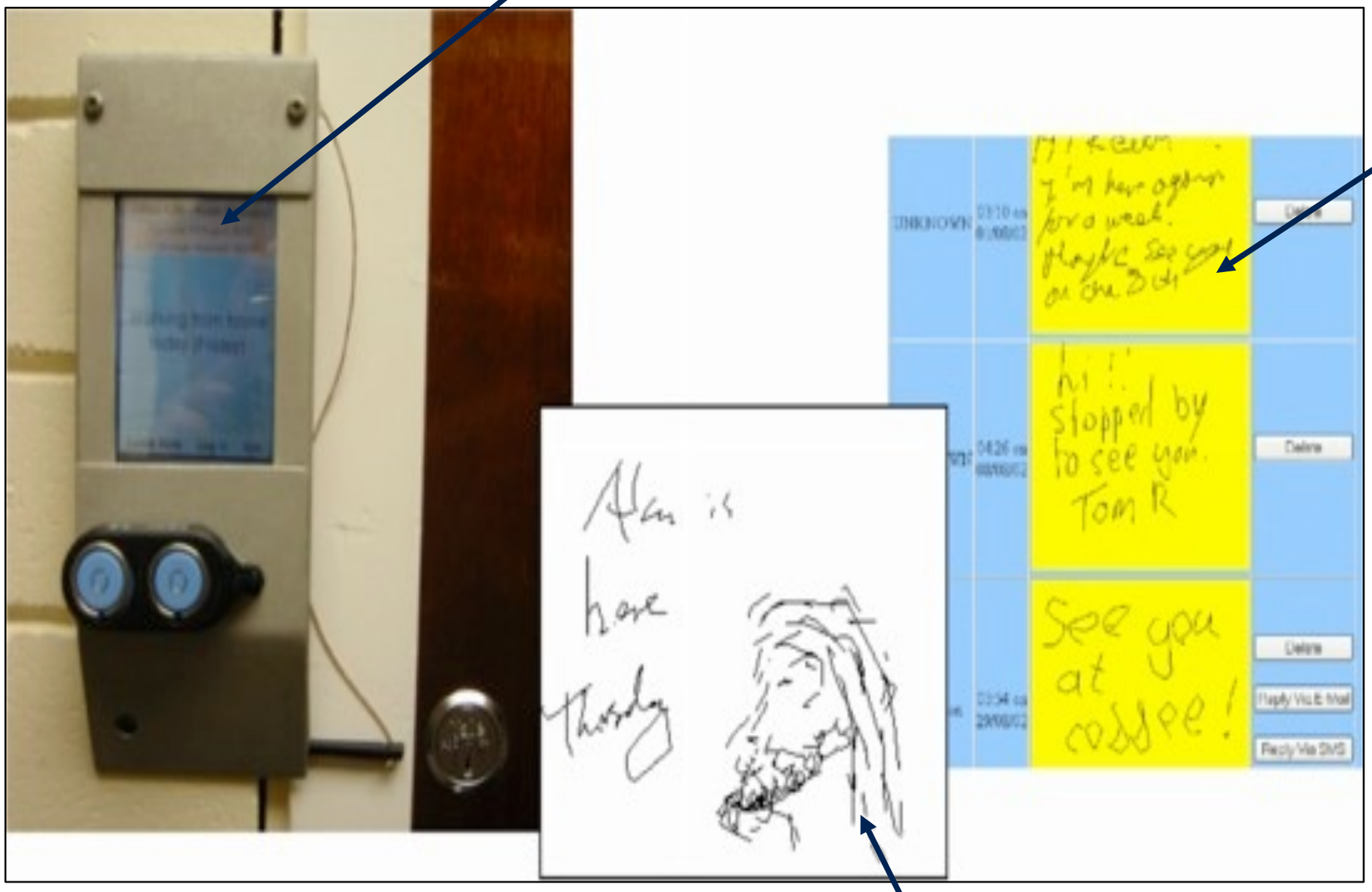
Situated Displays

- **Displays in ‘public’ places**
  - Large or small
  - Very public or for small group
- **Display only**
  - For information relevant to location
- **Or interactive**
  - Use stylus, touch sensitive screen
- **In all cases … the location matters**
  - Meaning of information or interaction is related to the location, the **context of operation**.



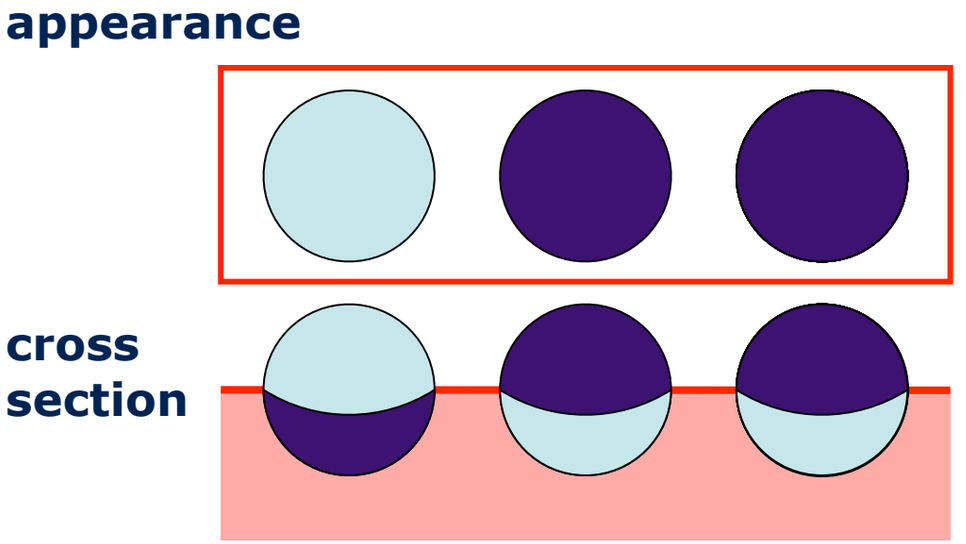
Hermes a situated display

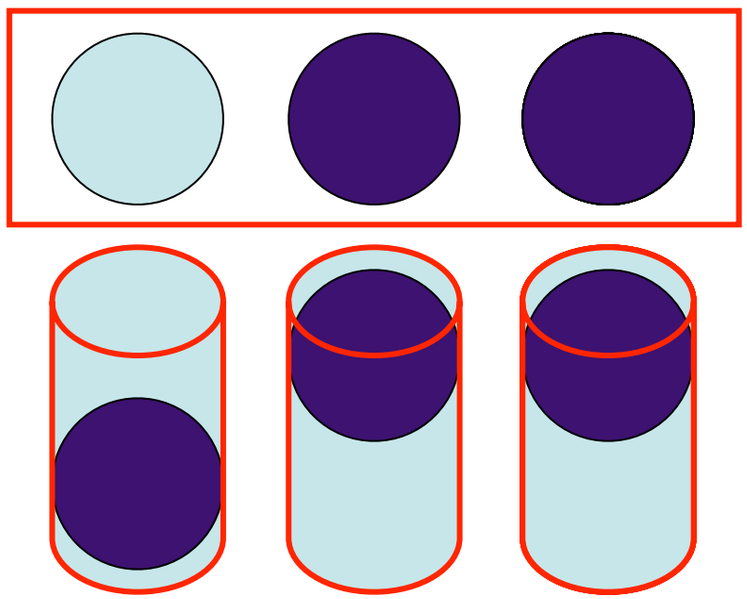
Small displays beside office doors



Digital/Interactive Paper

- **What?**
  - Thin flexible sheets
  - Updated electronically
  - But retain display
- **How?**
  - Small spheres rotated
  - Or channels with colored liquid and contrasting spheres
  - Rapidly developing area



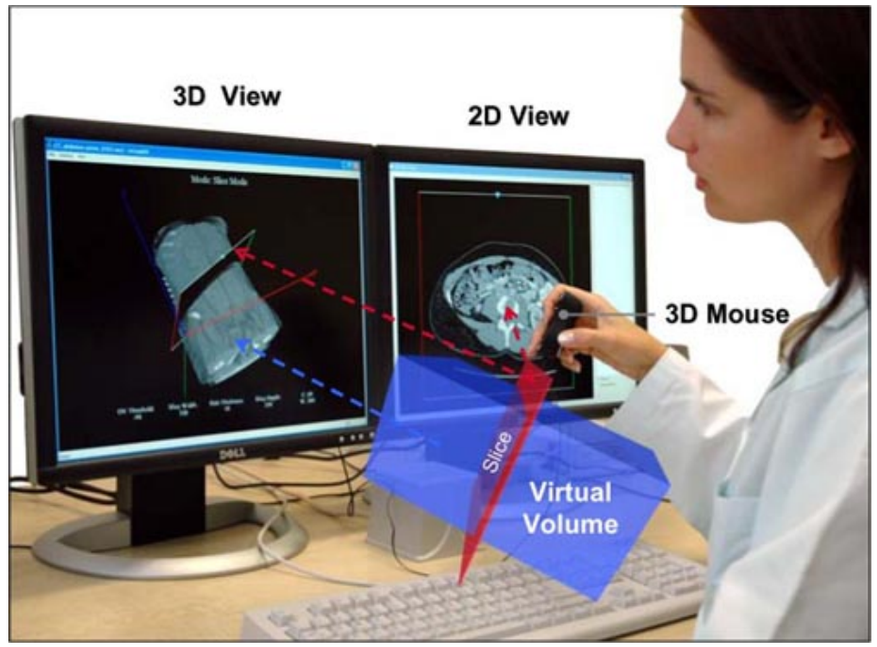


Virtual Reality and 3D Interaction

positioning in 3D space
moving and grasping
seeing 3D (helmets and caves)

Positioning in 3D space

- **Cockpit and virtual controls**
  - Steering wheels, knobs and dials … just like real!
- **The 3D mouse**
  - Six-degrees of movement: x, y, z + roll, pitch, yaw
- **Data glove**
  - Fibre optics used to detect finger position
- **VR helmets**
  - Detect head motion and possibly eye gaze
- **Whole body tracking**
  - Accelerometers strapped to limbs or reflective dots and video processing

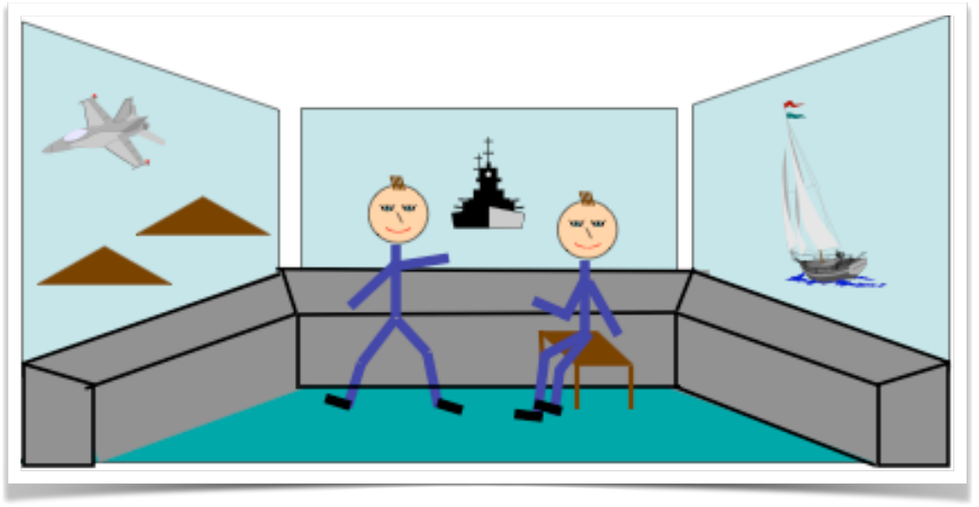


Positioning in 3D space

- **Whole body tracking**
  - Accelerometers strapped to limbs or reflective dots and video processing

Simulators and VR caves

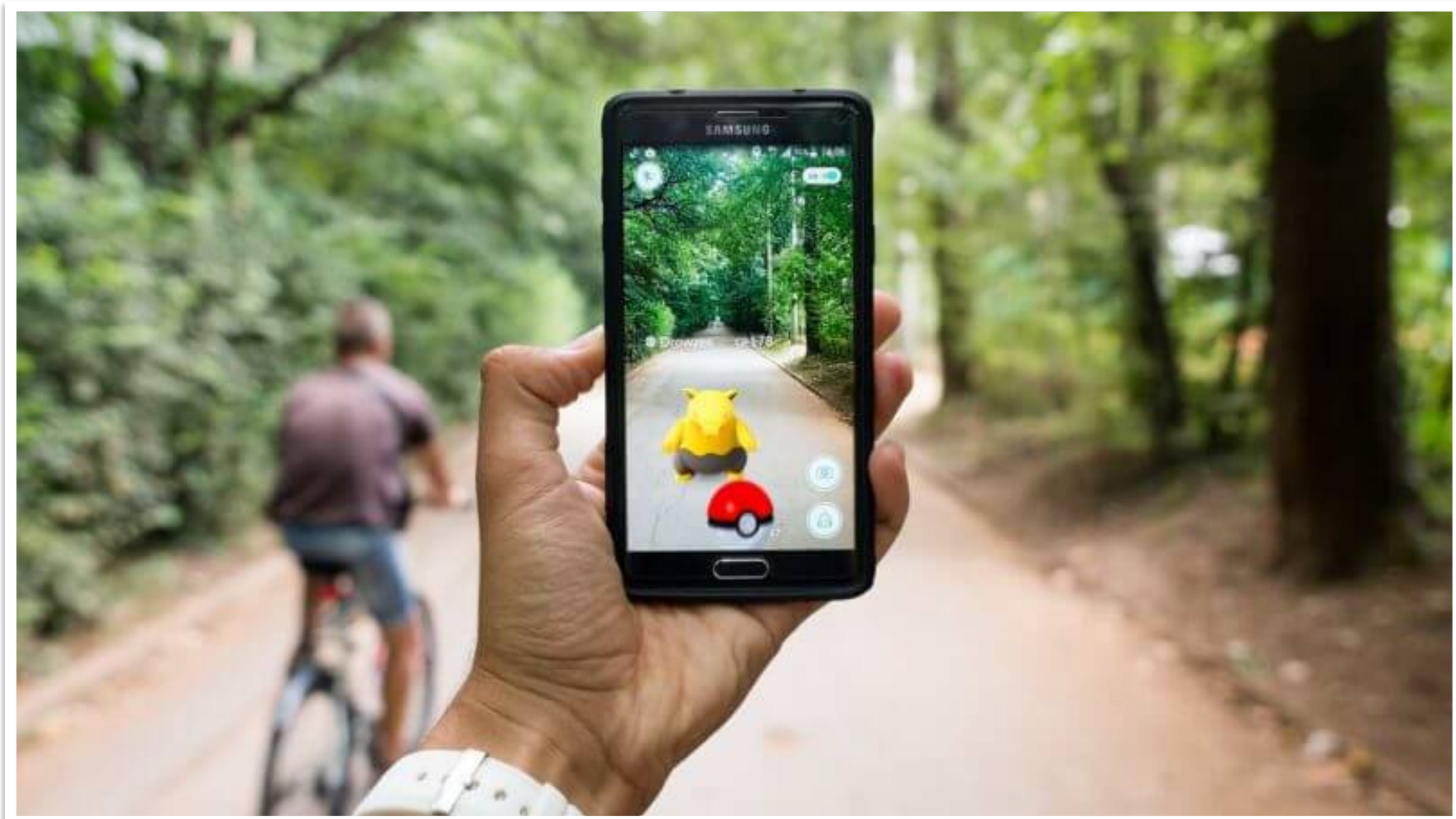
- Scenes **projected** on walls
- **Realistic** environment
- **Hydraulic** rams!
- **Real** controls
- Interact with **other** people



e.g. **A380** Virtual Cockpit

Augmented Reality

It is a created environment that mixes **virtual** and **effective** **reality** elements, creating so a mixed environment in real time.



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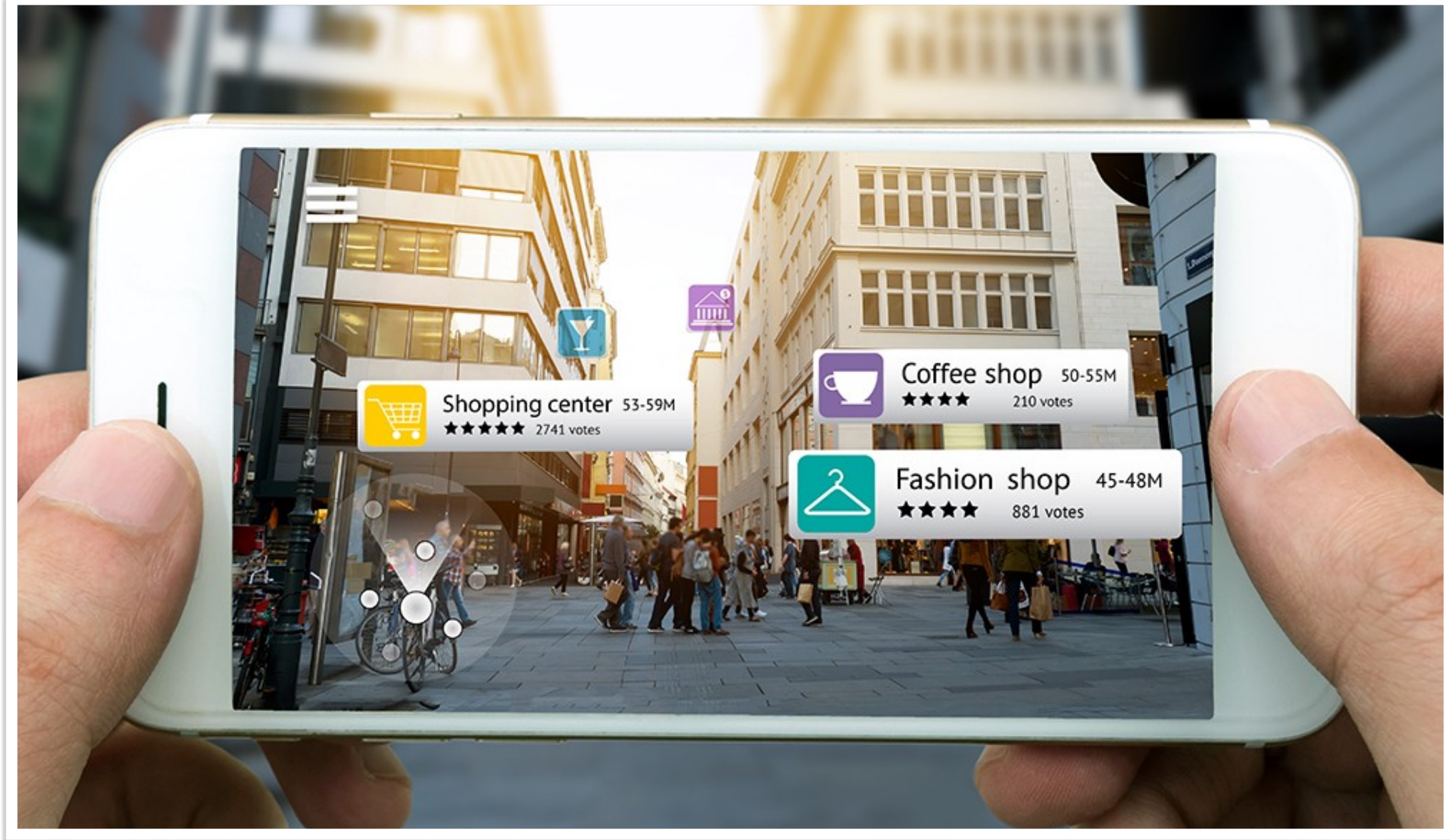

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