

Multimodal Interaction

Lesson 1 Evolution of Interaction

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Course information

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Course page:

<https://sites.google.com/a/di.uniroma1.it/multimodal-interaction/>

Office hours: see course page

Course schedule: see course page

Course resources

- Everything you find interesting on the web (and that you are invited to present to your colleagues)
- Course lectures
- Selected papers

Some course topics

- Multimodal interaction
- Communicative modes
- Exploring Multimodal Input Fusion Strategies
- Modal density
- Levels of attention/awareness
- Affective Computing
- Ambient intelligence

Interface from dictionary

Merriam-Webster online:

in·ter·face *noun* \ 'in-tər-, fās \

Definition of *INTERFACE*

1 : a surface forming a common boundary of two bodies, spaces, or phases <an oil-water *interface*>

2 a : the place at which **independent and often unrelated systems** meet and act on or communicate with each other <the man-machine *interface*>

b : the means by which [interaction](#) or communication is achieved at an interface



Interface in Human Computer Interaction

From Wikipedia:

The **user interface** in [human-machine interaction](#), is the space where interaction between humans and machines occurs.

The goal of interaction between a human and a machine at the user interface is effective operation and control of the machine, and feedback from the machine which aids the operator in making operational decisions.

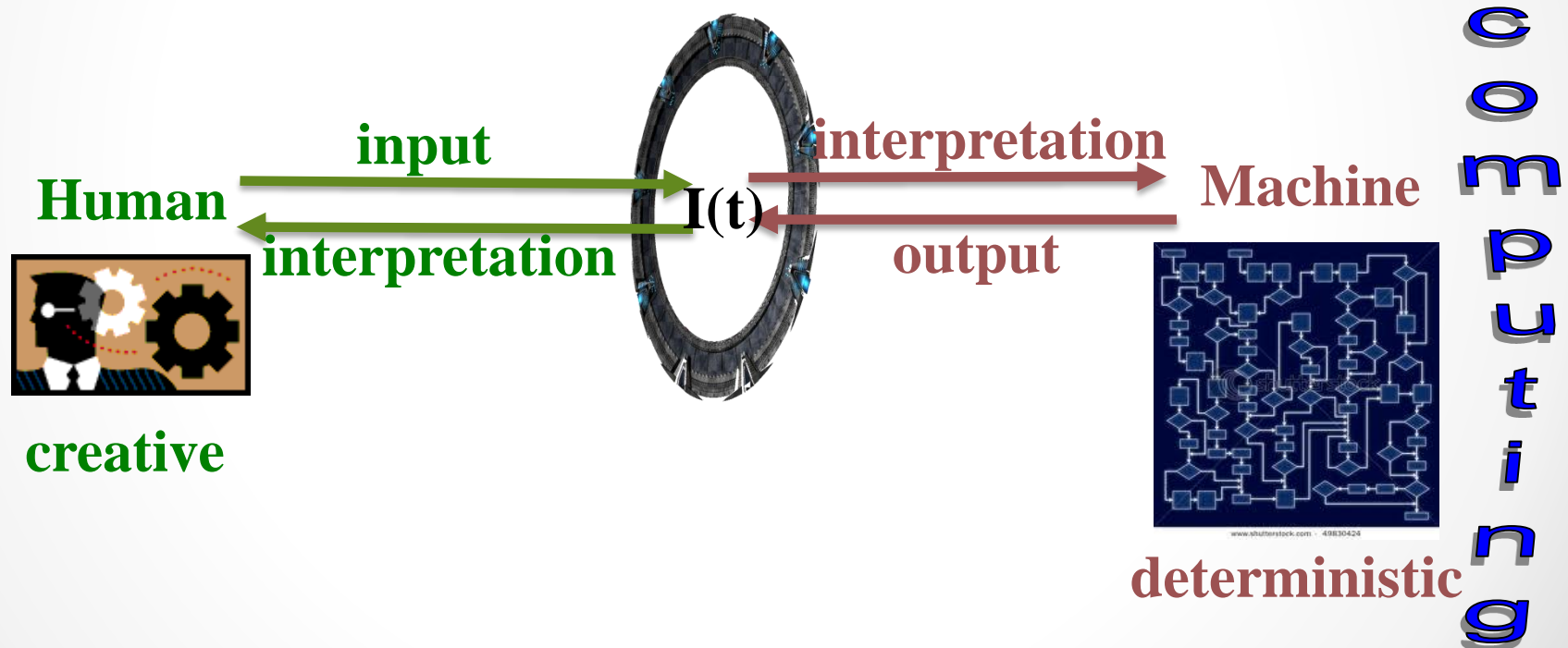
The user interface includes hardware (physical) and software (logical) elements. User interfaces provide :

- Input, allowing the users to manipulate a system
- Output, allowing the system to indicate the effects of the users' manipulation

The goal of human-machine interaction engineering is to produce a user interface which makes it easy, efficient, and enjoyable to operate a machine to produce the desired result. This generally means

- minimal input to achieve the desired output
- the machine minimizes undesired outputs to the human.

An interface, two actors



Short history of computing machines

- Origins:
 - Abacus : Greeks, pre-Columbian civilizations, Chinese



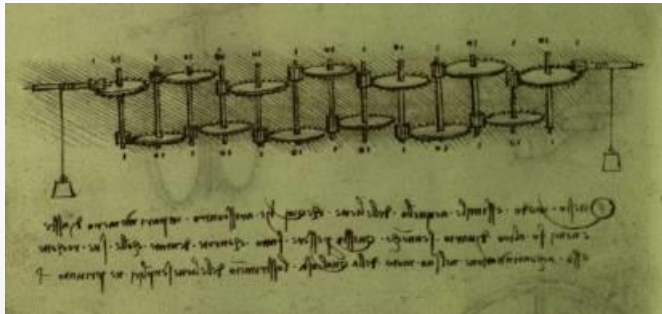
Interface

Input: fingers on computing elements

Output: arrangement of computing elements

Where are the computing rules?

- Around 1550 : Leonardo da Vinci designs a machine able to trace carry-overs!



Short history of computing machines

- One step forward:
 - Pascal (1642) builds the *Pascaline*: sums and subtractions

Interface

Input: levers

Output: arrangement of external elements

Computing rules “wired” in the arrangement of internal elements

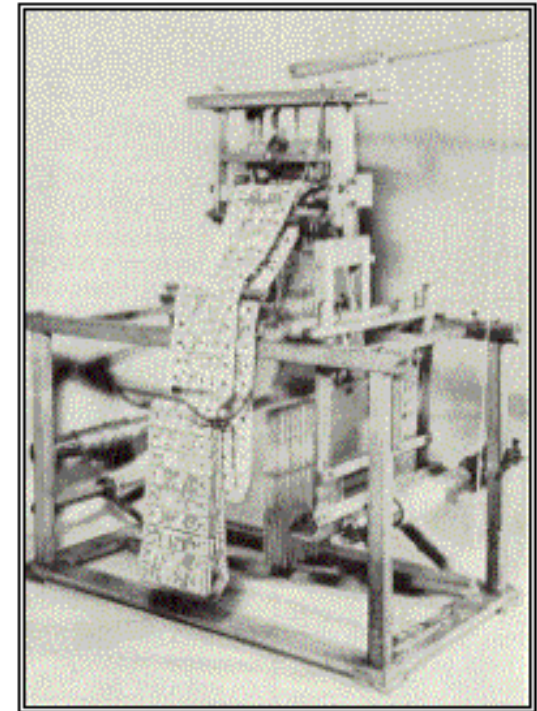


- Leibniz (1673) builds a machine for multiplications and divisions



Short history of computing machines

- XIX century:
 - In 1803 the French Joseph Marie Jacquard presents a device designed to revolutionize textile production. It consists of a structure mounted over a weaving loom, with a ribbon made of punched cardboards and a drive chain which makes punched frames to step forward
 - It seems that a prototype of Jacquard's loom had been already created in the second half of **XV** century by a weaver from **Catanzaro**, which was known in Lion as Jean le Calabrais.



Short history of computing machines

- XIX century
 - Babbage (1833) invents the analytic machine, which anticipates programmable computers
 - In 1842 countess of Lovelace, Ada Byron (1815-1852), daughter of poet Lord Byron and of mathematician Annabella Milbanke, writes the first programs in history, using Babbage machine.

(<http://www.di.uniba.it/~infobase/lovelace.html>)

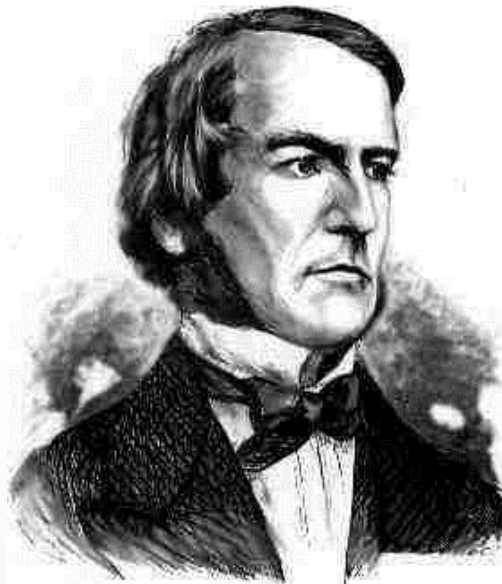


Short history of computing machines

- XIX century

- In 1854 an Irish primary school teacher, George Boole (1815-1864), invents the binary code. Boolean algebra is born. Most logics, left out insignificant details, can be conceived as a series of binary choices

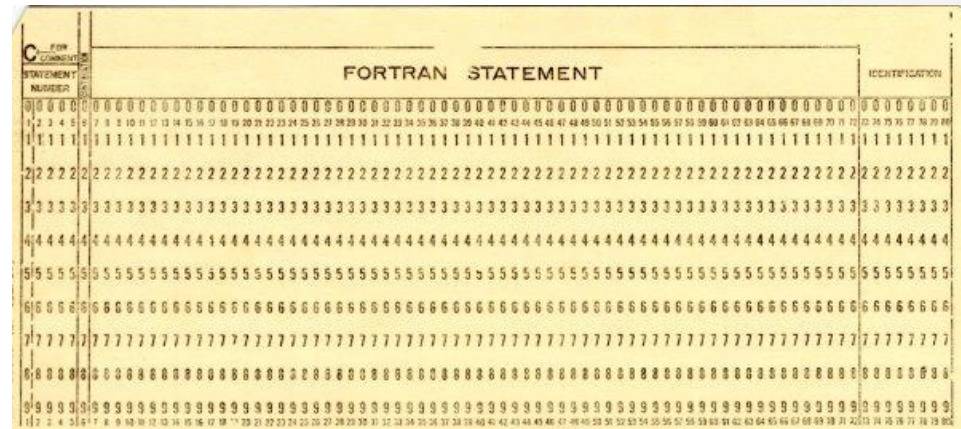
<http://www.nemesi.net/boole.htm>



Idempotencia	$A \wedge A = A$
	$A \vee A = A$
Conmutativa	$A \wedge B = B \wedge A$
	$A \vee B = B \vee A$
Asociativa	$A \wedge (B \wedge C) = (A \wedge B) \wedge C$
	$A \vee (B \vee C) = (A \vee B) \vee C$
Absorción	$A \wedge (B \vee A) = A$
	$A \vee (B \wedge A) = A$
Distributiva	$A \wedge (B \vee C) = (A \wedge B) \vee (A \wedge C)$
	$A \vee (B \wedge C) = (A \vee B) \wedge (A \vee C)$
Ley del ínfimo	$A \wedge \square = \square$
	$A \vee \square = A$
Ley del supremo	$A \wedge \blacksquare = A$
	$A \vee \blacksquare = \blacksquare$
Complementario	$A \wedge \neg A = \square$
	$A \vee \neg A = \blacksquare$

Short history of computing machines

- XIX century
 - In 1889 Hermann Hollerith (1860-1929) patents the use of punched cards which are read through the analysis of electric circuits (closed in correspondence of card holes) which will be used for the American census in 1890. He creates the Tabulating Machine Company, which will become IBM.



IBM punched card in '70

Interface

Input: punched cards

Output: punched cards (paper)

Computing rules “wired” in holes

Who needs a computer ?

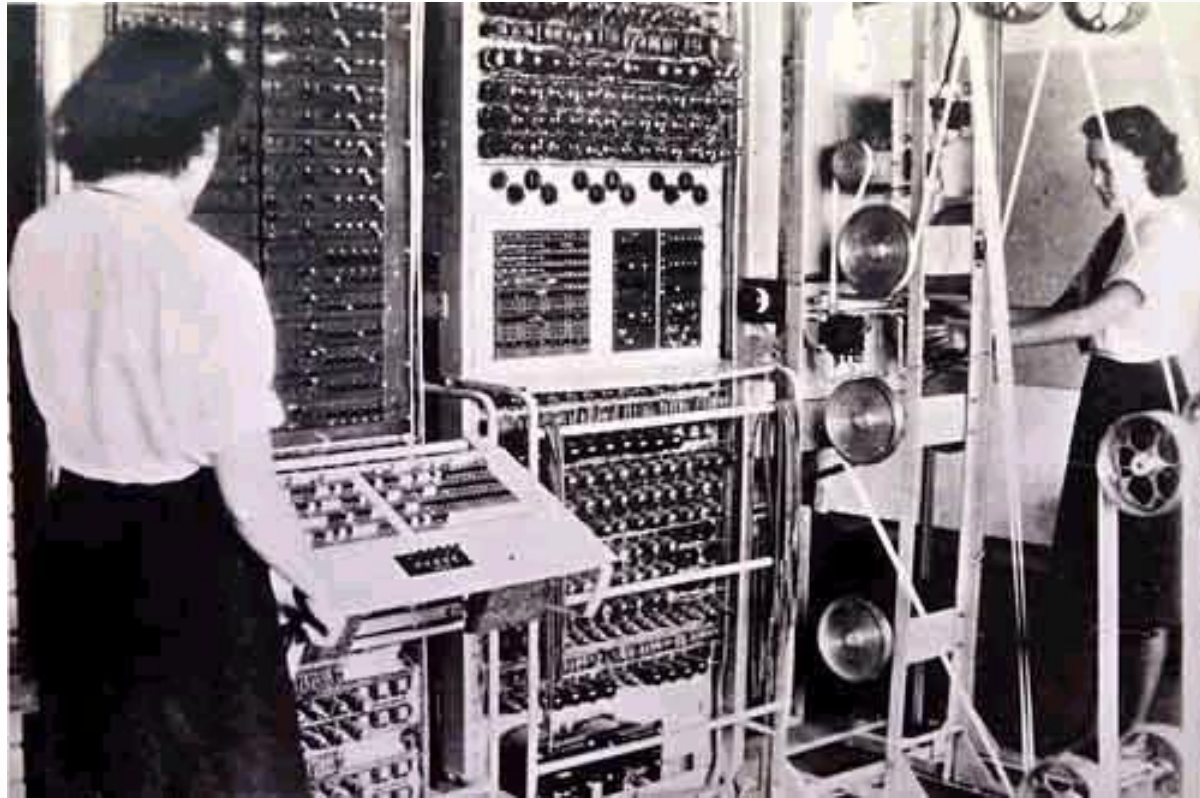
« I think that there is no market for more than five computers on the Earth.»

(Thomas J. Watson, president of IBM, early '40)

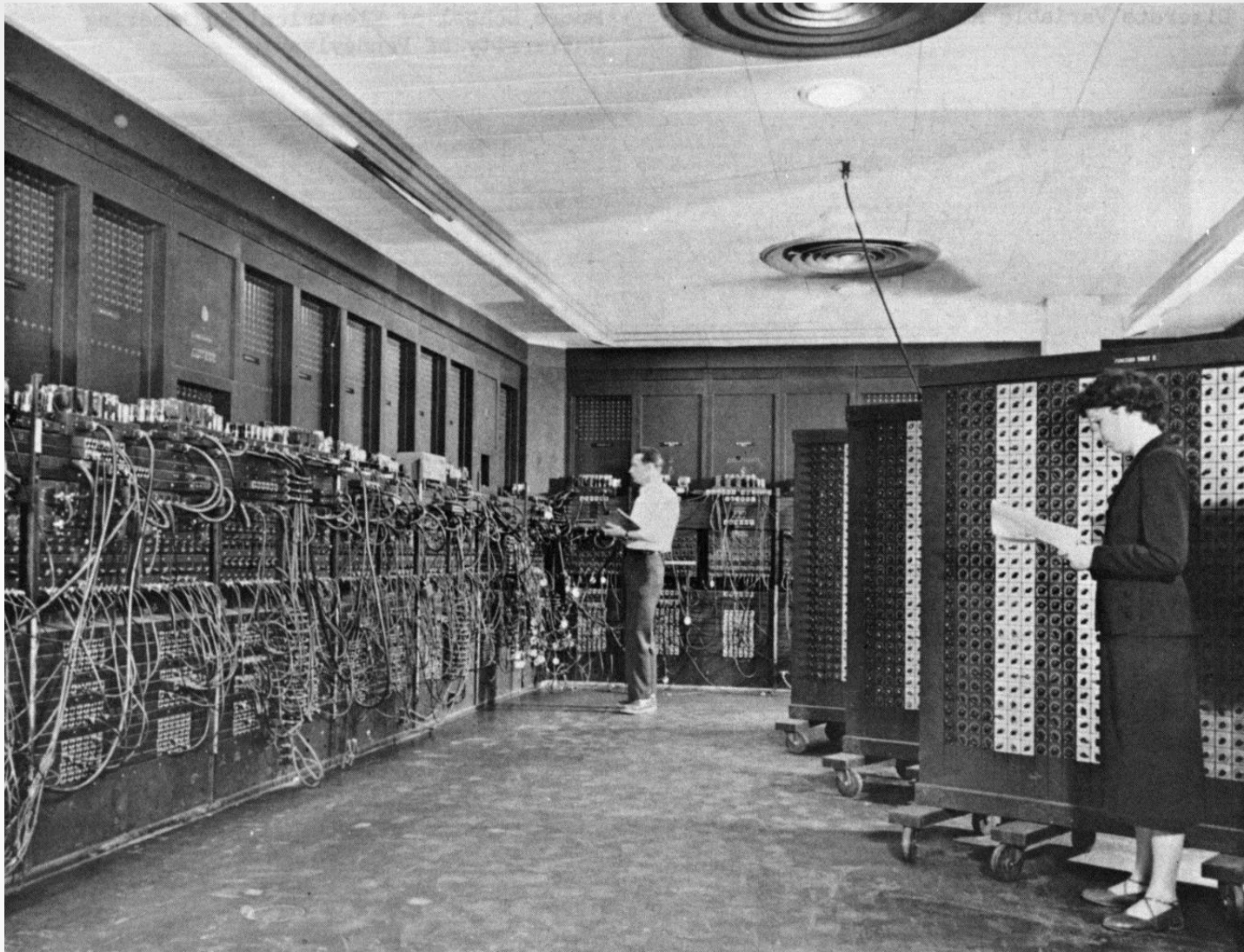
« There is no reason anyone would want a computer in their home.»

(Ken Olsen, late '70)

Actually...



Colossus Mark II, was part of a war project to decipher German messages produced by Enigma



ENIAC computed ballistic trajectories
'Electronic Numerical Integrator and Computer

Program defined through connection of electrical circuits by patch cables and switches

ENIAC computed ballistic trajectories



ENIAC_ The First Computer

http://www.youtube.com/watch?v=k4oGI_dNaPc



First Computer ENIAC

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

Computers yesterday

- In early days of computing, a computer was considered as a kind of super-fast machine to compute, the natural evolution of the calculators.
- It was normal to use a series of punched cards to provide not only the input, but also a rudimentary form of what today is called the operating system.
- These early computers were slow, and it was normal that the result of the calculation was available several hours, even days later. Between an input and the other, also, the computer remained inactive, just as a calculating machine. (Wikipedia)



But...



In 1965 PDP-8 allows
to pass from
“computer room ”
to “desktop
computer”

And then ...



Interface

Input: keyboard (command language)

Output: thermal paper (text lines)

Computing rules ?

In 1965 Olivetti (ITALIA!) presents at New York exhibition Programma-101, the first personal computer

Moreover...

- 1977-1990 Home Computer
 - 1977- Apple II, the very first personal computer
 - 1984- Commodore 64, the best selling computer of all times



Interface

Input: keyboard (command language)

Output: video (text lines)

Computing rules in programs

A screenshot of a text-based user interface for a program called 'File Translator'. The window title is 'File Translator'. The text inside shows copyright information for 'Buckhorn Inc.' and a list of command-line options with their descriptions. At the bottom, there is a section titled 'Supported Languages:' followed by a grid of language names in different colors.

```
File Translator v1
Copyright (c) Buckhorn Inc. All rights reserved.
Syntax: "File Translator.exe" [path of File or Folder that is to be translated]
      -from [Original Language] -to [Translate To Language] -out [Folder Path] [-skip]
      [-recursive]

Commands      Description
-----
-from [Language] --Original language of the files.
-to [Language] --Translate files to language.
-out [Folder Path] --The folder where translated files will be saved.
-skip --Files with the same name that are present in the
       output folder will be skipped. When this option is not
       present, translated files with the same name in the output
       folder will be overwritten.
-recursive --When translating files in a folder, include the files
             within subdirectories.
-help or -? --Show help for command descriptions.

Examples:
"File Translator.exe" "D:\BookHere" -from english -to german -out "D:\BookHere\
German" -skip -recursive

"File Translator.exe" "D:\BookHere\*.asp" -from english -to german -out "D:\B
ookHere\German" -skip -recursive

Supported Languages:

English  Russian  Spanish
Danish  German  Czech  Swedish
Filipino  Finnish  French  German
Hungarian  Indonesian  Norwegian  Polish
Portuguese  Swedish  Turkish  Dutch

C:\>
```

Finally... (?)

- 1984- the second Apple revolution : the graphic interface; **WIMP interaction paradigm**: *Windows Icons Mouse and Pointer*.
- 1985- Windows
- 1991- Linux
- ...Notebook, PDA (Personal Digital Assistant), Pervasive Computing ...

Interface

Input: keyboard, mouse, menus, direct manipulation

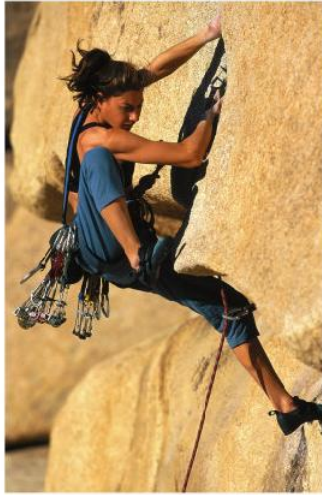
Output: video, audio

Computing rules in programs



From climbing to elevator

d
i
f
f
i
c
u
l
t
y

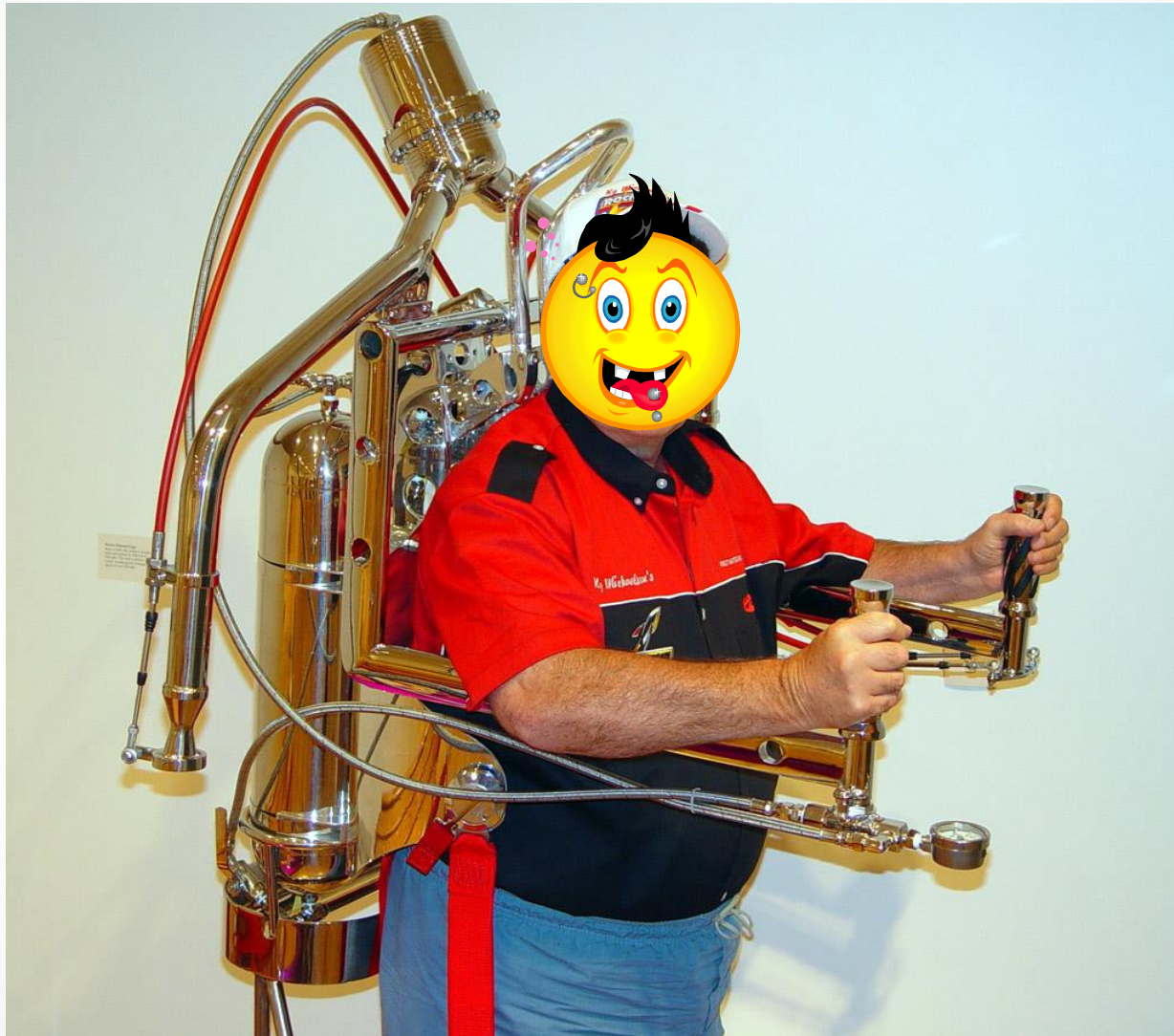


user

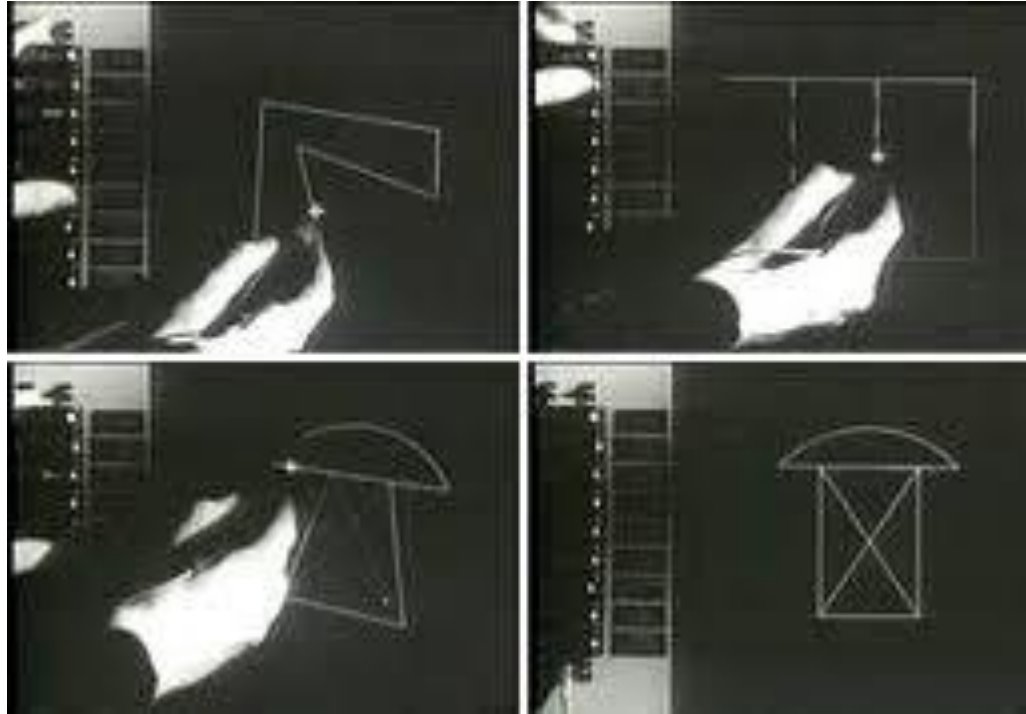


expressiveness

What next?



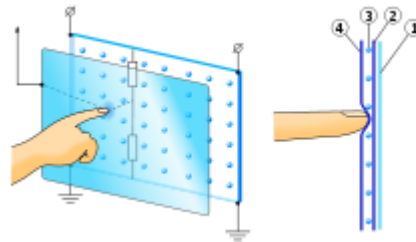
POST-WIMP interfaces ... before WIMP?



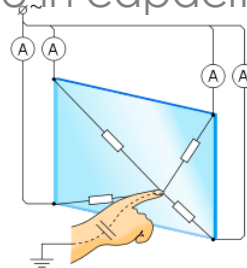
Ivan Sutherland's 1963 **direct manipulation** drawing program, Sketchpad

POST-WIMP interfaces

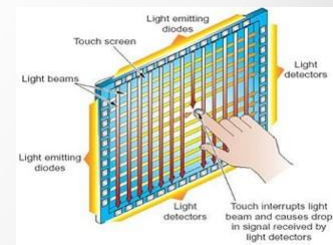
- Touch Screens
 - can detect the presence and location of a touch within the display area
 - **Resistive:** Resistive touch is used in restaurants, factories and hospitals due to its high resistance to liquids and contaminants



- **Capacitive:** As the human body is also an electrical conductor, touching the surface of the screen results in a distortion of the screen's electrostatic field, measurable as a change in capacitance.

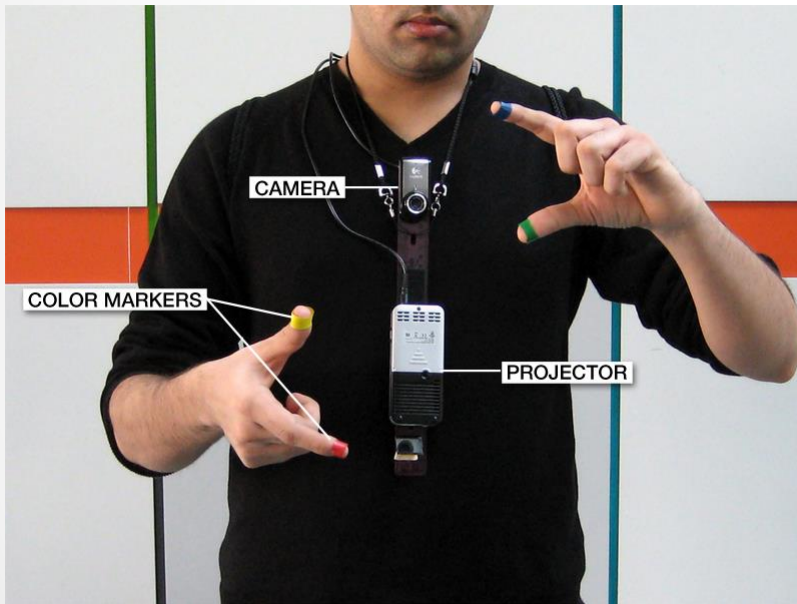


- **Infrared:** beams of infrared rays are interrupted by user finger



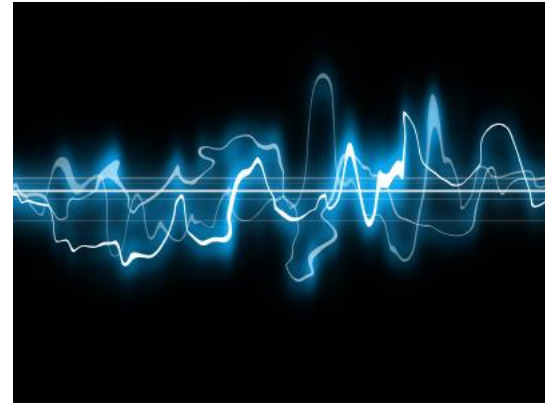
POST-WIMP interfaces

- Gesture-based interfaces
 - Pointing device gesture
 - Need tracking sensors or image processing



POST-WIMP interfaces

- Voice user interfaces
 - Need speech recognition
 - Speaker dependent
 - Speaker independent



KITT Supercar

http://www.youtube.com/watch?v=9RILbOMbaB4&feature=player_embedded

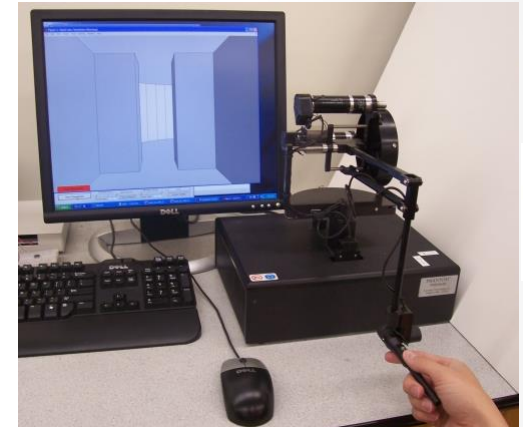


POST-WIMP interfaces

- Haptic user interfaces
 - Need specialized hardware
 - May need to configure force feedback



<http://www.youtube.com/watch?v=REA97hRX0WQ>



<http://www.sensable.com/haptic-application-videos.htm>

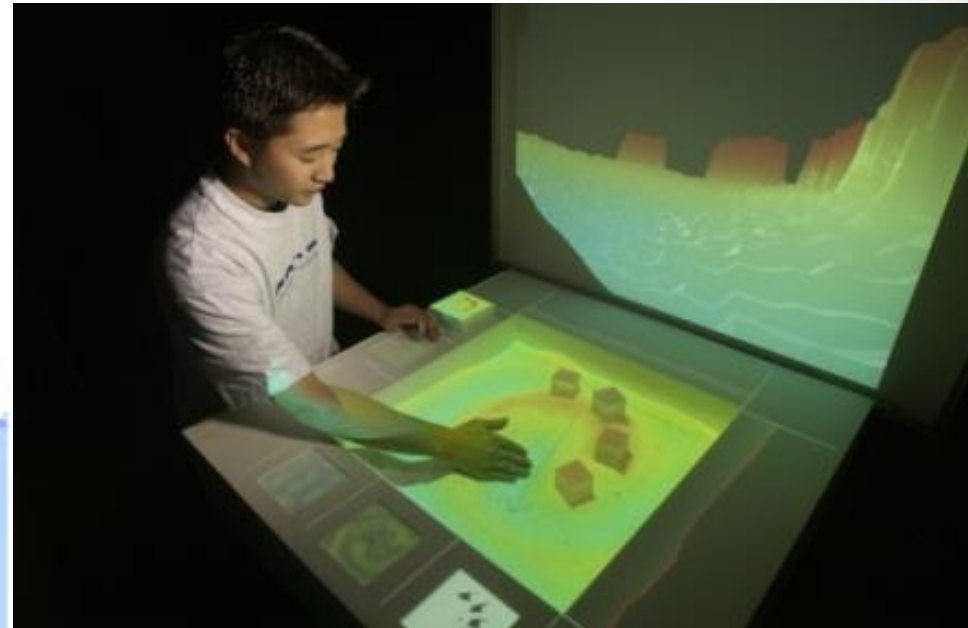
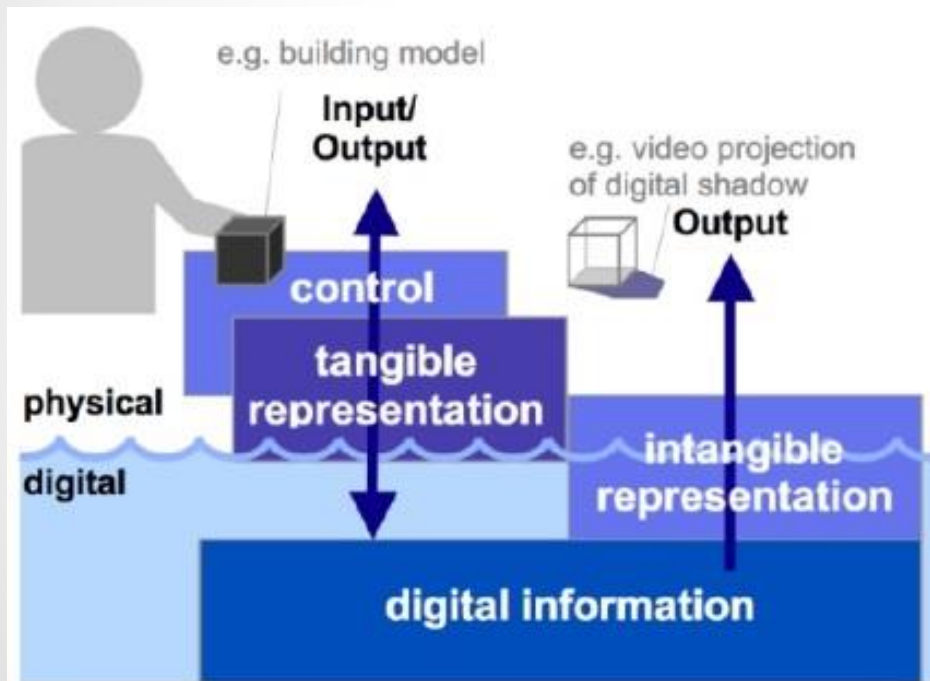


<http://www.youtube.com/watch?v=viFFErz5Y94>

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POST-WIMP interfaces

- Tangible user interfaces
 - The key idea is to give physical forms to digital information .
 - The physical forms serve as both representations and controls for their digital counterparts.



SandScape (2004)

POST-WIMP interfaces

- Natural user interfaces
 - a user interface that is effectively invisible, or becomes invisible with successive learned interactions, to its users.
 - “natural” because relies on a user being able to quickly transition from novice to expert.
 - “natural” refers to a goal in the user experience – that a user feels “like a natural” while interacting with the technology, **rather than referring to some inherent property of the interface itself.**

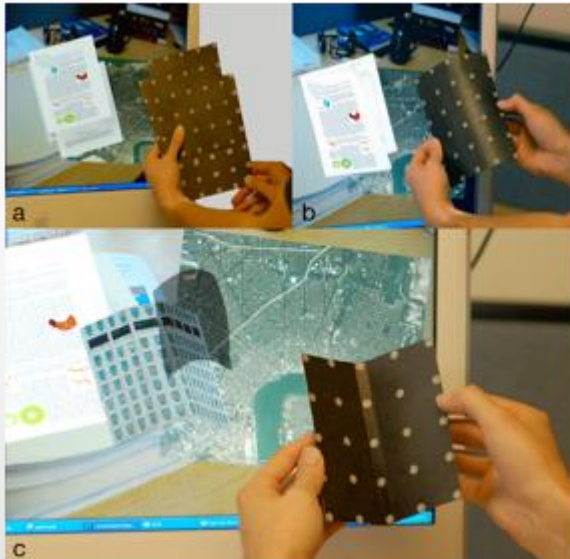
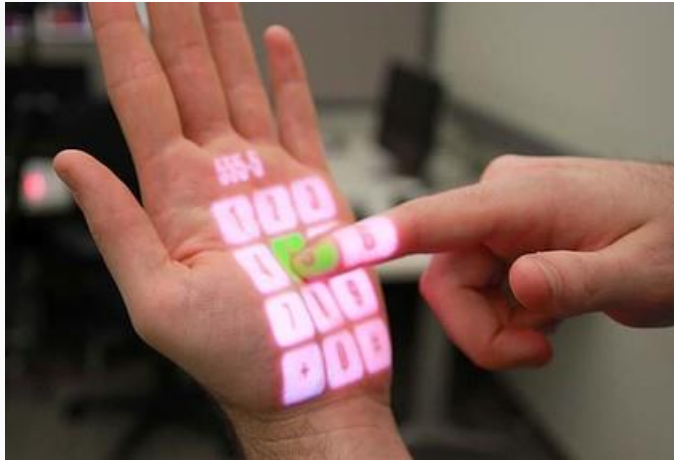


<http://www.youtube.com/watch?v=Hy9bNhALo4g>

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POST-WIMP interfaces

- Organic user interfaces
 - computers in any way, shape, or form



Ubiquitous Computing

POST-WIMP interfaces

- Kinetic user interfaces
 - Beyond gesture ...
 - Implicit interaction
 - Motion-aware computing system



http://www.youtube.com/watch?v=ClPnq-2_TU0&feature=player_embedded#!

Incidental Interaction

<http://www.alandix.com/academic/topics/incidental/>

POST-WIMP interfaces

- Immersive user interfaces
 - Virtual reality
 - Augmented reality



The ultimate frontier (?)

- Brain interfaces



Only a game?



From UI to UX

- From User Interface design to User eXperience design



Some readings ...

- Pen and Touch Computing Center
<http://www.cs.brown.edu/research/ptc/index.html>
- <http://www.cs.brown.edu/research/ptc/relatedWork-ChinaTalks.html>
- Incidental Interaction. By Alan Dix
<http://www.alandix.com/academic/topics/incidental/>