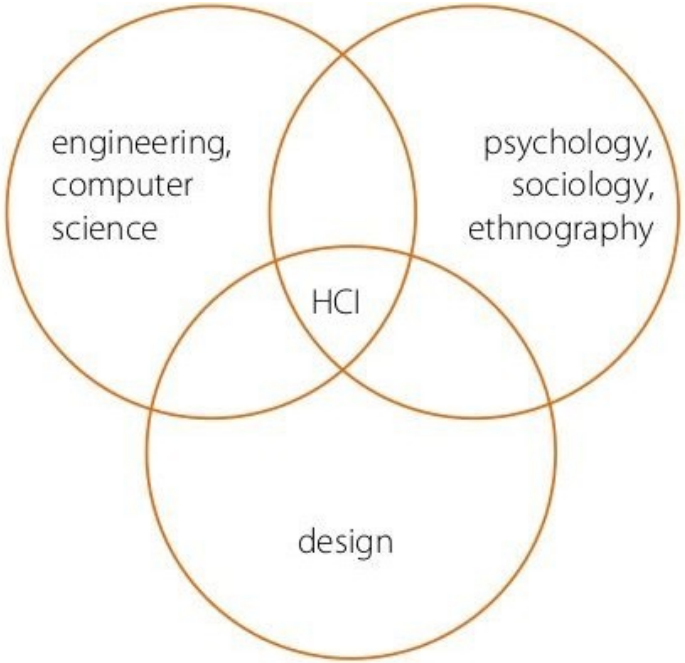
CS 4320 / 7320 Software Engineering

Methods for Design, Prototyping and Evaluating User Interaction

What is HCI?

HCI (human-computer interaction) is the study of how people interact with computers and to what extent computers are or are not developed for successful interaction with human beings.



HCI !=Usability

A usable system is easy to learn, easy to remember how to use, effective, efficient, safe, and enjoyable to use.

Usability is only one part of HCI, but has been one of the main goals

For example, HCI has contributed to the **development of guidelines and standards** that support designers

HCI has also developed **methods of evaluation** that help us to evaluate the usability of a given product/system (and other aspects of the user experience)

In addition, HCI uses **mathematical models** to predict users' performance with a system (e.g., Fitt's law to predict mouse movement time, or models that predict search time or mental effort)

HCI also investigates new **interaction paradigms** or new ways of integrating technology in our daily lives (think smart clothes, touch displays, VR/AR, Voice-based interfaces …)

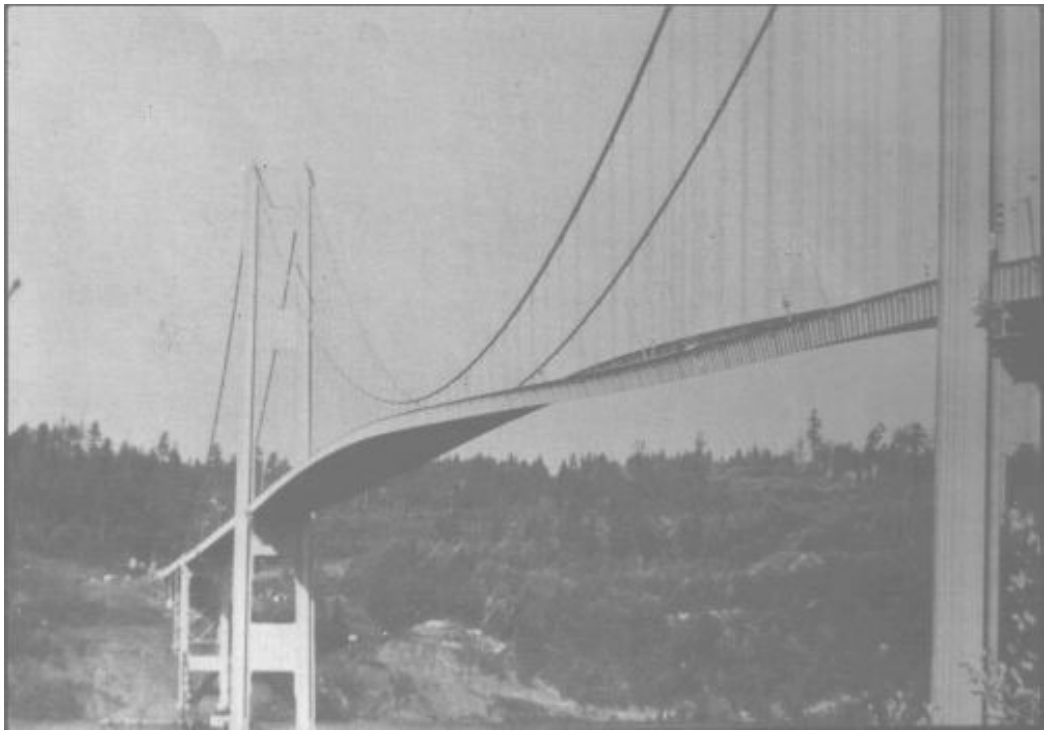
Boehm-Davis, Deborah A. "Discoveries and developments in human-computer interaction." *Human factors* 50.3 (2008): 560-564.

Why do we do HCI in CSE?

Every engineering discipline includes the **study of breakdowns** and the **design of improved / or new solutions** that address those breakdowns

Why do we do HCI in CSE?

Tacoma Narrows (nicknamed "Galloping Gertie")



Why do we do HCI in CSE?

Tacoma Narrows (nicknamed "Galloping Gertie")

2-minute activity

Can you find a technology analogue to the collapse of the Tacoma bridge?


Inside Facebook's Myanmar operation
Hatebook
A REUTERS SPECIAL REPORT

Why do we do HCI in CSE?

Understanding how and why **human interaction breaks down** is fundamental to designing better computing systems

This study must include computer scientists, as we are the ones creating the technology

HCI is an extension of traditional CS disciplines

We design, scale, and evaluate computing systems for particular tasks (e.g., parallel programming, network routing)

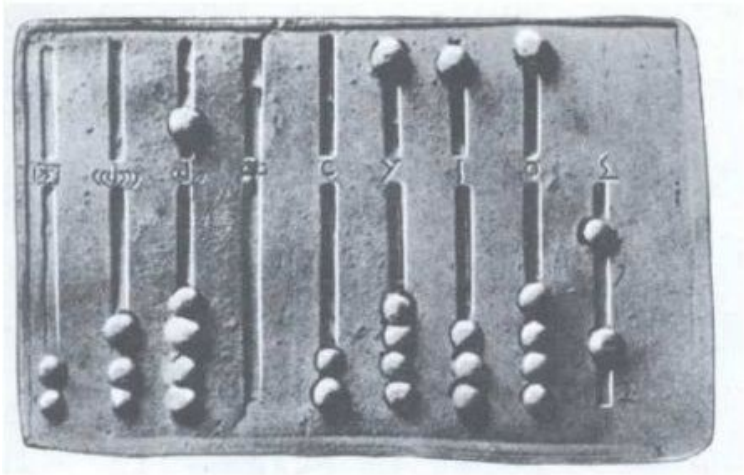
HCI incorporates humans into the computing system
Humans as an additional constraint

Any computer system must be designed taking into account
- the physical constraints of the machine (e.g., processor speed, networking capabilities)
- the human physical and mental constraints (e.g., attention, memory)
- (should we add, social level constraints?)

http://www.pgbovine.net/what-is-hci-research.htm

A history of HCI

Calculating devices in antiquity



Konrad Zuse (1910-1995)

Invented the world's first programmable computer (in 1941)

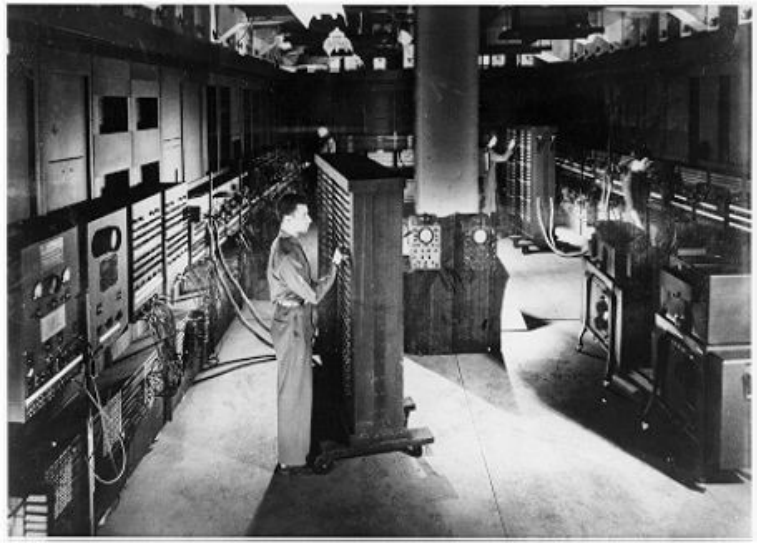
This remained the only working computer in Europe up to 1951

ENIAC (~1946)

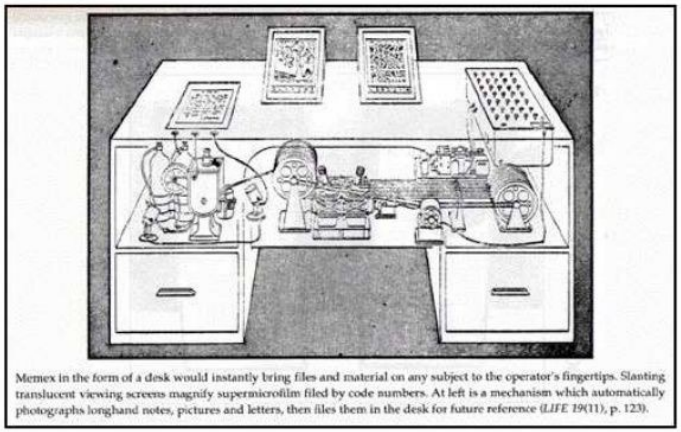
First electronic numerical integrator and computer in the US

Construction contract was signed in 1943

The first programmers of the ENIAC were six women ("Refrigerator Ladies")



Memex (1945)



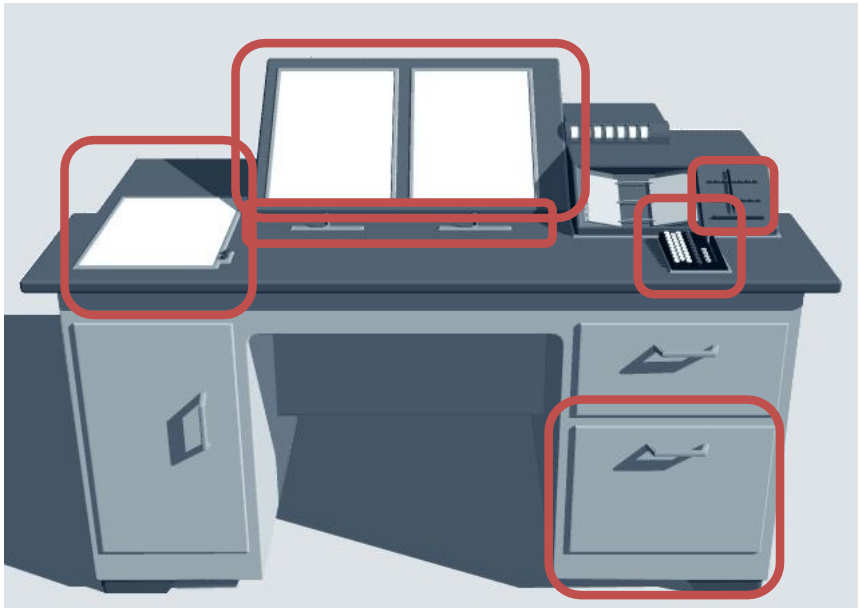
Memex in the form of a desk would instantly bring files and material on any subject to the operator's fingertips. Slanting translucent viewing screens magnify supermicrofilm filed by code numbers. At left is a mechanism which automatically photographs longhand notes, pictures and letters, then files them in the desk for future reference (*LIFE* 19(11), p. 123).

https://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/

Memex (1945)

"wholly new forms of encyclopedias will appear, ready made with a mesh of associative trails running through them…"

Memex (1945)



Memex (1945)

"If the user wishes to consult a certain book, he taps its code on the keyboard…"

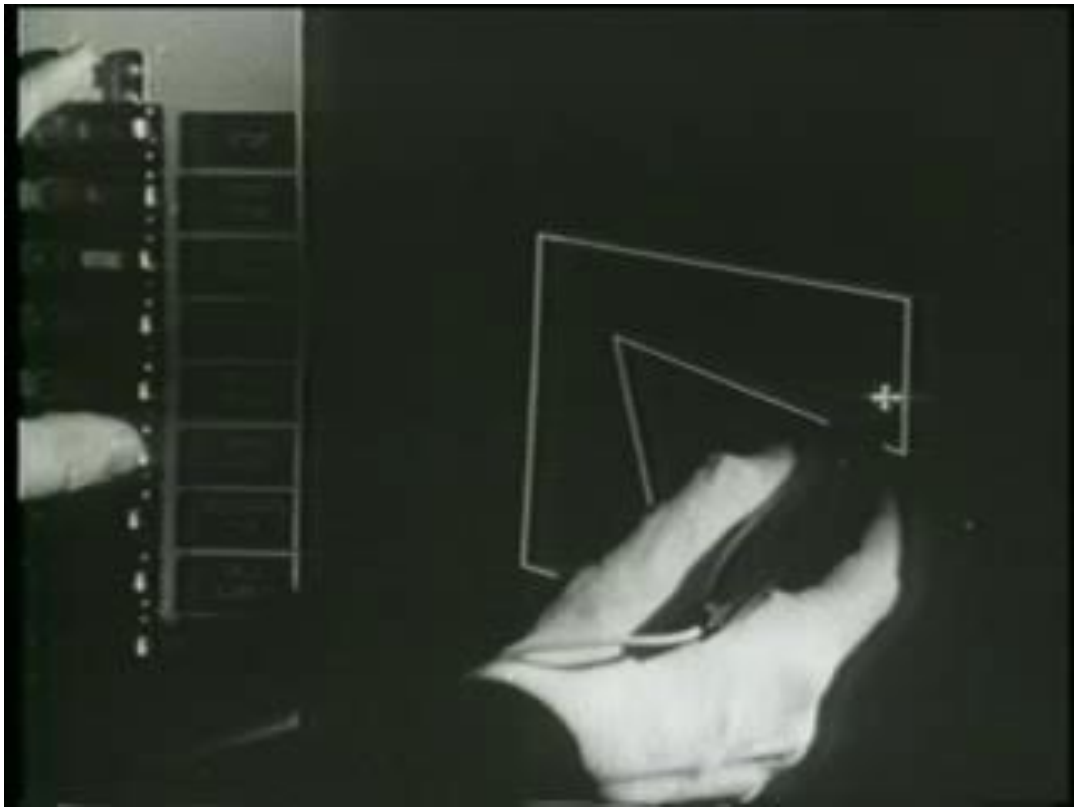
"Frequently-used codes are mnemonic, so that he seldom consults his code book;"

"He can add marginal notes and comments … even … by a stylus scheme"

"All this is conventional…"

SketchPad by Ivan Sutherland at MIT (1963)

SketchPad by Ivan Sutherland



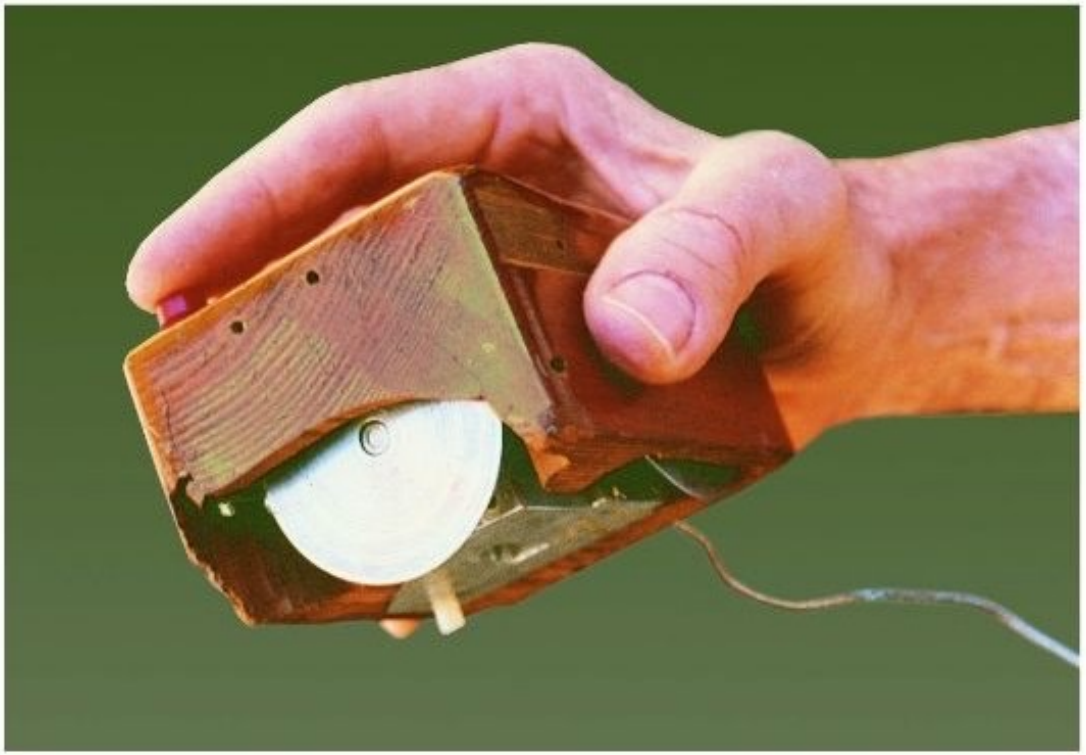
SketchPad by Ivan Sutherland at MIT (1963)

Direct manipulation of objects

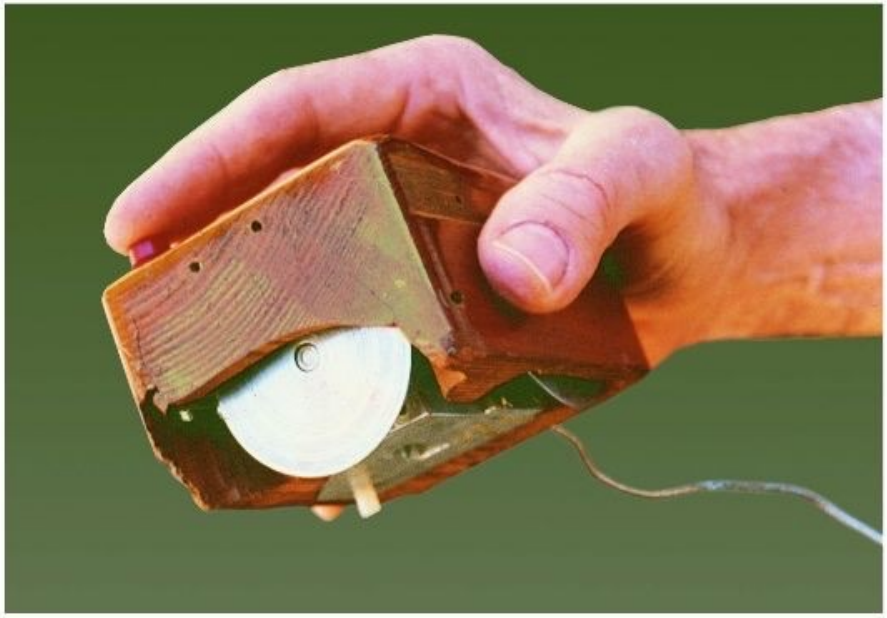
SketchPad paved the way for the Graphical User Interface

Sutherland's PhD thesis also defined the terms "objects" and "instance"

SketchPad is the first object-oriented programming system



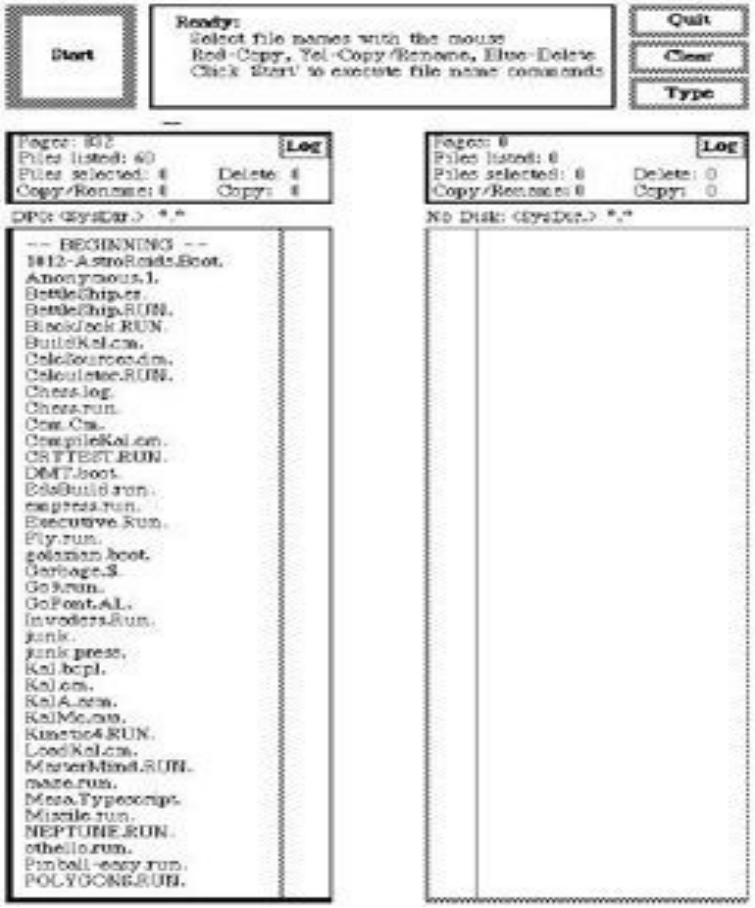
First mouse by Engelbard at Stanford (1963)



Nothing eventful happened in the next 10 years…

Xerox Alto (1973)

Xerox Alto


Start
Ready:
Select file names with the mouse
Red-Copy, Yel-Copy/Rename, Blue-Delete
Click 'Start' to execute file name commands
Quit
Clear
Type
Log
Files listed: 60
Files selected: 0
Delete: 0
Copy/Rename: 0
Copy: 0
-- BEGINNING --
1812-AstroRoids.Boot.
Anonymous.1.
BattleChip.cr.
BattleChip.RUN.
BlackJack.RUN.
BuildKal.cm.
CalcSource.cm.
Calculator.RUN.
Chess.log.
Chess.run.
Com.Cm.
CompileKal.cm.
CRTTEST.RUN.
DMT.boot.
EdsBuild.run.
empress.run.
Executive.Run.
Fly.run.
goldbar.boot.
Garbage.S.
Go.bcpl.
Go.run.
GoFont.AL.
Invaders.Run.
junk.
junk.press.
Kal.bcpl.
Kal.cm.
KalA.asm.
KalMc.mac.
Kinetic4.RUN.
LoadKal.cm.
MasterMind.RUN.
maze.run.
Mess.Typescript.
Missile.run.
NEPTUNE.RUN.
othello.run.
Pinball-easy.run.
POLYGONS.RUN.

VisiCalc (1979)

VisiCalc was the Killer App for Personal Computers

Turned the microcomputer from a hobby for nerds into a serious thing

Because of it, IBM introduced the IBM PC 2 years later

Suddenly, small and large business bought computers

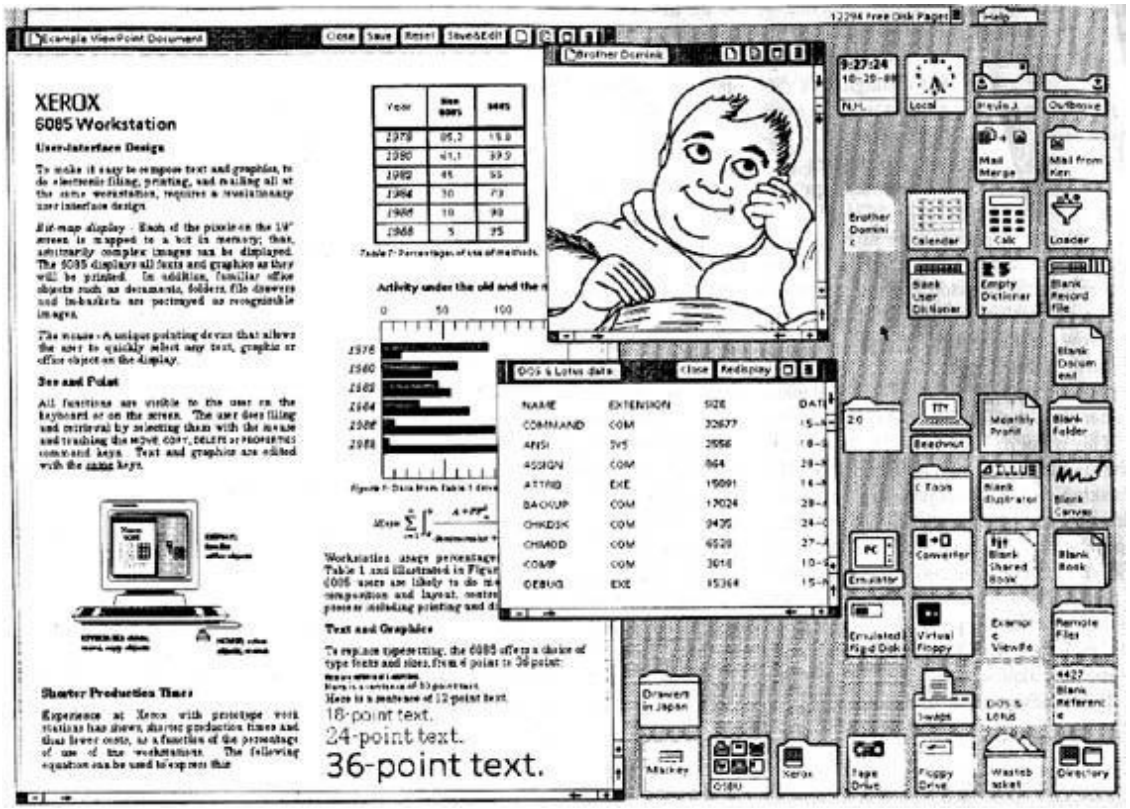
With the emergence of personal computing in the late 1970s, everyone became a potential computer user

With the emergence of personal computing in the late 1970s, everyone became a potential computer user…

… but computer users still had to deal with arcane commands and system dialogs

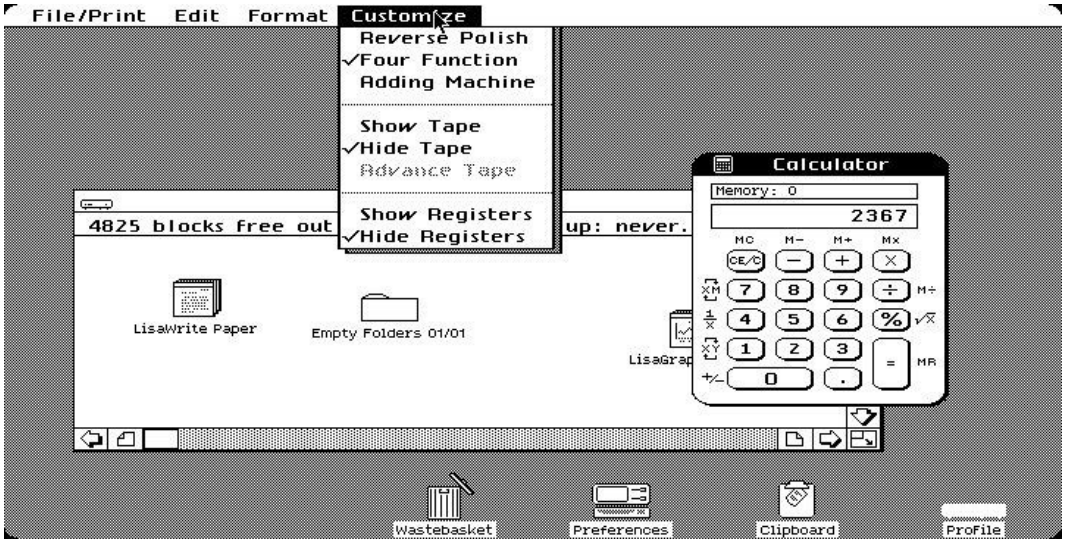
Xerox Star (1981)

Xerox Star


XEROX
6085 Workstation
User-Interface Design
Shorter Production Times
Text and Graphics
18-point text.
24-point text.
36-point text.

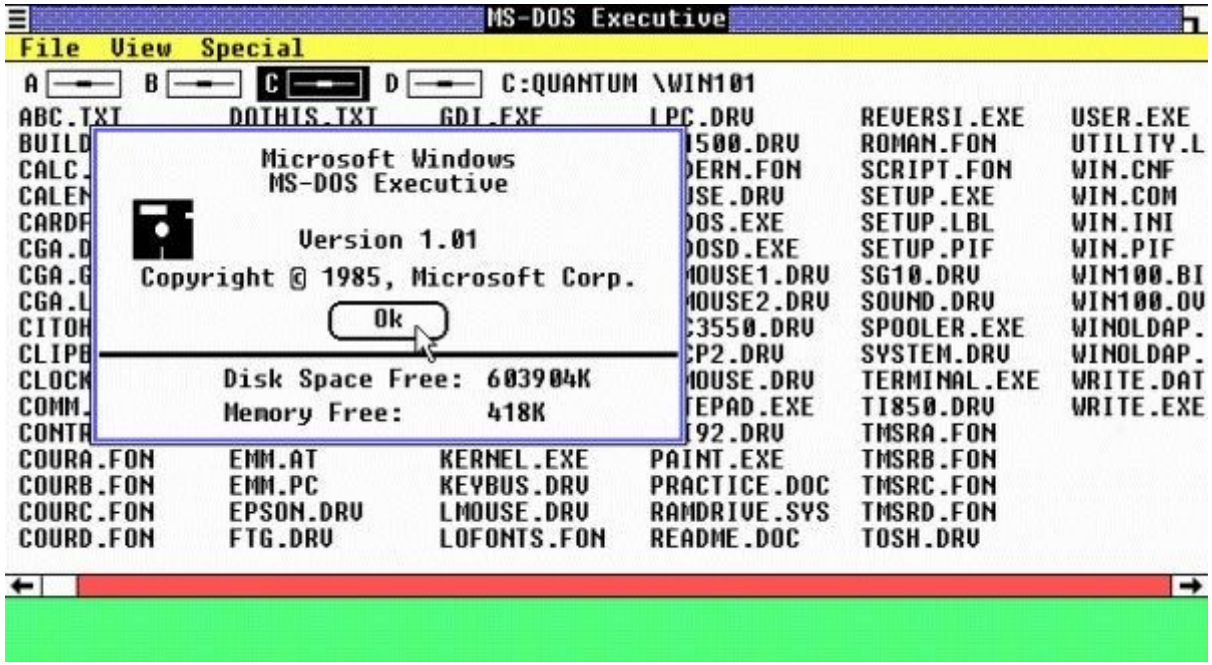
Apple Lisa (1981)

Apple Lisa (1981)

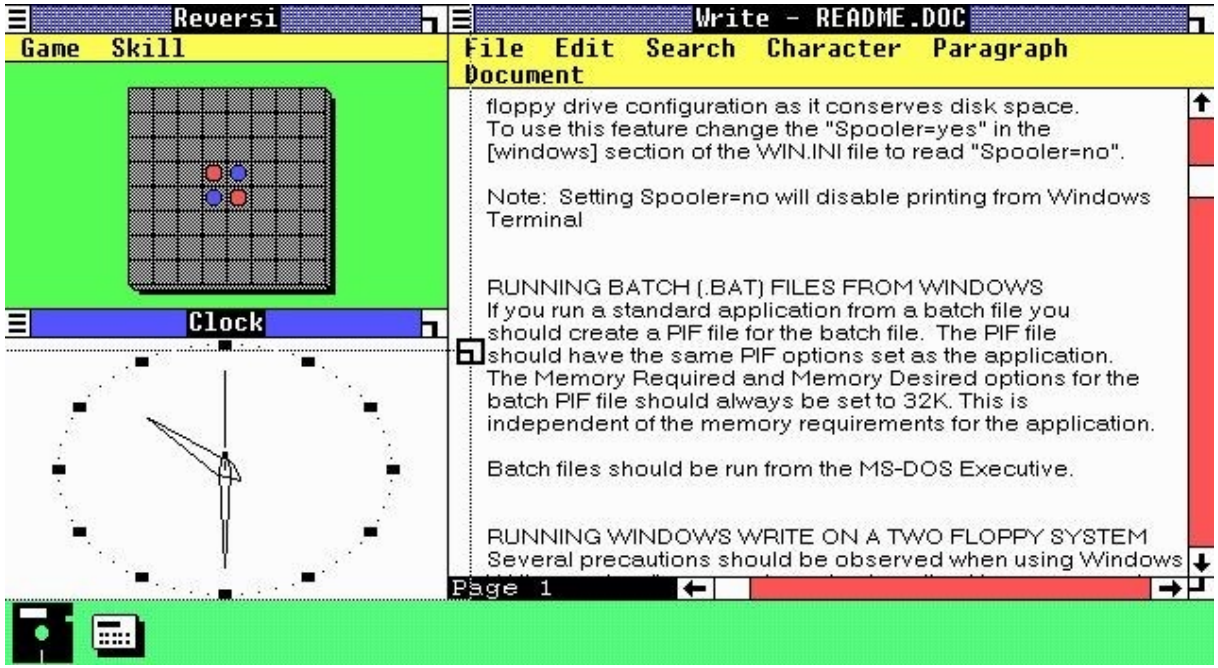


Apple Mac (1984)

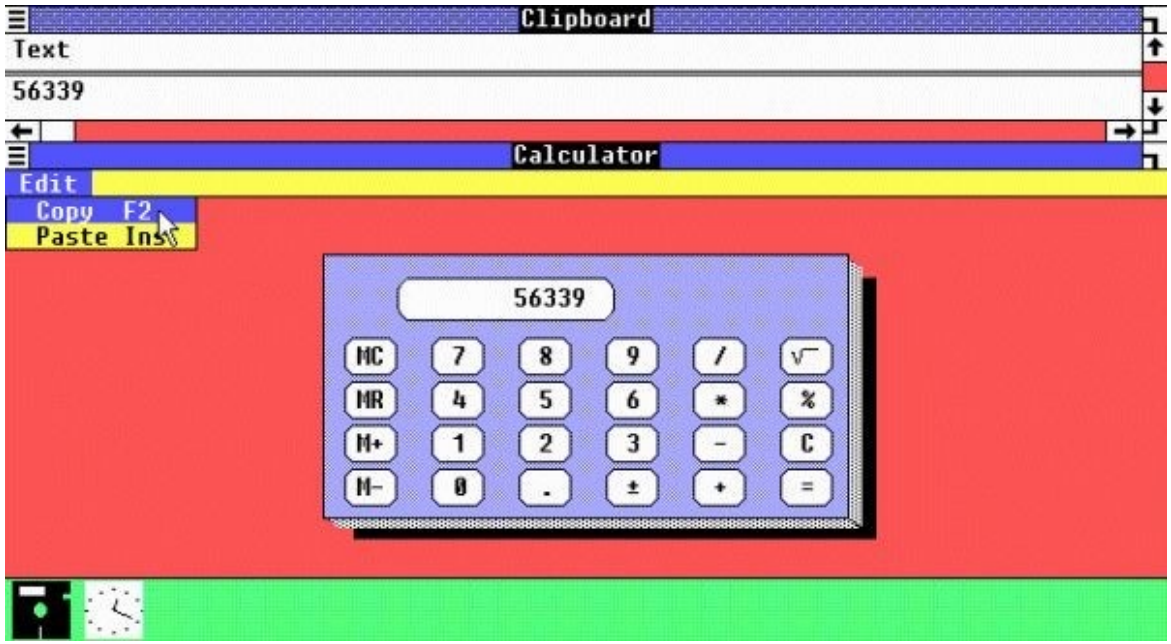
Windows 1.0 (1985)



Windows 1.0 (1985)

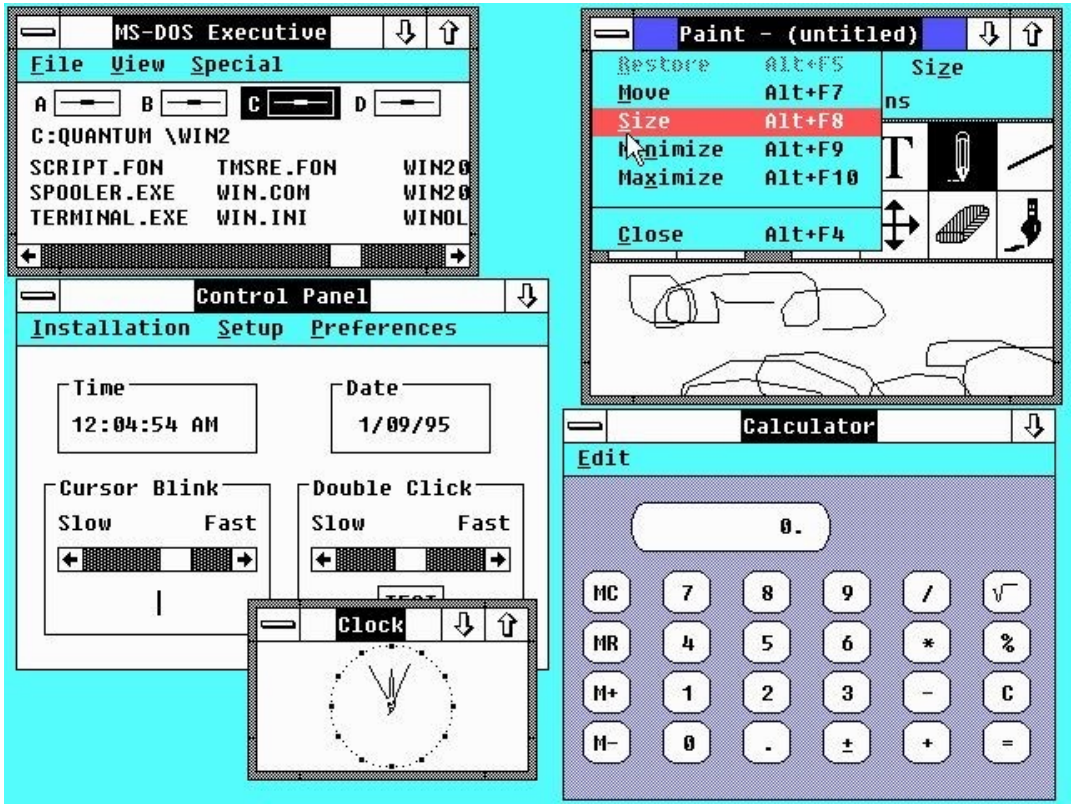


Windows 1.0 (1985)

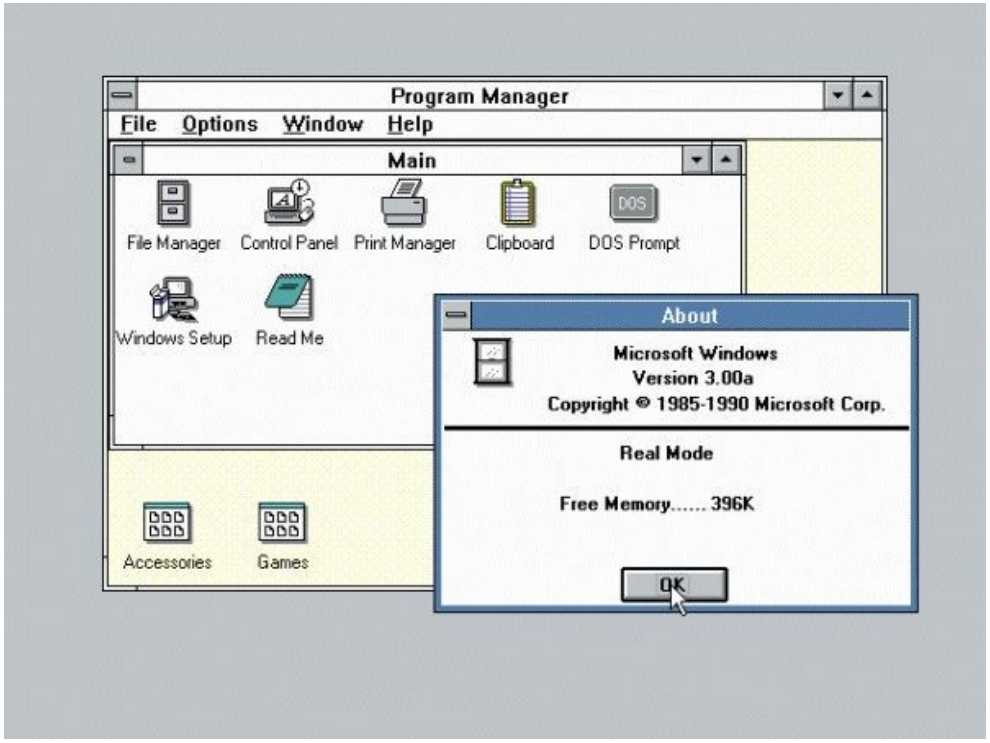


Windows 2.0 (1987)

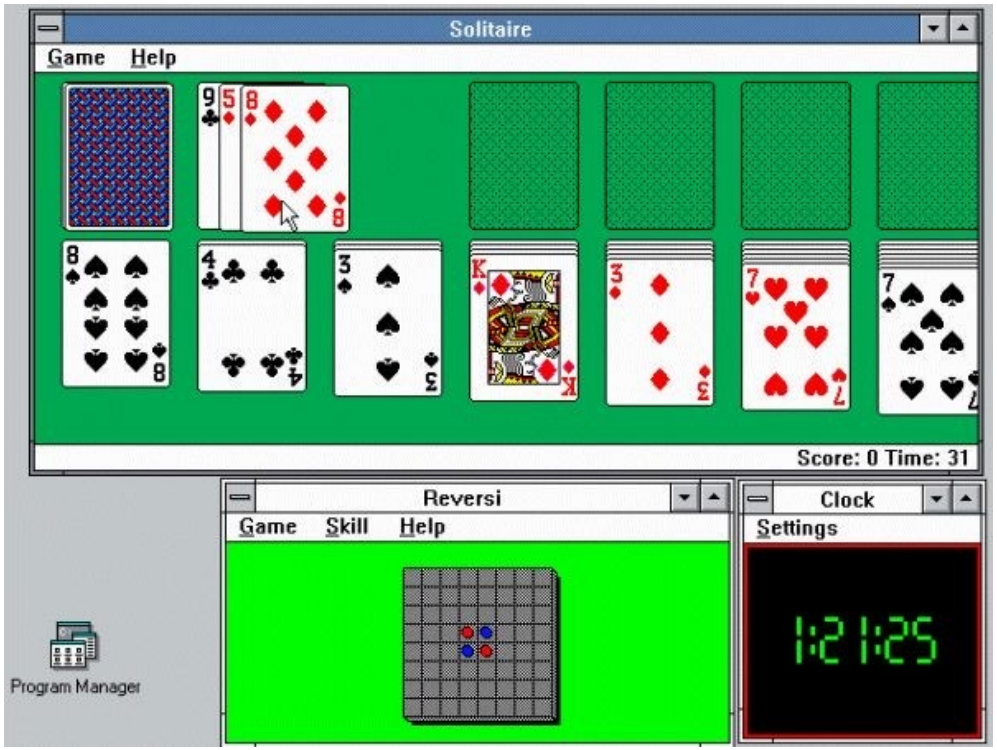
Windows 2.0 (1987)



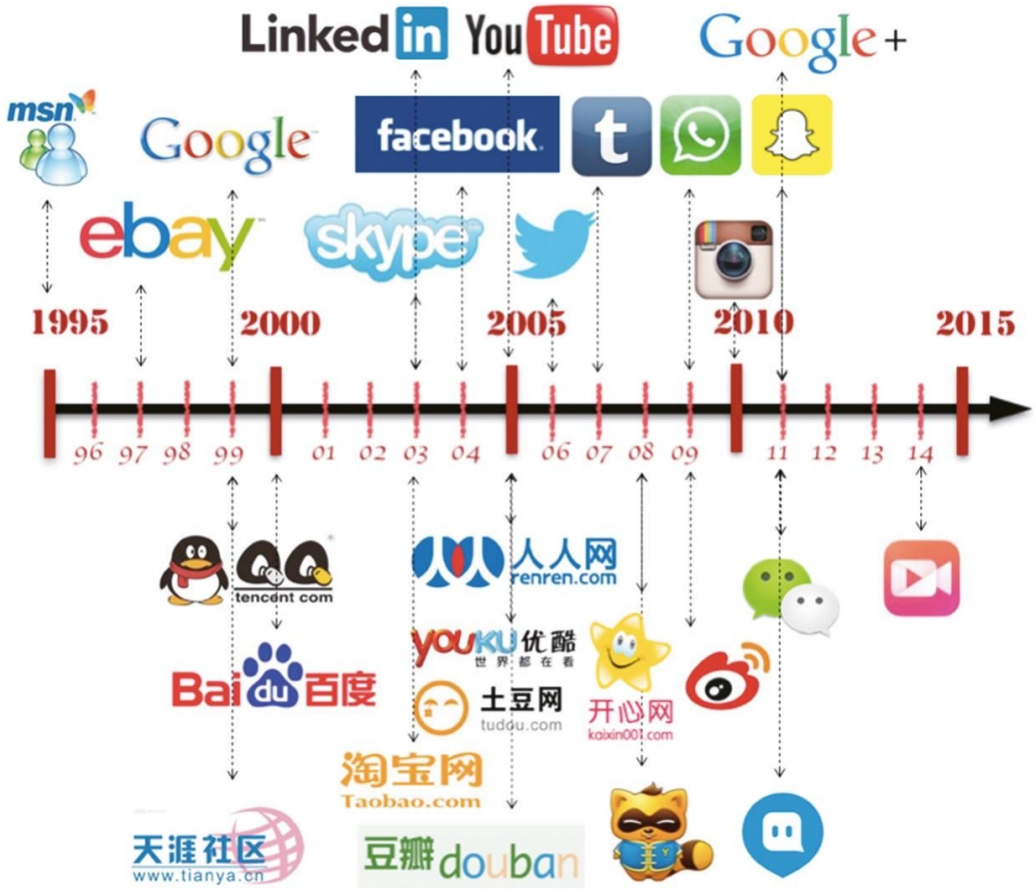
Windows 3.0 (1990)

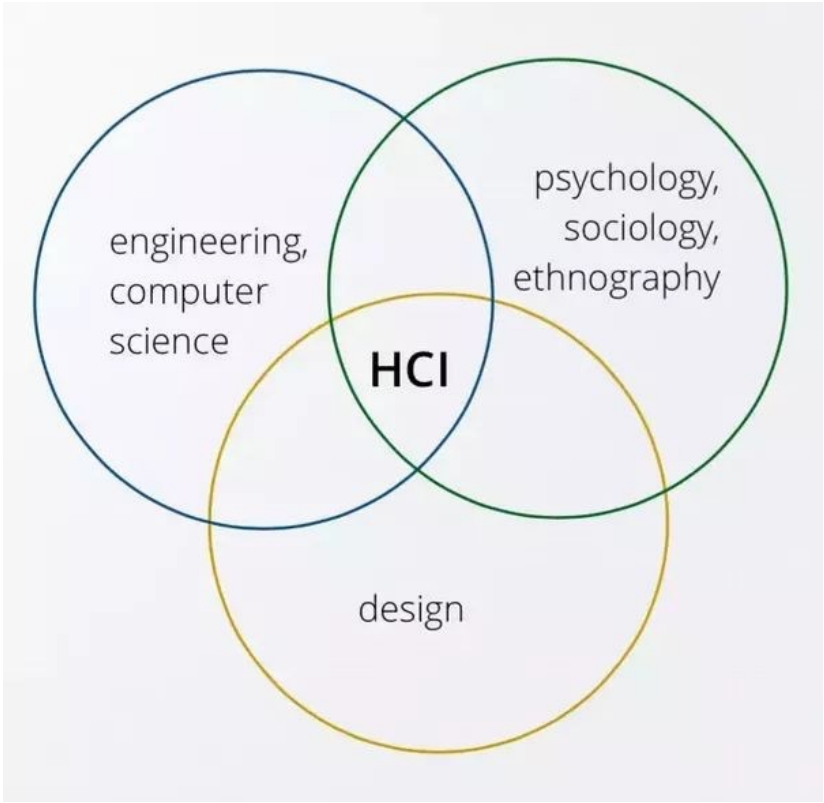


Windows 3.0 (1990)



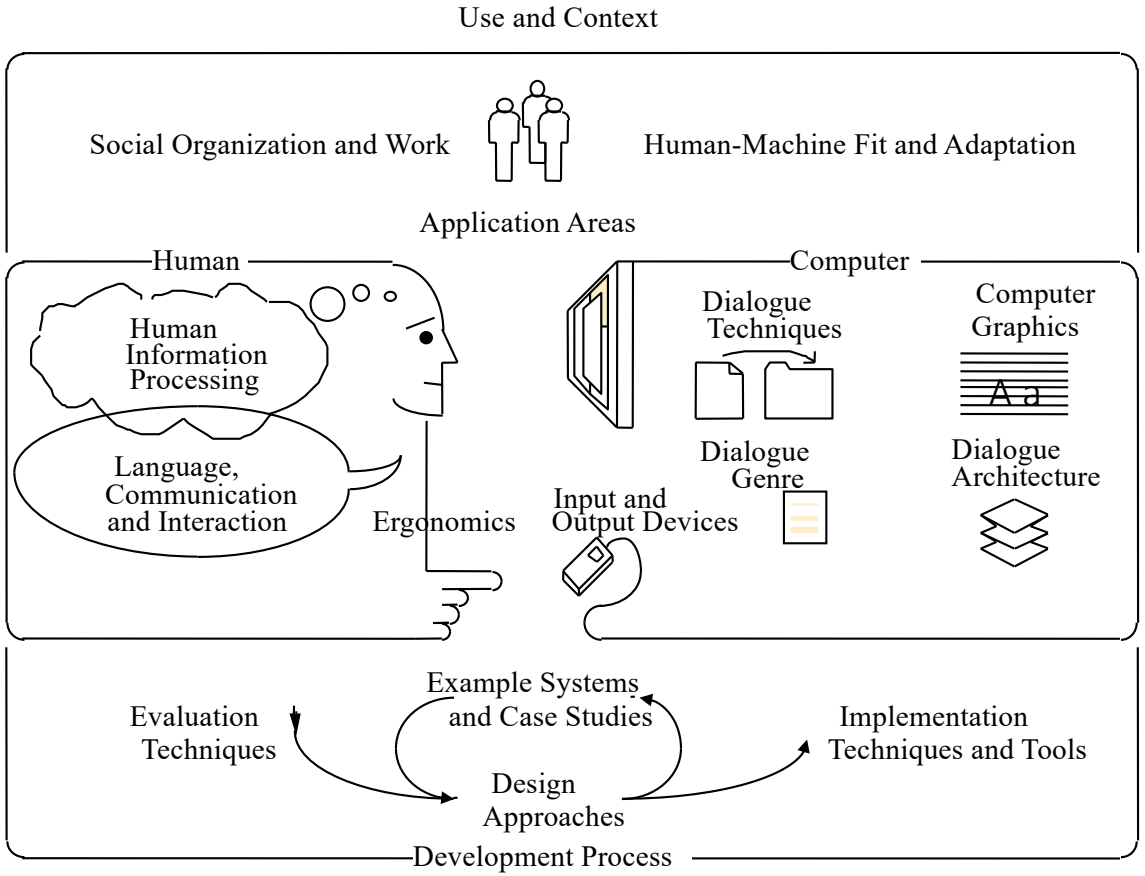
World Wide Web (1990)


LinkedIn
YouTube
Google+
msn
Google
facebook
ebay
skype
1995
2000
2005
2010
2015
96 97 98 99 01 02 03 04 06 07 08 09 11 12 13 14
tencent com
人人网
renren.com
youku 优酷
世界都在看
Baidu 百度
土豆网
tudou.com
开心网
kaixin001.com
淘宝网
Taobao.com
天涯社区
www.tianya.cn
豆瓣 douban



"HCI is concerned with understanding the influence technology has on how people think, value, feel, and relate and using this understanding to inform technology design." Wright & McCarthy (2008)

Overview: Map of Human Computer Interaction



Why study human use of computer systems?

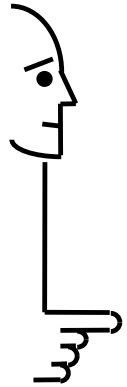
The *system* view:

- complex human
- complex computer
- complex interface between the two

The human factors view:

- humans have necessary limitations
- errors are costly in terms of
  - *loss of time*
  - *loss of money*
  - *loss of lives in critical systems*
  - *loss of morale*
- design can cope with such limitations!

Human characteristics



To understand the human as an information-processing system,
how humans communicate, and
people's physical and psychological requirements

Human information processing

- characteristics of the human as a processor of information
  - *memory, perception, motor skills, attention, problem-solving, learning and skill acquisition, motivation, conceptual models, diversity...*

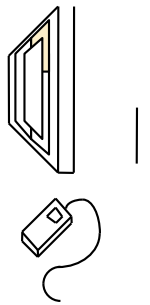
Language, communication and interaction

- aspects of language
  - *syntax, semantics, pragmatics; conversational interaction, specialized languages*

Ergonomics

- anthropometric and physiological characteristics of people and their relationship to workspace and the environment
  - *arrangement of displays and controls; cognitive and sensory limits; effects of display technology; fatigue and health; furniture and lighting; design for stressful and hazardous environments; design for the disabled...*

Computer system and interface architecture



The specialized components computers have for interacting with people

Input and output devices
- mechanics and characteristics of particular hardware devices, performance characteristics (human and system), esoteric devices, virtual devices

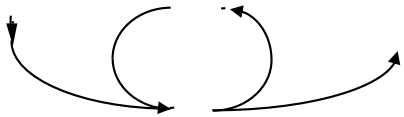
Dialogue techniques
- the basic software architecture and techniques for interacting with humans
  - *e.g. dialog inputs and outputs; interaction styles; issues*

Dialog genre
- The conceptual uses to which the technical means are put
  - *e.g. interaction and content metaphors, transition management, style and aesthetics*

Computer graphics
- basic concepts from computer graphics that are especially useful to HCI

Dialogue architecture
- software architecture and standards for interfaces
  - *e.g., screen imaging; window managers; interface toolkits; multi-user architectures, look and feel, standardization and interoperability*

The Development Process



The construction and evaluation of human interfaces

Design approaches

the process of design

e.g. graphical design basics (typography, color, etc); software engineering; task analysis; industrial design...

Implementation techniques and tools

tactics and tools for implementation, and the relationship between design, evaluation and implementation

e.g. prototyping techniques, dialog toolkits, object-oriented methods, data representation and algorithms

Evaluation techniques

philosophy and specific methods for evaluation

e.g. productivity, usability testing, formative and summative evaluation

Example systems and case studies

classic designs to serve as example of interface design genres

HCI's impact on society

We can now use computers as an every-moment- partner

Less and less training is required for most application and devices

Some examples

- Touch screen: direct interaction with objects
- Voice control: for some people the only way to interact with computers

HCI’s impact on culture

Smartphones have changed how we spend our "empty times": should we read the news? answer emails? chat with friends? play "2 Dots"? should we just be bored?

Social Media have influenced how we stay in touch with each other and how find new friends and lovers.

Games, more than entertainment, can be used as social and even productive tools.

HCI's impact on economy

Massive increase in productivity

HCI found how to speed up input and reduce its complexity

People can perform tasks faster than they used to

Reduced need for training

More people can use technology than ever before

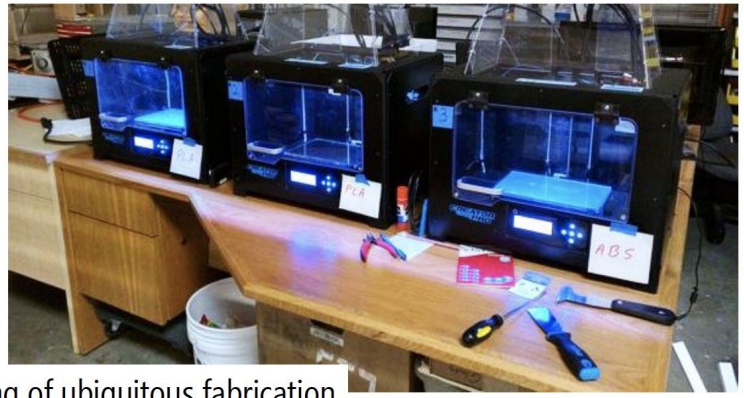
What now???

Fabrication (3D Printing) in HCI

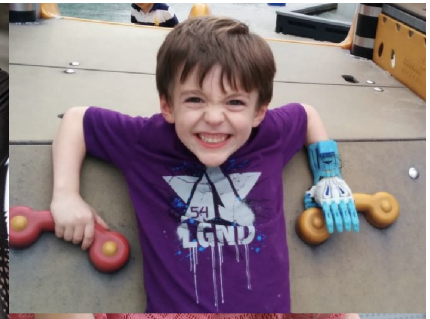
1987
The first commercial 3D printer
SLA-1 printer by 3D Systems Inc.
Invented by Charles Hull

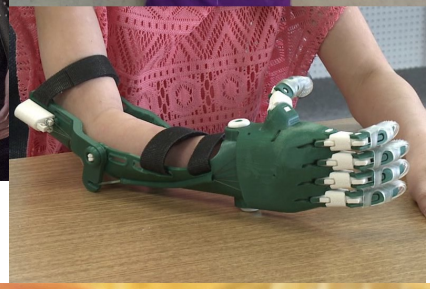
1992
The first commercial FDM printer
3D Modeler by Stratasys, Inc.
Invented by Scott & Lisa Crump

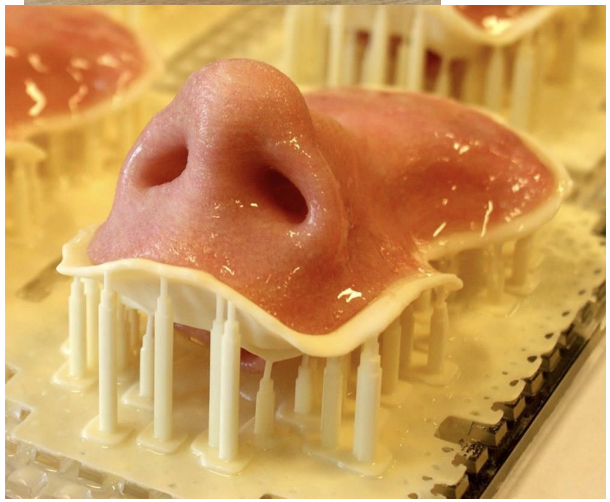
"The idea for the technology came to Crump in 1988 when he decided to make a **toy frog for his young daughter using a glue gun loaded with a mixture of polyethylene and candle wax**. He thought of creating the shape layer by layer and of a way to automate the process. In April 1992, Stratasys sold its first product, the 3D Modeler."



2009 marked the beginning of ubiquitous fabrication



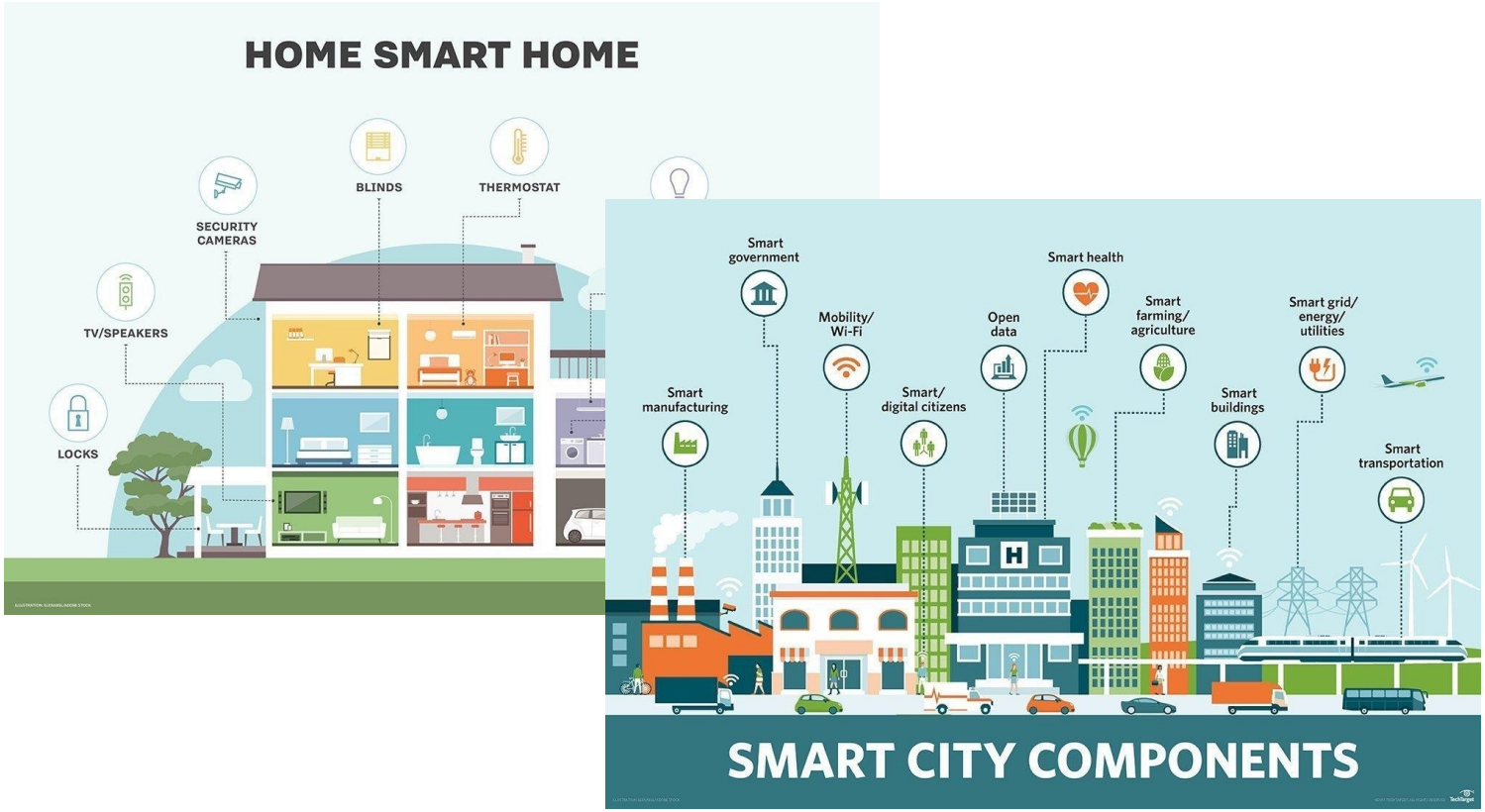




3D Printing houses using FDM

3D Printing pancakes using FDM

Society as the next platform



https://internetofthingsagenda.techtarget.com

And beyond (VR/AR)

Activity

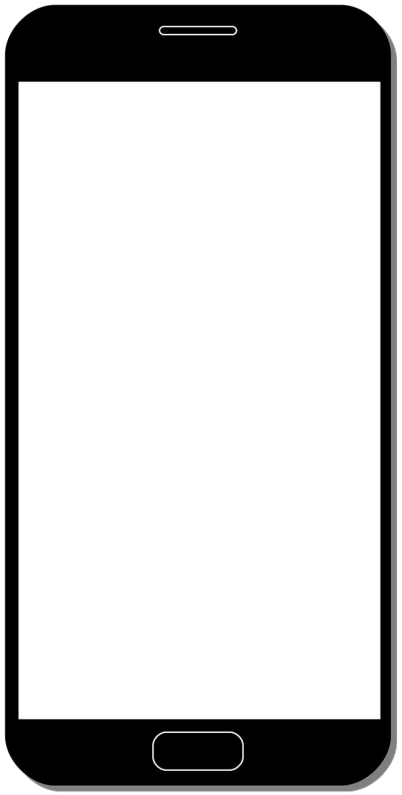
Activity (10 minutes)

In groups of 2…

How would you change this thing?

Make sure your idea is innovative!

Sketch out your design on a piece of paper and write your names on it
(this time we will collect it :))

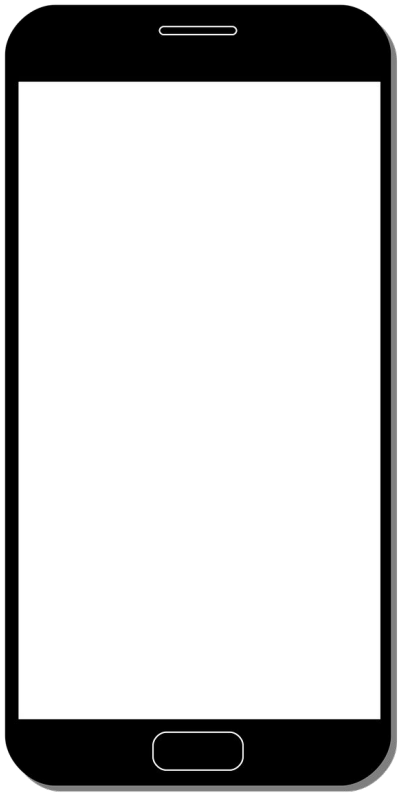


Reflection

What did you come up with?

What were the challenges?

How did your process differ from what you did on Thursday?



Ask me something!