Computer science in four eras

Jean-Jacques Lévy
Inria Paris & Irif

Huashang College - 2019-11-18
COMPUTER SCIENCE vs REAL WORLD
Science

nature

life sciences

machines
PRIMARY
THE LOGIQIAN
(1910 - 1950)
From paradoxes in logic
``the set of all sets``
to
Computability
The logicians

Hilbert → Gödel → Church → Turing → Kleene → Post → von Neumann
The logicians

- Turing: finite control, infinite memory
  (decoding Enigma machine)

- von Neumann: data AND programs in memory
  (Manhattan project)

- machines at UPenn, Cambridge, Mark I
Enigma

The Bombe

Colossus

Lorenz

Germany

Bletchley Park
Bletchley Park

the Bombe

day Colossus
Tony Sale
and the Colossus rebuild team
Cliff Horrocks, team manager
Bob Alexander  Don Grieg  John Pether
Frank Carter  Phil Hayes  Don Skeggs
Charles Couillas  Gil Hayward  David Stanley
Ron Clayton  Mark Hyman  Derek Turton
Adrian Cole  John Lloyd  Richard Watson
Rob Dickson  Peter Merriman  John Whetler

Bletchley Park
Mark I, Harvard
Mark I, Harvard
The logicians

Mark II,
Harvard
0800  Andam started
   stopped - andam ✓
1000  13°C (033) MP - MC
       (033) PRO 2
       condc 2.130476415

Relays 6-2 in 033 failed special speed test
in relay.
Relays changed

1100  Started Cosine Tape (Sine check)
1525  Started Multi Adder Test.

1545  Relay #70 Panel F
       (moth) in relay.

First actual case of bug being found.

#3/630  andam started.
1700  closed down.
SECONDARY
THE IBM ZOÏC
(1950-1980)
Multics

- IBM 704, 7040, 360/370
- SDS 940 (Lampson)
- GE 645, Multics; MIT, Bull

- batch processing, time sharing
- 10 to 100 users / computer
- electronic mail
Unix, the nirvanha of programmers

- simplification of Multics
- modular “small is beautiful”
- AT&T Bell laboratories
- theoreticians AND practitioners
- system of hackers for hackers
- pdp 11; Vax 780/750
Run programs

• programming languages
• write correct programs
• find simple algorithms
• moreover efficient

Jean Ichbiah
Don Knuth
Steve Cook
P=NP ?
vax 11/780
TERNARY
THE WINDOZOÏC
(1980-2000)
The garage

• intel 4004
• Xerox PARC (alto, dorado)
• the Apple garage (apple II, lisa, macintosh)
• IBM PC (ms-dos)

• selfish vision
• everyone has his own computer
• all is in user interface
Microsoft

• computer in each home
• bureautics (Word, Excel, Powerpoint)
• editor of software, no hardware
• improvements in systems (NT, 95, XP, Vista, …)

• Dave Cutler (DEC-VMS, NT)

Charles Simonyi
Linux and free software

• Emacs, extendible text editor
• gcc, C compiler of the Free Software Foundation
• Linux = Unix redone by Linus Tordsvald
• everyone participates to Linux
• source is public but invasive
• high quality software
A Personal Computer for Children of All Ages

Alan C. Kay
Xerox Palo Alto Research Center

Abstract

This note speculates about the emergence of personal, portable information manipulators and their effects when used by both children and adults. Although it should be read as science fiction, current trends in miniaturization and price reduction almost guarantee that many of the notions discussed will actually happen in the near future.

What we would like to do in this brief note is to discuss some aspects of the learning process which we feel can be augmented through technological media. Most of the notions have at their root a number of theories about the child that lie much closer to Piaget than to Skinner. We feel that a child is a "verb" rather than a "noun" or actor rather than an object, he is not...
Distributed calculations

- \( F_9 = 2^{512} + 1 \)

\[
= 13407807929942597099574024998205846127479365820592393377723561443721764030073546976801874298166903427690031858186486050853753882811946569946433649006084097
\]

\[
= 2424833 \\
\times 7455602825647884208337395736200454918783366342657 \\
\times 741640062627530801524787141901937474059940781097519023905821316144415759504705008092818711693940737
\]

- 100 machines during 1 month [Manasse, Lenstra, 1990].
QUATERNARY

THE GOOGLOÏC

(2000-2018)
1 - Internet (1/3)

- arpanet (1970), ethernet - cyclades (1975)
- 1 billion of internauts (2007)
- web 30%, p2p 30%, mail 2% of traffic (2007)
- 25% of phone is on IP
1 - Internet (2/3)

- 33 M internauts in France (2007)
- 53 M internauts in France (2018)
1 - Internet (3/3)

DIGITAL AROUND THE WORLD IN 2018
KEY STATISTICAL INDICATORS FOR THE WORLD’S INTERNET, MOBILE, AND SOCIAL MEDIA USERS

- **TOTAL POPULATION**: 7.593 billion
- **INTERNET USERS**: 4.021 billion
- **ACTIVE SOCIAL MEDIA USERS**: 3.196 billion
- **UNIQUE MOBILE USERS**: 5.135 billion
- **ACTIVE MOBILE SOCIAL USERS**: 2.958 billion

**Urbanisation**: 55%
**Penetration (Internet)**: 53%
**Penetration (Social Media)**: 42%
**Penetration (Mobile)**: 68%
**Penetration (Mobile Social)**: 39%
2 - Indexers (1/2)

• data is ubiquitous
• internet is the property of everybody
• data are no longer localized
• need for indexing (google, baidu, bing ...)

Louis Monier
Mike Burrows
altavista
2 - Google (2/2)

- global search
- hired most of Unix team from Bell labs
- 15 centers with global data
- ~1 million of servers
- net services (mail, calendar, maps)
3 - Smart phones

- Ericsson, Nokia, LG, Samsung, Blackberry
- iPhone (2007) with tactile interface
- Integration of music, photo, and video
- Net services
- AppStore (iPhone), Googleplay
4 - Social networks

- youtube (2004), facebook (2005), IG, twitter, ...
- whatsapp, viber, wechat, skype
- wikipedia
Impact on economy

- online shops (Amazon, eBay, Taobao, ..)
- Apple = Netherlands, Google = Belgium, ..
- management of companies
- engineering
- medical apps
- computational sciences
- banking (applepay, alipay, wechatpay, bitcoin)
- (distributed) games
Networks — Distribution

- security (secrecy, authentication, integrity)
- distribution of data (public Clouds)
- distribution of computing
- sensors
- energy
FUTURE
(2019- ??)
Future?

- Computers may disappear
- Software will be still present
- Sensors everywhere
- Medical apps
- Programming bio cells
- Computer science and environment
- Working AI
- ???
Computer Science is THE invention of 20th century