UC Berkeley
Computer Science
Lecturer SOE
Dan Garcia

CS10
The Beauty and Joy of Computing

Lecture #13
Applications That Changed The World

2011-10-17

STUNNING GRAPHICS ENGINE

Square Enix demo-ed their new *Luminous* graphics engine. Cornell Box realism but in real time!

http://www.pcgamer.com/2011/10/13/square-enix-show-off-stunningly-realistic-graphics/

Lecture Overview

- What counts?
- For each application
  - Historical context
    - What world was like before
    - On what shoulders does it stand?
  - Key players
    - Sometimes origins fuzzy
  - How it changed world
- Summary

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www.greatachievements.org

Applications that Changed the World

- **Lots of applications changed the world**
  - Electricity, Radio, TV, Cars, Planes, AC, …
- **We'll focus on those utilizing Computing**
- **Important to consider historical apps**
  - Too easy to focus on recent N years!

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When did the 1st computer debut?

a) ~1930
b) ~1940
c) ~1950
d) ~1960
e) ~1970

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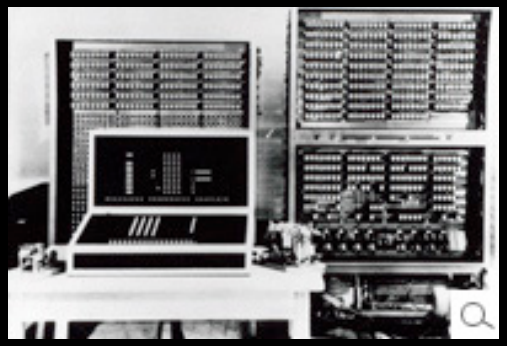
www.computerhistory.org/timeline

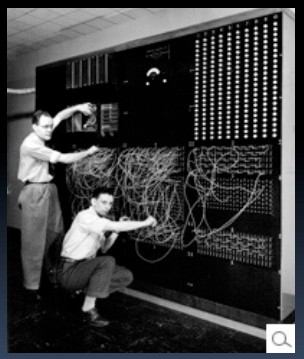
The Computer (1940s)

- **Early Inventions**
  - Bell Labs' CNC '39
  - Konrad Zuse's Z3 '41
  - Harvard's Mark-1 '44
  - Eckert & Mauchly's ENIAC '46
- **Early Theoreticians**
  - Shannon's theories
  - Turing's computability, AI
- **History : entire museum**
  - Lots of incremental progress
  - Early ones size of house
- **Everything today owes its success to this**

CNC



Z3



Mark-1

ENIAC

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en.wikipedia.org/wiki/History_of_the_transistor

The Transistor ("born" 1947-12-23)

- **Semiconductor device to <u>amplify</u> or <u>switch</u> signals**
  - Key component in ALL modern electronics
- **Who?**
  - John Bardeen, William Shockley, Walter Brattain
- **Before that?**
  - Vacuum Tubes
- **After that?**
  - Integrated circuit, microprocessor

"The Transistor was probably THE most important invention of the 20th Century"
- Ira Flatow, Transistorized! (PBS Special)

www.pbs.org/transistor
www.youtube.com/watch?v=-td7YT-Pums
www.youtube.com/watch?v=ZaBLiciesOU

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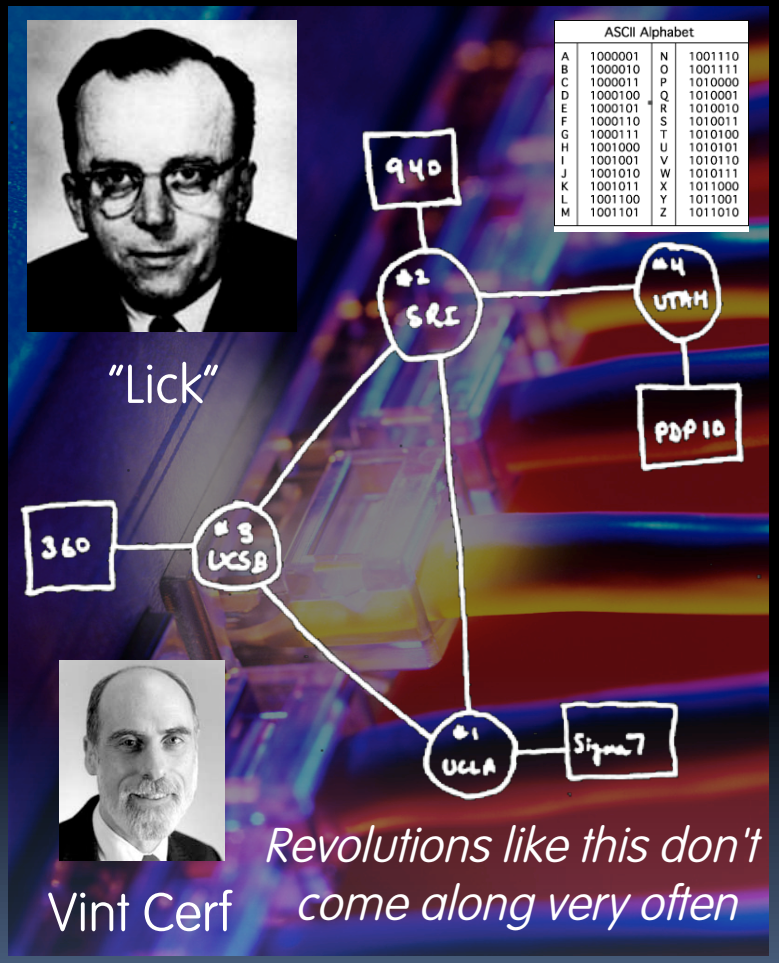
www.computerhistory.org/internet_history

The Internet (1962)

- **Founders**
  - JCR Licklider, as head of ARPA, writes on "intergalactic network"
  - 1963 : ASCII becomes first universal computer standard
  - 1969 : Defense Advanced Research Projects Agency (DARPA) deploys 4 "nodes" @ UCLA, SRI, Utah, & UCSB
  - 1973 Robert Kahn & Vint Cerf invent TCP, now part of the Internet Protocol Suite
- **Internet growth rates**
  - Exponential since start!



www.greatachievements.org/?id=3736

en.wikipedia.org/wiki/Internet_Protocol_Suite

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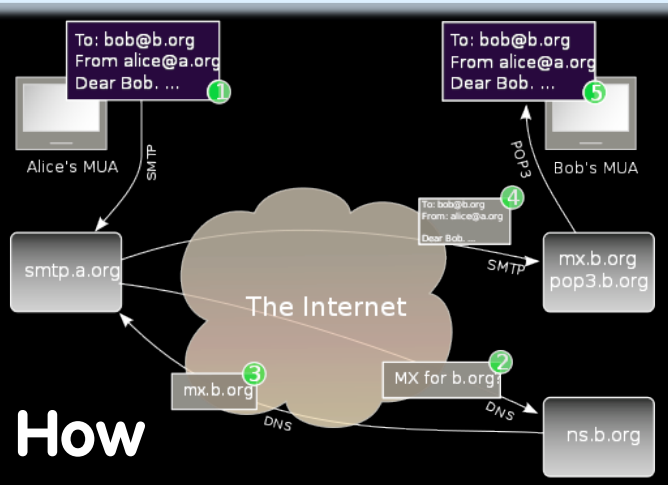
en.wikipedia.org/wiki/Email

Email (1965)

- **Fundamentally changed the way people interact!**
- **1965: MIT's CTSS**
  - Compatible Time-Sharing Sys
- **Exchange of digital info**
  - Model: "Store and Forward"
  - "Push" technology
- **Pros**
  - Solves logistics (where) & synchronization (when)
- **Cons**
  - "Email Fatigue"
  - Information Overload
  - Loss of Context



- **How**
  - Alice composes email to bob@b.org
  - Domain Name System looks up where b.org is
  - DNS server with the mail exchange server for b.org
  - Mail is sent to mx.b.org
  - Bob reads email from there

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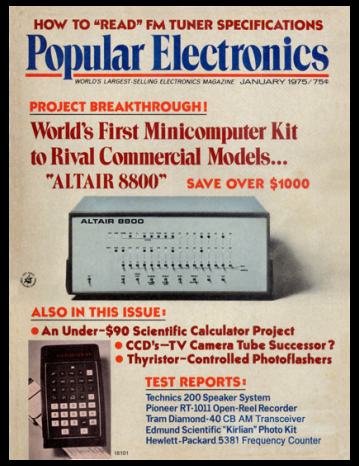
www.greatachievements.org/?id=3989 www.blinkenlights.com/pc.shtml

The Personal Computer (1970s)

- First PCs sold as kits to hobbyists
  - Altair 8800 (1975)
- Early mass-prod PCs
  - Apple I, II (Jobs & Woz)
  - Commodore PET
  - IBM ran away w/market
- Microprocessor key
- Laptops → portability
- Created industry, wealth
  - Silicon Valley!
  - Bill Gates worth $50 Billion



Altair 8800

Apple II

Commodore PET

IBM PC

en.wikipedia.org/wiki/Personal_computer

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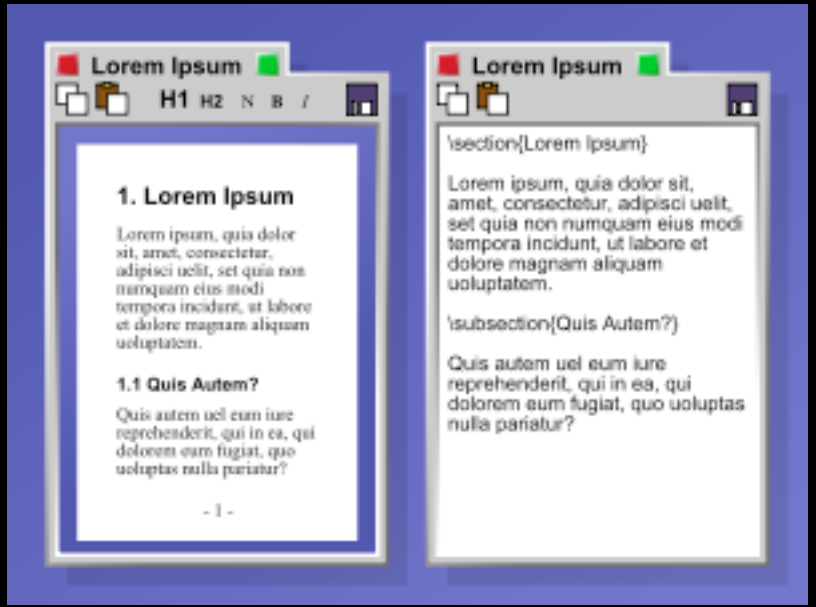
en.wikipedia.org/wiki/{Wysiwyg, WIMP_(computing)}

WIMP, WYSIWYG Interface (1973)

- **WIMP: Window, Icon, Menu/Mouse, Pointer**
  - Dominant style of Human-Somputer Interaction (HCI)
  - Contrast with a command-line interface it replaced
  - Both developed at Xerox PARC 1973, popularized by Apple's Mac computers 1984
- **WYSIWYG: What You See Is What You Get**
  - Display shows printed result
  - Before this, commands →
  - Even today, both WYSIWYG and non- available



"The program on the left uses a WYSIWYG editor to produce a document. The program on the right contains LaTeX code, which when compiled will produce a document that will look very similar to the document on the left."

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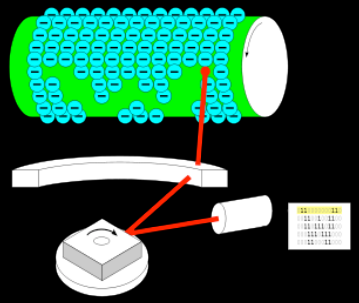
en.wikipedia.org/wiki/Laser_printer

The Laser Printer ('69), Postscript ('82)

- **Gary Starkweather @ Xerox invented it**
  - Modified an existing Xerox
  - Laser beam projects image onto electrically charged rotating drum
- **Picture is commands!**
  - John Warnock, founder of Adobe, invented Postscript
  - Turing-complete language!
  - The processor on the printer rasterized the image
    - Commands → Image bits on/off
- **Professional-quality output in hands of people**

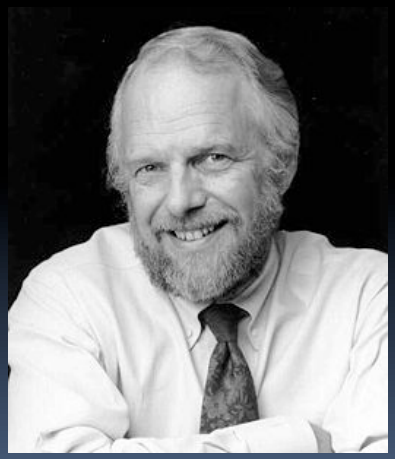
Gary Starkweather



How it works

```
%!PS
/Courier findfont
20 scalefont
setfont
72 500 moveto
(Hello world!) show
showpage
```

Adobe® PostScript® 3™



John Warnock

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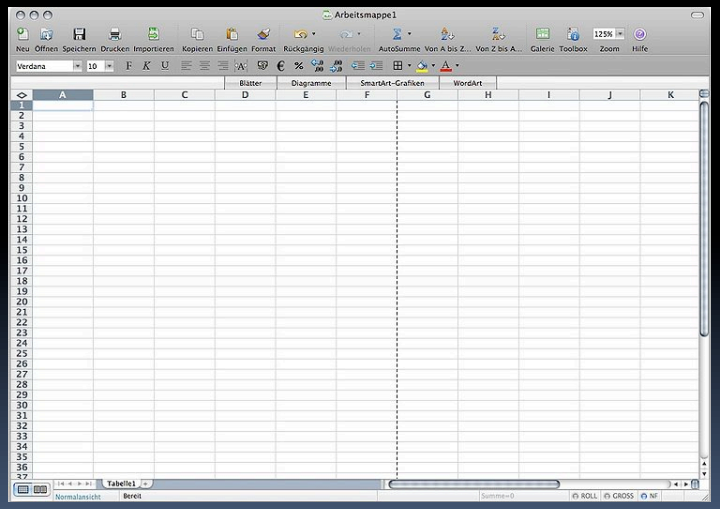
en.wikipedia.org/wiki/Spreadsheet

The Spreadsheet (1961, 1980)

- **Grid of rows and columns, with each cell a formula or data**
  - Simulates a paper worksheet
  - Commonly used for financial information (& grades!)
- **History**
  - Richard Mattessich 1961 paper
    - "Budgeting Models & System Simulation"
  - VisiCalc (by Dan Bricklin) helped drive the sales of Apple II ~1980
  - Lotus 1-2-3 with DOS in 1981
  - Excel the current market leader
- **Now online (Google Docs)**

VisiCalc, the first PC spreadsheet (1970s)



Microsoft Excel (2008)

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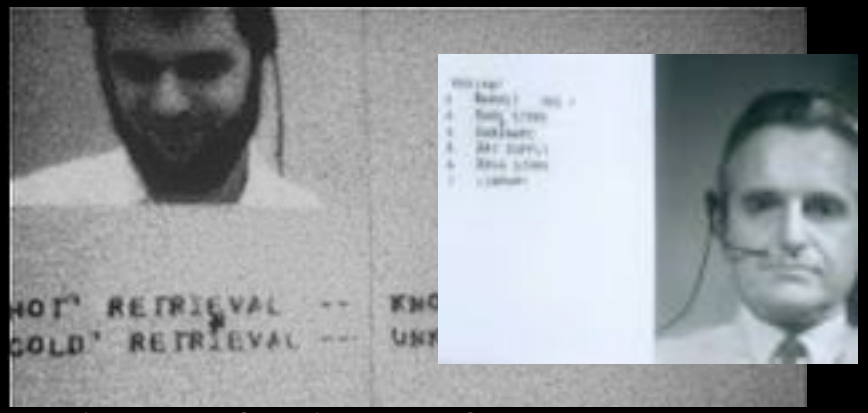
en.wikipedia.org/wiki/Videoconferencing

Audio/Videoconferencing (1980s)

- **History**
  - 1936 : closed-circuit TV
  - 1968 : Englebart's "Mother of All Demos"
  - 1980s : Digital Telephony (via ISDN)
  - 1990s : Internet Protocol (IP) based videoconferencing
- **Impact**
  - For some businesses, essential (e.g., Dreamworks)
  - Big with grandparents, sign language communication
  - Telemedicine
  - Education impact huge



First demo of videoconferencing in 1968

T3 ultra-high resolution telepresence

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en.wikipedia.org/wiki/History_of_the_World_Wide_Web

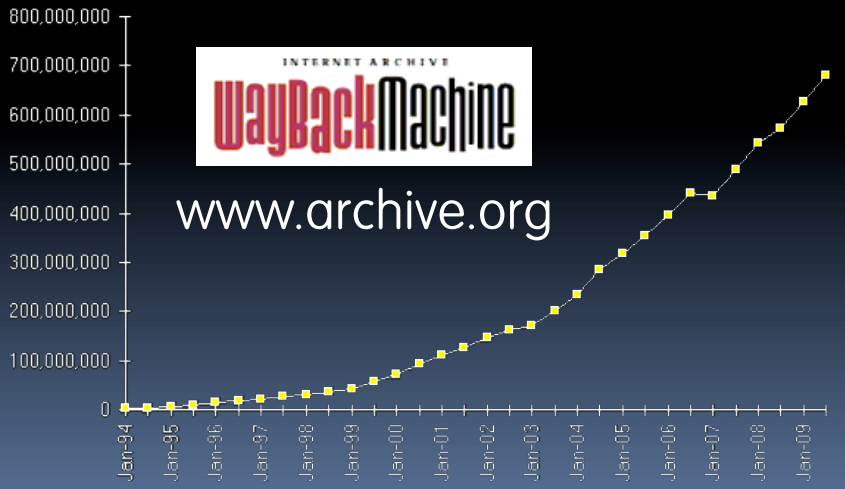
The World Wide Web (1989)

- "System of interlinked hypertext documents on the Internet"
- History
  - 1945: Vannevar Bush describes hypertext system called "memex" in article
  - 1989: Tim Berners-Lee proposes, gets system up '90
  - ~2000 Dot-com entrepreneurs rushed in, 2001 bubble burst
- Wayback Machine
  - Snapshots of web over time
- Today : Access anywhere!

Tim Berners-Lee

World's First web server in 1990

Internet Domain Survey Host Count



INTERNET ARCHIVE WayBackMachine

www.archive.org

Source: Internet Systems Consortium (www.isc.org)

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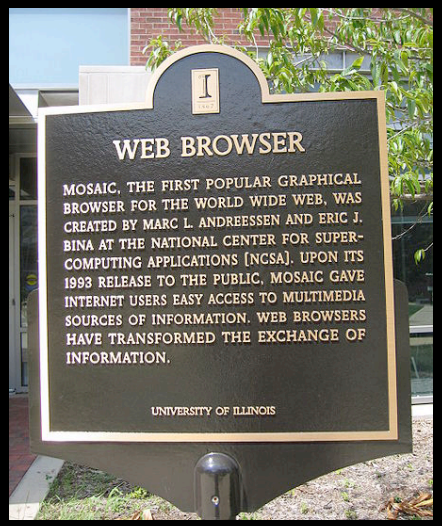
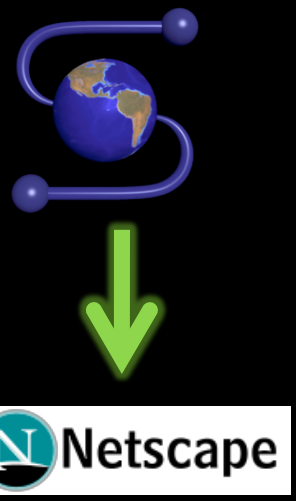
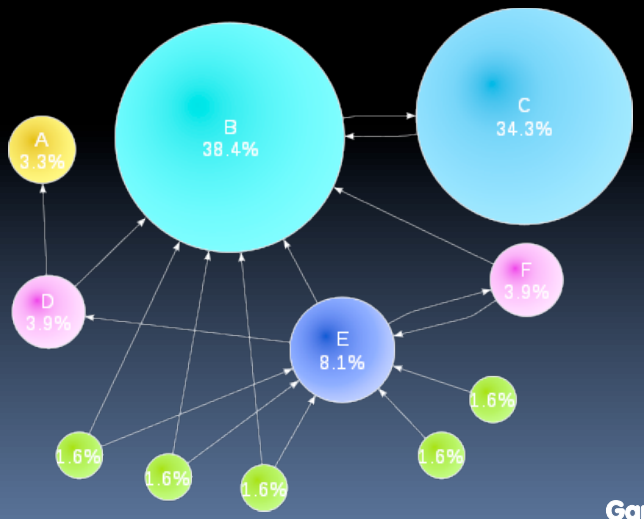
en.wikipedia.org/wiki/History_of_the_web_browser

WWW Search & Browser (1993)

- **Browser**
  - Marc L. Andreesen and Eric J. Bina @ NCSA create Mosaic, 1st popular WWW browser
    - First Internet "Killer App"
    - Later: Netscape Navigator
  - Now IE (23%), Firefox (30%)
- **Search**
  - Before engines, there was a complete list of all servers!
  - 1993 Martijn Koster Aliweb is 1st web search engine
  - 1997 Stanford Sergey Brin and Larry Page develop Google's search, based on PageRank (each: $16 Billion)







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en.wikipedia.org/wiki/Web_2.0

Web 2.0 : The Social Network (2004)

- **"…web development & design that facilitates interactive information sharing, interoperability, user-centered design and collaboration on WWW"**
  - Users change content via "architecture of partipation"
- **Examples**
  - Web communities, apps, social networks, video & photo sharing, wikis, blogs, tweets, …
- **"Take back the web!"**

"You" – Time's 2006 Person of the Year

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en.wikipedia.org/wiki/{Web_mapping, Gps}

Web Mapping (1993)

- **"Designing, implementing, generating and delivering maps on the WWW"**
- **Advantages**
  - Mobile computing + GPS means you're never lost again!
  - Real-time traffic!!
  - Collaborative maps have lots of potential (E.g., WikiMapia)
  - Street view can allow you to see what it looks like on the ground
  - Can have hyperlinking, yet another way to connect to web
  - Can layer content, many uses!

Different views of this classroom

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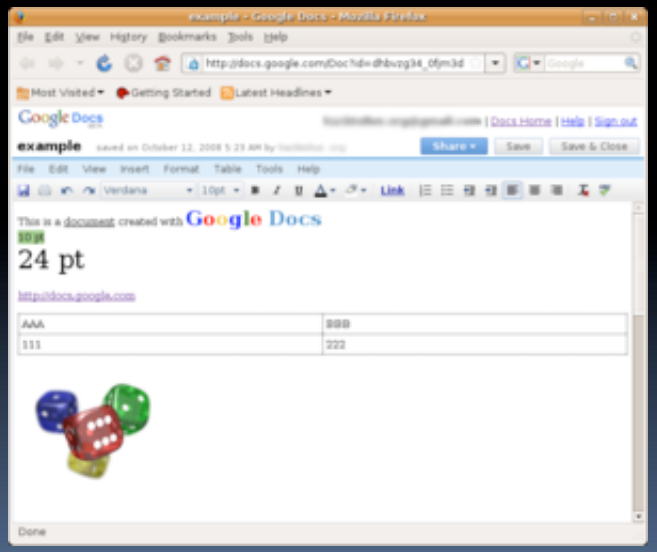
en.wikipedia.org/wiki/Google_Docs

Google Docs, SW as a Service (2006)

- Free, web-based word processor, spreadsheet, presentation and form application
- Single source of truth!
- Fundamentally changing the way people collaboratively author documents
  - No more attachments and versions!!
  - Much better than Wikis, which are not WYSIWYG, so folks grabs local temp copy



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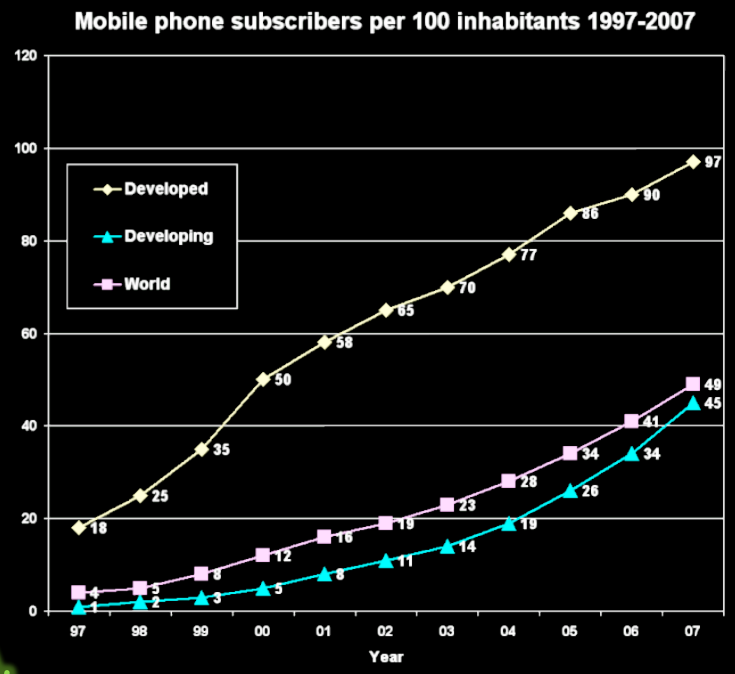
en.wikipedia.org/wiki/{Personal_digital_assistant, Mobile_phone, Texting}

The Mobile Phone, PDA & Texting

- **History of Cell Phones**
  - 1908: Nathan Stubblefield patents wireless telephone
  - 1945: 0G introduced
  - 1983: Motorola DynaTAC 1st FCC-approved phone
- **PDA: handheld computer**
  - 1983: First PDA (Casio)
  - Phones became "smart"
- **Texting (short messages)**
  - Most popular mobile service
  - Has affected language…gr8!



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What's the most important in your life?

a) Cell Phone
b) Videoconferencing
c) Email
d) Facebook
e) Web search

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Summary

- **How many of the 21st cent engineering achievements are happening today?**
- **What's the next big thing?**
  - Natural language processing?
  - 3D displays?
  - Robotics? Self-driving cars?
  - Optical or quantum computing?
  - Personal air vehicle?
  - Space travel?
  - Computer displays in glasses?
  - Flexible displays?
  - Brain machine interfaces?
  - Energy!

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