



CS10

The Beauty and Joy of Computing

Lecture #18: Applications That Changed The World

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COURSERA GOES BIG

Now 16 schools including Caltech and UPenn as investors. Online education is gaining legitimacy and research focus (see also Udacity and edX).

<http://huff.to/NGAUws>

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



Applications that Changed the World

- Lots of technologies 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!



When did the 1st computer debut?



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



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

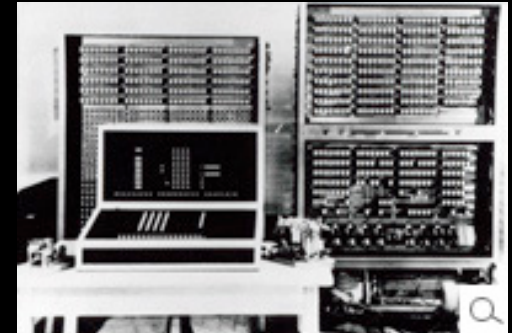
- **History : entire museum**

- Lots of incremental progress
- Early ones size of house

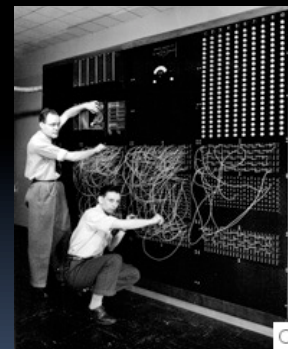
- **Everything today owes its success to this**



CNC



Z3



Mark-1



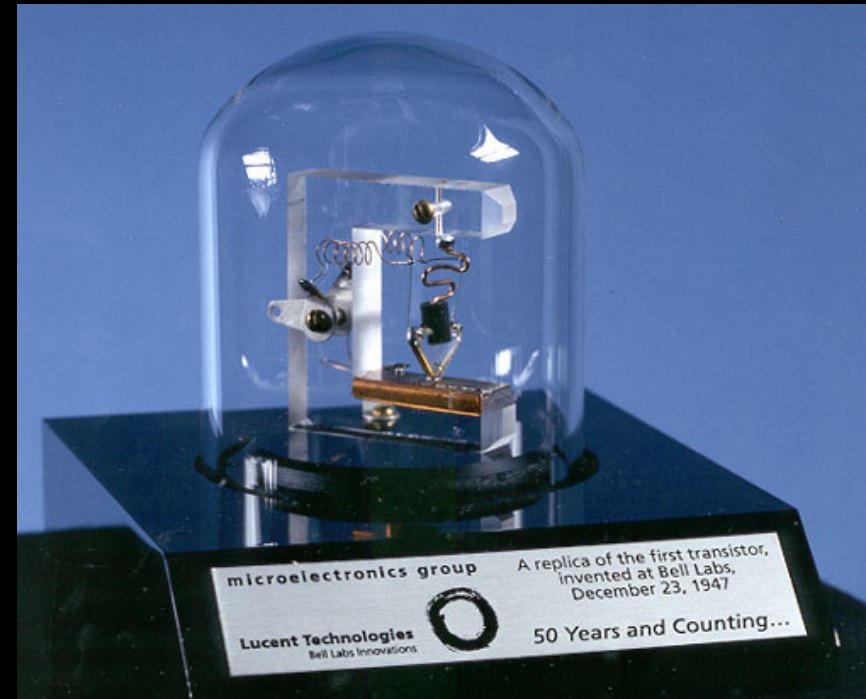
ENIAC



en.wikipedia.org/wiki/History_of_the_transistor

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

- Semiconductor device to amplify or switch 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



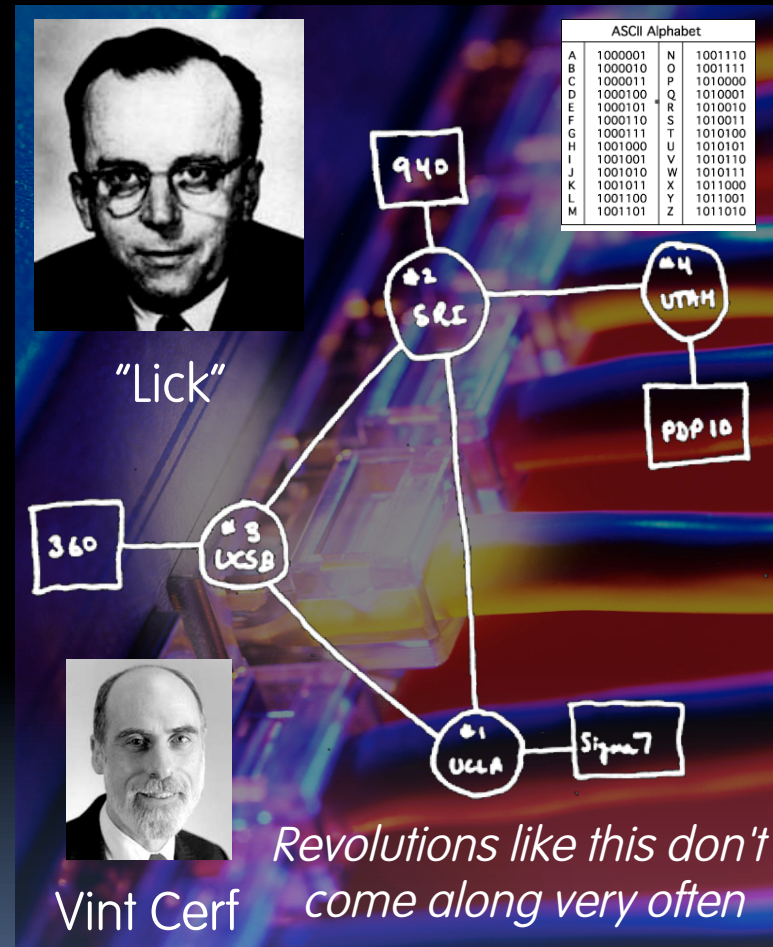
The Internet (1962)

■ 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!

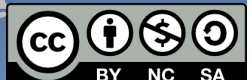


www.greatachievements.org/?id=3736

en.wikipedia.org/wiki/Internet_Protocol_Suite

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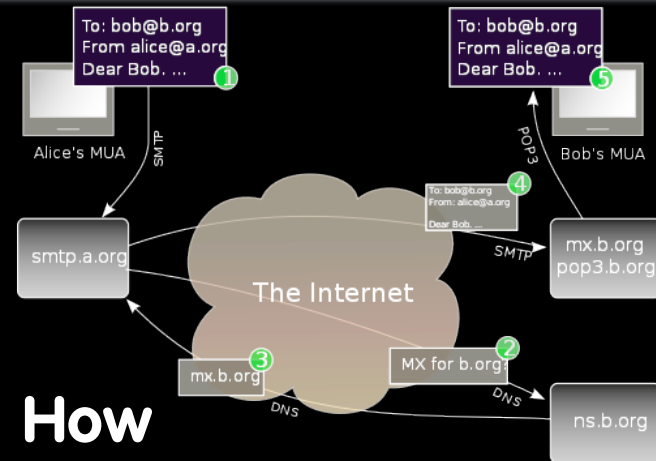


Email (1965)

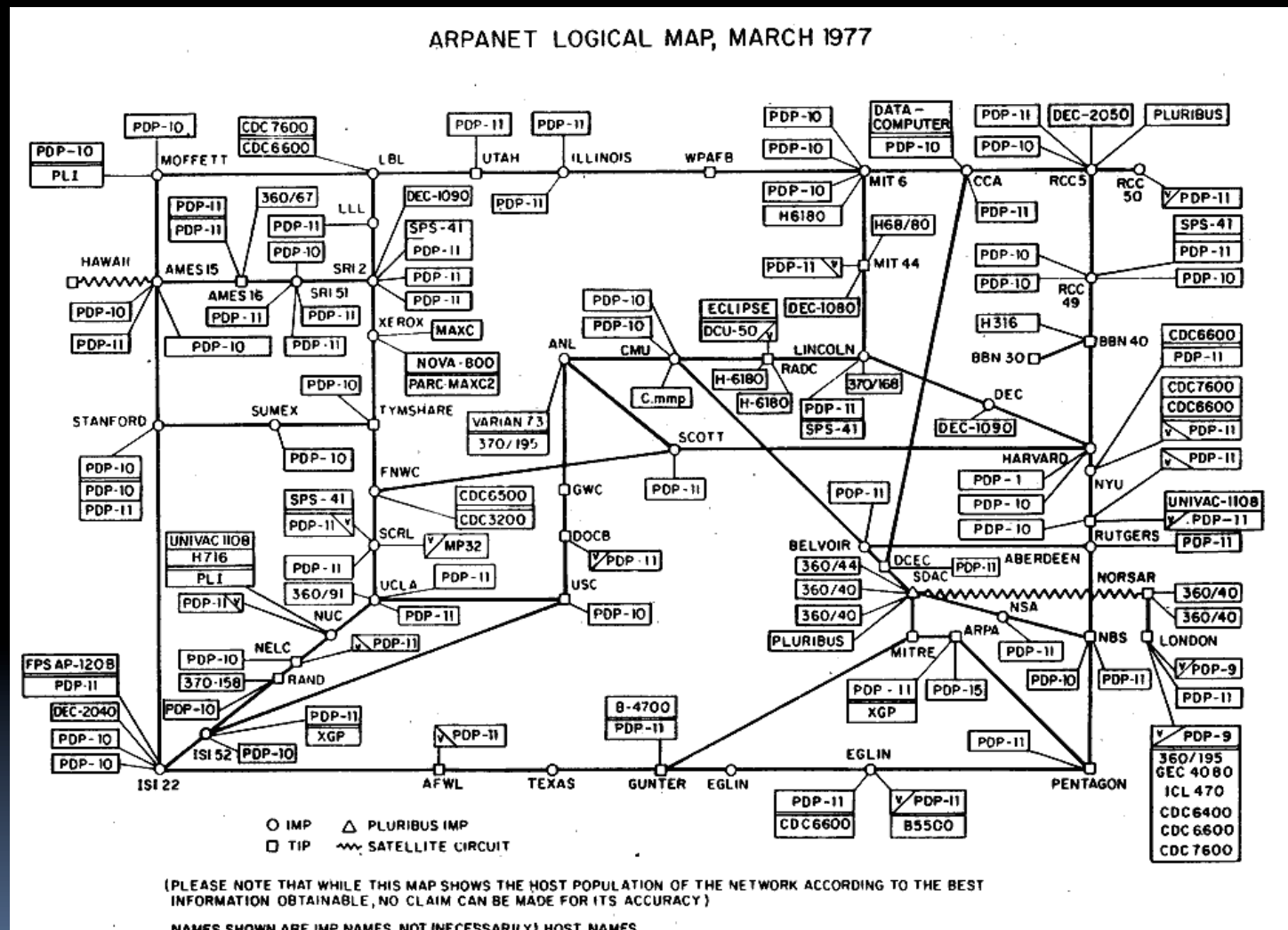
- **Fundamentally changed the way people interact!**
- **1965: MIT's CTSS**
 - Compatible Time-Sharing Sys
- **Exchange of digital info**
 - Model: "Store and Forward"
 - "Push" technology
- **Pros**
 - Solves logistics (where) & synchronization (when)
- **Cons**
 - "Email Fatigue"
 - Information Overload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



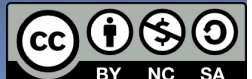
ARPANET in 1977



en.wikipedia.org/wiki/ARPANET

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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 was key
- Laptops → portability
- Created industry, wealth
 - Silicon Valley!
 - Bill Gates worth \$60 Billion



Altair 8800



Apple II



Commodore PET



IBM PC



en.wikipedia.org/wiki/Personal_computer

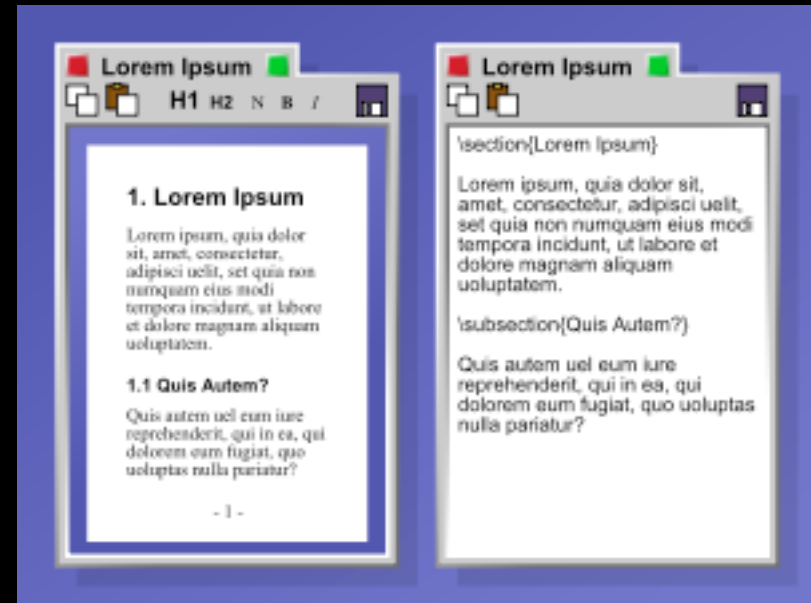
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WIMP, WYSIWYG Interface (1973)

- **WIMP: Window, Icon, Menu/Mouse, Pointer**
 - Dominant style of Human-Computer 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."

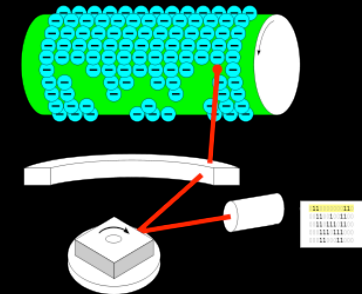


The Laser Printer ('69), Postscript ('82)

- 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

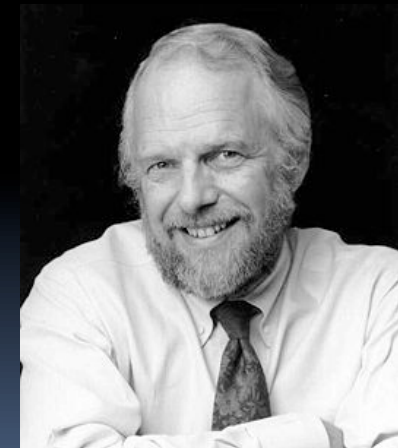


How it works

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



Adobe® PostScript® 3™



John Warnock

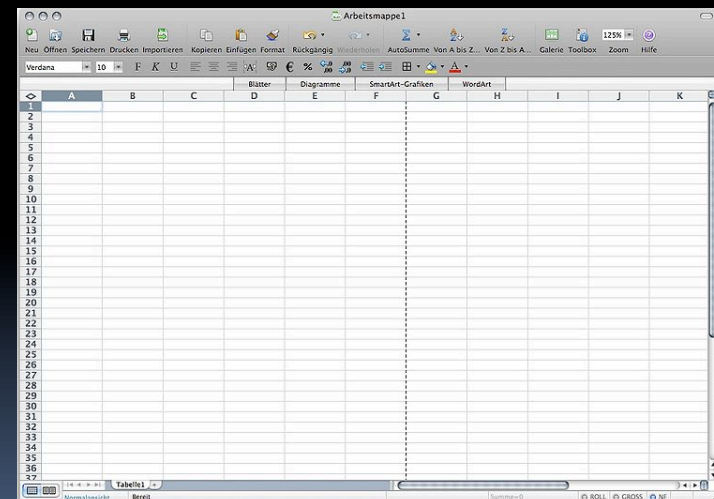


The Spreadsheet (1961, 1980)

- 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)



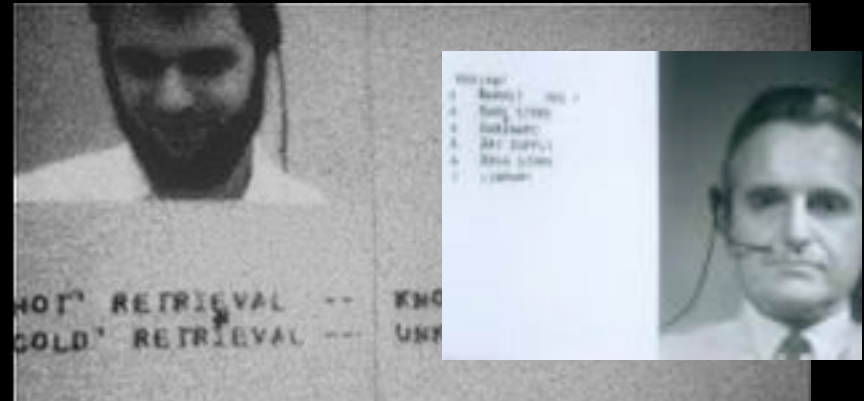
Audio/Videoconferencing (1980s)

■ 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



Cisco T3 ultra-high resolution telepresence



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
 - Late 1990s: Dot-com boom
 - 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



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

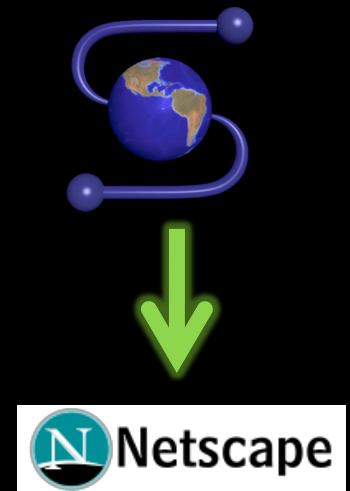
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WWW Search & Browser (1993)

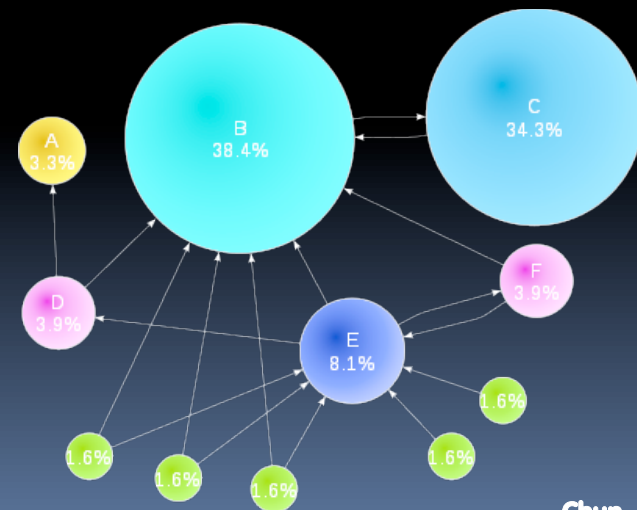
■ Browser

- Marc Andreessen 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: \$18 Billion)



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 participation”

- **Examples**

- Web communities, apps, social networks, video & photo sharing, wikis, blogs, tweets, ...

- **“Take back the web!”**

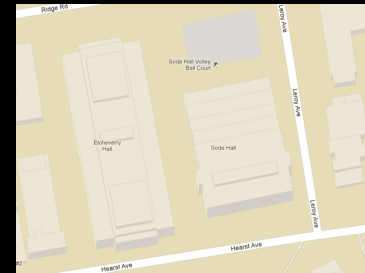


“You” – Time’s 2006 Person of the Year



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!

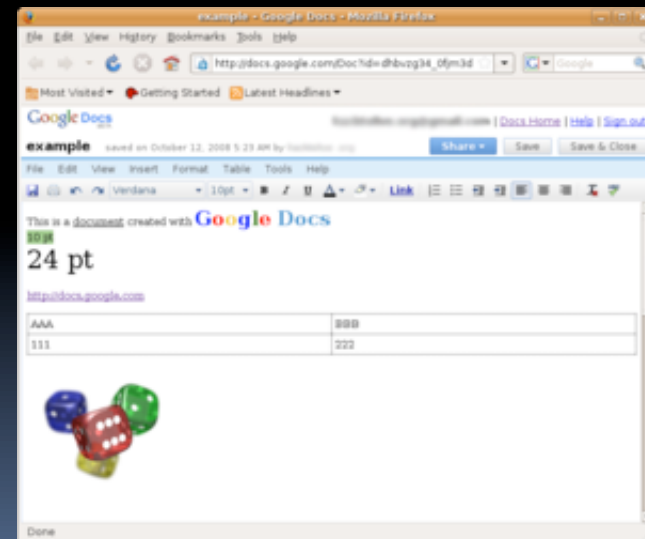


Different views of Soda Hall



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 grab local temp copy



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

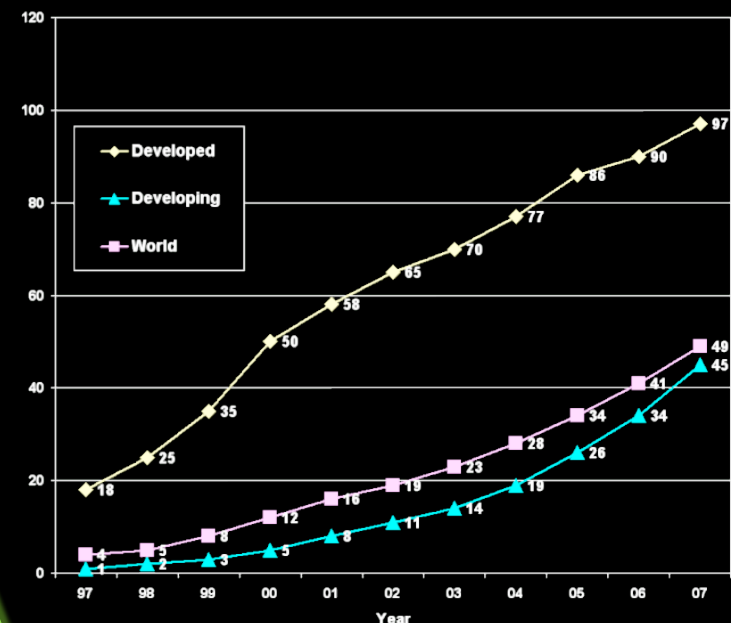
■ PDA: handheld computer

- 1983: First PDA (Casio)
- Phones became "smart"

■ Texting (short messages)

- Most popular mobile service
- Has affected language...brb

Mobile phone subscribers per 100 inhabitants 1997-2007



What's the most important in your life?



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



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?
 - Computer displays in glasses?
 - Flexible displays?
 - Brain machine interfaces?
 - Energy/climate sim?
 - Education?
- CS is an entry point!

