# CS39N
# The Beauty and Joy of Computing

## Lecture #7
## Applications That Changed The World

### 2009-10-05

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Computer Science
Lecturer SOE
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## INTEL TO REPLACE COPPER WIRES

We've all heard of "Fiber Optic" cables, using photons instead of electrons to transport data. That's great for long distances, but copper wiring is still used for short distances. Intel hopes to change that with its prototype "Light Peak" cables, which will be lighter & cheaper with higher bandwidth.

technologyreview.com/computing/23523/

# 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 applications changed the world**
  - Electricity, Radio, TV, Cars, Planes, AC, ...
- **We'll focus on those utilizing <u>Computing</u>**
- **Important to consider historical apps**
  - Too easy to focus on recent N years!

# 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
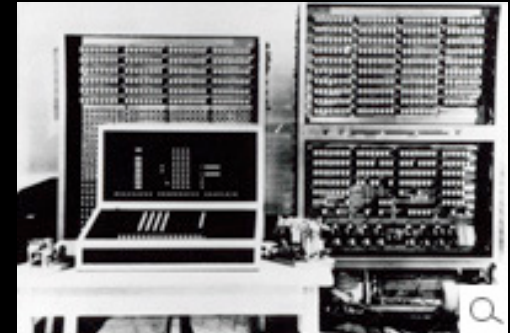  - Turing's computability, AI
- **History : entire museum**
  - Lots of incremental progress
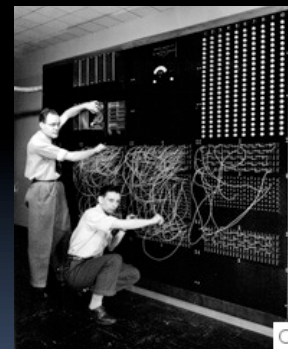  - Early ones size of house
- **Everything today owes its success to this**
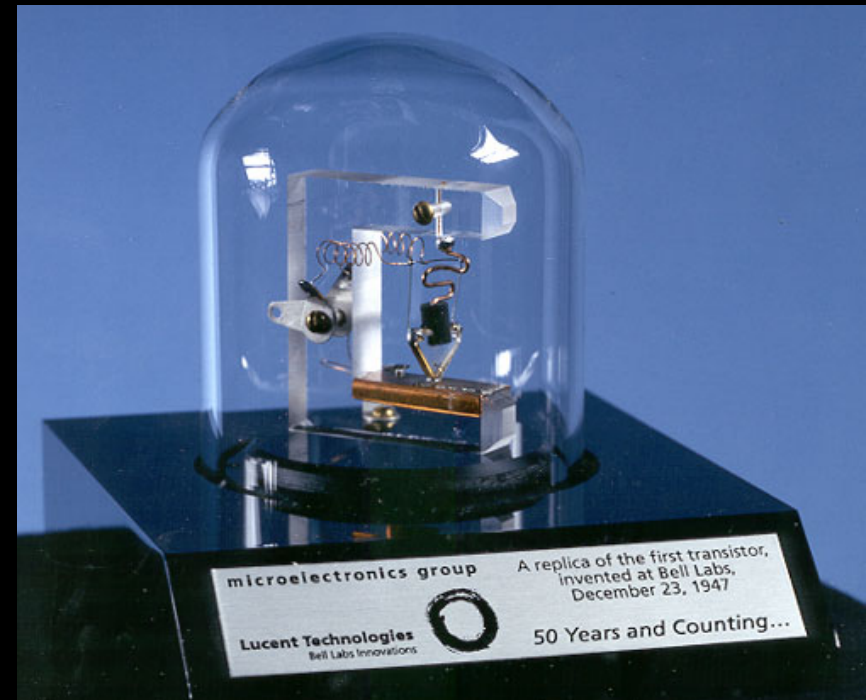
CNC

Z3

Mark-1

ENIAC

# 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

# 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 <u>TCP</u>, now part of the <u>Internet Protocol Suite</u>

- ## Internet growth rates
  - Exponential since start!

"Lick"

Vint Cerf

*Revolutions like this don't come along very often*

www.greatachievements.org/?id=3736
en.wikipedia.org/wiki/Internet_Protocol_Suite

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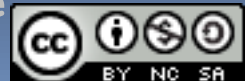
# Email (1965)

- **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
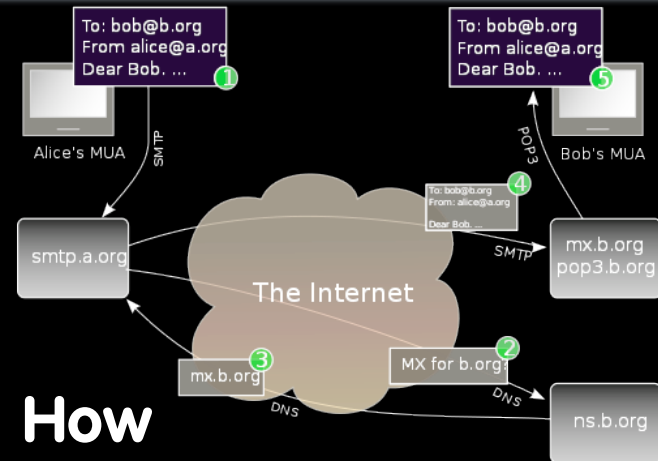


- **How**
  - Alice composes email to bob@b.org
  - Domain Name System looks up where b.org is
  - DNS server with the mail exchange server for b.org
  - Mail is sent to mx.b.org
  - Bob reads email from there

# 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

UC Berkeley CS39N "The Beauty and Joy of Computing" : Applications that Changed the World (8)

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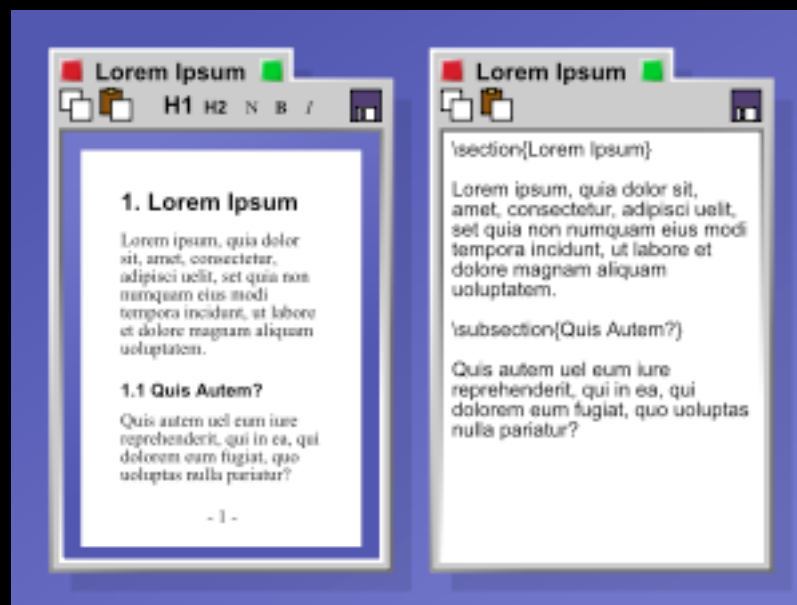
*"The program on the left uses a WYSIWYG editor to produce a document. The program on the right contains LaTeX code, which when compiled will produce a document that will look very similar to the document on the left."*

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

- **Gary Starkweather @ Xerox invented it**
  - Modified an existing Xerox
  - Laser beam projects image onto electrically charged rotating drum

Gary Starkweather

How it works

- **Picture is <u>commands</u>!**
  - John Warnock, founder of Adobe, invented <u>Postscript</u>
  - Turing-complete language!
  - The processor on the printer <u>rasterized</u> the image
    - Commands → Image bits on/off

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

Adobe® PostScript® 3™

John Warnock

- **Professional-quality output in hands of people**
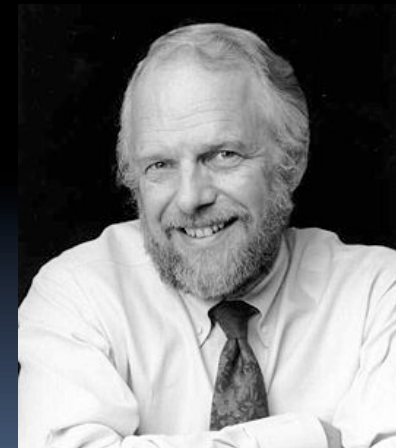
# The Spreadsheet (1961, 1980)

- **Grid of rows and columns, with each cell a formula or data**
  - Simulates a paper worksheet
  - Commonly used for financial information (& grades!)



VisiCalc, the first PC spreadsheet (1970s)

- **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)**
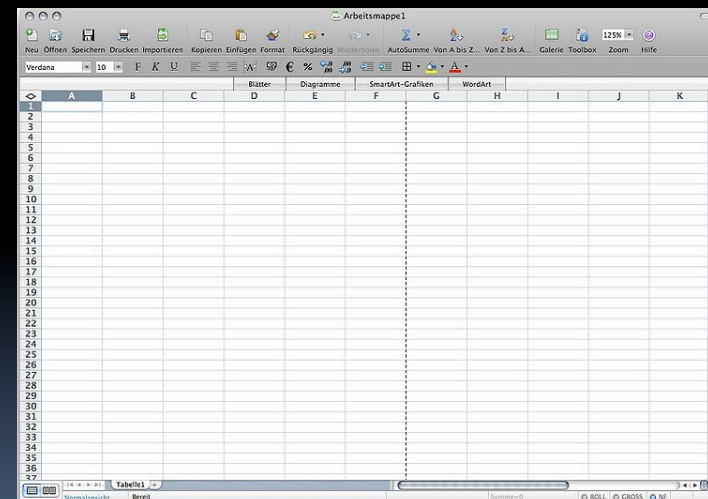


Microsoft Excel (2008)

# 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
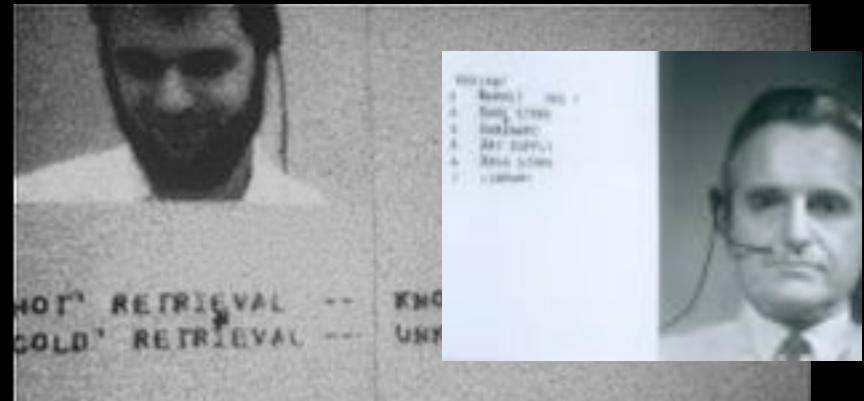


First demo of videoconferencing in 1968



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
  - ~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

800,000,000
700,000,000
600,000,000
500,000,000
400,000,000
300,000,000
200,000,000
100,000,000
0

Jan-94 Jan-95 Jan-96 Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09
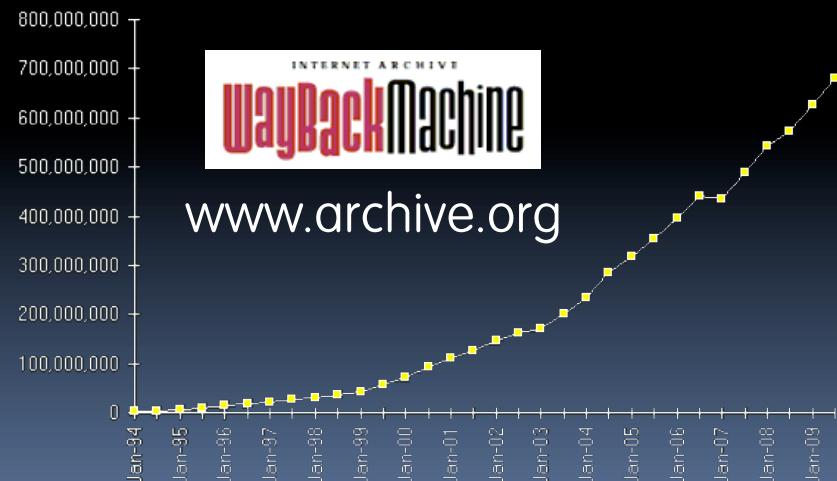
Source: Internet Systems Consortium (www.isc.org)

Garcia, Fall 2009

# 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 (68%), Firefox (22%)

- ## Search
  - □ Before engines, there was a complete list of all servers!
  - □ 1993 Martijn Koster Aliweb is 1st web search engine
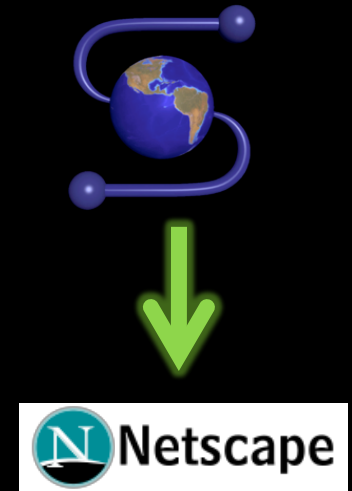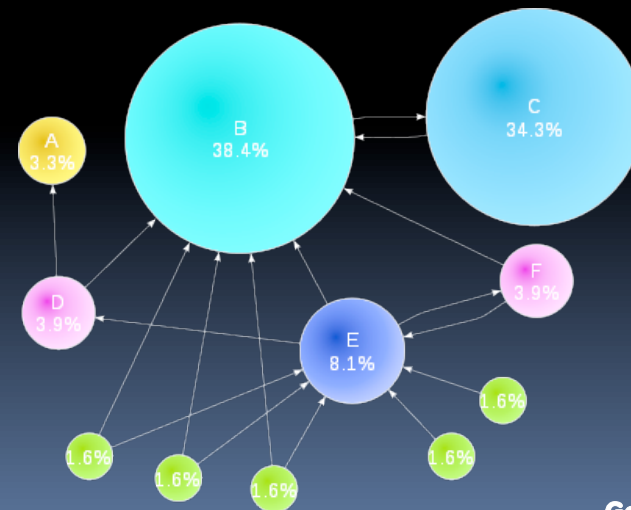  - □ 1997 Stanford Sergey Brin and Larry Page develop Google's search, based on PageRank (each: $12 Billion)

**WEB BROWSER**

MOSAIC, THE FIRST POPULAR GRAPHICAL BROWSER FOR THE WORLD WIDE WEB, WAS CREATED BY MARC L. ANDREESSEN AND ERIC J. BINA AT THE NATIONAL CENTER FOR SUPER-COMPUTING APPLICATIONS (NCSA). UPON ITS 1993 RELEASE TO THE PUBLIC, MOSAIC GAVE INTERNET USERS EASY ACCESS TO MULTIMEDIA SOURCES OF INFORMATION. WEB BROWSERS HAVE TRANSFORMED THE EXCHANGE OF INFORMATION.

UNIVERSITY OF ILLINOIS

Netscape

# 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

# 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!
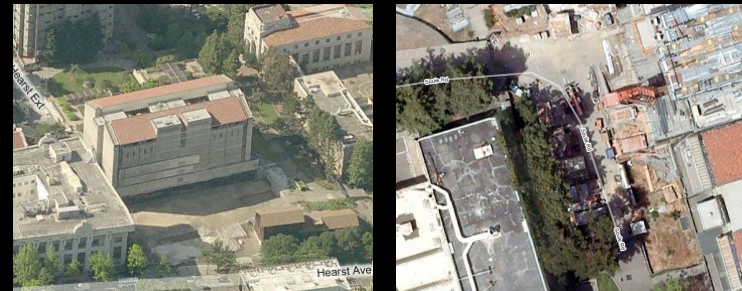


Different views of this classroom

# 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
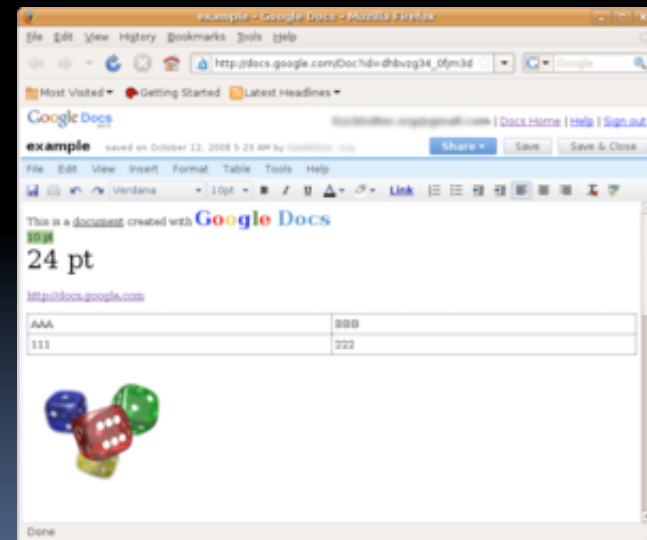
# The Mobile Phone, PDA & Texting

- **History of Cell Phones**
  - 1908: Nathan Stubblefield patents wireless telephone
  - 1945: 0G introduced
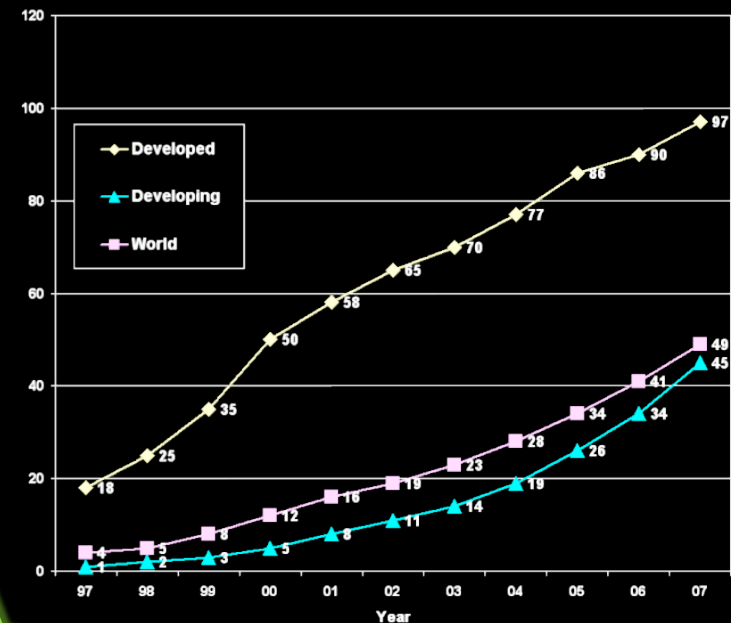  - 1983: Motorola DynaTAC 1$^{st}$ FCC-approved phone

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

- **Texting (short messages)**
  - Most popular mobile service
  - Has affected language...gr8!

**Mobile phone subscribers per 100 inhabitants 1997-2007**



- Developed
- Developing
- World

# 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!