967 Computer History and Hardware

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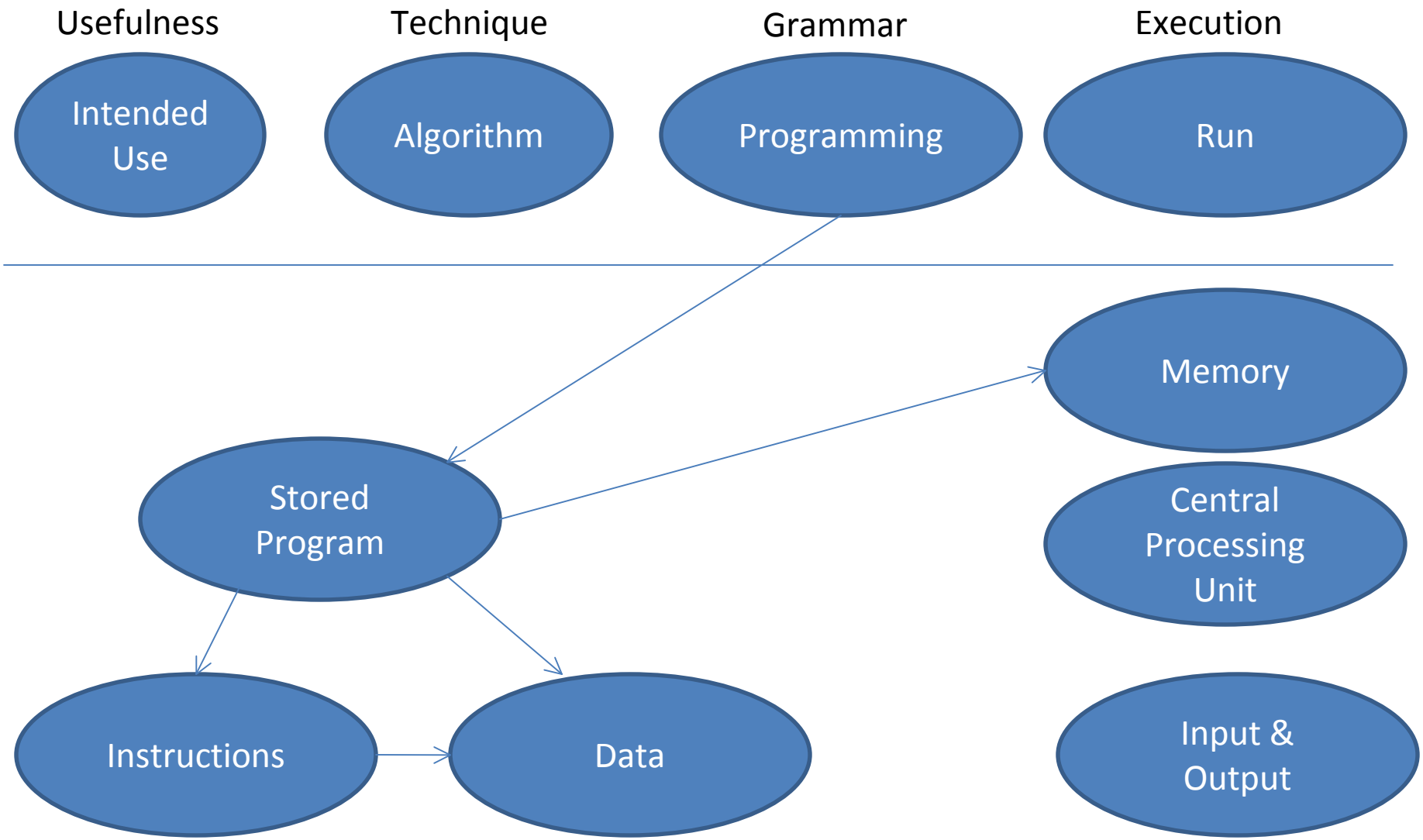
What is a computer?

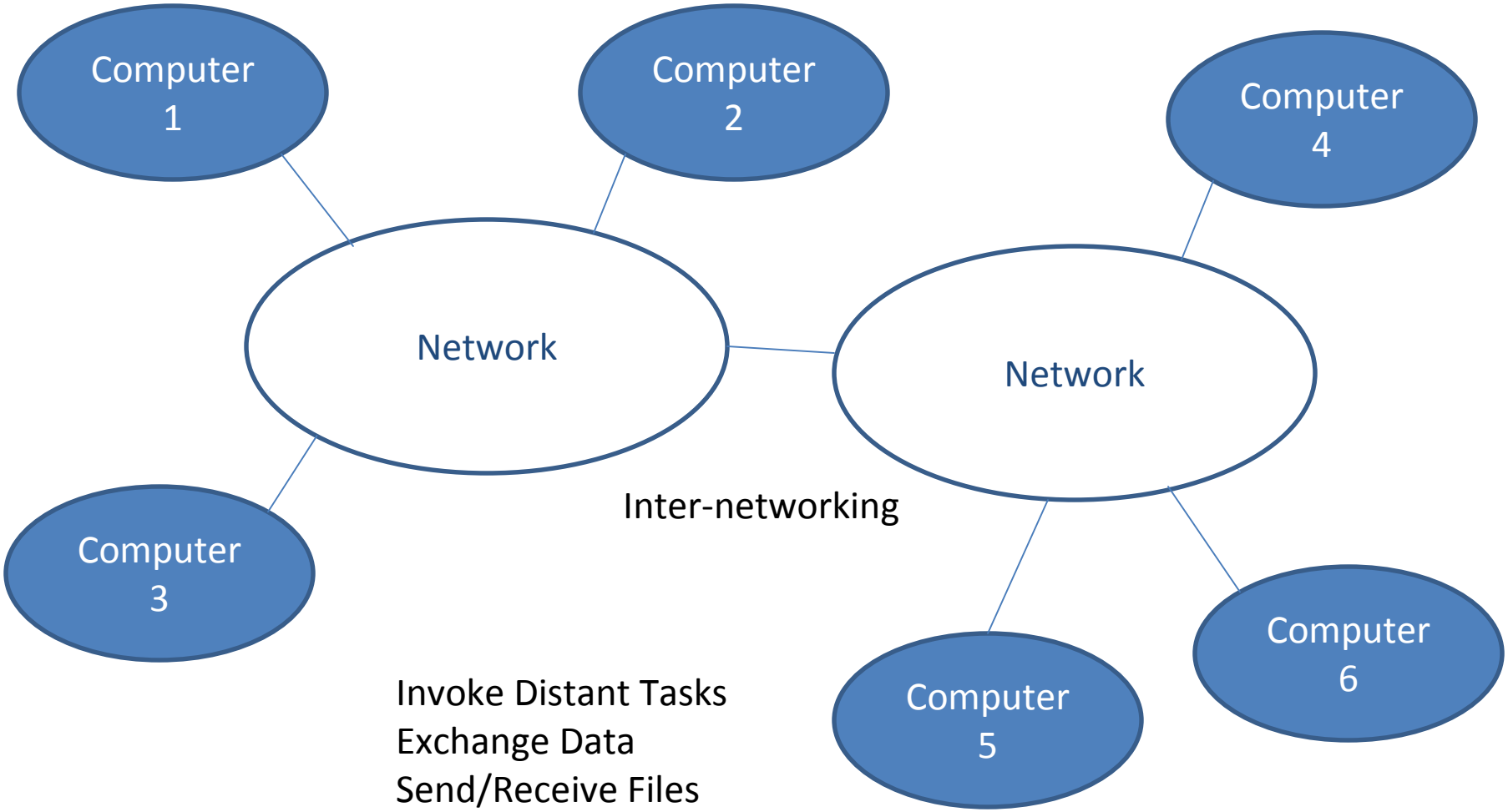
- Abacus? Slide Rule?
- Personal Computer/Macintosh?
- iPhone? Blackberry? Palmtop?
- iPad?
- Server?
- Mainframe?

Any device capable of computing/processing information
Computing = arithmetic/logic/functions
Processing = movement/transformation
Data = Voice/Image/Video/Text

Single Computing



More Concepts



What drove the evolution? A few examples

- Military need for competitive advantage
  - Code breaking/Ciphers
  - Ballistic Missile computations
  - Space launch and Mission Management
  - Nuclear Weapon Design
- Solving large, complex statistical, mathematical scientific and engineering problems
  - Weather calculations and predictions
  - Telephone call routing and transmission
  - Dispatch of truck fleets, trains, airliners
  - Design of very complex systems
  - Decennial Census
  - National Elections
  - Astrophysics
  - Quantum Mechanics
- Supporting Business Processes
  - Payroll processing
  - Taxes and accounting
  - Human Resource Management

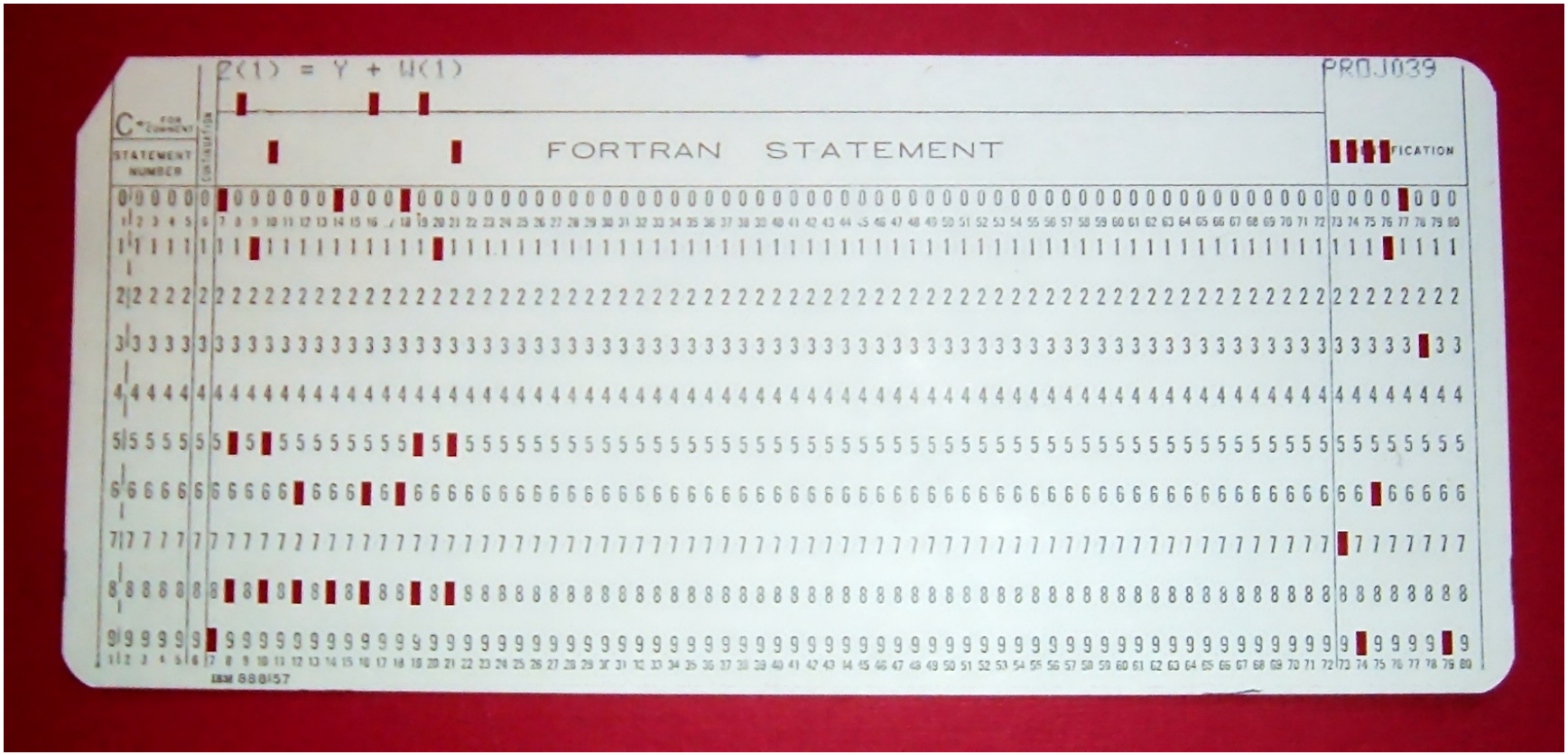
Drivers ..

- Personal and Corporate Productivity
  - Spreadsheet
  - Word Processing
  - Data Management
  - Pictures and Presentations
- Consumer Appliance
  - Video
  - Music
  - Entertainment
  - Games
  - Information Appliance
  - Communications and Talk
  - Photography

First Generation 1945-1956

- 1941 Konrad Zuse - Z3 in Germany for designing airplanes and missiles
- 1944 British Colossus to decode German messages
- 1944 Howard Aiken of IBM produced an all-electronic calculator (Mark I) as part of a Harvard-IBM partnership
- 1945 ENIAC was developed as a partnership between UPenn and US Government
- 1945 EDVAC was developed by Von Neumann at UPenn with a memory to hold stored program and data
- 1951 UNIVAC was developed by Eckert and Mauchly as arguably the first commercial computer

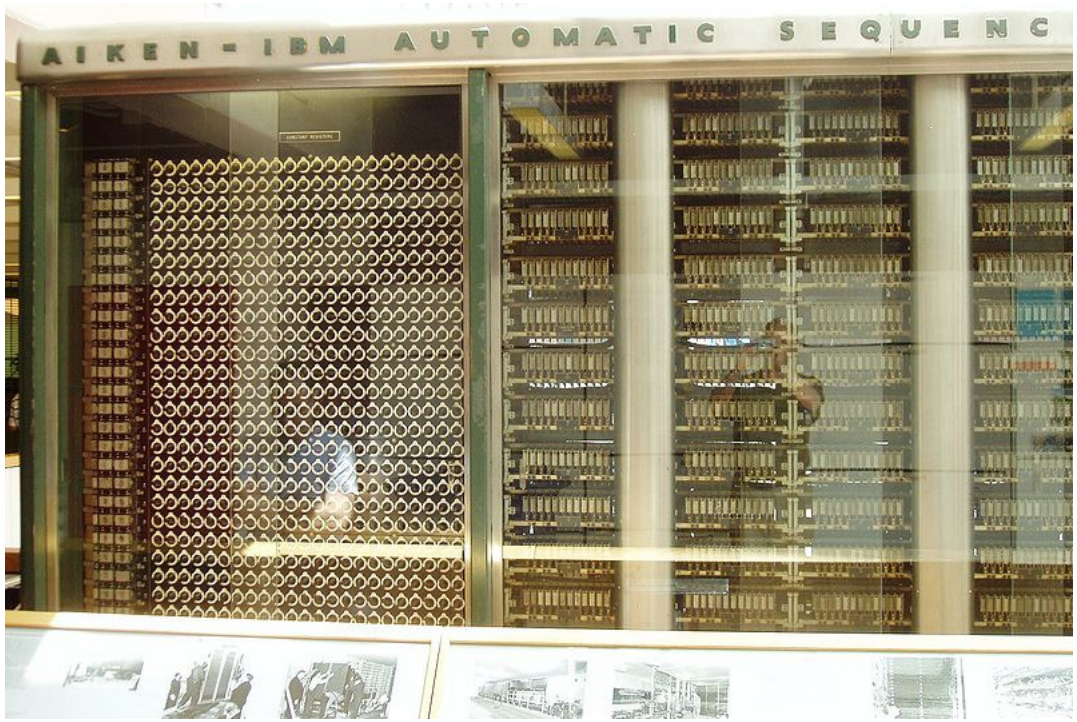
Punched Card



Harvard-IBM Aiken's Mark I Computer (1944)

- Create Ballistic Charts for the US Navy
- Half as long as a football field
- 500 miles of wiring
- Mechanical parts moved through electromagnetic signals
- 3-5 seconds per calculation
- Inflexible – sequences of calculations were pre-programmed.
- Perform basic arithmetic and more complex equations

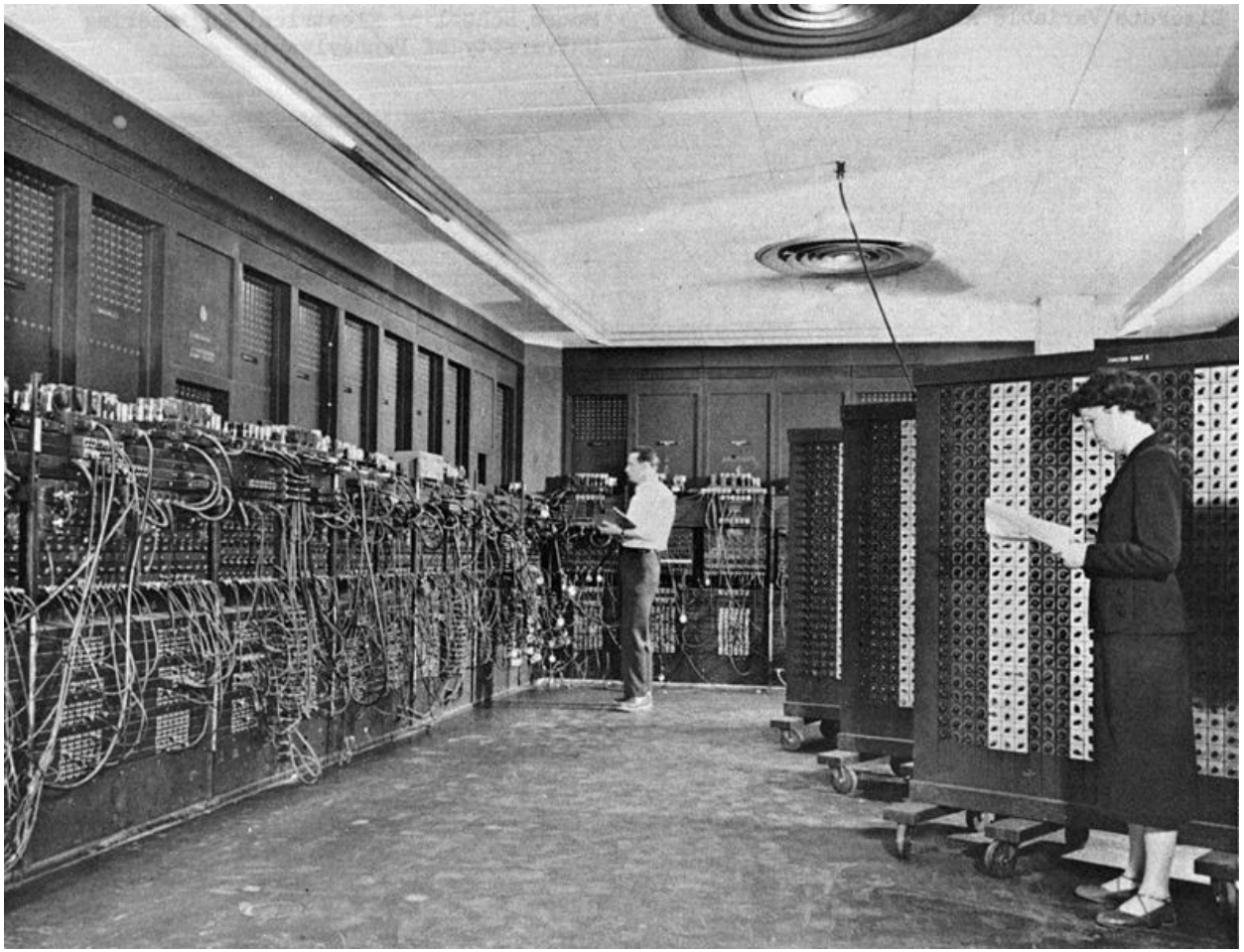
Mark I Computer



ENIAC (1945)

- Electronic Numerical Integrator and Computer
- Inventors: John Presper Eckert and John W. Mauchly
- 18,000 Vaccum Tubes, 70,000 resistors, 5 million soldered joints
- Consumed 160 KW of power – enough to dim the lights of a section of Philadelphia
- Used for calculations on the design of the Hydrogen Bomb
- Later used for design of wind tunnels, random number generators and weather prediction

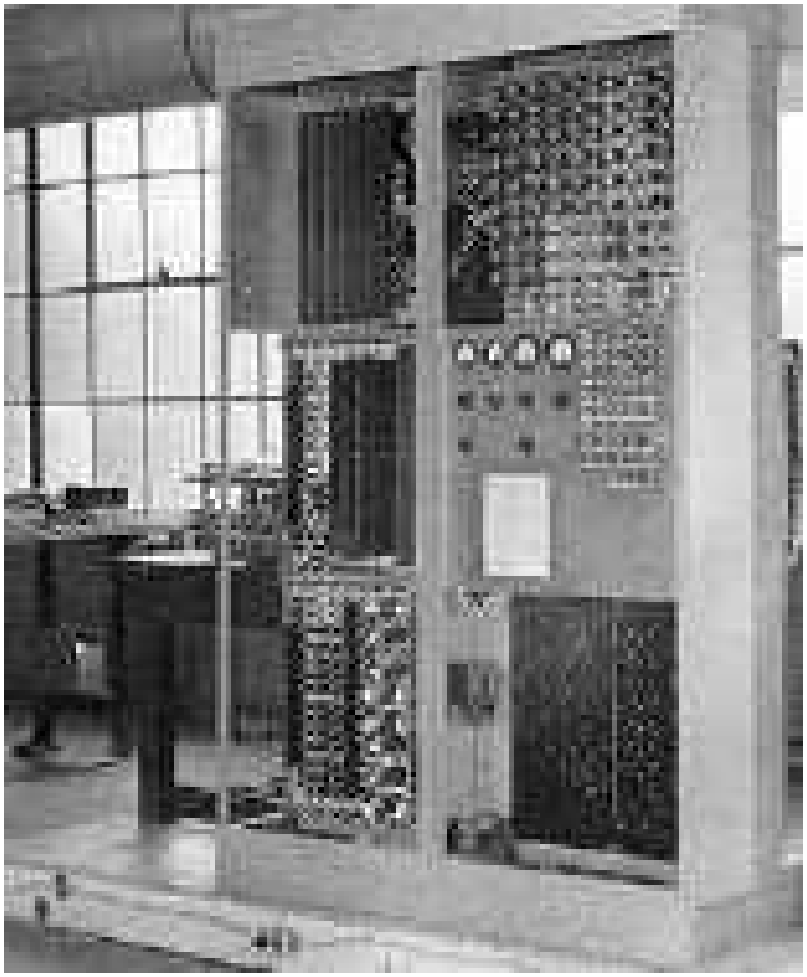
ENIAC



EDVAC (1945)

- Electronic Discrete Variable Automatic Computer
- First machine to store both program and data in memory
- Allowed programs to be suspended and restarted
- Centralized all computer functions into a Central Processing Unit (CPU)

EDVAC



http://cs.wellesley.edu/~cs110s08/lectures/history/edvac.JPG

UNIVAC (1951)

- Universal Automatic Computer
- Arguably first commercial computer
- Owned and used by US Census Bureau
- Owned and used by General Electric
- Used to predict DDE as winner of the 1952 Elections, 45 minutes after polls closed with 7% of the vote counted

UNIVAC

http://www.computerhistory.org/timeline/?year=1951

Second Generation (1956-1963)

- 1948 Invention of the transistor at Bell Labs
- 1950s Invention of Core Memory
- 1950s Invention of Assembly Language
- 1956 Computers began using transistors and core memories in their circuits (Solid State)
- Programmers started coding complex code using Assembly Languages
- Supercomputer STRETCH by IBM and LARC by Sperry-Rand used in Atomic Energy Labs

Second Generation continued..

- Several successful commercial computers used in business, universities and governments
  - Burroughs
  - Control Data
  - Honeywell
  - IBM
  - Sperry-Rand
- Used modern day-like computer components
  - Printers, Tape Storage, Disk Storage, memory and stored programs
- Evolution of High Level Languages such as COBOL and FORTRAN to speed up assembly programming
- Evolution of Data Processing (DP) Roles such as Programmer, Analyst, Computer Systems Expert)

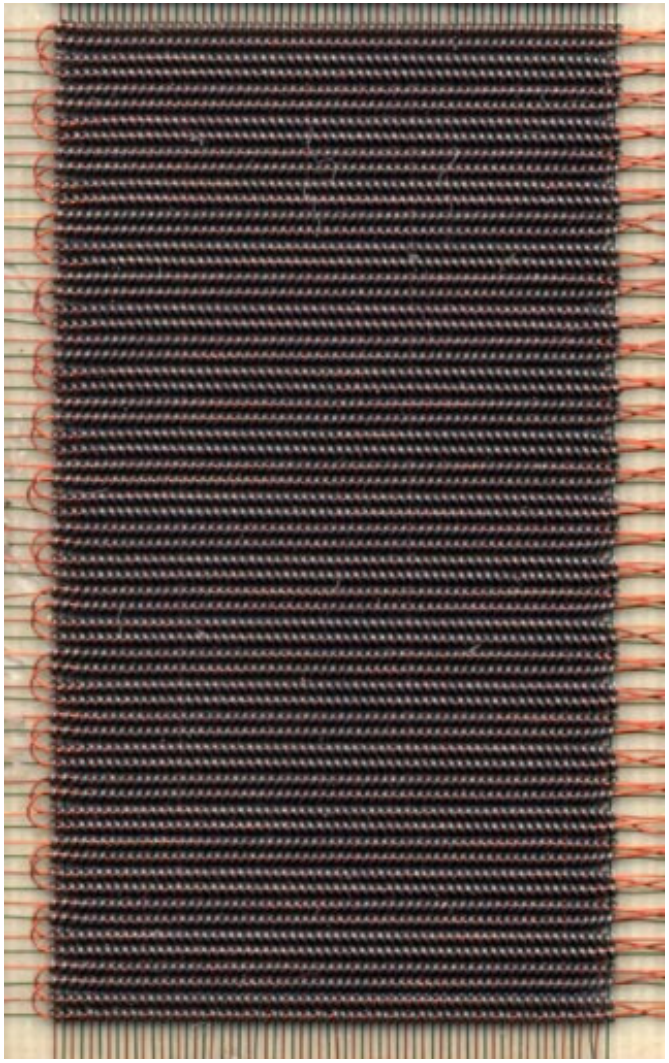
Transistor (1948) Bell Labs

- Invented by Bardeen, Shockley and Brattain at AT&T Bell Labs
- Replaced vaccum tubes as the core computing element
- Tremendous decreases in size
- Tremendous decrease in power consumption, heat generation, fragility
- Tremendous scaling power
- Tremendous reduction in cost
- Tremendous increases in reliability

Transistor vs Vaccum Tube

http://design.osu.edu/carlson/history/images/tubeandtransistor.jpg

Core Memory



http://oldcomputers.net/core.html

Printers

- 1938: Chester Carlson develops dry printing process electro-photography (later commonly known as Xerox) process that becomes basis for laser printing
- 1953: First high speed impact printer was developed by Remington-Rand for use on the Univac Computer
- 1971 First laser printer was developed by PARC Xerox
- 1976: Inkjet printer was invented but only became a consumer product in 1988 ($1000)
- 1992: HP releases the popular consumer laser printer

http://inventors.about.com/library/inventors/blcomputer_printers.htm

Floppy Disk Storage

- 1971 IBM (Alan Shugart team) introduces the 8” Floppy Disk
- 1976 Wang (Alan Shugart) introduces the 5.25” Floppy Disk
- 1981 Sony introduced the first 3.5” Floppy Disk
- Today flash memory stick has replaced floppy disks

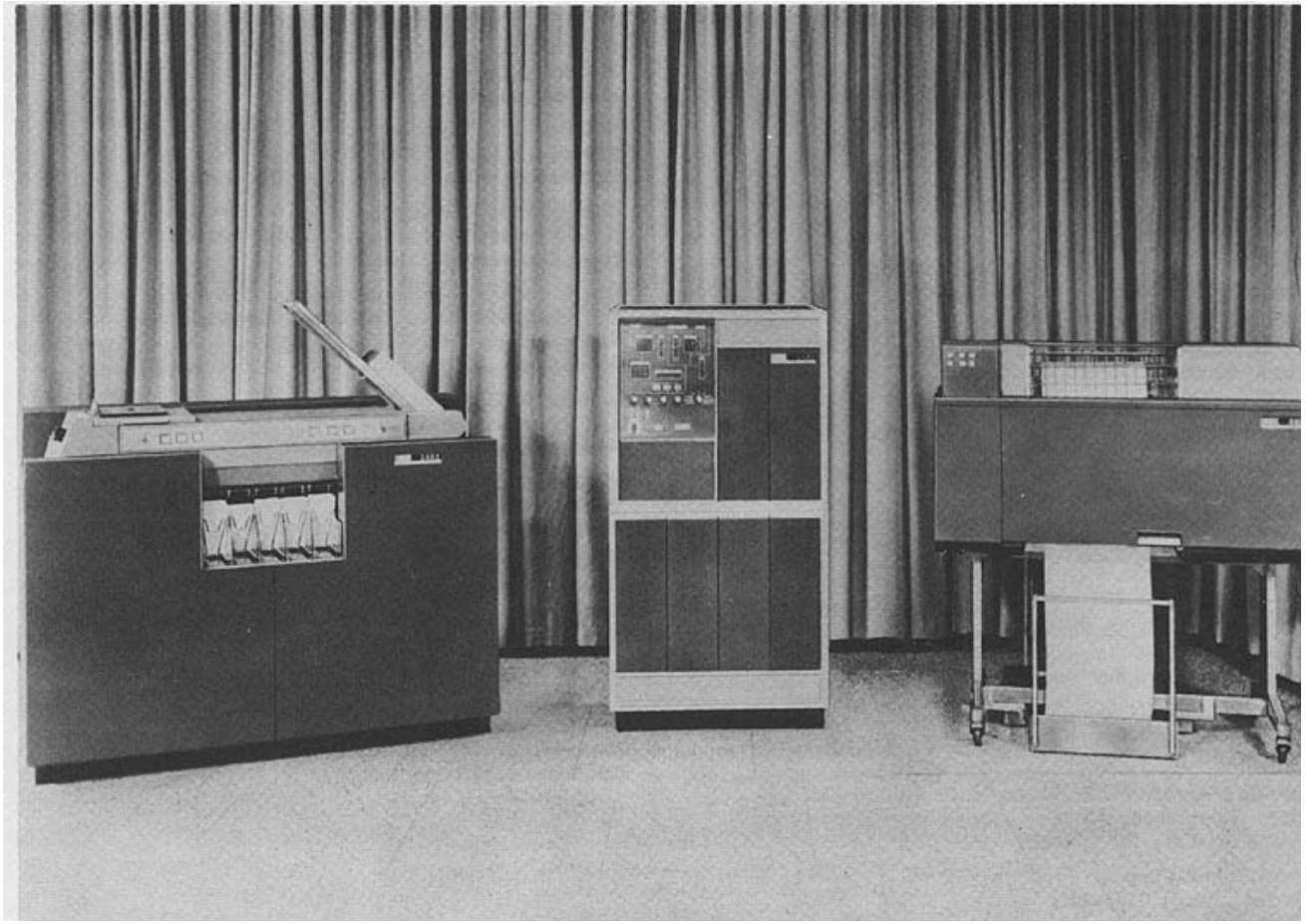
Assembly Language

Example listing of assembly language source code

Address	Label	Instruction (AT&T syntax)	Object code[28]
		.begin	
		.org 2048	
	a_start	.equ 3000	
2048		ld length,%	
2064		be done	00000010 10000000 00000000 00000110
2068		addcc %r1,-4,%r1	10000010 10000000 01111111 11111100
2072		addcc %r1,%r2,%r4	10001000 10000000 01000000 00000010
2076		ld %r4,%r5	11001010 00000001 00000000 00000000
2080		ba loop	00010000 10111111 11111111 11111011
2084		addcc %r3,%r5,%r3	10000110 10000000 11000000 00000101
2088	done:	jmpl %r15+4,%r0	10000001 11000011 11100000 00000100
2092	length:	20	00000000 00000000 00000000 00010100
2096	address:	a_start	00000000 00000000 00001011 10111000
		.org a_start	
3000	a:		

http://en.wikipedia.org/wiki/Assembly_language#Example_listing_of_assembly_language_source_code

IBM 1401 – Considered the Model T of the Computer Industry



http://en.wikipedia.org/wiki/File:BRL61-IBM_1401.jpg

COBOL

Syntactic features

COBOL provides an update-in-place syntax, for example

```
       ADD YEARS TO AGE
```

The equivalent construct in many procedural languages would be

```
age = age + years
```

This syntax is similar to the compound assignment operator later adopted by C:

```
age += years
```

The abbreviated conditional expression

```
       IF SALARY > 9000 OR SUPERVISOR-SALARY OR = PREV-SALARY
```

is equivalent to

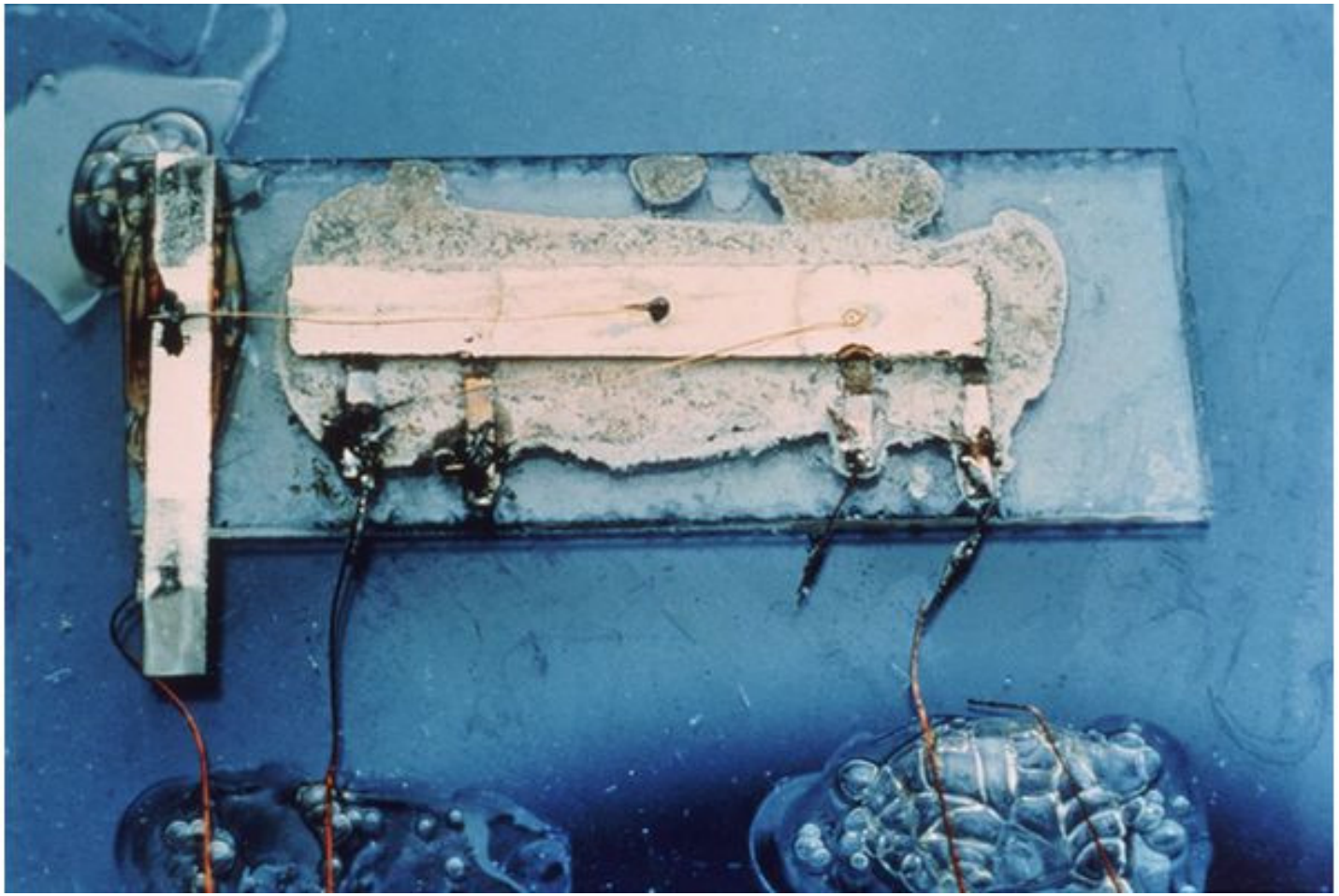
```
       IF SALARY > 9000
           OR SALARY > SUPERVISOR-SALARY
           OR SALARY = PREV-SALARY
```

http://en.wikipedia.org/wiki/COBOL

Third Generation (1964-1971)

- 1958 Invention of the Integrated Circuit (Jack Kilby of Texas Instruments).
- 1958 Fairchild's invention of MOSFET 8 bit ALU
- Further miniaturizing of the transistor.
- Invention of the Operating System as a housekeeper for a computer running multiple programs
- 1969 Development of UNIX by Thompson and Ritchie at Bell Labs – seamless integration of hardware and software
- 1971 Microprocessor was invented – computer on a single chip. Intel 4004
- Development of the IBM System/360 built completely of integrated circuits

Integrated Circuit (1958)



http://en.wikipedia.org/wiki/File:Kilby_solid_circuit.jpg

Operating System

- Housekeeping software for computer
- Manages operations
- Manages Resources: Memory and Disk
- Manages timeslicing
- Manages access to devices
- Manages User Interactions

Intel 4004 Microprocessor (1971)

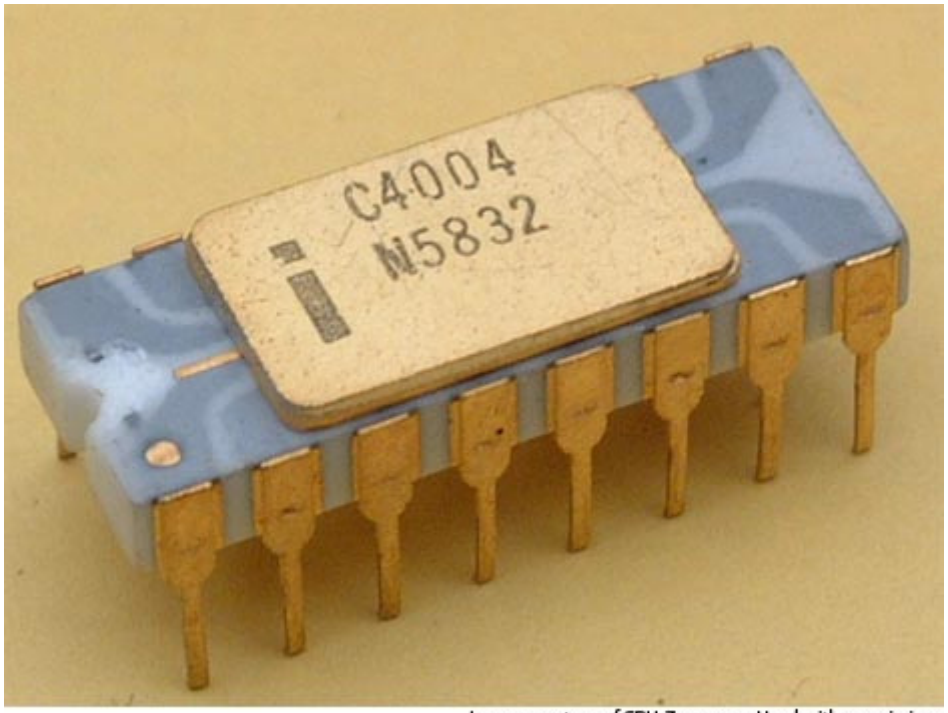


Image courtesy of CPU-Zone.com. Used with permission.

http://www.retrothing.com/2007/03/the_first_singl.html

Fourth Generation (1971 – Present)

- 1980s: Very Large Scale Integration squeezes thousands of circuits into a very small area
- 1980s: Ultra LSI squeezes millions of components into a very small area
- Microprocessors used everywhere: Microwave Ovens, TV Sets, Automobile electronics
- Mid 1970s Consumerization of computers
  - Commodore
  - Radio Shack
  - Apple

Fourth Generation

- 1980s penetration of computers into video game arcades and home game consoles: PacMan, Atari,
- 1981 IBM PC was introduced. Clones and variants soon proliferated
  - 2 Million PCs in 1981
  - 5.5 Million in 1982
  - 65 Million in 1992
- 1984 Apple introduced the MacIntosh. Popularized Graphical user interface, pointing devices

Fourth Generation

- Palm Development
- iPod, iPhone, iPad
- Blackberry
- Internet Protocol
- Worldwide Web
- Mozilla Browser
- Social Networking

Consumer Computer (MITS Altair)

http://oldcomputers.net/altair.html

Apple II (1977)

http://oldcomputers.net/appleii.html

Radio Shack TRS 80 (1977)

IBM PC (1981)

http://oldcomputers.net/ibm5150.html

Apple Macintosh (1984)

http://oldcomputers.net/macintosh.html

Arcade games (Atari 2600)

http://oldcomputers.net/atari-vcs.html

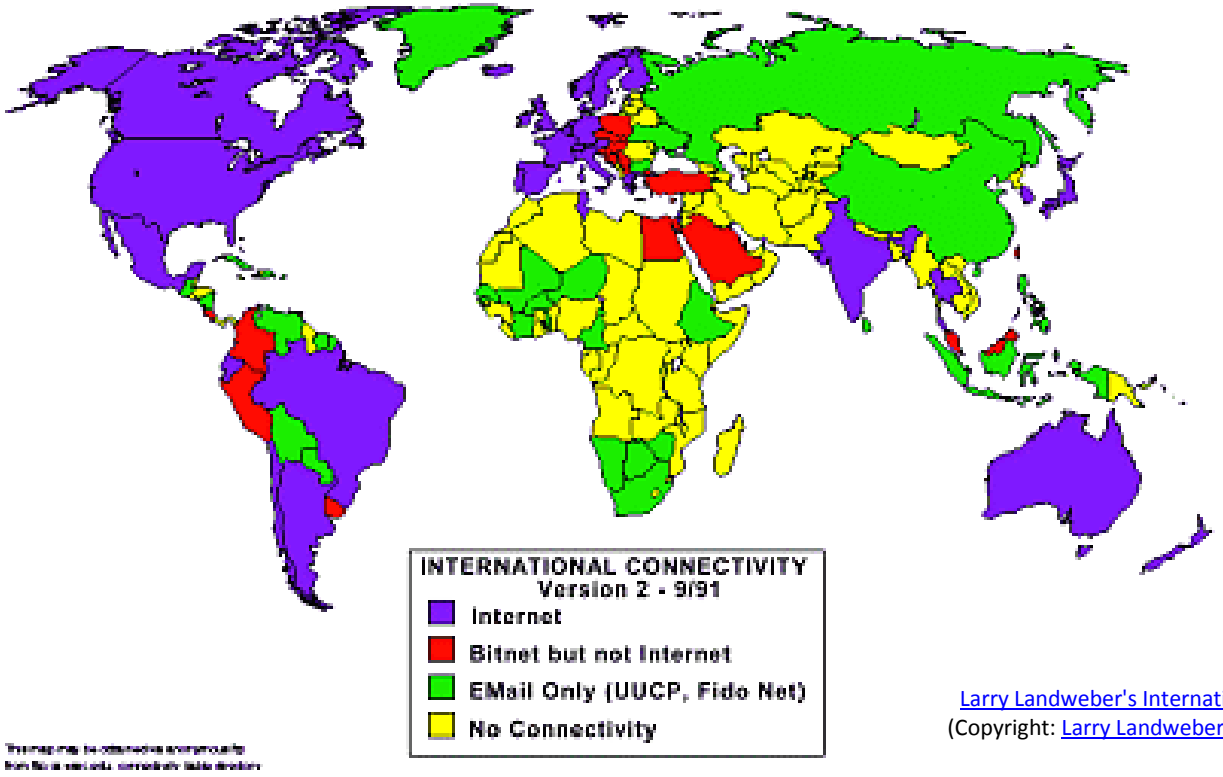
Consumer Computers
Timex Sinclair (1980)

http://oldcomputers.net/ts1000.html

Internet

- A network with a ubiquitously used PROTOCOL
- Protocol is used to define how messages are transferred
- Internet is based on TCP and IP (TCP/IP) layers of the ISO/OSI communications standards
- Very survivable – many nodes provide connectivity
- Very reliable – through multiple path alternatives

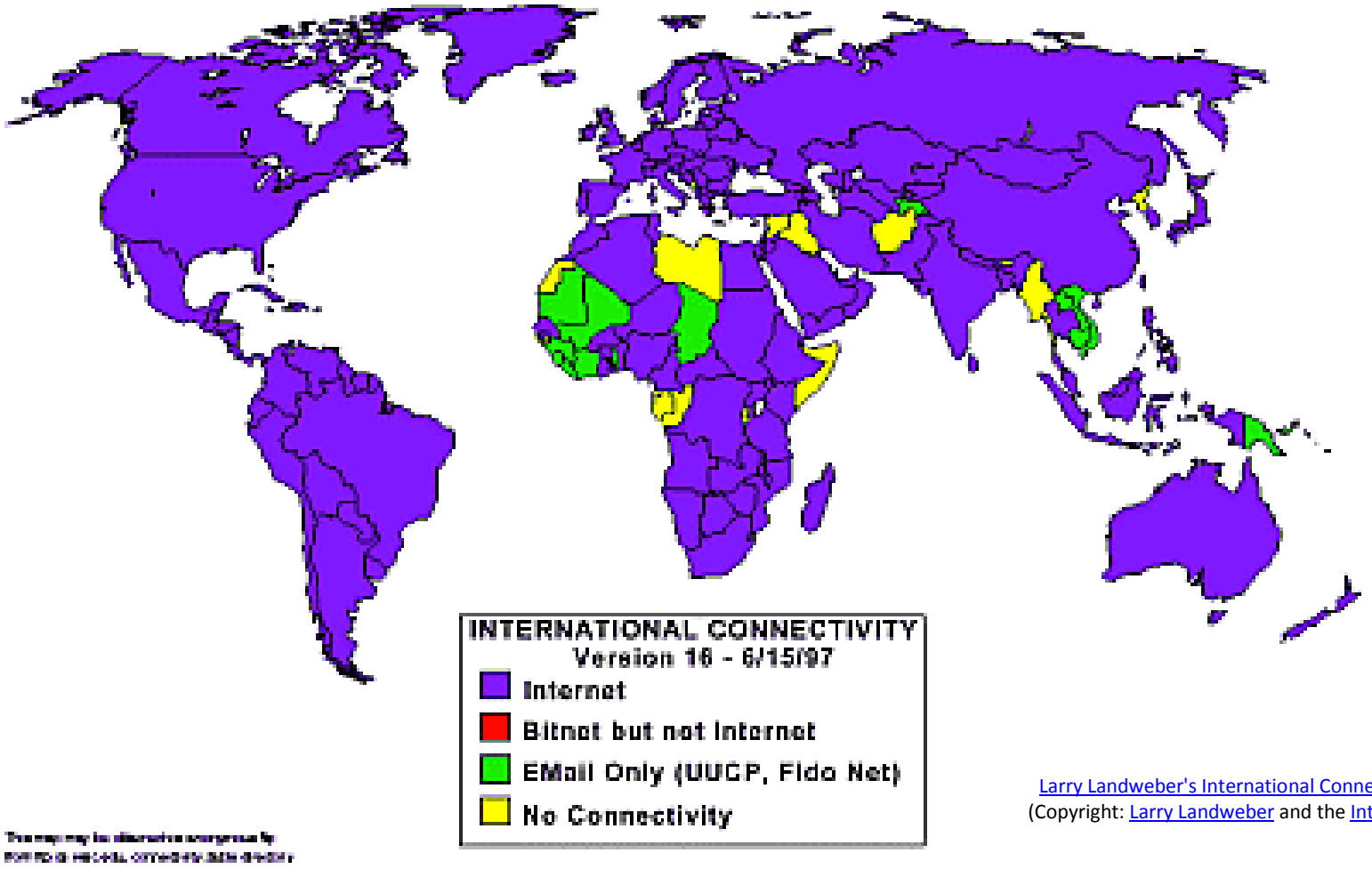
Internet (1991)



Larry Landweber's International Connectivity maps,
(Copyright: Larry Landweber and the Internet Society)

http://mundi.net/maps/maps_011/

Internet (1997)



Larry Landweber's International Connectivity maps,
(Copyright: Larry Landweber and the Internet Society)

http://mundi.net/maps/maps_011/

Worldwide Web

- Based on the HTTP Protocol
- Transfers markup files
- Provides ability to transmit text, image, and video content in a manner that is understood by all receivers
- Stateless

Hypertext Markup Language

blockquote
used to indicate a block of quoted text, with an attribution that identifies who said or wrote it

body
contains all the content to be displayed to user

br
creates a single line break in a block of text

div
divides a page into separate sections

h1
defines a level 1 heading

h2
defines a level 2 heading

h3
defines a level 3 heading

h4
defines a level 4 heading

h5
defines a level 5 heading

h6
defines a level 6 heading

head
identifies the head section of document

hr
creates a horizontal rule that might be used to delineate areas of content in a document

Example Tags

Mosaic Browser

- Original Internet Browser that made the WWW popular
- 1992: Developed at NCSA, University of Illinois Urbana-Champaign
- 1993: Released
- 1997: Terminated Support

Blackberry (2011)

Zeos Pocket PC (1992)

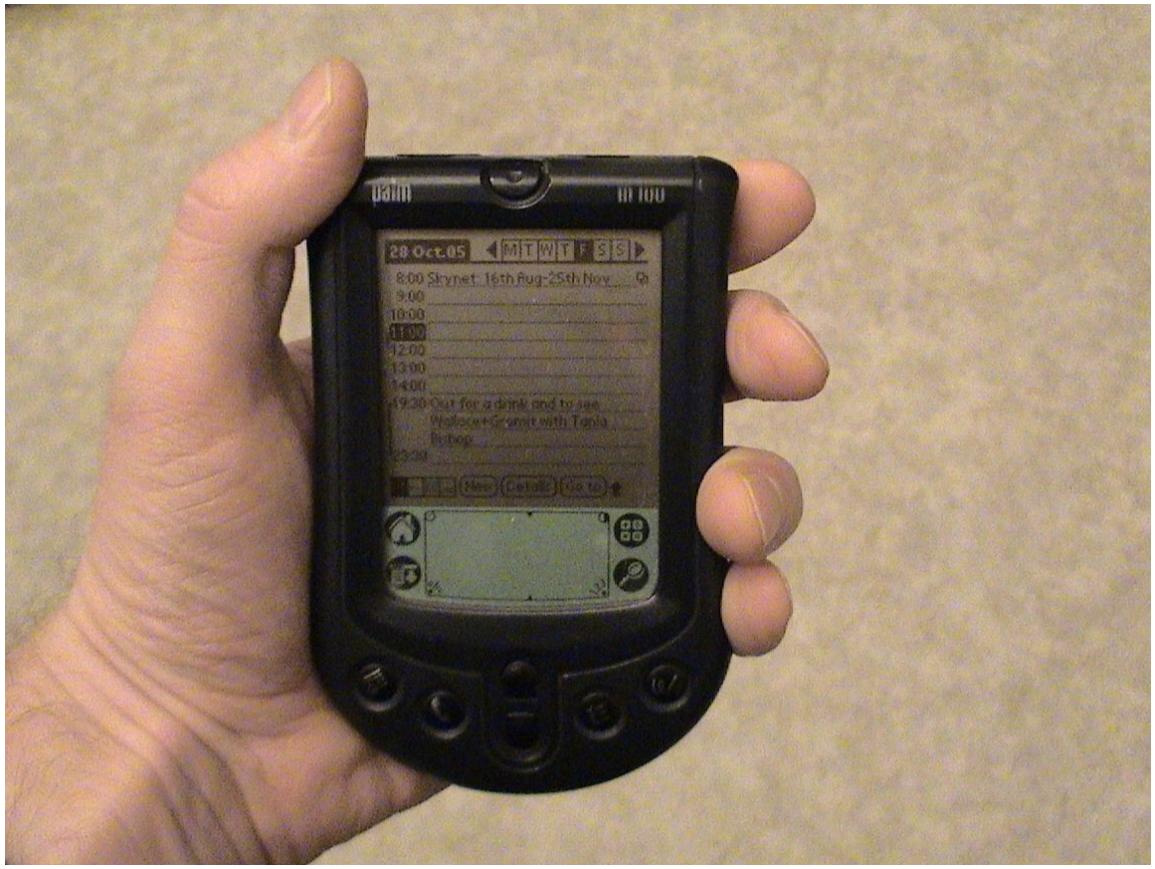
http://oldcomputers.net/zeos-ppc.html

Apple Newton (1993)

Newton

http://oldcomputers.net/apple-newton.html

Palm (2000)



http://www.esacademic.com/dic.nsf/eswiki/895246

iPhone, iPad, iPod (2011)

http://www.flickr.com/photos/axsdeny/3103771486/

Advances in Manufacturing

- Component Miniaturization
- Assembly miniaturization
- New materials
- New layout and design techniques
- New fabrication techniques
- Silicon “Foundries”
- Electronic Manufacture outsourcing
- Customization
- Reusable components

Concluding Remarks

- Fifth Generation? Fusion of Technologies
  - Raw Computing power
  - Gigantic memory
  - Ubiquitous Communication and Connectivity
  - Semantic Knowledge Management
  - Ubiquitous Business and Software Services
  - Ubiquitous Voice, Images and Video
  - Ubiquitous Geo-location
  - Small portable, ubiquitous software applications

Concluding Remarks

- Ubquitous tele-presence
- Ubiquitous collaboration

- CULTURAL CHANGES
- SOCIAL CHANGES
- POLITICAL CHANGES

References

- Gersting, Judith L. The Computer: History, Workings,Uses & Limitations. New York : Ardsley House, c1988
- Goldstine, Herman Heine. The Computer from Pascal to von Neumann. Princeton, NJ: Princeton University Press 1972.