The Invention of Electronic Digital Computing

Professor Vladimir Getov

Distributed and Intelligent Systems Research Group
School of Computer Science and Engineering

University of Westminster, London

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Who am I? – *V.S.Getov@westminster.ac.uk*

- Director of Distributed and Intelligent Systems Research Group

- Research focus on modelling, autonomy and dynamic tuning towards higher **performance**, **energy** efficiency, **security**, and **scalability**.

- Joined the University in 1992.

- Full Professor at Westminster since 2001.

- Visiting Professor, Peking University.
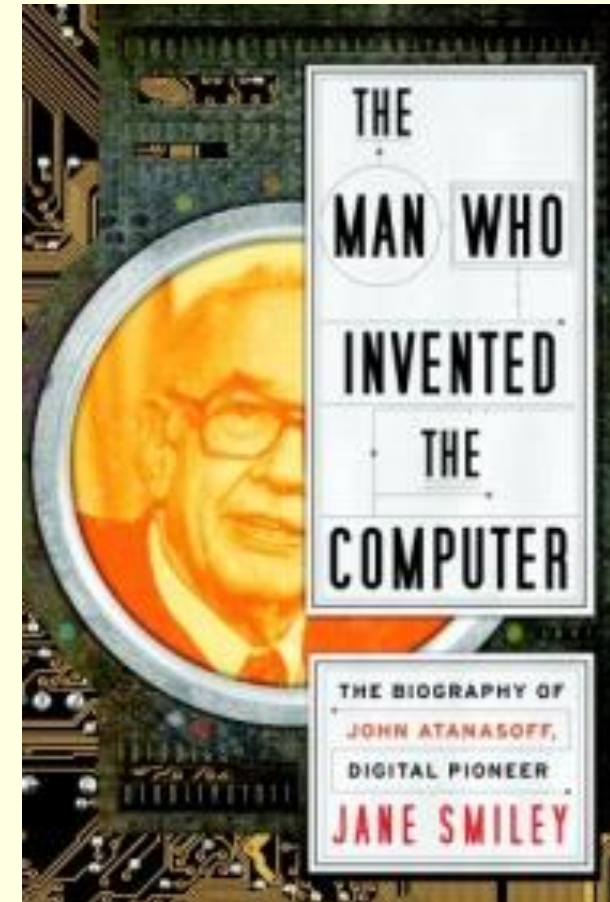
- Honorary Professor, Technical University of Sofia.

Outline

- Introduction: How the Computer on My Desk Got to Me?
- Jane Smiley answers the question
- Information in human history
- The fourth information revolution
- The invention of electronic digital computing by John Vincent Atanasoff
- Acceptance of John V. Atanasoff's invention
- Early computers and the WWII
- The fifth information revolution and the Web

How the Computer on My Desk Got to Me?

- Jane Smiley, The Man Who Invented the Computer, Doubleday, 2010.
- "Many characters took place – they were all brilliant"
- "The inventor of the computer was a 34-year old associate professor of physics named John Vincent Atanasoff"

The Information Revolutions – the Advent of Speech

■ Approximately 50,000 years ago – the first information revolution – the advent of speech

■ Since then, the accelerating development of self-expression, creativity and communication has reflected the enhanced mental and vocal powers of modern humankind (homo sapiens).

The Information Revolutions – Writing

- Introduced approximately 5000 years ago

The Library of Alexandria

- founded at the beginning of 3rd century BC

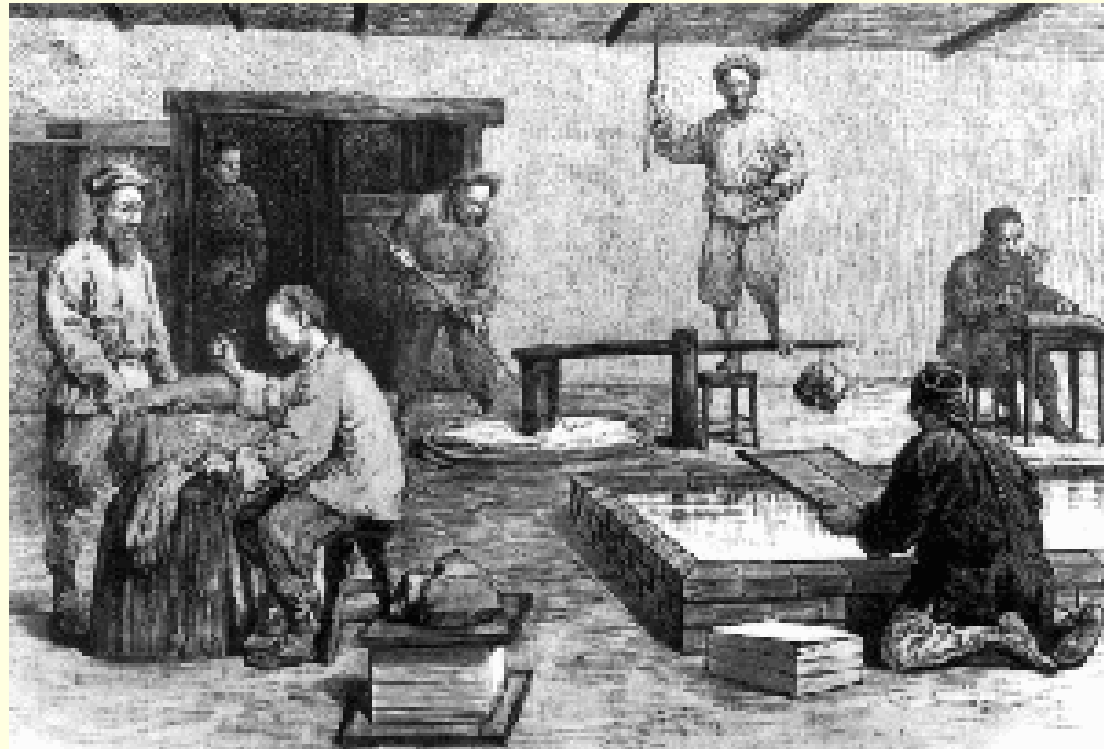- started with Aristotle's private collection

Reconstruction of the Museum of Alexandria. From Carl Sagan's Cosmos (1980)

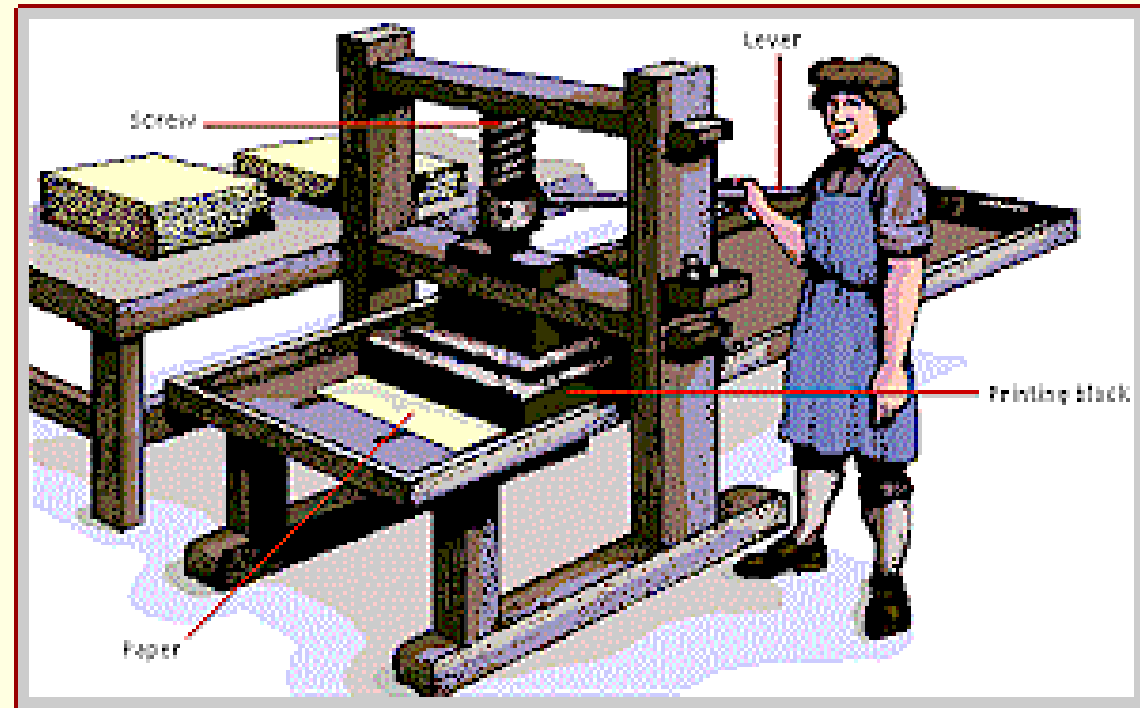# The Information Revolutions – Writing (continued)

- Problems with handwriting

- Advent of paper in China

The Information Revolutions – Printing and Other Technologies – Dissemination

The Information Revolutions – Information Processing

- Automatic processing and/or discovery of new information
- What is a computer?
  - Mechanical, electrical, relay, electronic?
  - Analog or digital?
  - Automatic or needing human intervention?
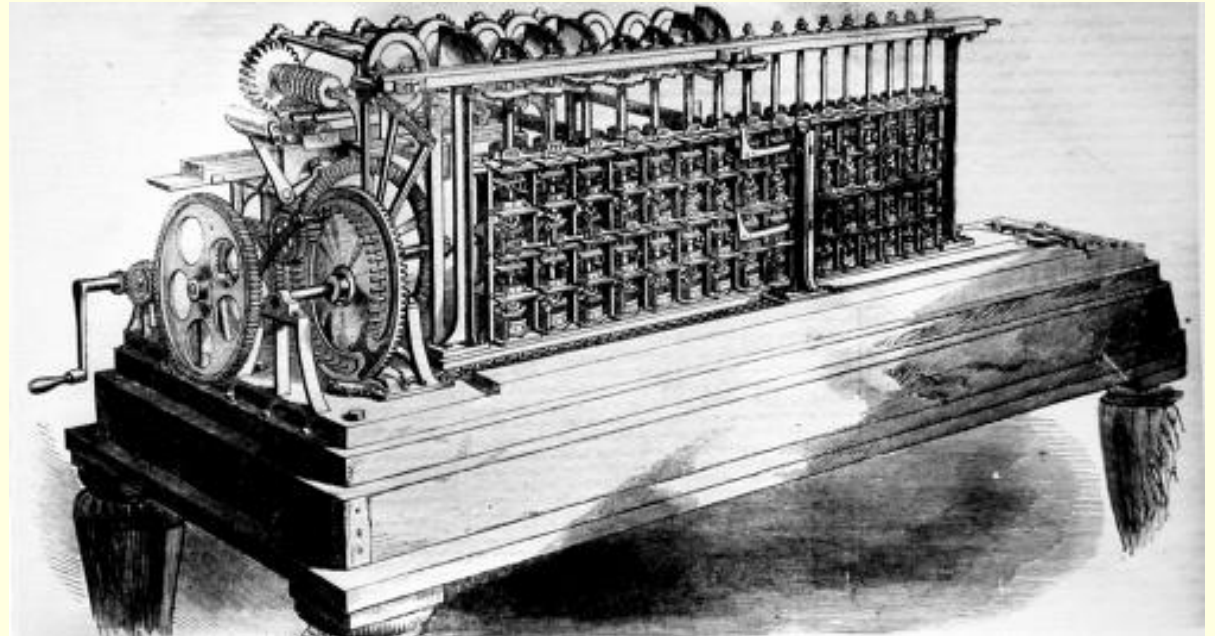 - Subsequent developments or dead end?

Early Ideas: Concept of Automatic Calculation

- **Charles Babbage**
  - **Difference Engine (1822)**
  - Analytical Engine (1835)
  - Published the concept (never had full working models)

First Working Mechanical Computer

- **Georg and Edvard Scheutz (Sweden) 1853**
  - First fully working automatic Difference Engine – calculated and printed tables
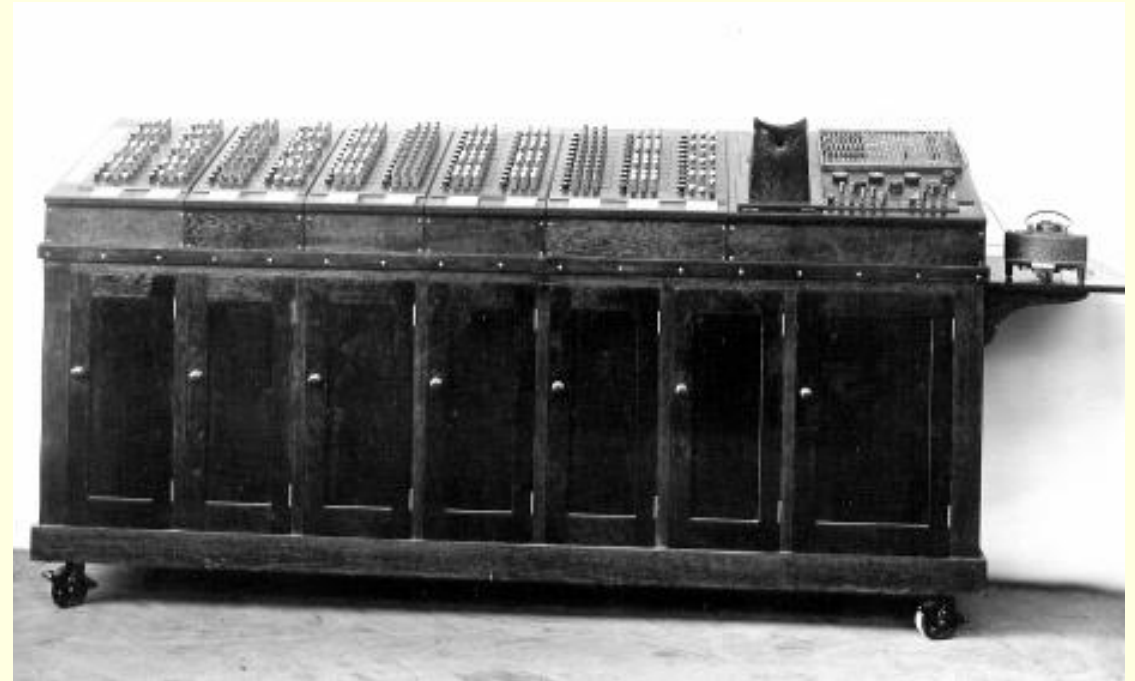
Analog Computers

- Prof Vannevar Bush – MIT (1930s)
  - Differential Analyzer
  - Solved differential equations
  - Based on earlier work by Lord Kelvin
  - Copies made around the world
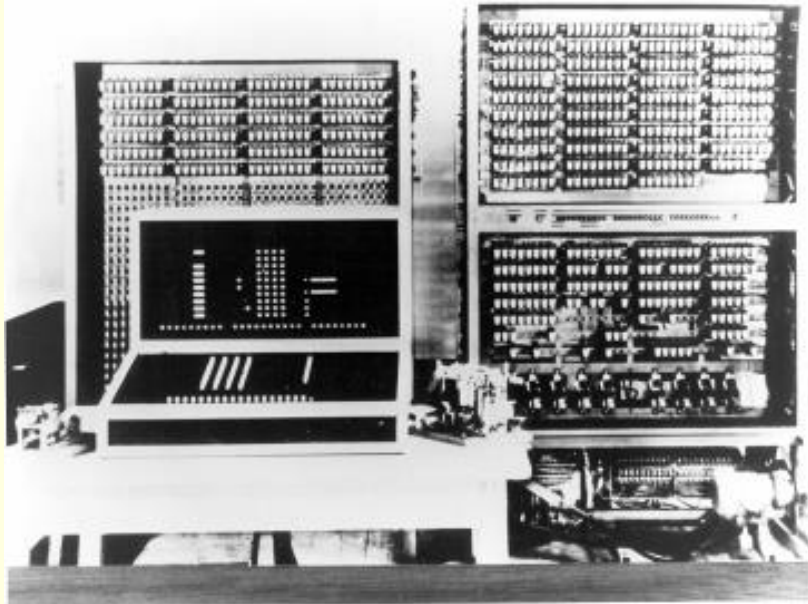
First Electrical Machines

- Richard Mallock (1931)
  - Cambridge
  - Solved systems of 10 linear equations in 10 unknowns

Computers on Relays

- ## Konrad Zuse
  - Z1 (1938) mechanical
  - Z2 (1939) relay
  - Z3 (1941) relay
  - Z4 (1950) relay

Computers on Relays

- Howard Aiken –
- Harvard Mark I (1943)

First Electronic Digital Computer – 1939 at Iowa State College
Prof. John Vincent Atanasoff

Prof. Atanasoff's Core Principles of Electronic Digital Computing

- He used fully-electronic operation of the calculating hardware for the computer.
- The computer was designed to use the binary number system internally and for communication.
- He used dynamic low-cost memory – condensers and a regenerative or "jogging" process to avoid lapses that might be caused by leakage of power.
- The machine computes by using Boolean logic operations and not by enumeration as adopted in analog calculating devices.

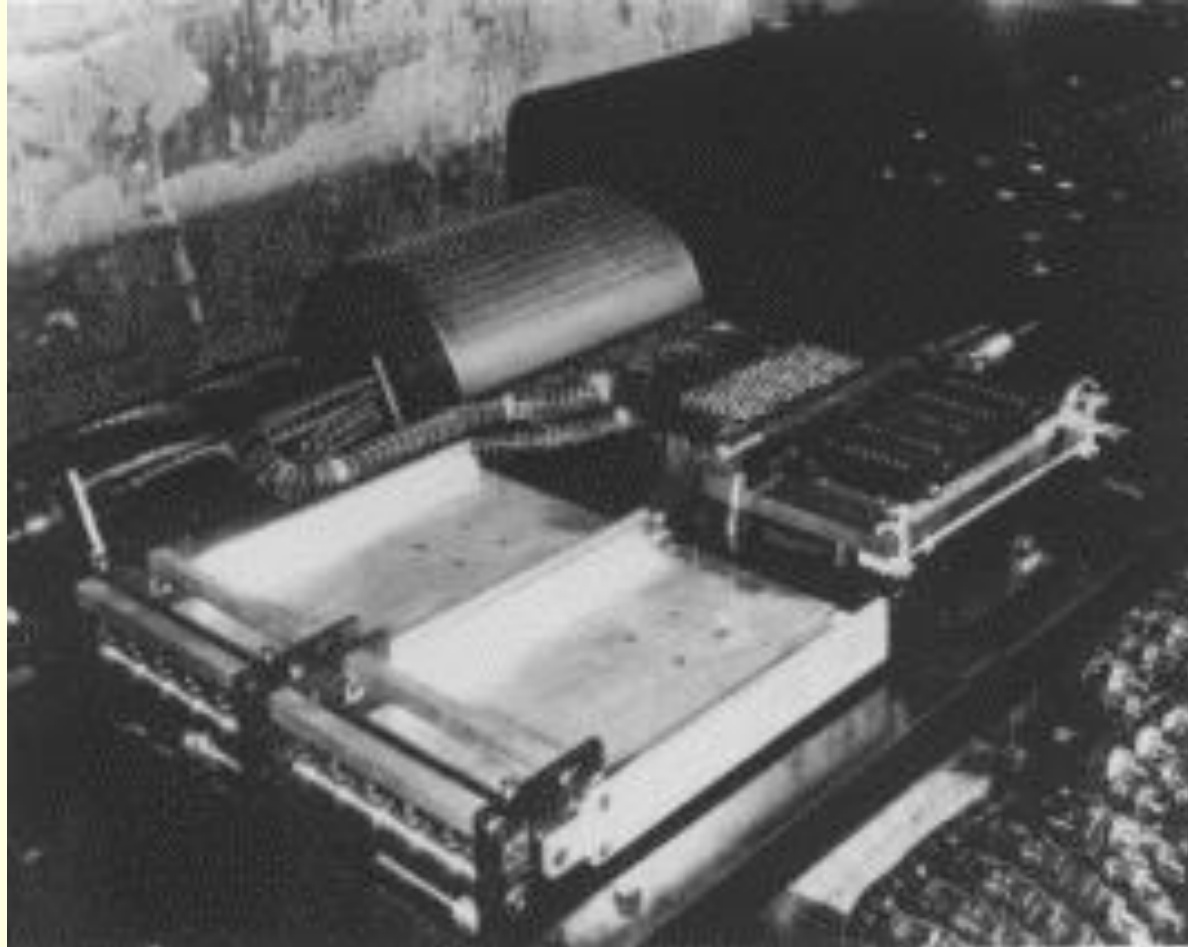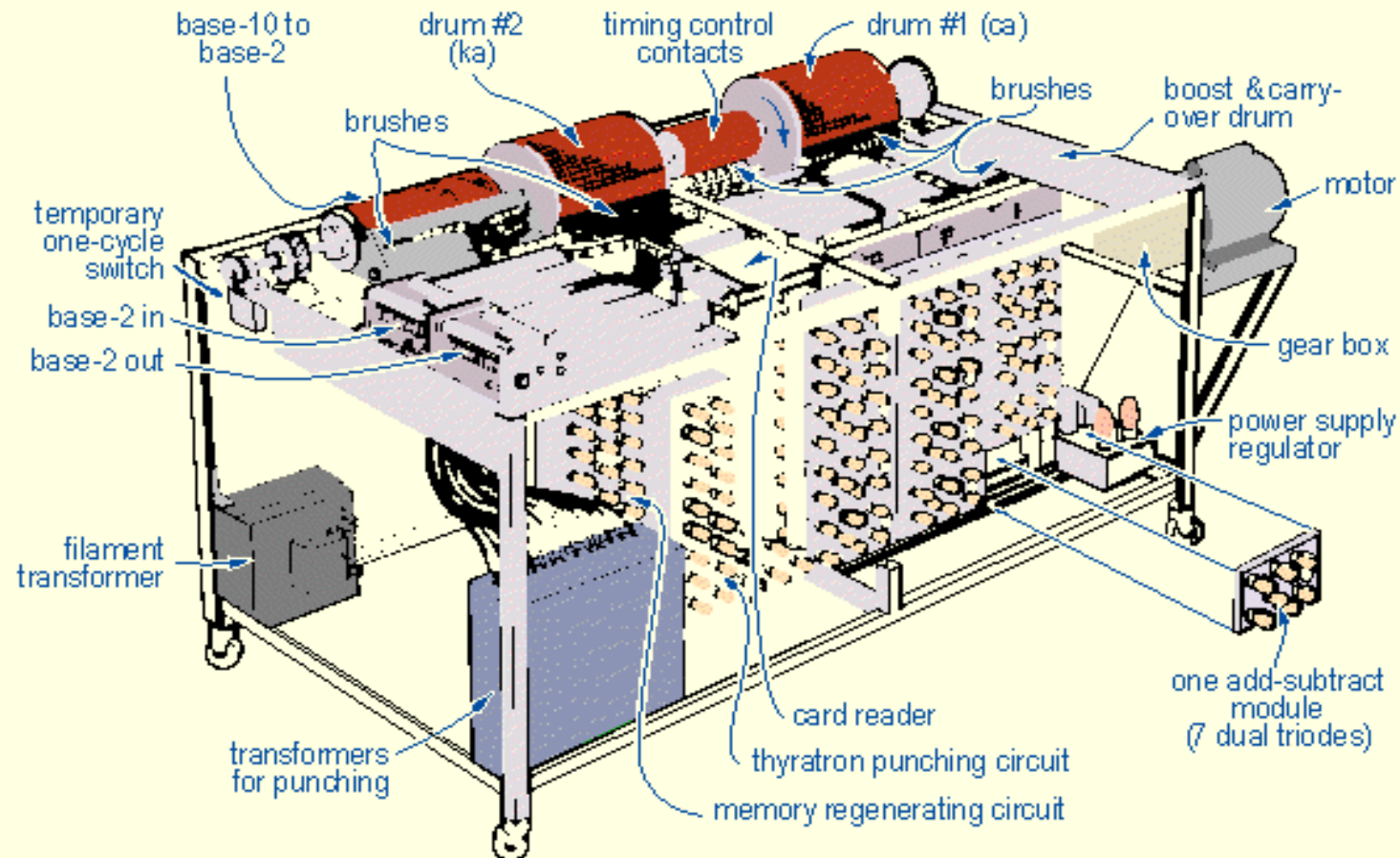# In 1939 the ABC Was the First Electronic Digital Computer

Diagram of the ABC Computer

Complete Reconstruction of ABC

The original ABC was dismantled decades ago. Ames Laboratory, using private funding, builds a working reconstruction of this historically important invention in 1997. Currently the ABC reconstruction is in the Computer History Museum, Mountain View, California.
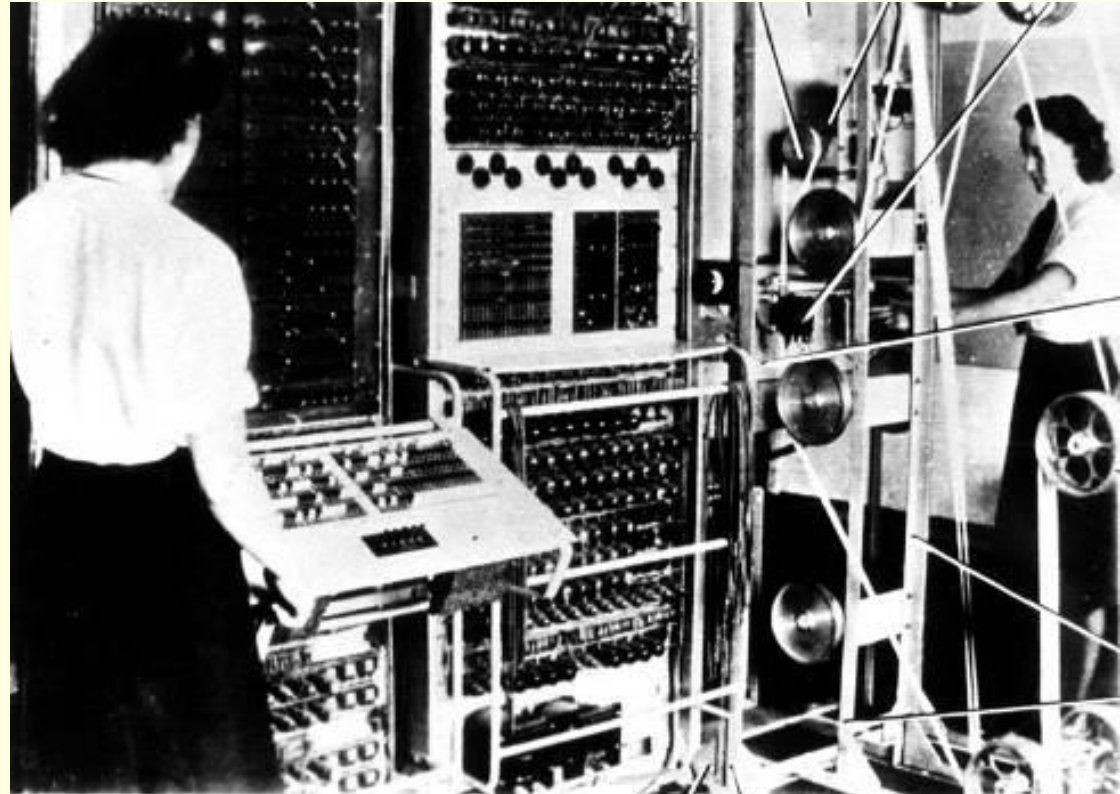
Acceptance of J.V. Atanasoff's Invention

- Bulgaria - Medal of Cyril-Methodius, 1970
- Federal Court Case 1973 Judge Larson, "ENIAC derived from John V. Atanasoff."
- IEEE Holey Medal, 1985
- National Medal of Technology "First Digital Computer" 1988 Pres. Bush
- Honors - ISU, Univ. of Wisc., Univ. of Florida, Univ. MD., Monrovia College
- International John V. Atanasoff Initiative since 2003
- IEEE JVA Medal proposal approved - 2008
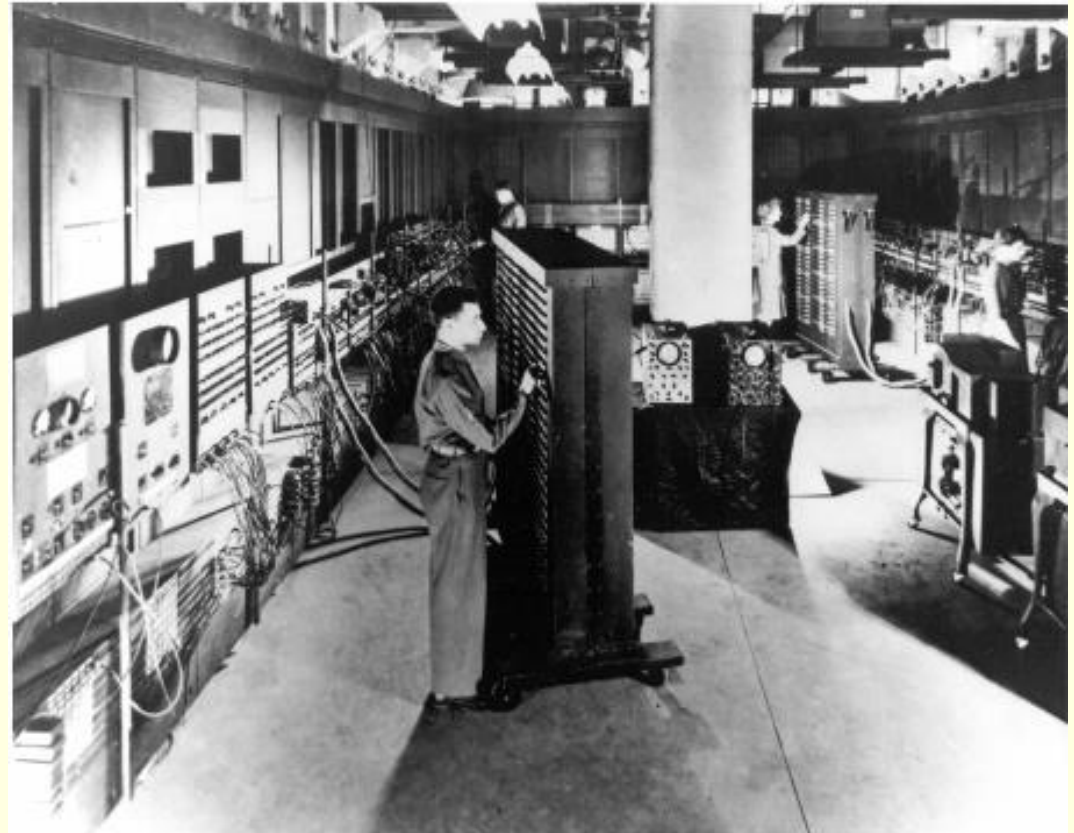
Early Electronic Digital Computers

■ British code breaking Colossus (Dec. 1943)
10 in heavy use in 1944 – 1945

■ Dr Bill Tutte – statistical method

■ Dr Tommy Flowers - project leader

■ Post Office Labs in Dollis Hill, north-west London

■ Code breaking at Bletchley Park

Early Electronic Digital Computers

■ ENIAC – operational in Dec 1945; unveiled to the public in Feb 1946

- Military project

- 17,000 vacuum tubes

- Built at the Moore School of Electrical Engineering at the University of Pennsylvania

John von Neumann:
Stored Program Principles - 1946

- Memory for programs; not only for data
- Program counter
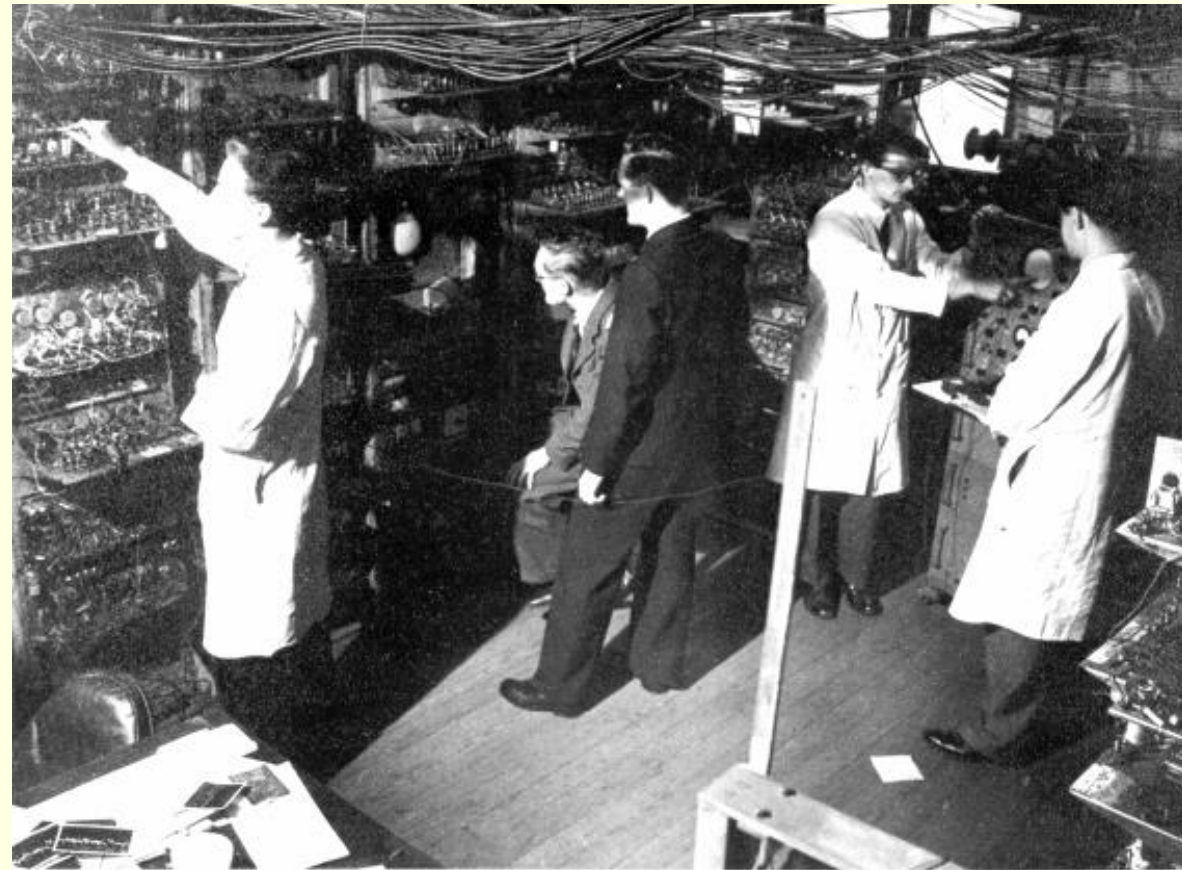- Control unit, Memory, Processor, and I/O – 'von Neumann architecture'

First Stored Program Computer

■ University of Manchester "Baby" (1948)

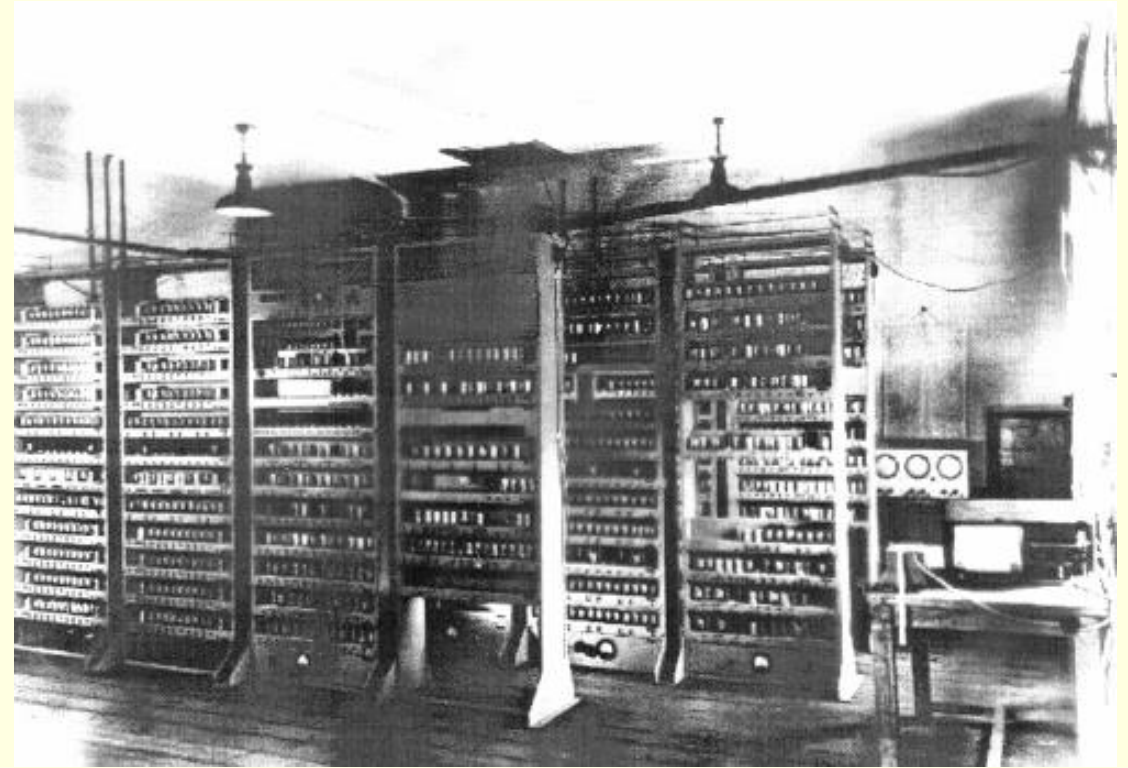First electronic stored program computer

Project leaders: Frederic C. Williams, Tom Kilburn, and Geoff Tootill

Ran its first program on 21 June 1948

First Stored Program Computers

- Cambridge EDSAC (1949)
- Maurice Wilkes

Brief History of Computers

ABC (1939)

One in a Country

UNIVAC-1 (1951)

One in a Company

IBM360 (1964)

One in a Group

VAX-11 (1977)

One per Person

IBM PC (1981)

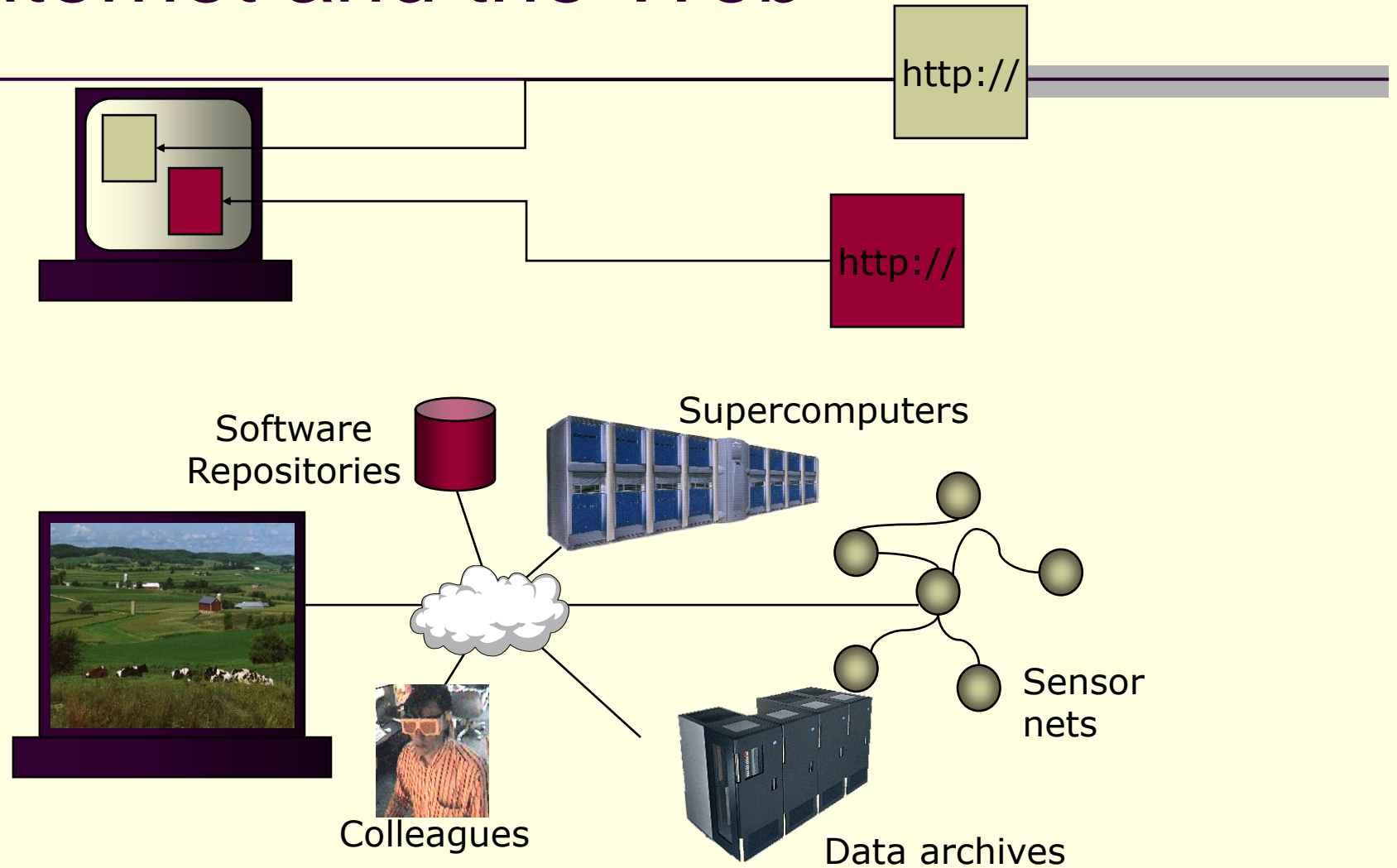**Computers Everywhere**

Mobile PC (today)

The World Wide Web – Tim Burners-Lee – CERN, 1989

- Tim Burner-Lee developed three keystones for the Web:
    - the language for encoding documents - HTML (HyperText Mark-up Language)
    - the system for linking documents – HTTP (HyperText Transfer Protocol)
    - the system for addressing documents – URL (Universal Resource Locator).
- Burners-Lee also wrote the first server software. His first Web tool was an editor-browser.
- Burners-Lee meant for the Web to be a social place for working together with others.
- Tim chose to stay above the competition and decided against starting a browser software company. He was not after the money.
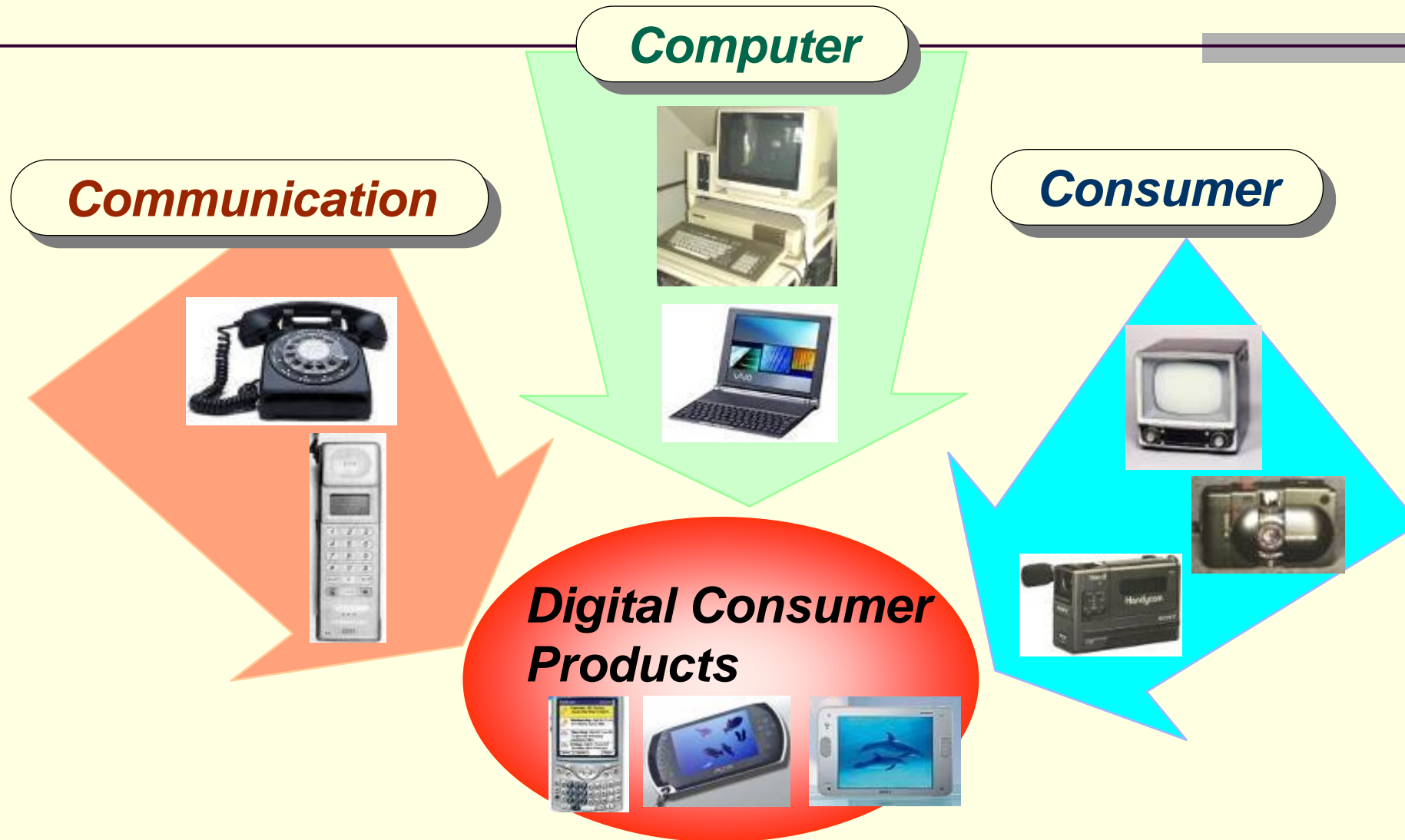
The Internet and the Web

http://

http://

Software
Repositories

Supercomputers

Colleagues

Sensor
nets

Data archives

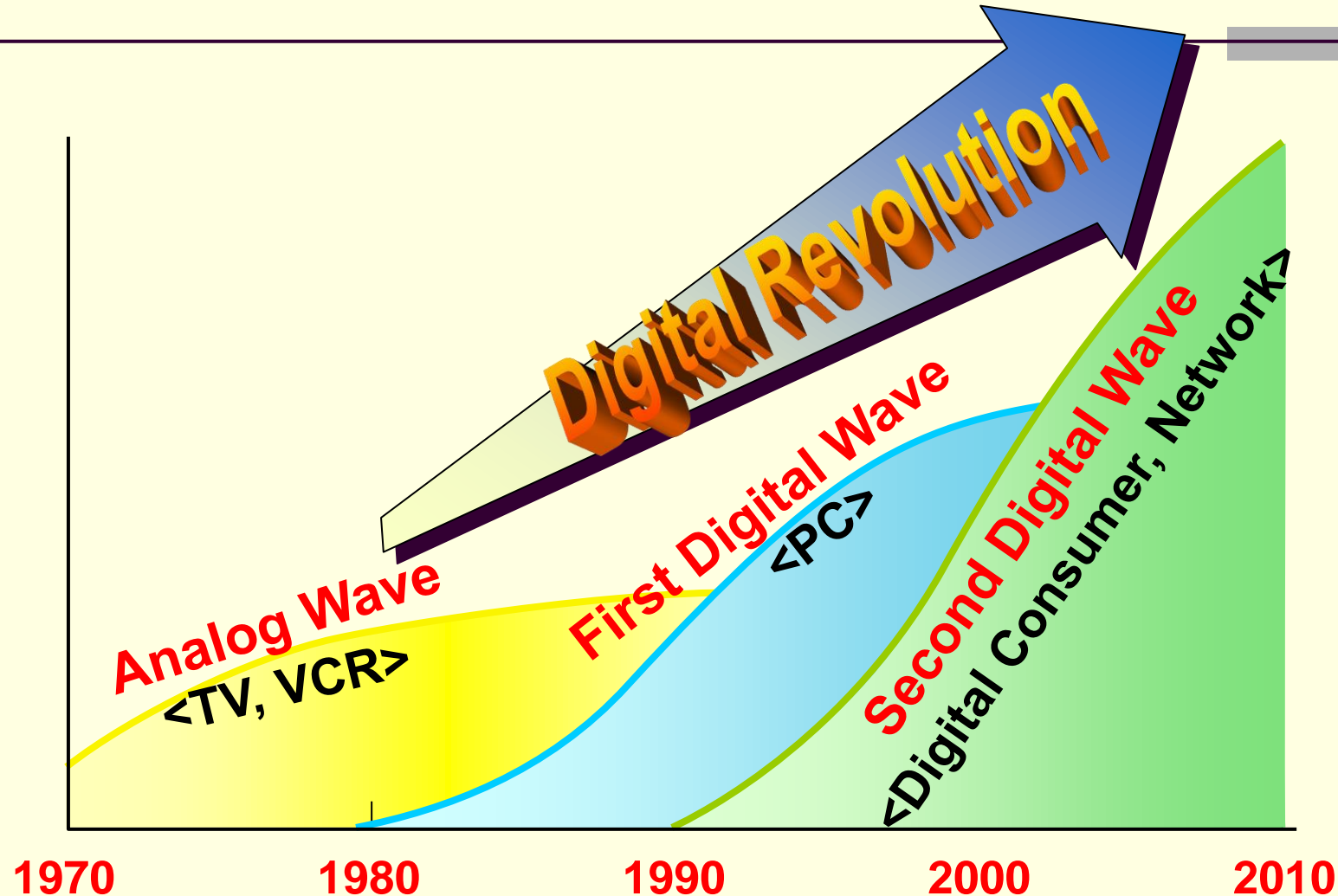*On-demand creation of powerful virtual computing systems*

The Five Waves of Electronic Digital Computing

- Wave 1, the era of mainframe computing;
- Wave 2, personal computing and software;
- Wave 3, the Internet;
- Wave 4, mobile and cloud computing;
- Wave 5, the Internet of everything – it will be data driven which means traditional algorithmic computing will give way to data flowing through machines and decisions being made based on what data is telling us.

Converging Technologies

Computer

Communication

Consumer

Digital Consumer Products

The Big Waves of Electronics

Digital Revolution

Analog Wave
<TV, VCR>

First Digital Wave
<PC>

Second Digital Wave
<Digital Consumer, Network>

1970   1980   1990   2000   2010

The Road to the Digital Future

- When John Vincent Atanasoff invented electronic digital computing, he did not know how much of an impact it would have on people's lives.
- The fifth information revolution – has it already happened?
- YES!
- How about the sixth information revolution?!?