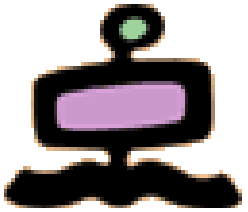
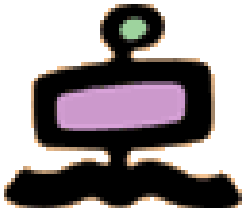
Corso di Biblioteche Digitali



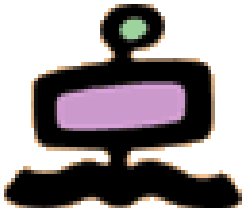
- Vittore Casarosa
  - Mail: casarosa@isti.cnr.it
  - Tel: 050 621 3115 (office) 348 397 2168 (mobile)
  - Skype: vittore1201
- “Ricevimento” at the end of the lessons or by appointment
- Final assessment
  - 70% oral examination
  - 30% project (development of a small digital library))
- Reference material:
  - Ian Witten, David Bainbridge, David Nichols, How to build a Digital Library, Morgan Kaufmann, 2010, ISBN 978-0-12-374857-7 (Second edition)
  - Material provided by the teacher
- **http://cloudone.isti.cnr.it/casarosa/BDG/**

Modules



- Computer Fundamentals and Networking
- A conceptual model for Digital Libraries
- Bibliographic records and metadata
- Information Retrieval and Search Engines
- Knowledge representation
- Digital Libraries and the Web
- Hands-on laboratory: the Greenstone system

Refresher



Refresher on Computer Fundamentals and Networking

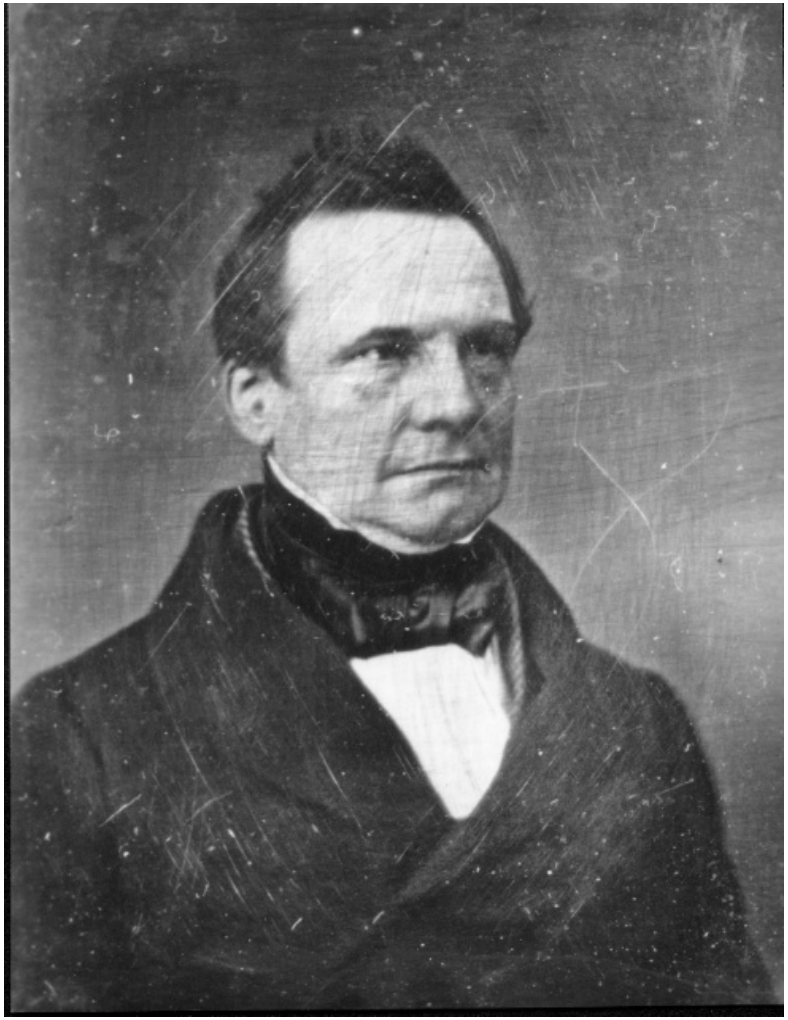
- History of computers
- Architecture of a computer
- Computer networks and the Internet
- Data representation within a computer

Early devices (not computers)

Abacus
2500 BC

Pascalina
1645

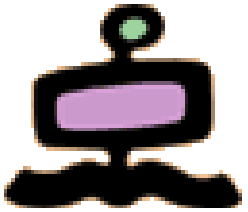
Early visions (of computers)



Charles Babbage
1791-1871

Professor of Mathematics, Cambridge University, 1827-1839

Babbage's engines



- *Difference Engine* 1823
- *Analytic Engine* 1833
  - The forerunner of modern digital computer

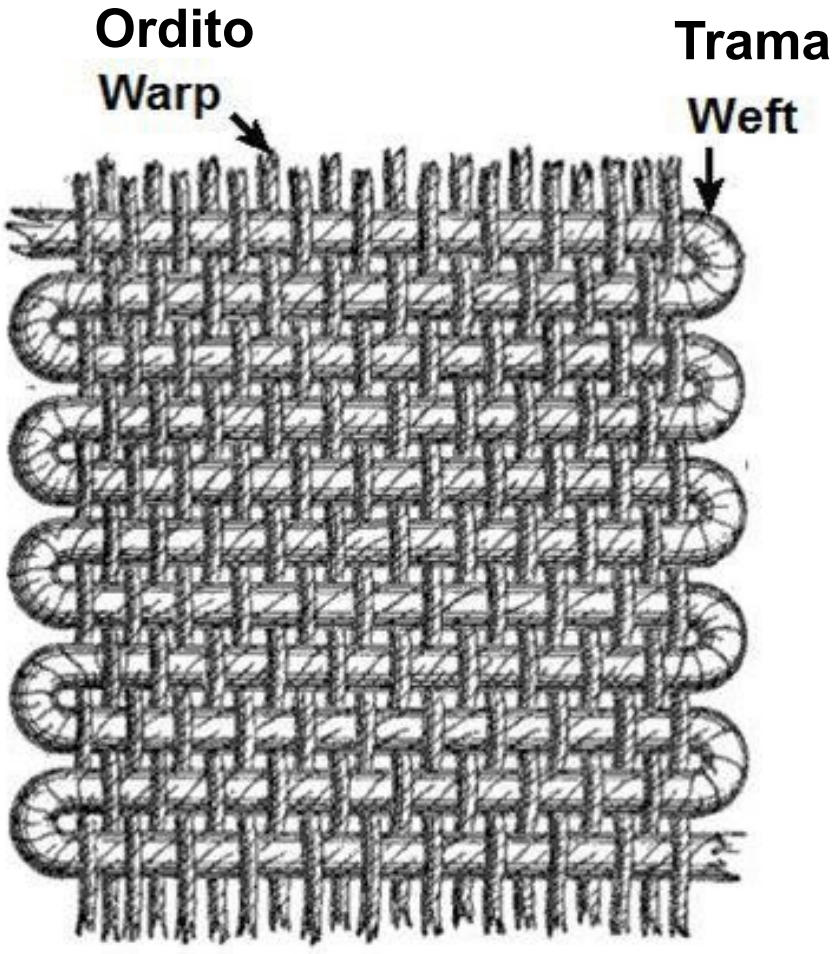
Application

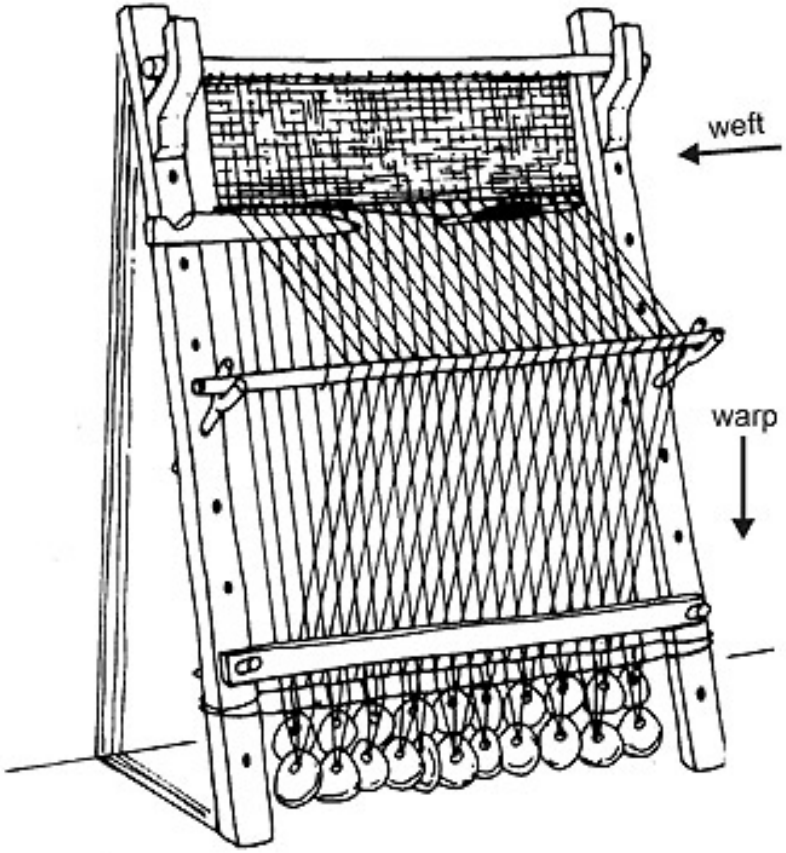
- Mathematical Tables – Astronomy
- Nautical Tables – Navy

Technology

- mechanical gears, Jacquard's loom (1801), simple calculators

The loom

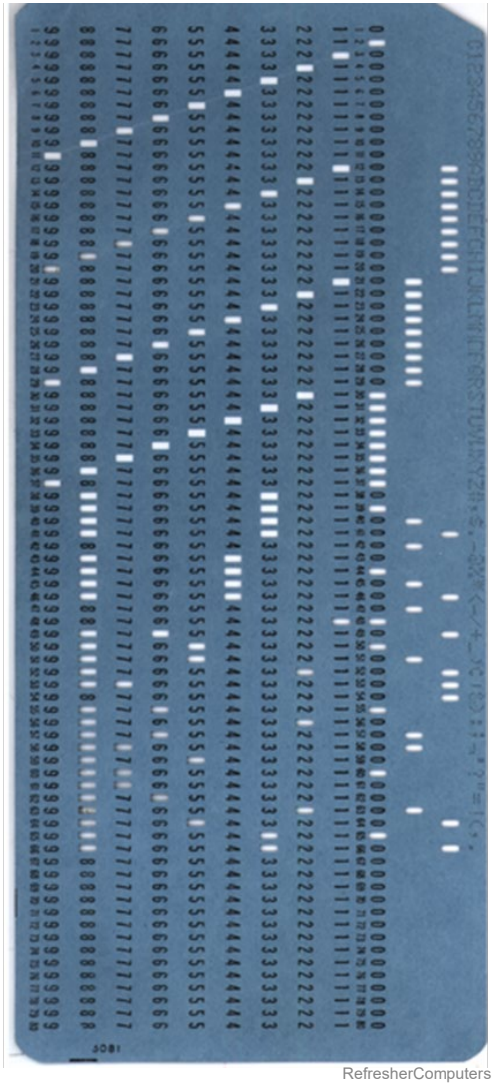




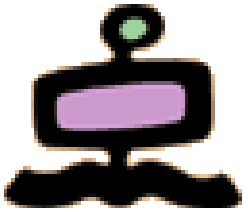
Use of punched paper tape

The organ grinder

«Programmable» carillon and punched cards



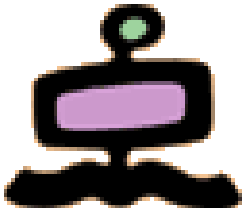
Early experiments
100 years later



- Z1 machine (Konrad Zuse, private entrepreneur, 1936-1941)
- ABC (Atanasoff-Berry Computer, Iowa State University, 1937-1942)
- Mark I (Howard Aiken, MIT, 1937-1941)

1942 Second World War

Harvard Mark I



- Built in 1944 in IBM Endicott laboratories
  - Howard Aiken – Professor of Physics at Harvard
  - Essentially mechanical but had some electro-magnetically controlled relays and gears
  - Weighed *5 tons* and had *750,000* components
  - A synchronizing clock that beat every *0.015* seconds (66KHz)

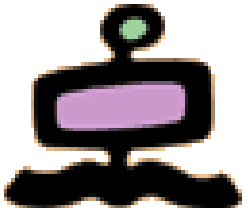
Performance:

0.3 seconds for addition
6 seconds for multiplication
1 minute for a sine calculation

WW-2 Effort

Broke down once a week!

ENIAC

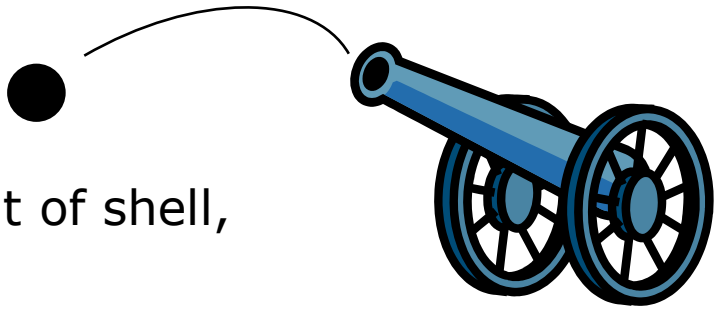


- Inspired by Atanasoff and Berry, Eckert and Mauchly designed and built ENIAC (1943-45) at the University of Pennsylvania
- The first, completely electronic, operational, general-purpose analytical calculator!
  - 30 tons, 72 square meters, 200KW
- Performance
  - Read in 120 cards per minute
  - Addition took 200 μs, Division 6 ms
  - 1000 times faster than Mark I
- Not very reliable!

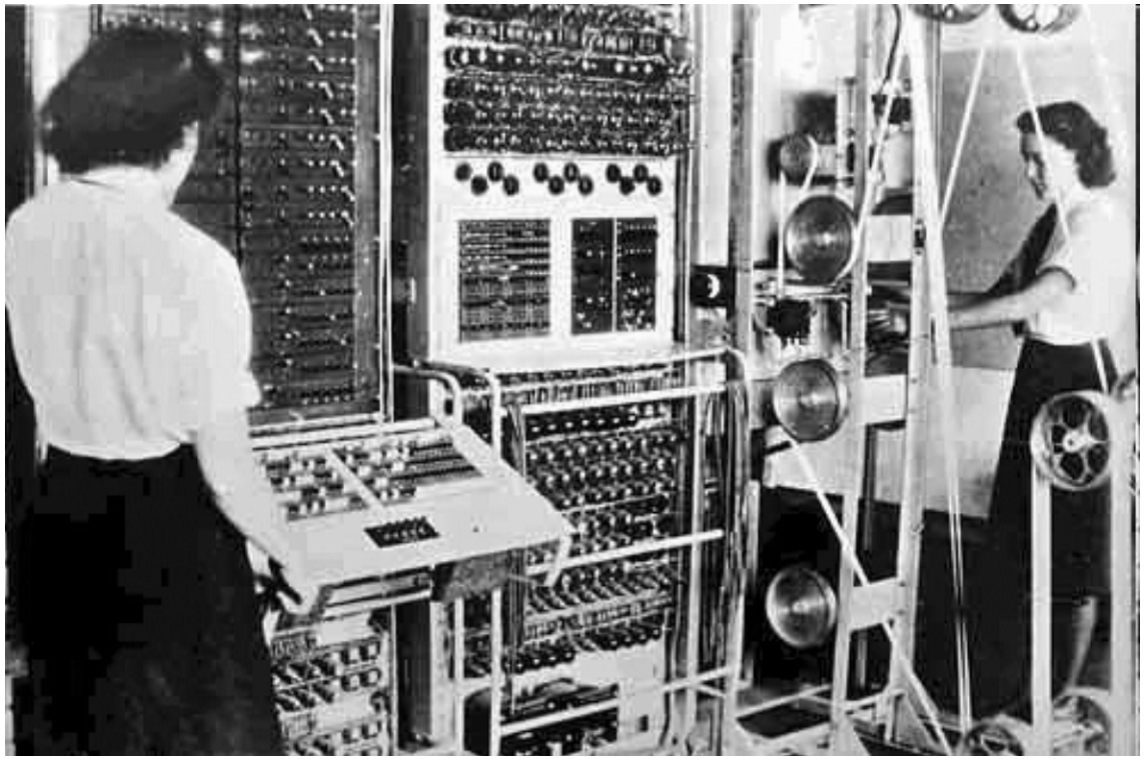
WW-2 Effort

Application: Ballistic calculations

angle = f (location, tail wind, cross wind,
air density, temperature, weight of shell,
propellant charge, ...)

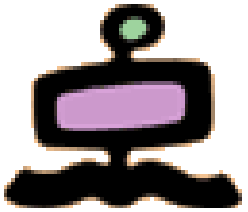


Colossus



Colossus (derived from Mark 1 and Mark 2) was used in London during the second World War to decipher secret German messages (Enigma machine)

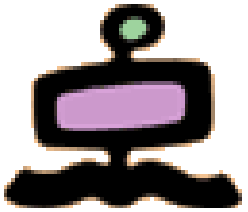
EDVAC - Electronic Discrete Variable Automatic Computer

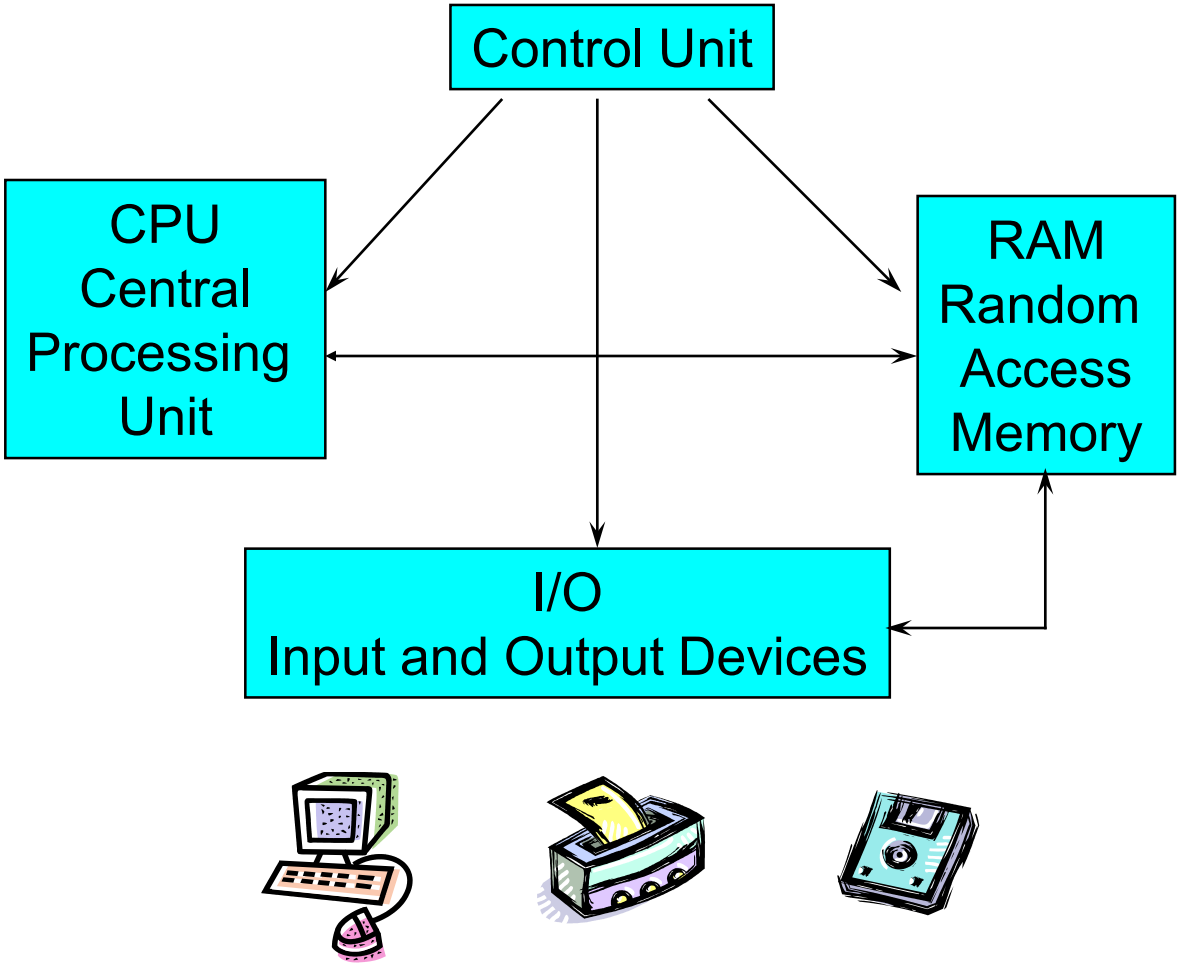


- ENIAC's programming system was external
  - Sequences of instructions were executed independently of the results of the calculation
  - Human intervention required to take instructions "out of order"
- Eckert, Mauchly, John von Neumann and others designed EDVAC (1944) to solve this problem
  - Solution was the *stored program computer*

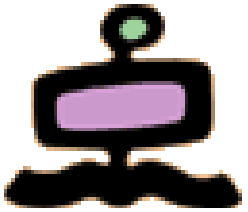
    ⇒ *"program can be manipulated as data"*
- *First Draft of a report on EDVAC* was published in 1945, but just had von Neumann's signature
- In 1973 the court of Minneapolis attributed the honor of *inventing the computer* to John Atanasoff

Basic components of a computer

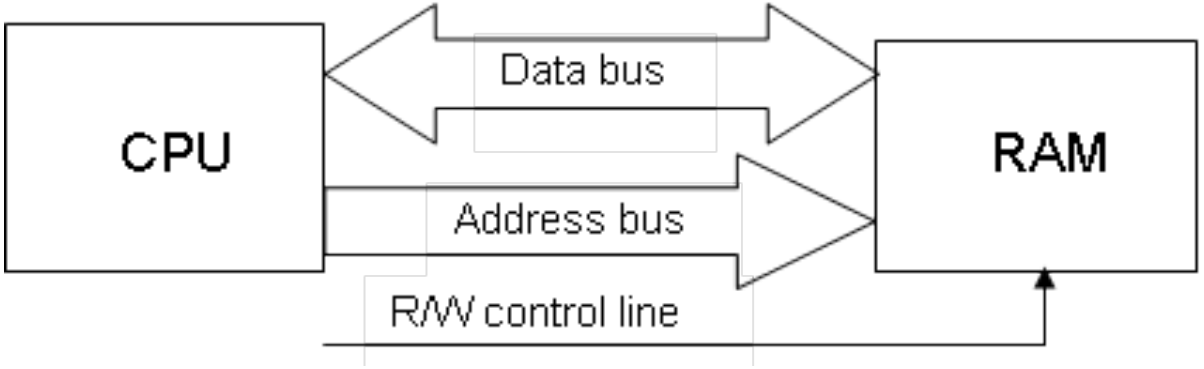




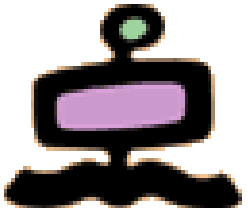
Random Access Memory



- The RAM is a linear array of “cells”, usually called “words”
- The words are numbered from 0 to N, and this number is the “address” of the word
- In order to read/write a word from/into a memory cell, the CPU has to provide its address on the “address bus”
- A “control line” tells the memory whether it is a read or write operation
- In a read operation the memory will provide on the “data bus” the content of the memory cell at the address provided on the “address bus”
- In a write operation the memory will store the data provided on the “data bus” into the memory cell at the address provided on the “address bus”

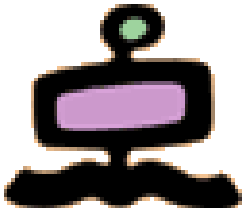


Von Neuman architecture



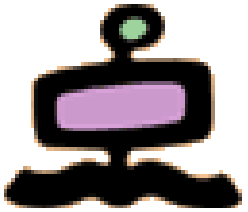
- The RAM contains both the program (machine instructions) and the data
- The basic model is “sequential execution”
  - each instruction is extracted from memory (in sequence) and executed
- Basic execution cycle
  - Fetch instruction (from memory) at location indicated by LC
  - Increment Location Counter (to point to the next instruction)
  - Bring instruction to CPU
  - Execute instruction
    - Fetch operand from memory (if needed)
    - Execute operation
    - Store result
      - in “registers” (temporary memory)
      - in memory (RAM)

Data within a computer



- The Control Unit, the RAM, the CPU and all the physical components in a computer act on electrical signals and on devices that (basically) can be in only one of two possible states
- The two states are conventionally indicated as “zero” and “one” (0 and 1), and usually correspond to two voltage levels
- The consequence is that all the data within a computer (or in order to be processed by a computer) has to be represented with 0s and 1s, i.e. in “binary notation”

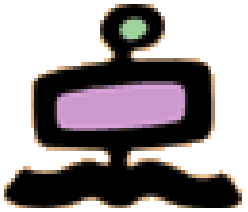
Evolution of computer technology



- First Generation
  mechanical/electromechanical
- Second Generation
  vacuum tubes
- Third Generation
  discrete transistors (solid state devices)
  SSI, MSI, LSI integrated circuits
- Fourth Generation
  VLSI integrated circuits

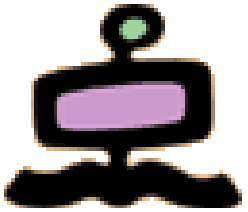
VLSI = Very Large Scale Integration

Evolution of computer components



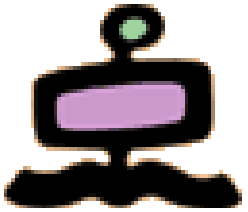
- Computer technology
  - CPU on integrated chips
    - From KHz to MHz to GHz
  - Random Access Memories
    - RAM – from KB to MB to GB
  - External memories
    - Tapes, hard disks, floppy disks
    - Memory sticks
    - CDs
    - DVDs
    - from MB to GB to TB to PB to EB

Size of digital information



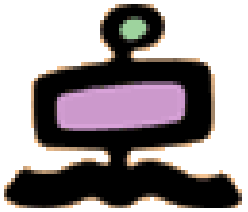
1000	k	kilo
1000^2	M	mega
1000^3	G	giga
1000^4	T	tera
1000^5	P	peta
1000^6	E	exa
1000^7	Z	zetta
1000^8	Y	yotta

Evolution of the software



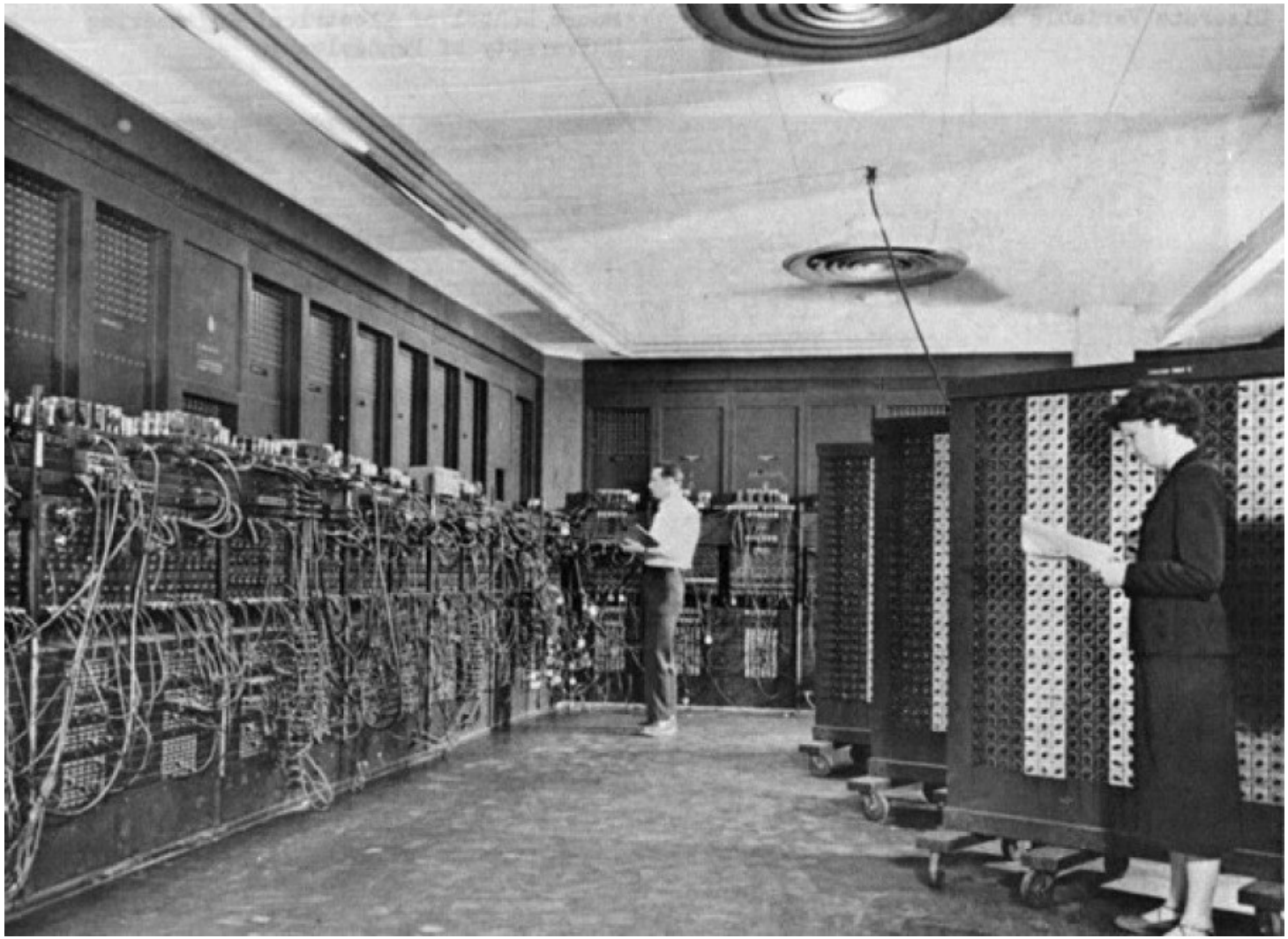
- Operating systems
  - Multi user
  - Multi tasking
- Applications
  - Client-Server
  - Multimedia
- Communication

Evolution of computer market



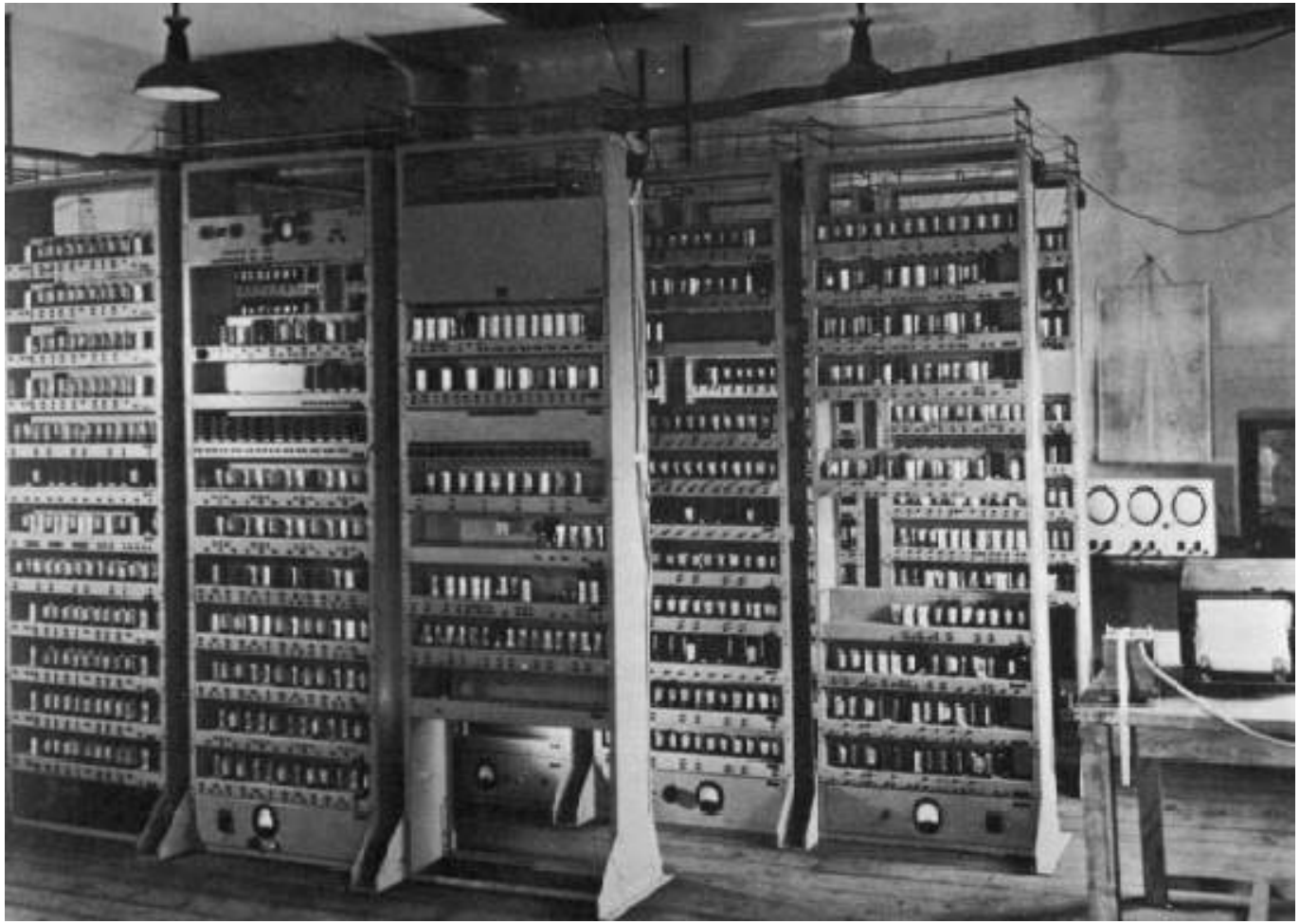
- Military applications in early 40s
- Scientific/research applications in late 40s
- Commercial applications appear in early 50s
- Monopoly of IBM starts with 650, 701, 702
- Monopoly of IBM continues with 7070, 7090 and the 360 series, starting the “mainframe era” (in the 60s)
- Arrival of the “minicomputers” in the 70s
- Arrival of the PC in the 80s
- Arrival of the Internet in the 90s
- Arrival of the Web in the 90s

ENIAC - Electronic Numerical Integrator And Computer



EDSAC - Electronic Delay Storage Automatic Calculator

EDSAC, University of Cambridge, UK, 1949



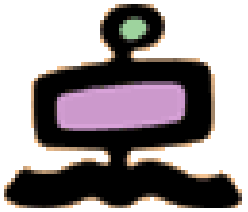
A “mainframe” in the 60’

A “mainframe” in the 70’

Minicomputers

Early PCs

Evolution of technology



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  - CPU and integrated chips
  - Random Access Memories
    - RAM – from KB to GB
  - External memories
    - Tapes, hard disks, floppy disks
    - Memory sticks
    - CDs
    - DVDs
    - from MB to GB to TB to PB to EB
- Communication technology (networks)
  - (Telephone) line speed
  - Point to point (leased lines)
  - Local Area Networks
  - Inter-networking (TCP/IP)