Introduction to informatics

Piroska Biró

Course 02

Information

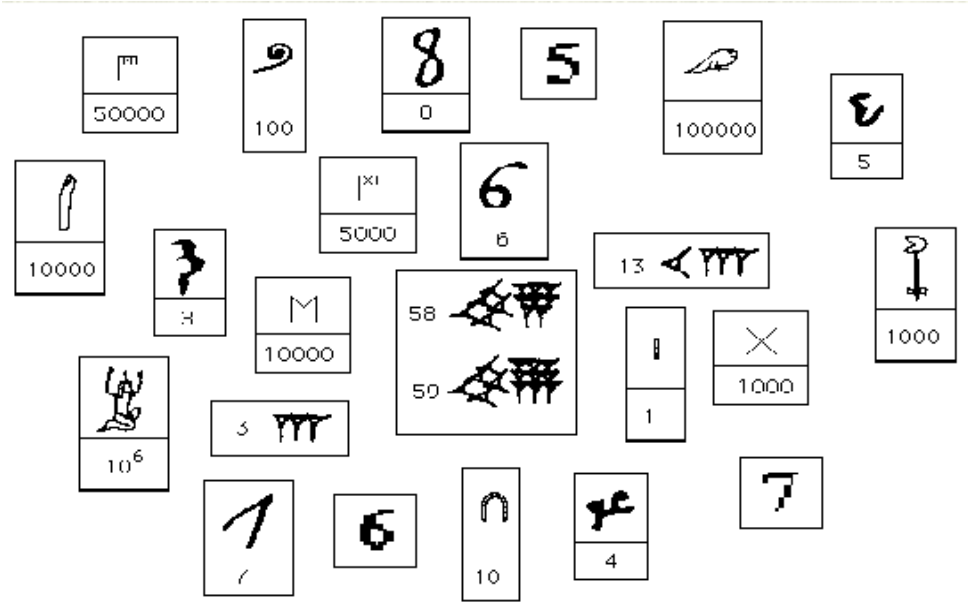
- Webpage
  - w1.inf.unideb.hu/web/biropiroska/introduction-to-infromatics
- Maximum 15 minutes of late arrival is accepted in labor.
- Maximum 3 absences are allowed in labor.
- Signature – Syllabus

Topics

- History of computing
- Computer components
- Software
- Hardware
- Units of information
  - Bit
  - Byte
- Computer number/numeral systems

The history of computing

- prehistoric man
  - fingers
  - stones
- number systems
- digit
- calculator



The history of computing

- first devices
- abacus/counting frame
  - ancient China and Egipt
  - astronomy and shipping
  - multiplication
  - division

The history of computing

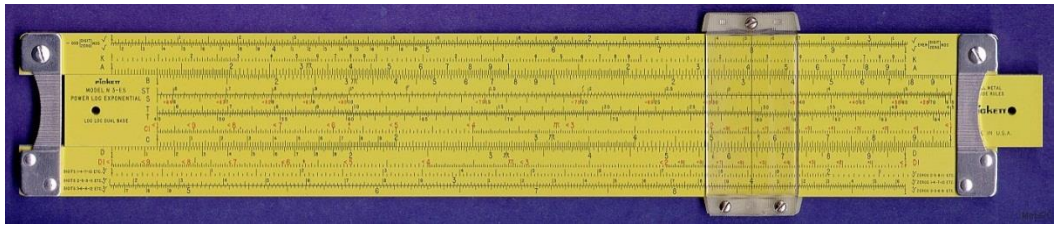
- Table of Pythagoras
  - developed in ancient Greece
  - the frequently needed calculations are placed into a table
  - multiplication table

		1	2	3	4	5	6	7	8	9	10
1		1	2	3	4	5	6	7	8	9	10
2		2	4	6	8	10	12	14	16	18	20
3		3	6	9	12	15	18	21	24	27	30
4		4	8	12	16	20	24	28	32	36	40
5		5	10	15	20	25	30	35	40	45	50
6		6	12	18	24	30	36	42	48	54	60
7		7	14	21	28	35	42	49	56	63	70
8		8	16	24	32	40	48	56	64	72	80
9		9	18	27	36	45	54	63	72	81	90
10		10	20	30	40	50	60	70	80	90	100

- Gelosia method
  - made multiplication possible

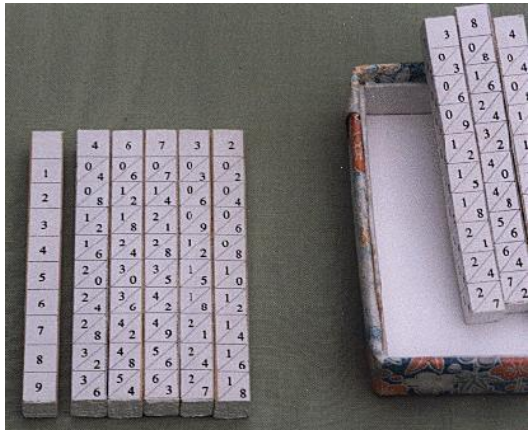
The history of computing

- slide stick, saun-pan, soroban scso ti, etc.
- Adam Riese (1492-1559) German mathematician developed calculation based on the lines of the slide rule



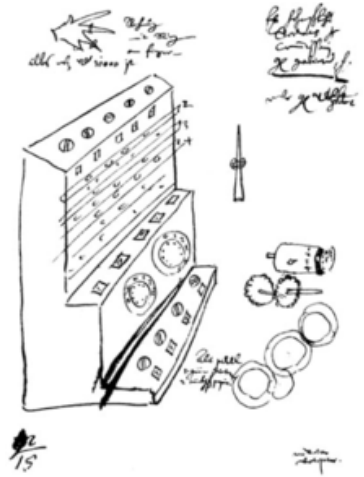
The history of computing

- John Napier (1550–1617)
- Jobst Bürgi (1552–1623)
- William Oughtred (1574–1664)
- logarithm function
- Napier rods/Napier bones



The computer generations
0. Generation to 1946

- mechanical and electrical calculators
- Wilhelm Schickard (1592–1635), German
  - first automatised calculator (1623, calculating clock)
  - multiplication, division
  - addition, subtraction
  - demolished by fire, reinvented (1957)

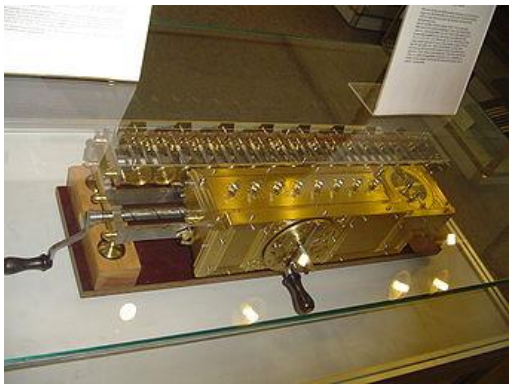


The computer generations
0. Generation to 1946

- Blaise Pascal (1623–1662), French
  - addition, subtraction (1642, Pascaline, until 1799 tax calculation, Paris, Drezda)
  - integrated execution steps
  - input, output: reading switch states

The computer generations
0. Generation to 1946

- Gottfried Wilhelm Leibniz (1646–1716), German
  - four basic operations (1671–1694, Step Reckoner, Hannover)
  - integrated executing steps
  - input, output: reading switches states
  - logic, binary system

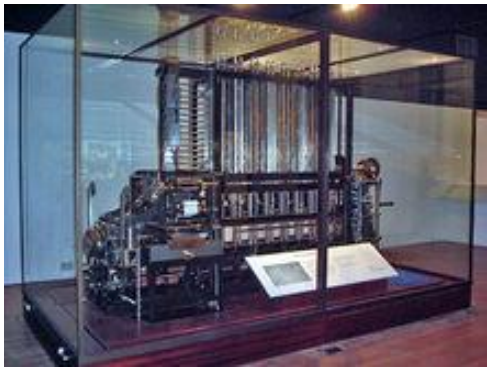


The computer generations
0. Generation to 1946

- Joseph Jacquard (1752–1834)
  - punch card (loom/weaving machine, 1801)

The computer generations
0. Generation to 1946

- Charles Babbage (1792–1871), English
  - **Difference Engine** (1822, unfinished, accessories)
    - to compute values of polynomial functions
  - **Analytical Engine** (1834, not finished, constructed later on the basis of the plans)
    - six-degree polynoms
    - digital calculator operated by external program, instructions, data on punch card
    - output: in printed form



The computer generations
0. Generation to 1946

- Lady Lovelace Ada Augusta Byron (1815-1852)
  - Analytical Engine
  - first computer programmer

The computer generations
0. Generation to 1946

- Konrad Zuse (1910–1995)
  - Z1 (1936–1938)
    - electromechanical
    - binary number system
    - limited programmability
    - instructions, data on punch cards
  - Z2, Z3, Z4
    - Z3: electromechanical
    - the first operating and totally automatic calculator

The computer generations
0. Generation to 1946

- Howard Aiken (1900–1973)
- **Mark I** (1944, ASCC)
  - based on Babbage's principles
  - decimal number system
  - invoicing phone calls and the military purposes
  - the speed of the machine could have been improved by the elimination of the mechanical components
  - punch tape

The First Generation: 1946-1958 The Vacuum Tube Years

- vacuum tube
  - elimination of mechanical components
  - invented: Lee de Forest (1906)
- peripheral units
  - punched card
  - punched tape
- **ENIAC** (Electronic Numerical Integrator and Calculator)
  - University of Pennsylvania
  - 1946 (beginning: 1943, in use until 1955)
  - first, general purpose, programmable
  - external program control, punched cards
  - no memory, registers
  - 2000 times faster than Mark I
  - decimal number system
  - relays remain
- **EDVAC** (Electronic Discrete Variable Automatic Computer)
  - electronic
  - binary number system
  - stored program concept
  - 1951 - UNIVAC

The First Generation: 1946-1958 The Vacuum Tube Years

- Neumann-principles
  - the computer should operate completely electronically
  - application of the binary number system
  - the use of an arithmetical unit
  - the use of a central processing unit
  - storage and control of a program and data storage

The Second Generation: 1959-1964 The Era of the Transistor

- invention of transistors
  - semiconductor switching device
  - smaller and faster than the first generation computers, fewer energy need
  - peripheral units cannot keep up with it
- peripheral units
  - punch cards, punch tape
  - magnetic tape, magnetic disk
  - non-CU operated, periphery processors
- memory-centered structure
- interruption management
- High-level programming languages (COBOL, FORTRAN)

The Third Generation: 1965-1970
Integrated Circuits - Miniaturizing the Computer

- Silicon based integrated circuit (1959)
  - transistors were miniaturized
  - increased the speed and efficiency of computers
  - energy consumption is decreased
- Small Scale Integration (SSI),
- Medium Scale Integration (MSI) technology
- multiprogramming mode
- using operation systems
- High-level programming languages (FORTRAN, ALGOL, COBOL, PL/1, BASIC, PASCAL)

The Fourth Generation: 1971-Today The Microprocessor

- Large Scale Integration (LSI) technology
- chip
- microprocessor (1971)
- microcomputers
- the central processing unit and memory located to input/output controls – on a single chip.

The Fifth Generation

- non Neumann-principles computers
- increasing the number of processors
- parallel processing
- artificial intelligence based
  - usage
    - voice recognition
  - aims
    - natural language communication
    - learning abilities
    - self-organization

Computer

- electronic and electomechanical machine
  - data admission
  - data storage
  - data search
  - data processing
  - visualisation of the results
- personal computers
  - hardware – physical elements
  - software – untouchable

Types of Computers

- Portable computers (Laptop)
- The Personal Digital Assistans (PDA)
- Tablet computers
- Workstations
- Mainframe
- Supercomputers

Types of Computers

- Desktop computers

Types of Computers

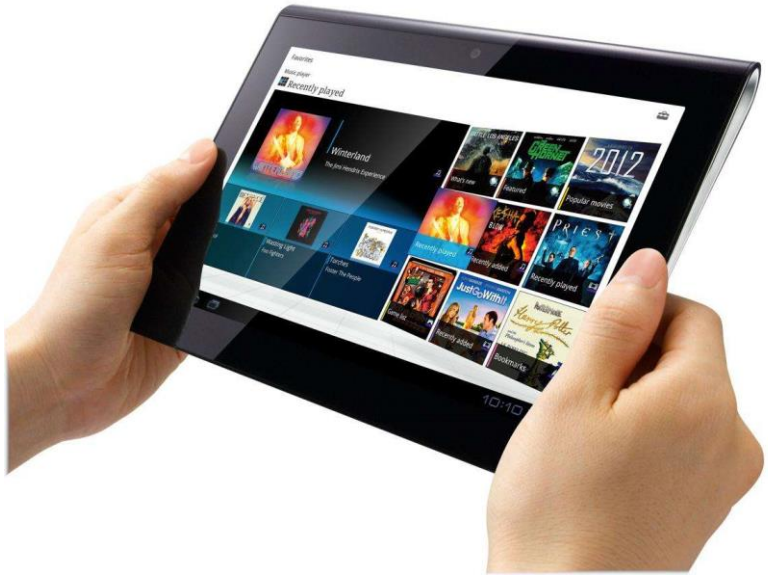
- Portable computers (Laptop)

Types of Computers

- The Personal Digital Assistans (PDA)

Types of Computers

- Tablet computers



Types of Computers

- Workstations

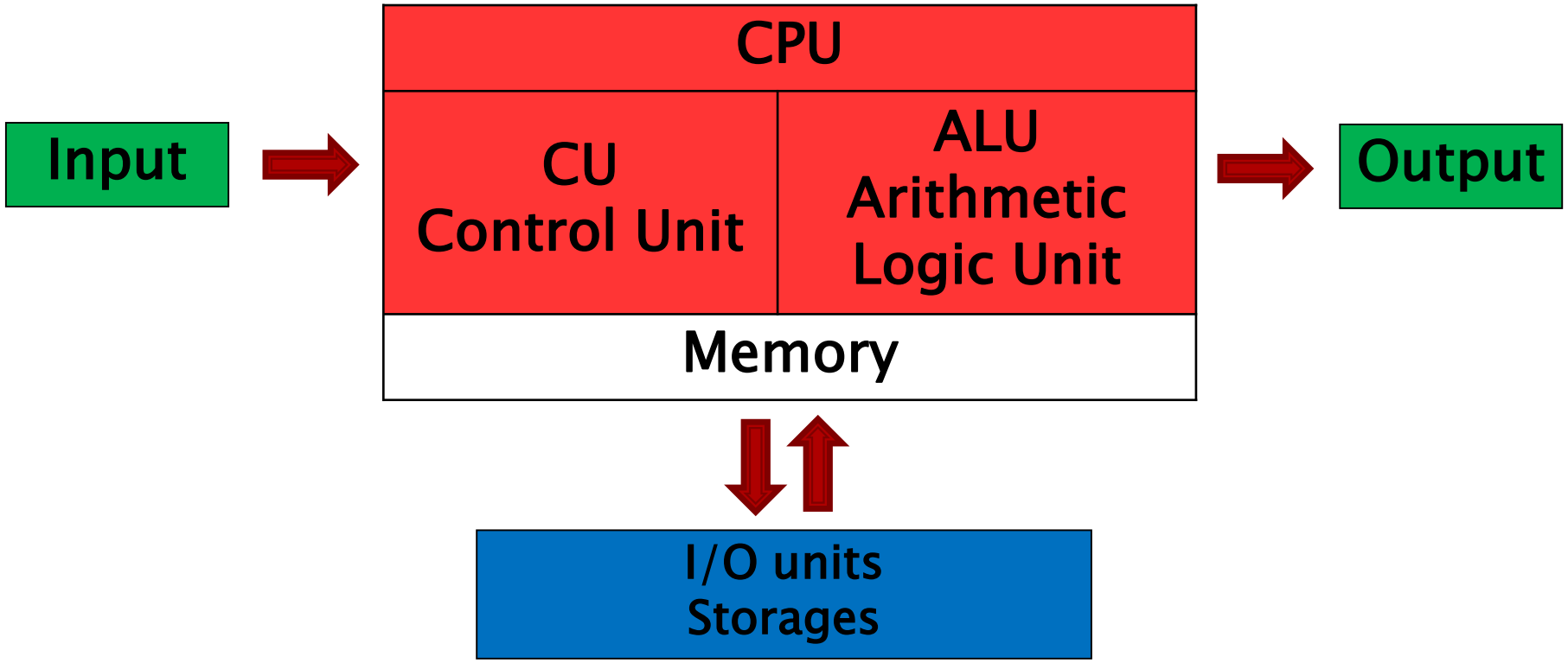
Types of Computers

- Mainframe

Types of Computers

- Supercomputers

Computer structure



CPU – Central Processor Unit

- central processor unit
  - basic arithmetical, logical, and input/output operations
- use in the computer industry at least since the early 1960s.
- housed in a single silicon chip called a microprocessor
- less than four centimeters square
- two components
  - ALU – arithmetic logic unit
  - CU – control unit

ALU – Arithmetic Logic Unit

- a digital circuit that performs arithmetic and logical operations
- must process numbers using the same format as the rest of the digital circuit
- the format of modern processors is almost always the two's complement binary number representation.
  - ones' complement
  - two's complement

CU – Control Unit

- coordinates the components of a computer system
- the circuitry that controls the flow of data through the processor
- coordinates the activities of the other units within it
- „brain within the brain”
  - controls what happens inside the processor, which in turn controls the rest of the computer.

Memory

- the physical devices used to store programs (sequences of instructions) or data (e.g. program state information) on a temporary or permanent basis for use in a computer or other digital electronic device
- primary and secondary memory
- semiconductor memory: volatile and non-volatile
  - **non-volatile** memories are flash memory and ROM/PROM/EPROM/EEPROM memory
  - **volatile** memories are primary memory (typically dynamic RAM, DRAM), and fast CPU cache memory (typically static RAM, SRAM)

Basic computer components

- Input devices
- Output devices
- Removable data storage
- Computer case
- Data ports

Hardware

- component devices
- installed into a computer
- attached by cable or through a port
- peripherals

Hadware components

- computer case: "computer chassis", "cabinet", "box", "enclosure", "housing", or simply "case"
- power supply unit – PSU
- motherboard – CPU, chipset, ROM, RAM, BIOS, Buses, Ports
- expansion card
- computer data storage, memory

Input peripherals

Text input device

- Keyboard – a device to input text and characters by depressing buttons (referred to as keys or buttons).

Pointing devices

- **Mouse** – a pointing device that detects two dimensional motion relative to its supporting surface.
- **Trackball** – a pointing device consisting of an exposed protruding ball housed in a socket that detects rotation about two axes.
- **Touchscreen** – senses the user pressing directly on the monitor.
- **Light Pen** – a pointing device with the shape of a pen or pencil. With a light pen we can touch the points of the monitor and can control the operation of the computer more precisely.
- **Graphic Tablet** – is usually an A4 or A5 size censoring board.

Input peripherals

Image, Video input devices

- **Scanner** – is a device used for the digitalization of pictures.
- **Digital camera** – the pictures are stored in memory cards in digital format. Their great advantage is that the pictures can be immediately seen, and if we make a bad photo, we can delete it easily.
- **Digital video camera** – digital video cameras save the digital video material on minicasettes, DVDs or memory cards. If we want to upload the stored image on the computer, we use most frequently FireWire connector, rarely USB port.
- **Webcam** – a video camera used to provide visual input that can be easily transferred over the internet.

Audio input devices

- Microphone – an acoustic sensor that provides input by converting sound into electrical signals.

Input peripherals

Gaming devices

- **Joystick** – a hand-operated pivoted stick whose position is transmitted to the computer.
- **Game pad** – a hand held game controller that relies on the digits (especially thumbs) to provide input.
- **Game controller** – a specific type of controller specialized for certain gaming purposes.

Output peripherals

Printer – a device that produces a permanent human-readable text or graphic document.

- Laser printer
- Inkjet printer
- Dot matrix printer
- Thermal printer

Computer monitors

- **CRT** – Cathode Ray Tube
- **LCD** – Liqiud Crystal Display
  - Thin film transistor liquid crystal display (**TFT-LCD**)
- **TFT** (Thin Film Transistor)
- **OLED** (Organic light-emitting diode)

Speakers

Plotter

Software

- collection of computer programs
- a set of programs, procedures, algorithms and its documentation concerned with the operation of a data processing system
- untouchable
- usually written in high-level programming languages
- assembly language
- operating systems

Units of information

- **Bit**
  - value: 0, 1
  - **bi**nary digi**t**

Multiples of bits				
SI decimal prefixes		Binary usage	IEC binary prefixes	
Name (Symbol)	Value		Name (Symbol)	Value
kilobit (kbit)	10^3	2^{10}	kibibit (Kibit)	2^{10}
megabit (Mbit)	10^6	2^{20}	mebibit (Mibit)	2^{20}
gigabit (Gbit)	10^9	2^{30}	gibibit (Gibit)	2^{30}
terabit (Tbit)	10^{12}	2^{40}	tebibit (Tibit)	2^{40}
petabit (Pbit)	10^{15}	2^{50}	pebibit (Pibit)	2^{50}
exabit (Ebit)	10^{18}	2^{60}	exbibit (Eibit)	2^{60}
zettabit (Zbit)	10^{21}	2^{70}	zebibit (Zibit)	2^{70}
yottabit (Ybit)	10^{24}	2^{80}	yobibit (Yibit)	2^{80}

Byte

Multiples of bytes				
SI decimal prefixes		Binary usage	IEC binary prefixes	
Name (Symbol)	Value		Name (Symbol)	Value
kilobyte (kB)	10^3	2^{10}	kibibyte (KiB)	2^{10}
megabyte (MB)	10^6	2^{20}	mebibyte (MiB)	2^{20}
gigabyte (GB)	10^9	2^{30}	gibibyte (GiB)	2^{30}
terabyte (TB)	10^{12}	2^{40}	tebibyte (TiB)	2^{40}
petabyte (PB)	10^{15}	2^{50}	pebibyte (PiB)	2^{50}
exabyte (EB)	10^{18}	2^{60}	exbibyte (EiB)	2^{60}
zettabyte (ZB)	10^{21}	2^{70}	zebibyte (ZiB)	2^{70}
yottabyte (YB)	10^{24}	2^{80}	yobibyte (YiB)	2^{80}

1byte = 8 bit

Questions?

- 1 byte = ? bit
- 1 Kbit = ? byte
- 1 Kbit = ? bit
- 24 Kbit = ? bit = ? byte
- 16 Mbit = ? bit = ? Mbyte = ? byte
- 32 Mbit = ? Kbit = ? byte
- 3 Gbit = ? Mbit =? Kbit
- 2 Tbyte = ? Gbyte

Questions?

- 1 byte = 8 bit
- 1 Kbit = 128 byte
- 1 Kbit = 1024 bit
- 24 Kbit = 24576 bit = 3072 byte
- 16 Mbit = 16777216 bit = 2 Mbyte = 2097152 byte
- 32 Mbit = 32768 Kbit = 4194304 byte
- 3 Gbit = 3072 Mbit = 3145728 Kbit
- 2 Tbyte= 2048 Gbyte