Introduction to informatics

Course 02

Information

- Webpage
  - https://it.inf.unideb.hu/honlap/biropiroska/students/IntroInfo
- Maximum 15 minutes of late arrival is accepted in labor.
- Signature – Syllabus

Revision

- History of computing, Computer generations
- What is the name of the first device of calculation?
  - abacus
- Who invented the Difference Engine?
  - Charles Babbage
- Who was the first computer programmer?
  - Lady Lovelace Ada Augusta Byron
- In which computer generation did the transistors appear?
  - The Second Generation

Basic concepts

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

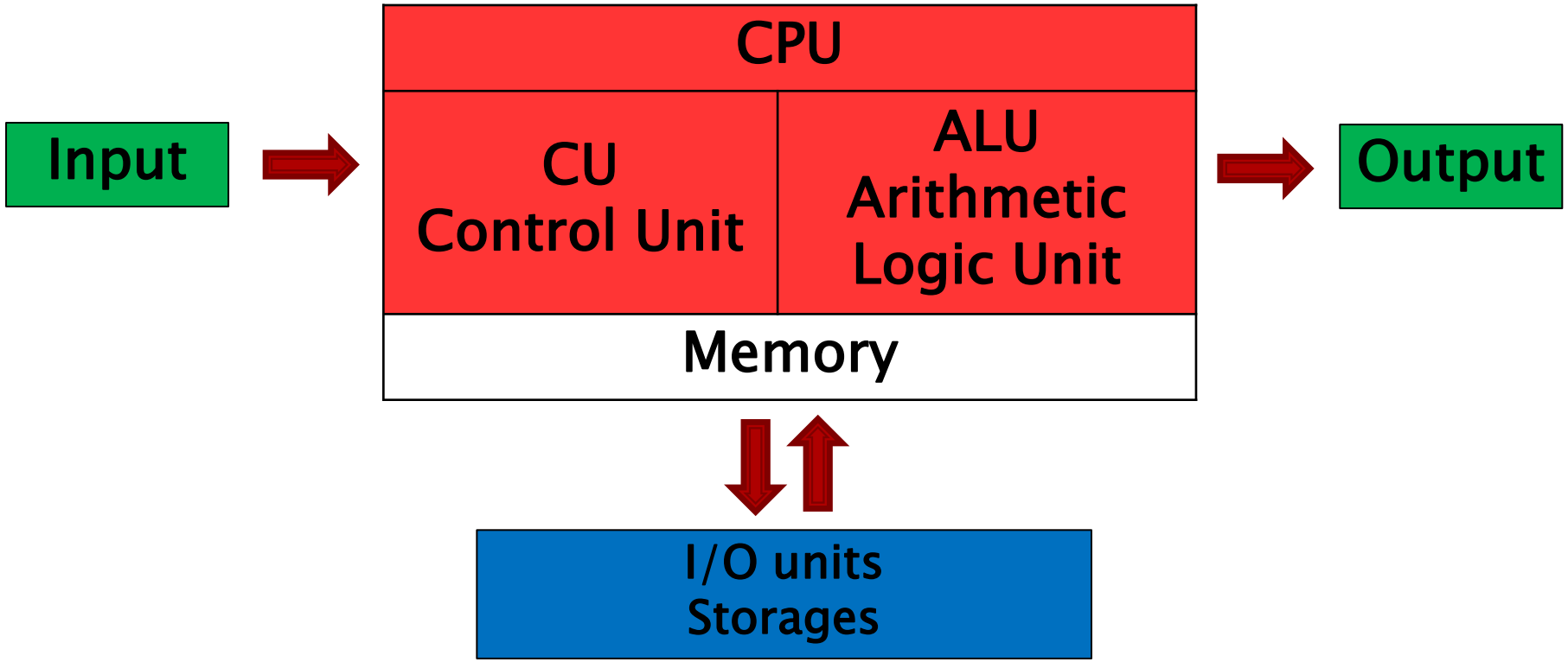
Computer

- 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

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

Number/Numeral system concepts

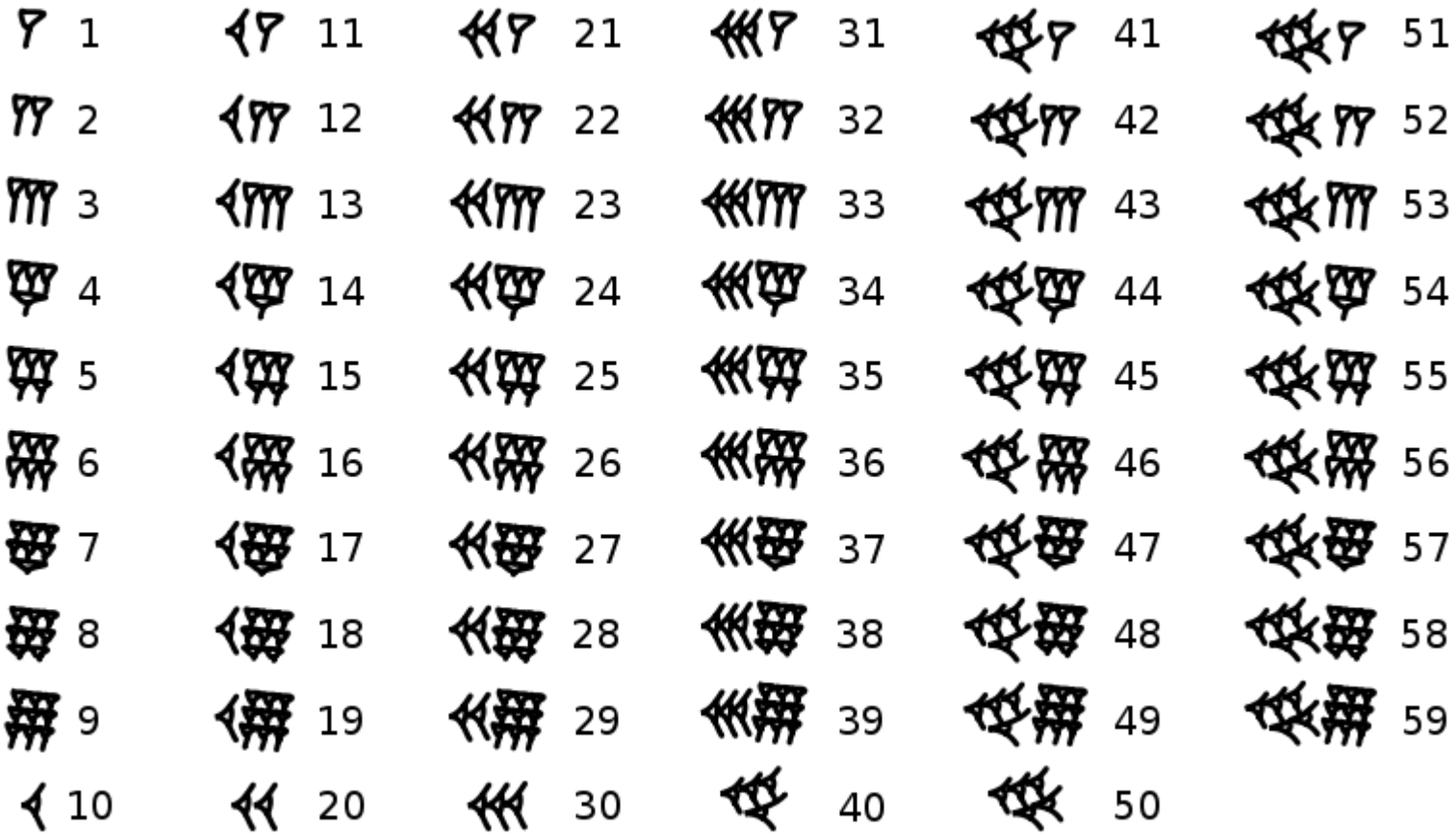
- The numeral or number systems are all the processes of the denominations and the description of numbers.
  - **non-positional** (e.q. Egyptian, Mayan, Roman; difficult calculation in them)
  - **positional notation** or **place-value notation**
    - Babylonian(B.C.1750): sexagesimal (time and angle measuring)
    - Indian (A.D. 600): decimal system (digits: 1, 2, . . . , 9)
    - Arabic (A.D. 750): appereance of the 0
    - Europe between 1200-1600 spread generally

Name	Base	Sample	Approx. first appearance
Babylonian numerals	60		3100 B.C.
Greek numerals	10	α β γ δ ϵ ϝ ζ η θ ι	
Roman numerals	10	I II III IV V VI VII VIII IX X	1000 B.C.
Chinese rod numerals	10		1st century
Arabic numerals	10	0 1 2 3 4 5 6 7 8 9 10	9th century
Nepers's Location arithmetic	2	a b c d e f g h i j	1617 in Rabdology, a non-positional binary system

Babylonians

- sexagesimal (base-60)
- first appeared around 3100 B.C
- to count units 
- to count tens 
- 23 
- 23 or 23×60 or 23×60×60 or 23/60

Babylonian symbols



Greek numerals

Letter	Value	Letter	Value	Letter	Value
α′	1	ι′	10	ρ′	100
β′	2	κ′	20	σ′	200
γ′	3	λ′	30	τ′	300
δ′	4	μ′	40	υ′	400
ε′	5	ν′	50	φ′	500
ϝ′ or ϛ′ or στ′	6	ξ′	60	χ′	600
ζ′	7	ο′	70	ψ′	700
η′	8	π′	80	ω′	800
θ′	9	ϟ′	90	ϡ′	900

Roman numerals

1 = I
2 = II
3 = III
4 = IV
5 = V
6 = VI
7 = VII
8 = VIII
9 = IX
10 = X

11 = XI
12 = XII
13 = XIII
14 = XIV
15 = XV
16 = XVI
17 = XVII
18 = XVIII
19 = XIX
20 = XX
21 = XXI

25 = XXV
30 = XXX
40 = XL
49 = XLIX
50 = L
51 = LI
60 = LX
70 = LXX
80 = LXXX
90 = XC
99 = XC

Roman numerals

I=1

V=5

X=10

L=50

C=100

D=500

M=1000

Exercise:

49 = XLIX
68 = LXVIII
156 = CLVI
496 = CDXCVI
1347 = MCCCXLVII
2013 = MMXIII

Arabic numerals

0123456789

General Numeral systems

Definition: The p-based positional notation or place-value notation number systems rule is:

$$(\ldots \bar{a}_2 \bar{a}_1 \bar{a}_0 . \bar{a}_{-1} \bar{a}_{-2} \ldots)_r =$$

$$= \sum_{i=-\infty}^{\infty} a_i p^i =$$

$$= \cdots + a_2 p^2 + a_1 p + a_0 + a_{-1} p^{-1} + a_{-2} p^{-2} + \cdots .$$

Decimal number system

3457,28 3457.28

$3\text{thousand} + 4\text{hundred} + 5\text{ten} + 7\text{one} + 2\text{tenth} + 8\text{hundreth}$

$$3 \cdot 10^3 + 4 \cdot 10^2 + 5 \cdot 10 + 7 + 2 \cdot 10^{-1} + 8 \cdot 10^{-2}$$

$$\bar{a}_n \bar{a}_{n-1} \bar{a}_{n-2} \dots \bar{a}_2 \bar{a}_1 \bar{a}_0 . \bar{a}_{-1} \bar{a}_{-2} \dots \bar{a}_{-m}$$

$$S_{(10} = \sum_{i=-m}^{n} a_i \cdot 10^i$$

Number systems

- p base system (any $p>1$)
  - digits: 0, 1, …, $p-1$

$$\sum_{i=-m}^{n} a_i \cdot p^i$$

- binary system
  - $p = 2$
  - digits: 0, 1

$$\sum_{i=-m}^{n} a_i \cdot 2^i$$

- octal system
  - $p = 8$
  - digits: 0, 1, 2, 3, 4, 5, 6, 7

$$\sum_{i=-m}^{n} a_i \cdot 8^i$$

- hexadecimal system
  - $p = 16$
  - digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

$$\sum_{i=-m}^{n} a_i \cdot 16^i$$

Rules

- Convert from p-base to decimal system.

Exercises

- Convert from p-base system to decimal.
  - $101.101_{(2}=$
  - $32121.41_{(4}=$
  - $423.45_{(6}=$
  - $293.745(_{8}=$
  - $154.485_{(9}=$

Rules

- Convert from decimal to p-base system.

Exercises

- Convert from decimal to other p-base system.
  - $45.55_{(10}=?_{(2}$
  - $111.45_{(10}=?_{(4}$
  - $23.45_{(10}=?_{(5}$
  - $23.45_{(10}=?_{(8}$
  - $54.45_{(10}=?_{(16}$

Rules

- Conections between binary, octal and hexadecimal systems.

Exercises

1. $1000\ 1001\ 1111\ 1101_{(2}=$
2. $1010\ 0111\ 1101\ 1110_{(2}=$
3. $1011\ 1100\ 0001\ 0001_{(2}=$
4. $1000\ 0101\ 0110\ 1001_{(2}=$
5. $BCDFA_{(16}=$
6. $A94F6_{(16}=$
7. $DF237_{(16}=$
8. $A12F8_{(16}=$

Exercises

- $23612.352_{(9} =?_{(10}$
- $32918.35_{(10} =?_{(7}$
- $B7E3DAC_{(16} =?_{(2} =?_{(8}$
- $10100101101111010110111_{(2} =?_{(8} =?_{(16}$