

Computer Systems

1. Introduction
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The goal of the subject

- To get to know the role and tasks of computers
- To give base knowledge which is needed for learning other subjects
- To form a common base for students who arrived with different pre-knowledge
- To show the architecture, the elements and the main operations of computers
- To teach the base commands of Unix, Windows systems
- To present the possibilities of script programming
 - Unix (Linux) shell script, Windows Powershell

The content of the subject

- Computers of yesterday, today and tomorrow
- Architectures, important elements
- Role of operating systems
- The essential possibilities of Linux, Windows systems
 - Commands, network possibilities, basic applications
- Programming, programming, programming...
- Unix shell script
- Powershell

Contact, information

- The homepage of the subject: <http://comsys.inf.elte.hu>
- Schedule of the subject: 2+2+1
- Credit value: 5
- Grading with a complex mark (X-type subject)
- Conditions for getting a complex mark:
 - 4 part-examens, each of them must be ≥ 2 (50%)
 - Part-examens are at about the 4th, 8th and 12th week
 - 3 homeworks (keep deadlines!)
 - At the end of the term you may retry them if it is needed!

Literature

- Unix manual (man)
- <https://www.linux.com/learn>
- <http://www.microsoftvirtualacademy.com/>
- <http://www.powershell.com>

What next today?

- Computer concepts
- Computers yesterday, today, tomorrow
- Symbols, informations, information storage
- Numbers, characters, storage, coding
- Computer architectures, main components
- Hardware-Software
- Role of Operating systems
- Basic steps

Computers, concepts

- Generally about the concepts, topics and descriptions of learning content
 - We aim to use a picturesque, simple, clear and consistent phrasing!
 - We do not want to give complete descriptions!- It is a very big topic, the most important parts of the last 50 years of informatics belong to it – there is not enough time for everything!
- Concept of computers, calculators – Computer
 - Calculating machine, the forefather of computers, for simple everyday mathematical calculations, they appeared 40 years ago or so
 - Computers are used not only for simple calculations but for general calculations, controlling tasks etc.
- General computer – Special (control) computers

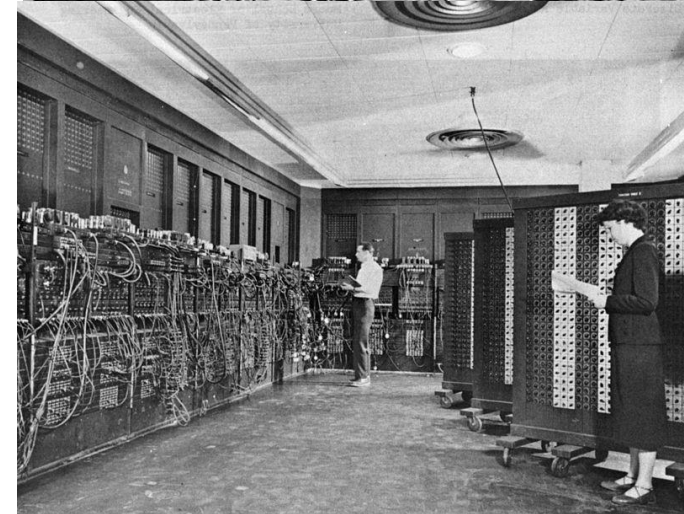
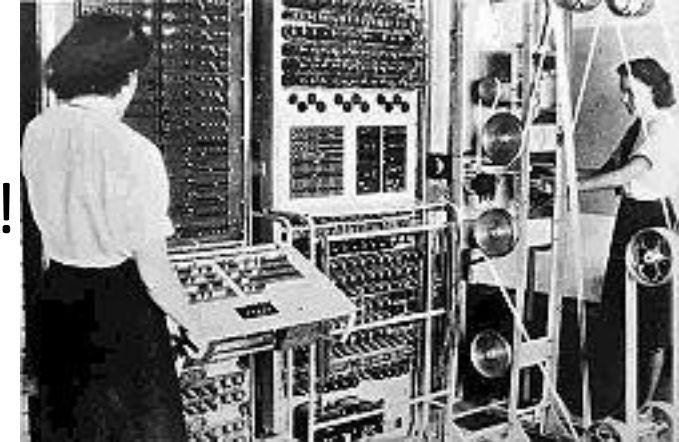
Information revolution (boom)

Born of new generation!



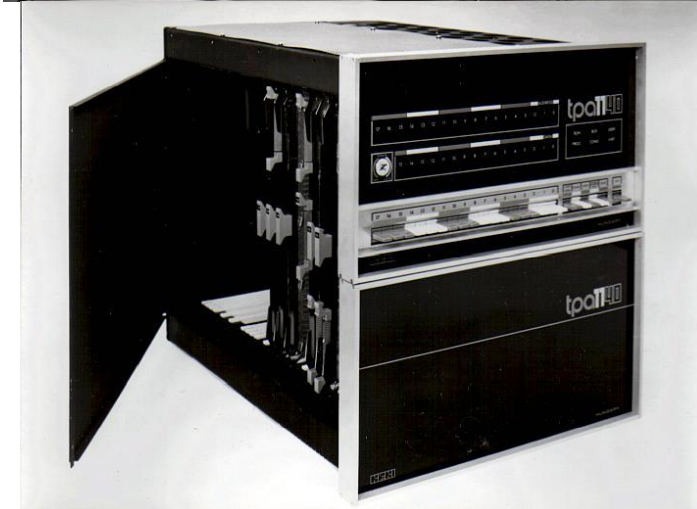
Computers of yesterday I.

- By my opinion this period lasted till 1980 or so.
 - This is not the classical division of generations!
- Tasks are similar to the task of „calculating machines”!
- Featuring keyelements:
 - Table of calculation (szcsotka), mechanical, electromechanical machines
 - 1943: Alan Turing's Colossus computer
 - 1946: ENIAC (*Electronic Numerical Integrator And Computer*). It used decimal system, weight 30 tonnes!



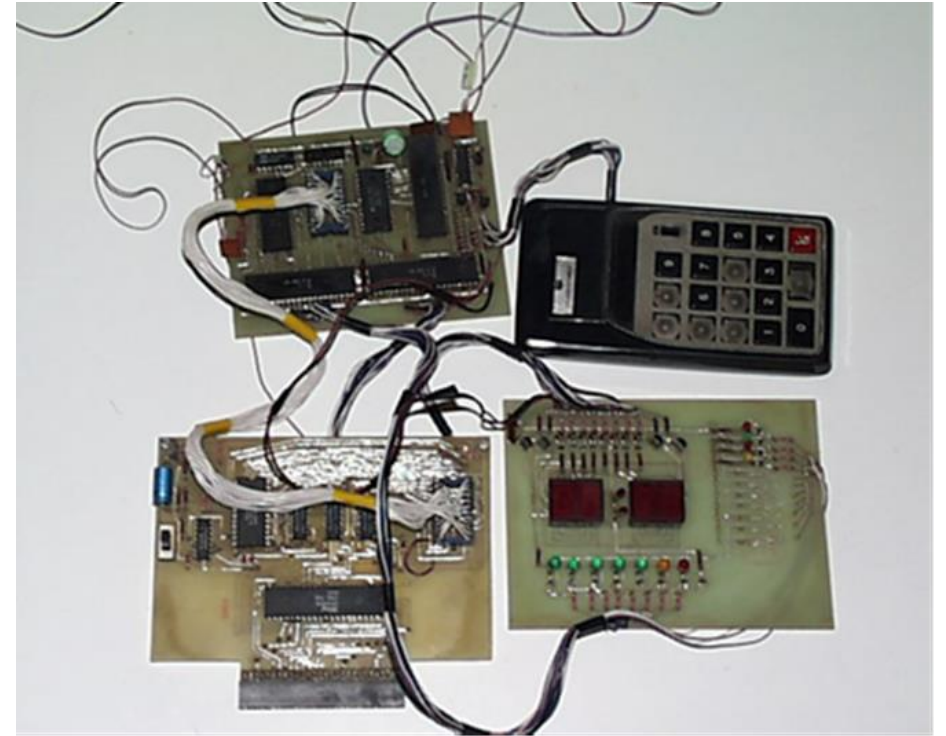
Computers of yesterday II.

- 1949 – EDVAC (***E**lectronic **D**iscrete **V**ariable **A**utomatic **C**omputer*)- Binary system, digital principle
- 1964: IBM System/360
- Hungarian aspect:
DEC PDP11/40- KFKI TPA 1140
 - Serial terminals, Fortran compiler, modularity, „solid” size!
- Operating system is formed!



Computers of yesterday III.

- Special mini computers for controlling!
 - The ancestor of IoT „boards”.
 - On the pictures: Prototype of a Z80 based „IoT” unit.
 - Developer computer: ZX_Spectrum.
 - Years of 1980.
 - Later, 1990th, became this model as a general one (PIC vezérlők)



Computers of today I.

- Permanently become smaller and smaller the size of electronic devices and grow the capacity of them!
 - Processors and disks are smaller in size but greater in efficiency.
- Development of operating systems, virtualization!
- One computer is not a computer! Networks!
 - „Cloud” services, reach information universal!
- Starts the world of computer controlled devices!
 - Started with phones, but we do not know where it would stop!
 - Smart devices, IoT (Internet of Things)

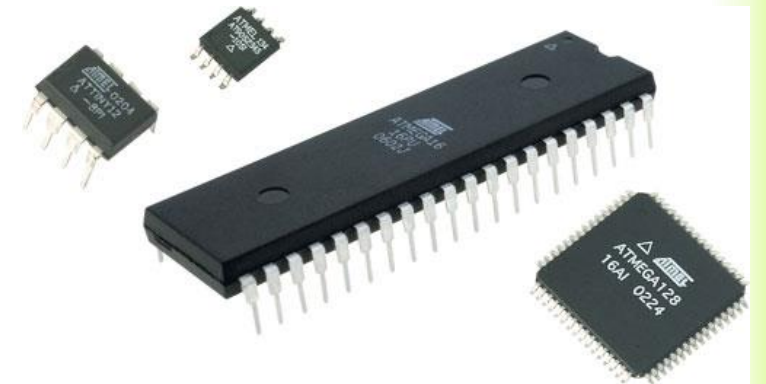
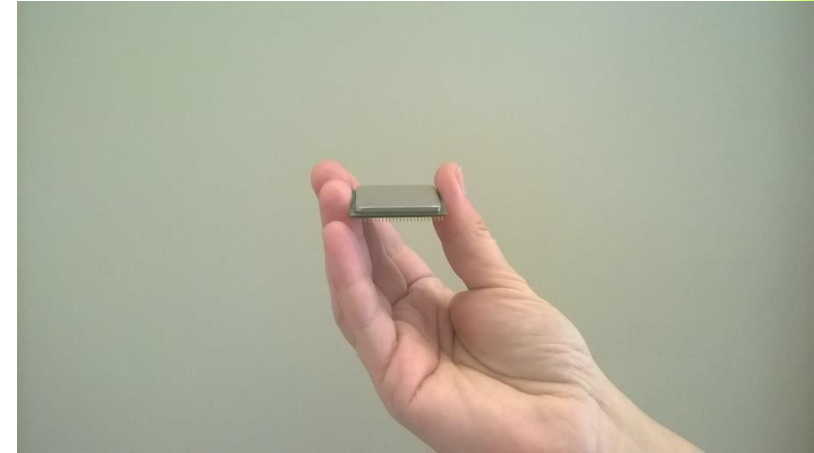
Computers of today II.

- Typical data:
 - Type of processor, how many are there in it
 - Size of memory
 - Disk
- 1 processor, multi (4,6,8,10,12) cores
- HPC (High Performance Computing)
 - Debrecen, Hungary - HPC: (SGI)1536 cores, 165. in the hierarchy
 - MIPS,FLOPS, <http://www.top500.org>
 - ELTE-atlasz: 90 pieces of quad-core processors (1 head node + 44 node)



Computers of today III.

- Microprocessors – Microcontrollers
 - How speed they are? MHz, GHz
 - CISC-RISC
 - How many bits CPU?
 - Nowadays microprocessors are usually 64-bit types.
 - Microcontrollers are typically 8-bit types!
 - The role of Cache in microprocessors.
 - The role of TLB in microprocessors.
 - Neumann architecture
 - Harvard architecture
 - (data and instruction memory are separated)



What components do we need?

- Obligatory, mandatory components
 - CPU – after switching on, this main part starts to work. The instructions, stored in the memory, are executed!
 - Memory – an electronic circuit, to store data and instructions
 - RAM and ROM type of memory
- Optional components
 - Storage subsystem – HDD or SSD
 - Other peripheral units (input-output devices)

Computers of tomorrow

- It is perceptible for nowadays, that computers work more and more instead of the people, automatization is to continue!
- The growing of capacity, the growing of quantity induces growing in quality, artificial intelligency becomes more intensive!
- Processes of visual information strengthen, evolve verbal communication!
- Computers conquest.. Who knows, where the development stops? (free after Arany, famous hungarian poet)

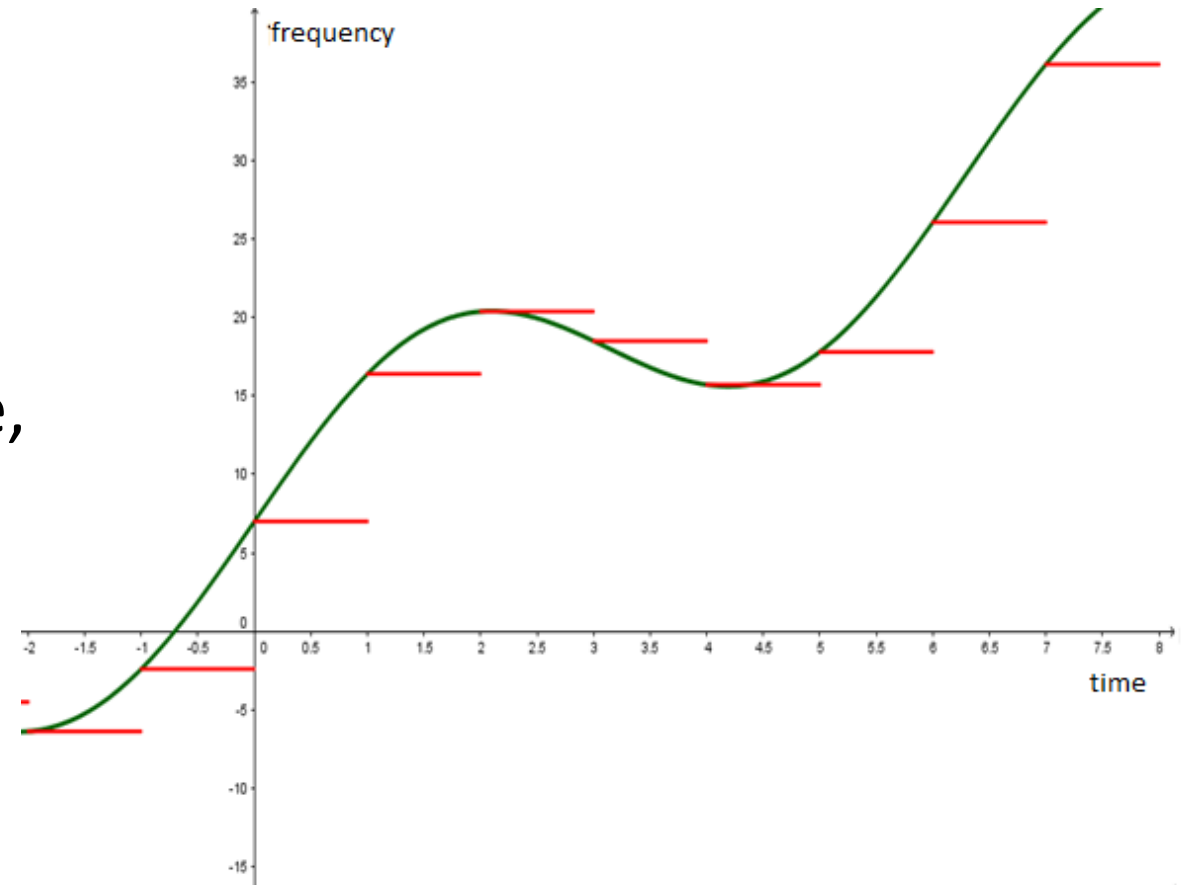
Signals, informations

- Analog signal, information, signal values are continuous!

E.g. Parameters of the nature like distance, temperature, music, noise, current etc.

- Digital signal, information, discrete, not continuous values!

E.g. Music stored on a CD.



Storage of information (signal)

- Though there were analog computers as well, but from the 50th practically the digital discipline is the typical.
- How can we store discrete values?
 - There was storage in decimal system too (1946, ENIAC).
 - But since then we use mainly **binary systems**!
 - Octal and hexadecimal writing is also appearing but only for the sake of easier description!
 - Bit, Byte, Word, Kilobyte(KB), Megabyte(MB), Gigabyte(GB), Terrabyte(TB)
 - 1024 (2^{10}) transfer (1KB=1024byte, 1MB=1024KB), except bit-byte (8)

Word

0 1 0 1 0 1 1 1

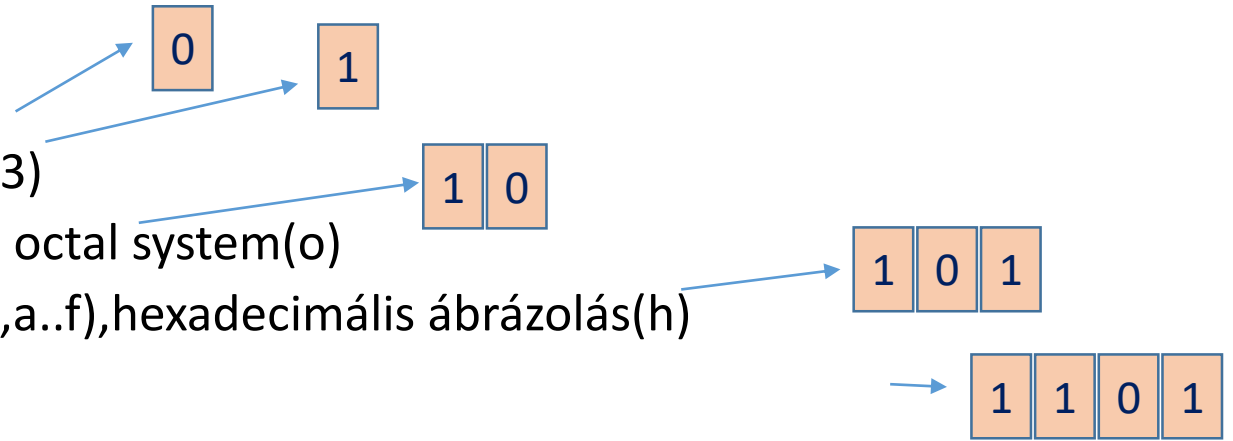
Bit

1 1 0 1 0 1 1 0

Byte

Representation of numbers I.

- Base: binary representation
- Fixed point representation – fix number of bits
 - Natural numbers (N) :
 - On 1 bit 2 different values (0,1)
 - On 2 bit 4 different values (0,1,2,3)
 - On 3 bit 8 different values (0,..7), octal system(o)
 - On 4 bit 16 different values (0,..9,a..f),hexadecimális ábrázolás(h)
 - 8 bit -> 1 byte (0-255)
 - 16 bit, 2 byte (0-65535, $2^{16}-1$)
 - How many bits can we use to represent a natural number?



Representation of numbers II.

- Representation of integers – stored typically on 4 byte
 - Ones' complement representation: first bit is the sign!
 - The inverse of a bit is : 0->1, 1->0
 - We get the negative version of a number by inverting the bits!
 - $-x = \text{inverse } x$
 - Typically: there are 2 zeros! 😊
 - So on 1 byte you can represent numbers between -127 +127!
 - Two's-complement representation
 - $-x = \text{inverse } x + 1$
 - One zero, on 1 byte numbers between -128 +127.

Decimal numbers	Binary number representations		
	sign & absolute value	one's complement	two's complement
+7	0111	0111	0111
+6	0110	0110	0110
+5	0101	0101	0101
+4	0100	0100	0100
+3	0011	0011	0011
+2	0010	0010	0010
+1	0001	0001	0001
+0	0000	0000	0000
-1	1000	1111	1111
-2	1001	1110	1111
-3	1010	1101	1110
-4	1011	1100	1101
-5	1100	1011	1100
-6	1101	1010	1011
-7	1110	1001	1010
-8	1111	1000	1001
-	-	-	1000

Representation of numbers III.

- What is the situation with real numbers?
E.g.: 3,14159265358979
 - It is not a problem! Represent the integer and the fraction part one after the other!
 - But it is not the best solution due it's huge storage need!
- Floating point number representation.
 - The normal form of a number is: $\pm M * A^K$, $M < 1$
 - M- mantissa, A- base, K- exponent (characteristic)
 - Eg: A = 10, then 517 will be: $0,517 * 10^3$
 - E.g.: A=2 then, 517= $1000000101 \rightarrow 0,1000000101 * 2^{10}$
 - 4 byte long representation: 1 bit->sign, 8 bit->exponent, 23 bit mantissa(IEEE754)
 - 8 byte long representation: 1 bit->sign, 11 bit->exponent, 52 bit mantissa(IEEE754)
 - Which is the greatest number you can represent?

Coding, the representation of characters

- Now, we can represent numbers! Binary system is preferred!
- But how about characters? Is it important at all?
- Coding: code is a french originated word, connected to cipher, a symbol of bearing information, a method which connects symbols and their meanings!
 - Coding, decoding (ciphering, deciphering) – old tool
- Numbers are existing in the world of computers -> we have to create a table of assignment between characters and numbers!
 - This is how character code tables were born: ASCII, UTF-8, etc.

Data storage devices I.

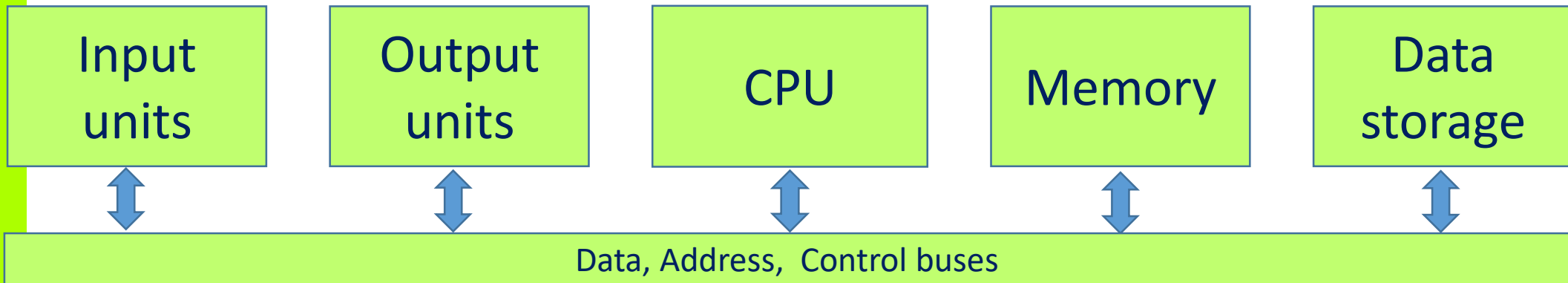
- Memory – stores the instructions of the processor, the data of the program
- Memory types
 - RAM, SRAM, DRAM, DDR, DDR2,DDR3,DDR4
 - ROM, PROM, EPROM, EEPROM, FLASH
 - FLASH – nowadays it is used alone, cheap(er), solid-state based
 - Working idea: information is given by the charge in a cell (1 bit) inside flash transistor.
 - There are two main types: NOR (Not OR), NAND (Not AND)
 - NOR – you can reach each byte to read and write, it is more convenient, developed by Intel.
 - NAND- you can reach memory blocks in sequence, quicker, cheaper, developed by Samsung

Data storage devices II.

- Magnetic tape – it is used today as well, mainly for saving data
- Magnetic disk– nowadays it is the most often used backup
 - FDD – Floppy Disk Drive
 - HDD - Hard Disk Drive
- The idea of operation: The magnetic polarity of a cell means the information.
- Optical disc – CD, DVD, Blu-Ray
 - The idea of operation: The time-difference of the reflected light (laser) holds the information.(Pit-Land)

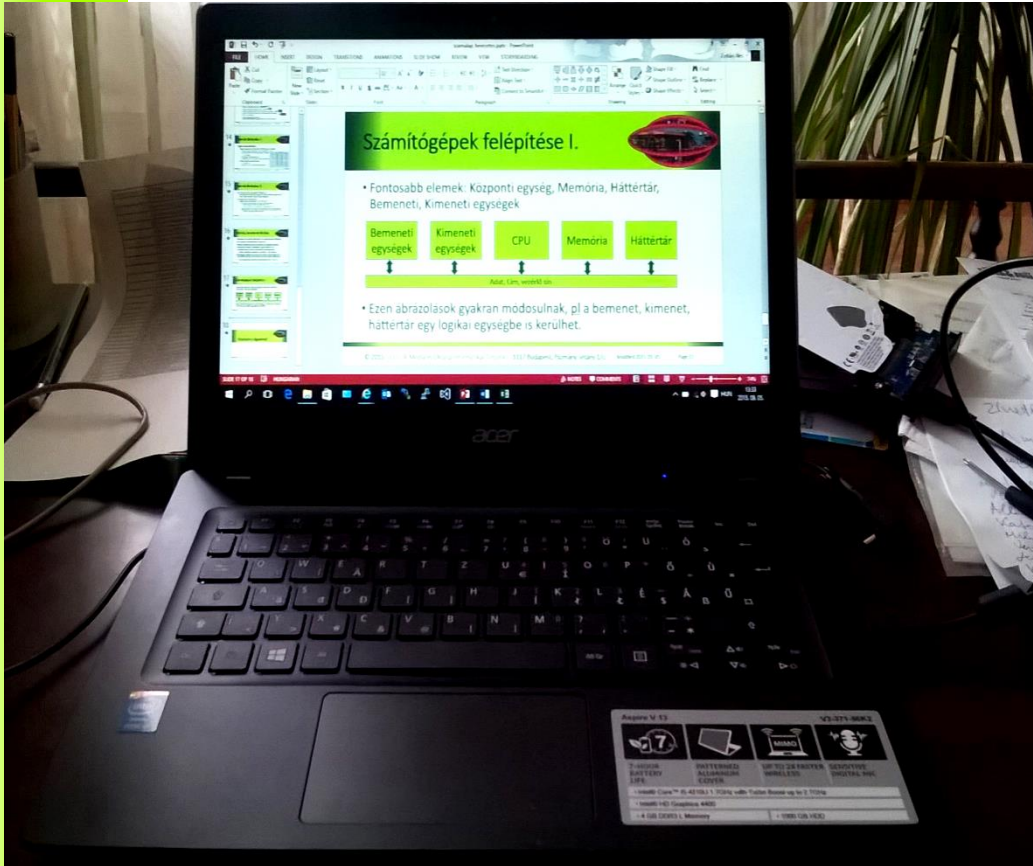
Computer architecture I.

- Important elements: Central Processing Unit, Memory, Data storage device, Input, Output units



- Figuring of the base computer architecture often vary, e.g. the input and output units can be grouped into one logical unit.

Computers inside - outside



Where can we find a computer?

- In the university laboratories...😊
- In the cloud, in our phones, in a camera, in a television, in a web-camera... everywhere!
- In what are they different?
 - Mainly in tasks!
 - General-purpose computers
 - Special computers
- Hardware, software differences!

Hardware-Software differences

- Client-server computers.
 - Client, typically serves out a single user.
 - Server, typically serves out a lot of users!
- Hardware differences
 - In the case of a server the classical input/output devices are missing!
 - In the case of a client this is important!
- Software differences
 - Operating systems
 - Other user-applications

Operating systems

- Linux (SUSE, Ubuntu, Red Hat, Debian, etc.)
 - UNIX-LINUX
- Apple OSX,iOS
- Windows (7,8,10), Win2012
- User interfaces
 - Graphical
 - Character-like
- During the term we are going to see the base features of LINUX(UNIX)!
 - Afterwards we shall write scripts!

Connecting to a server I.

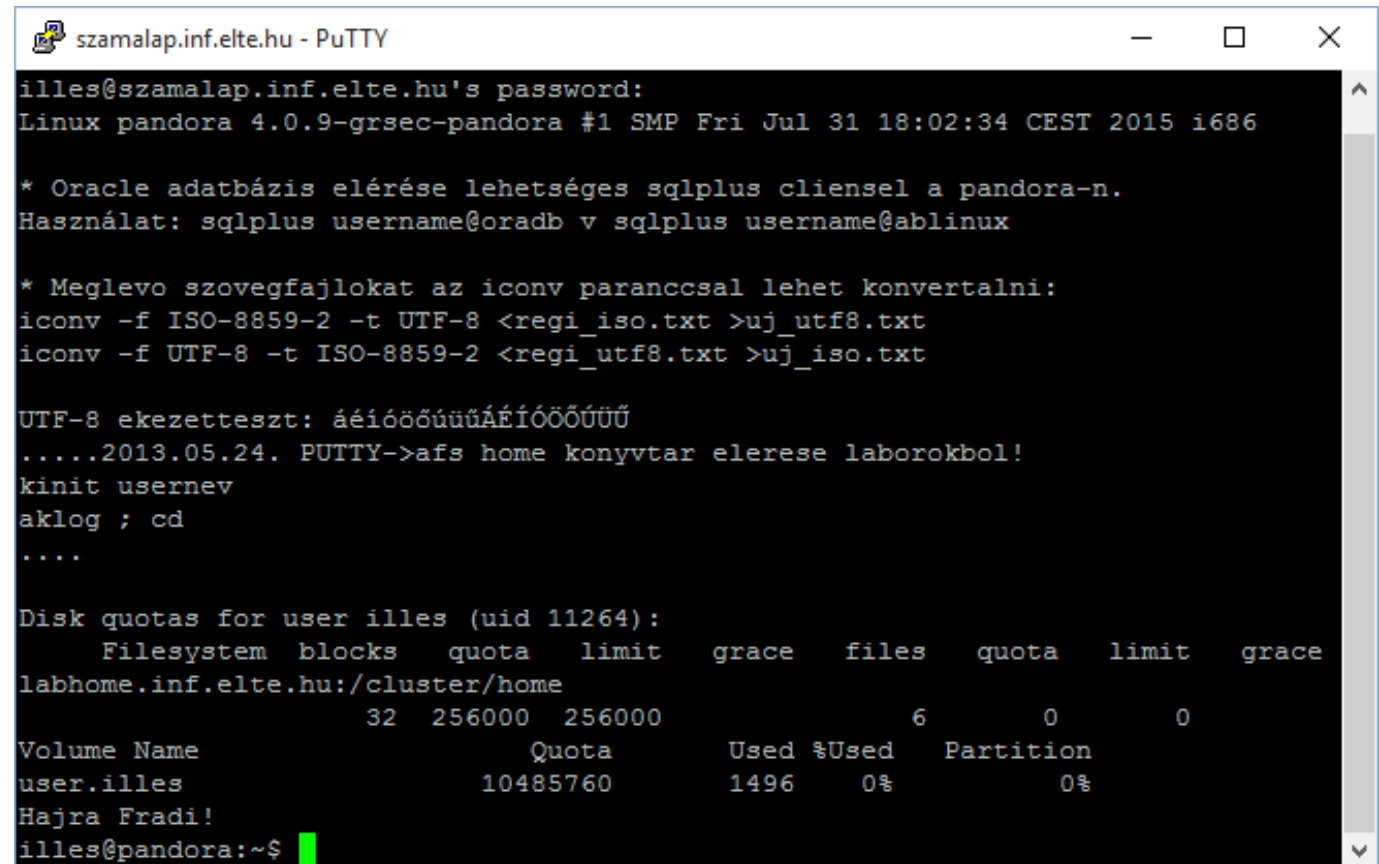
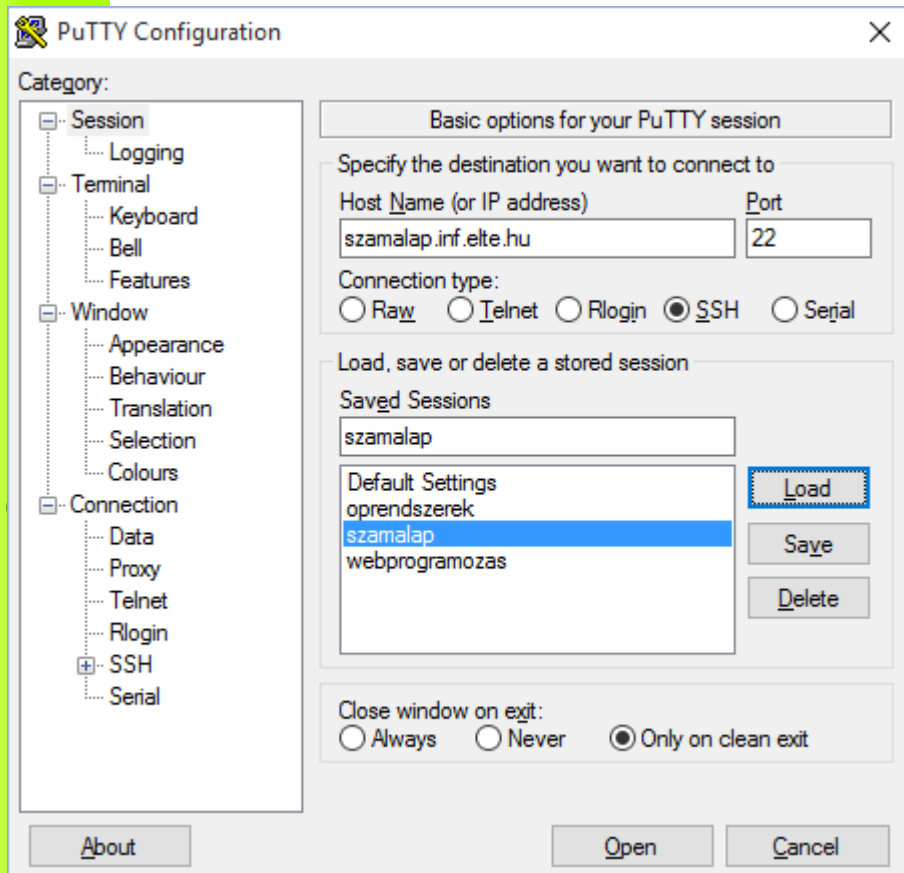
- Previously it was possible only from terminals placed in computer-rooms!
- Today through „network” connections!
 - Terminal-rooms ceased...☹
- Devices – for building network connection
 - Serial, paralel, they are not used today.
 - USB port, typically used in special cases.
 - Network (ethernet) card(LAN), RJ-45 port, UTP(STP) cable,10/100/1000
 - Wireless card(WIFI), IEEE 803.11 a/b/g/n/ac

Connecting to a server II.

- Security of network connections
 - The base standards typically do not contain any encryption!
 - E.g. HTTP, encrypted connection HTTPS.
- Character-like connection
 - Telnet – it is used rarely today, because it uses unencrypted connection!
 - FTP – unencrypted file transfer protokol!
 - Encrypted connections are used:
 - SSH or SSL base
 - RSA (**Rivest-Shamir-Adleman**) asymmetric encryption.
- Graphical connections

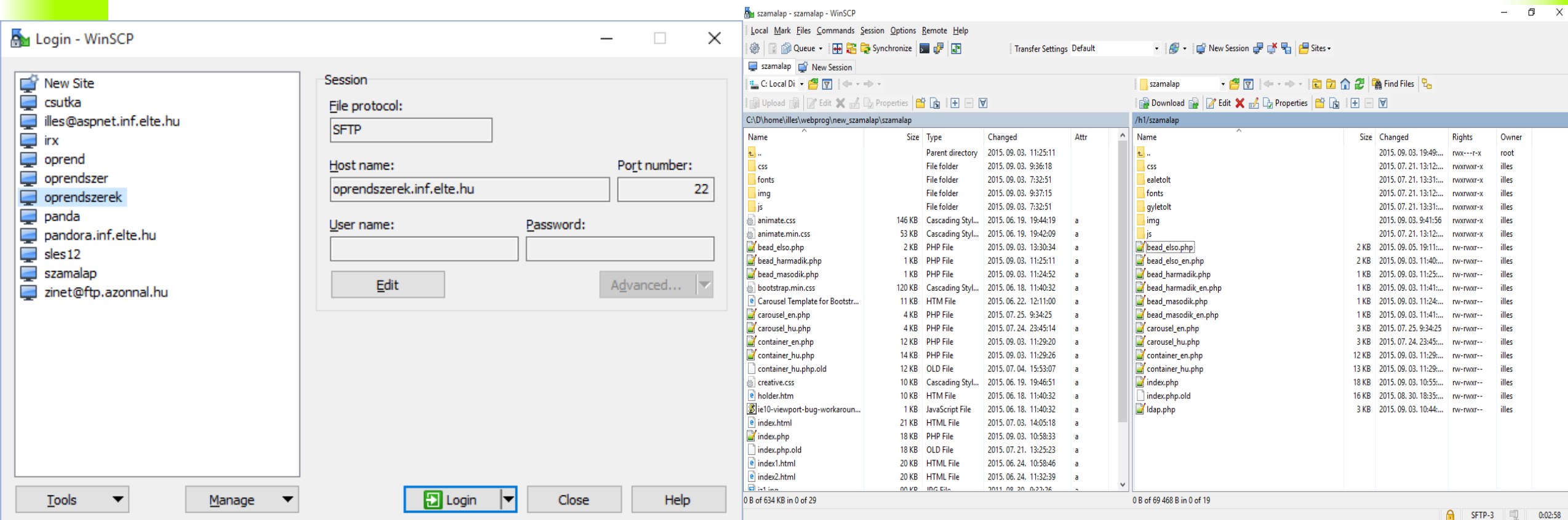
Terminal connection

- Putty.exe –downloadable from www.putty.hu !



File copy

- winscp.exe – downloadable from <http://www.winscp.net/>!



Summary

- Review
 - Computers today
 - General architectures, components
 - Signs, storage, numbers in computers
 - Software-hardware-operating systems

Thank You!

