Informatics 1.
Lecture 1: Hardware

using Ferenc Wettl's
and Kristóf Kovács's material

Budapest University of Technology and Economics

2018-09-03

Requirements to pass

- 3 written exams

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  - week 5, 10, 14

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- 10 "pop quizzes"
  - at the start of each practical class, 1-2 minutes
  - each of them is worth 1%
  - 50% required to pass (not individually)

Curriculum

1. **Hardware**

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2. Operating system, programs, file structure

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Hardware

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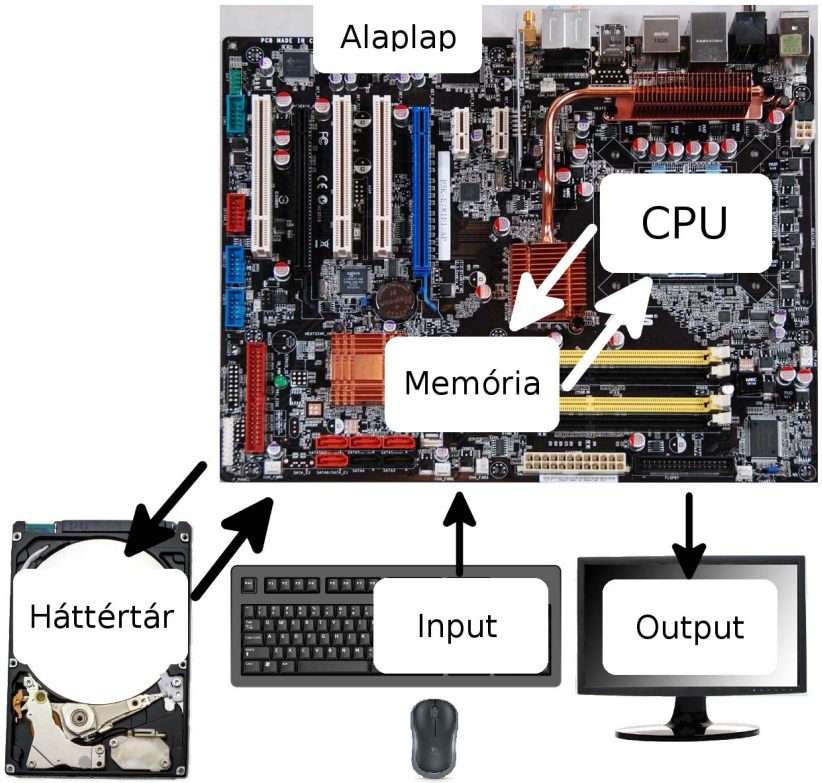

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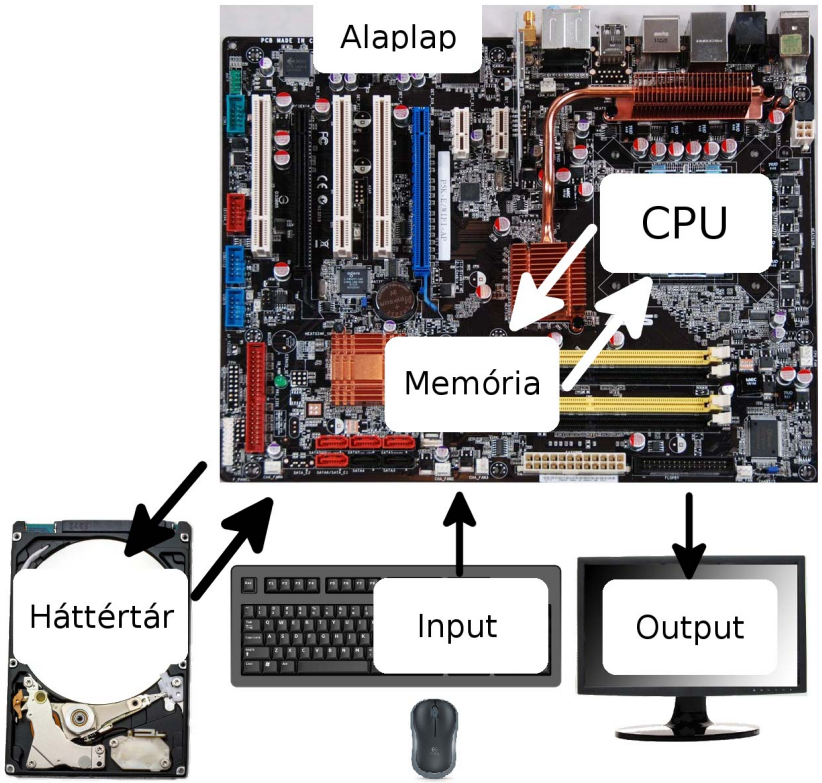

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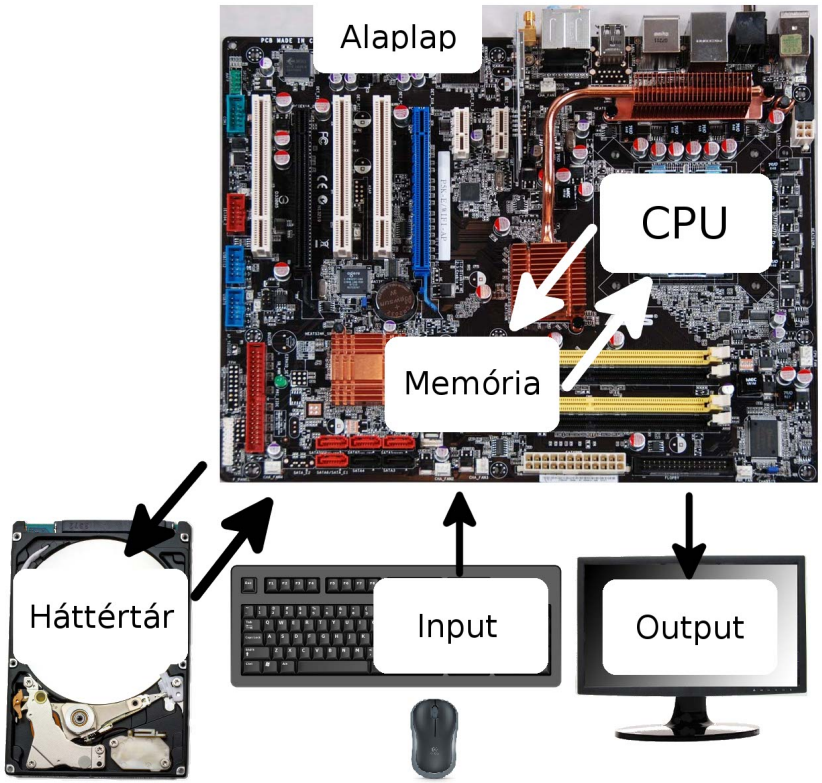

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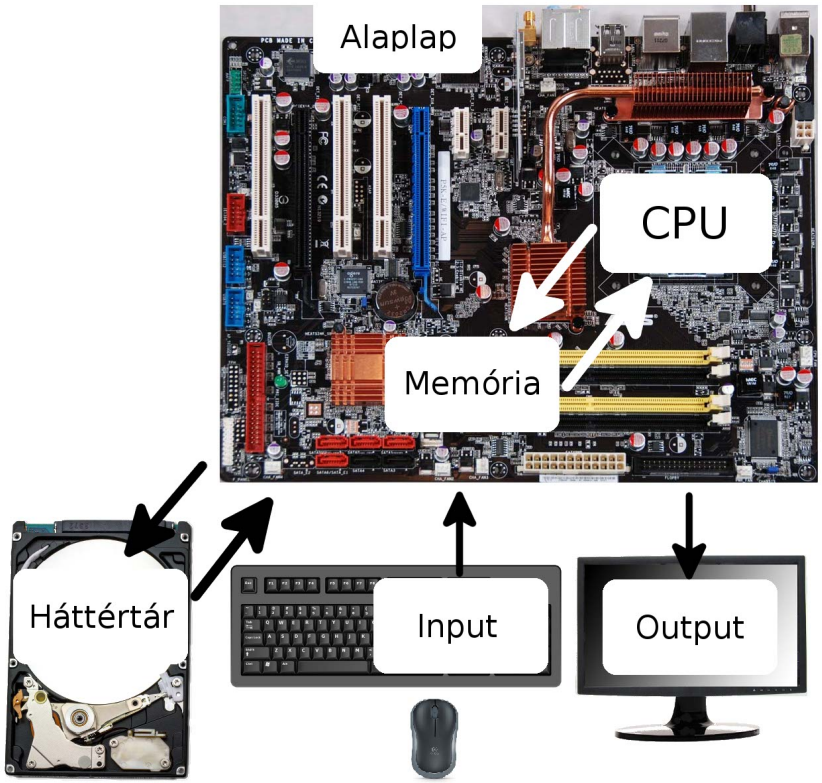

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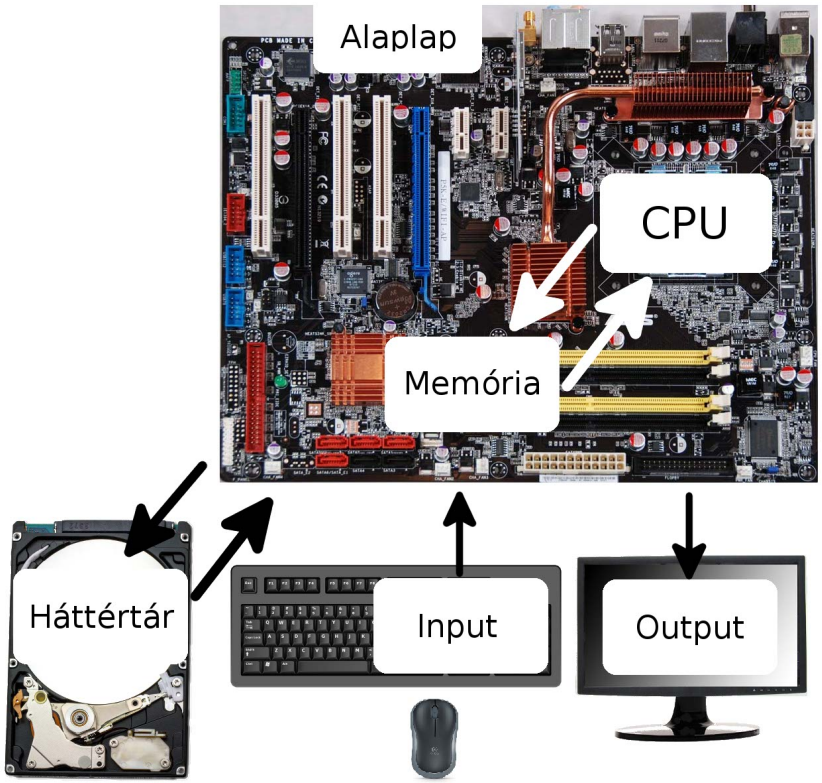

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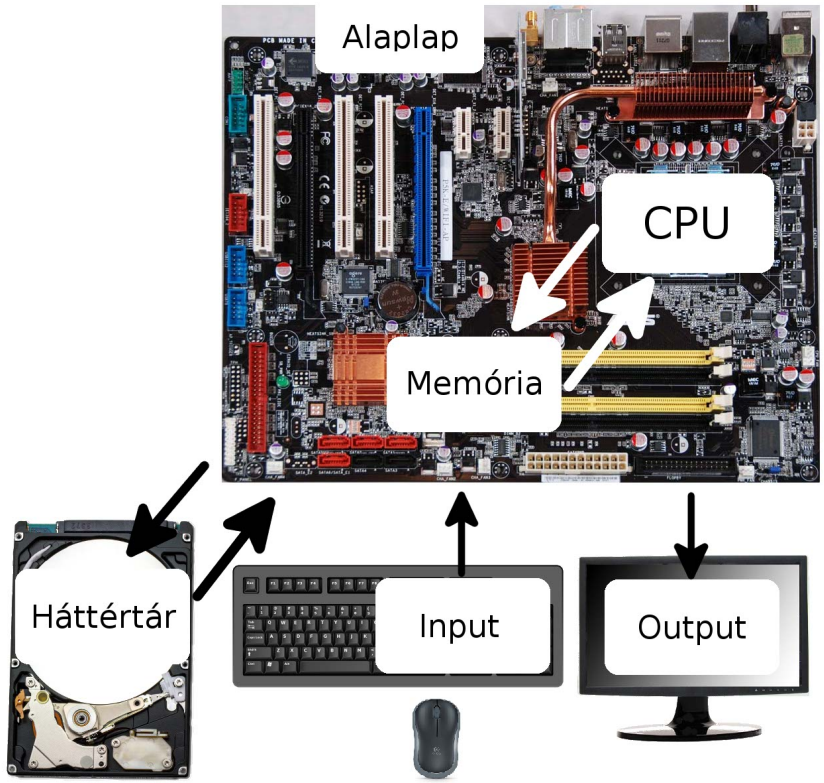

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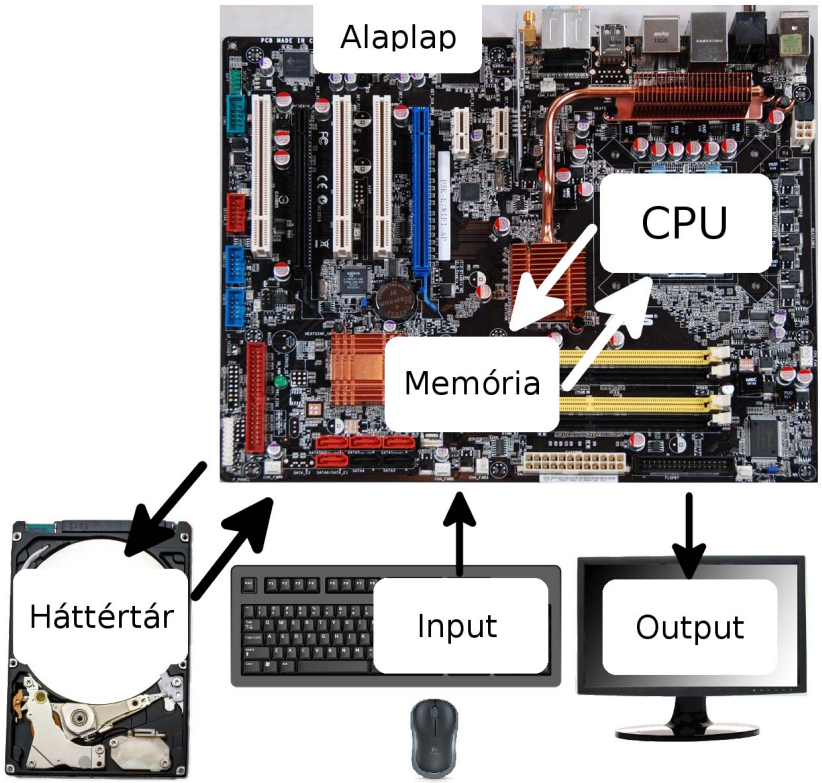

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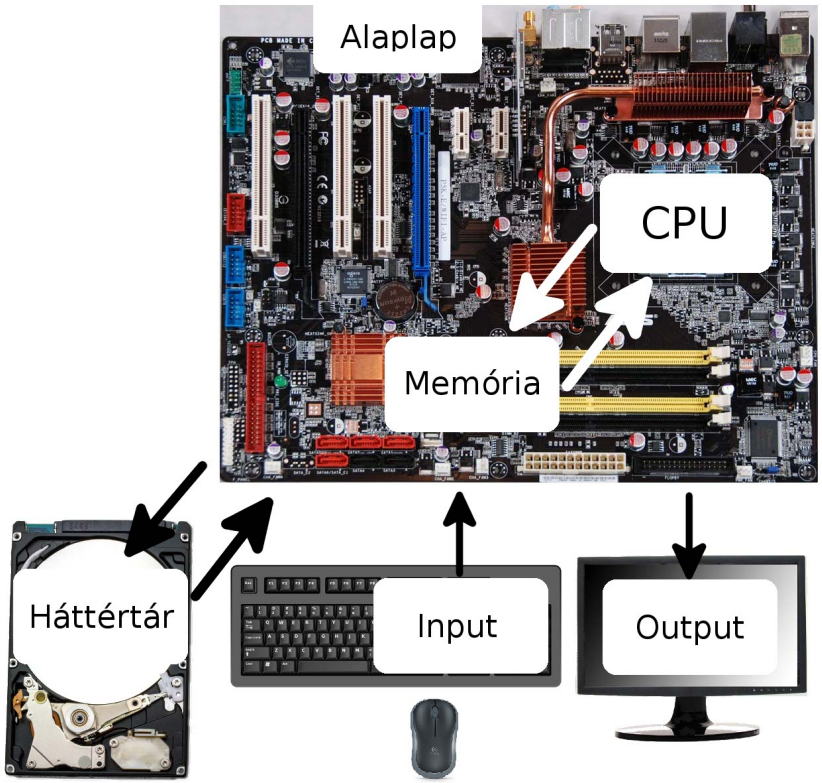

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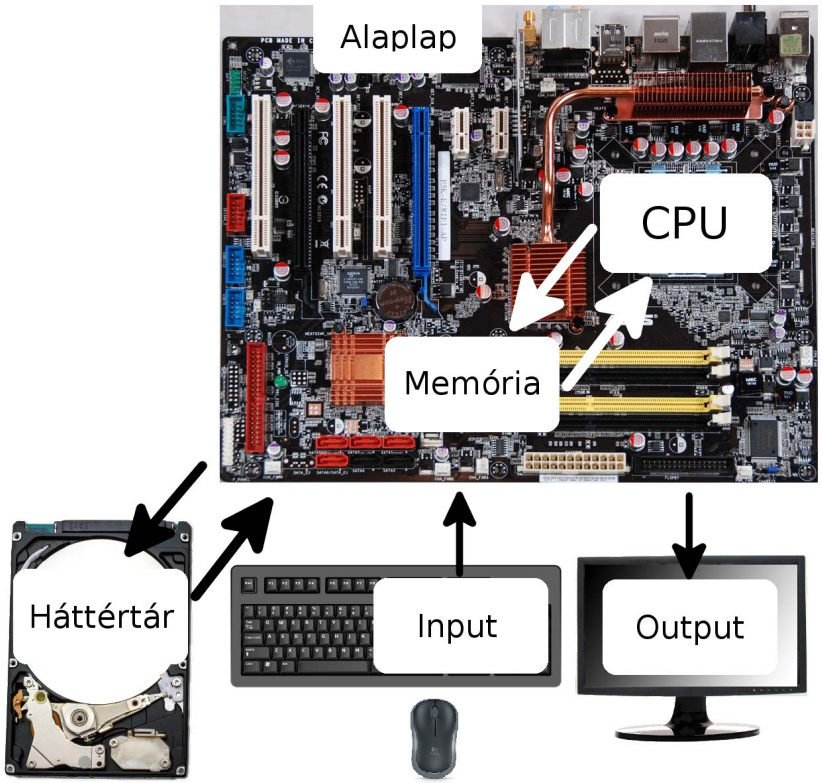

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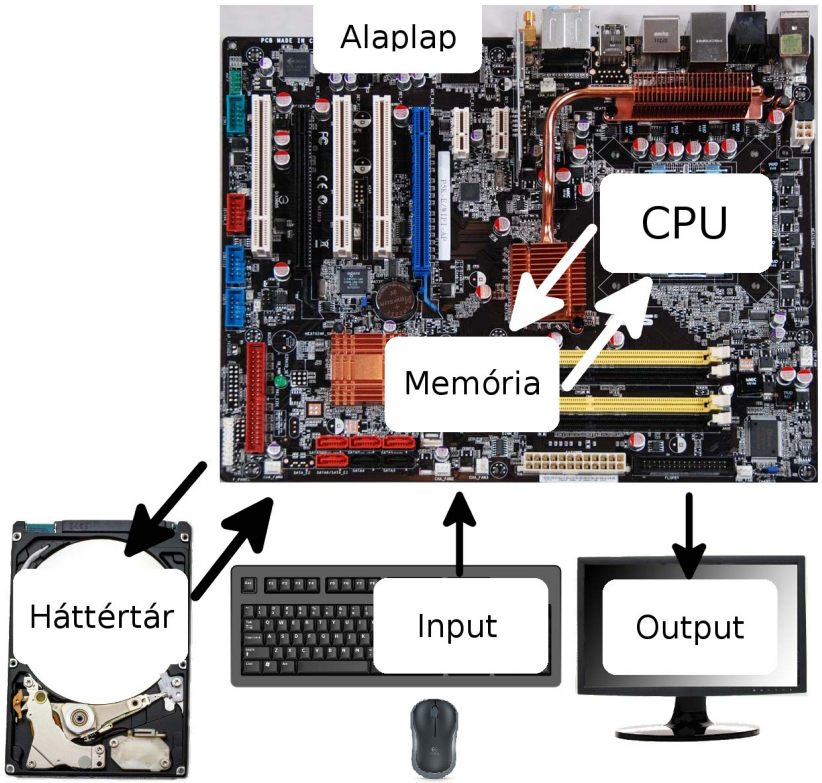

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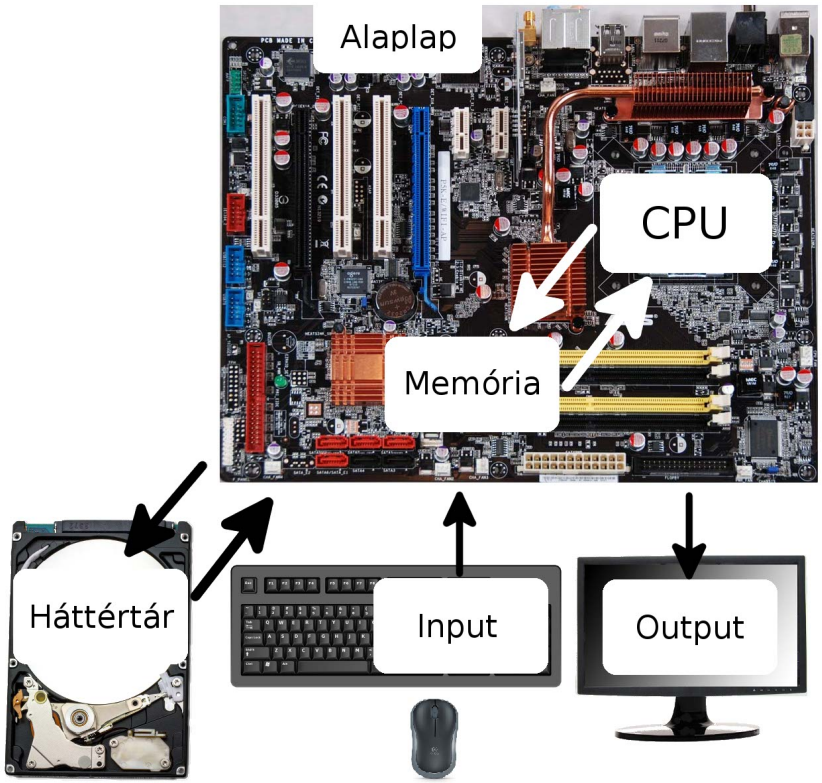

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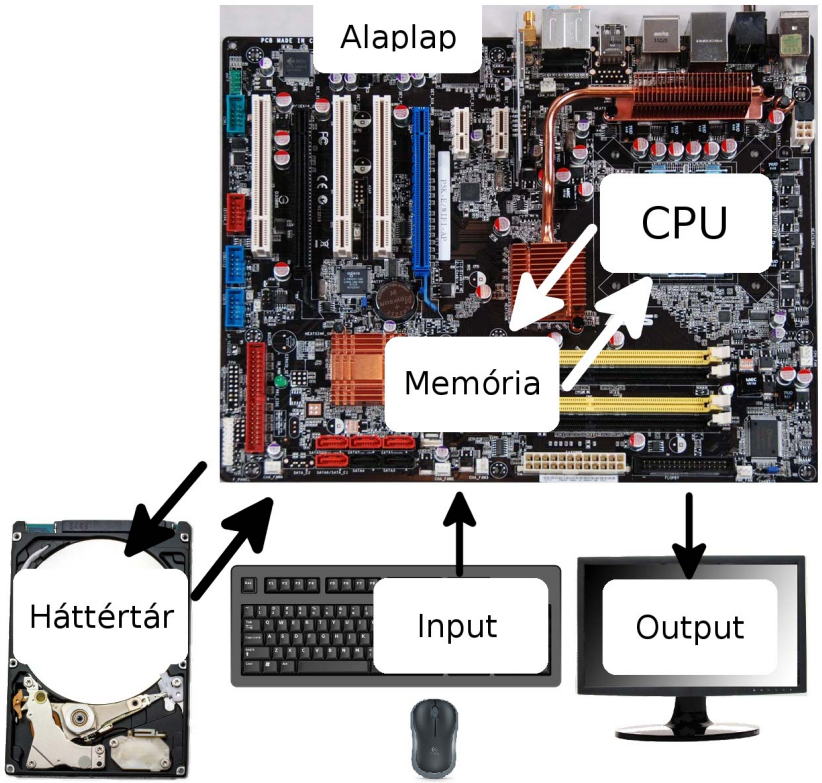

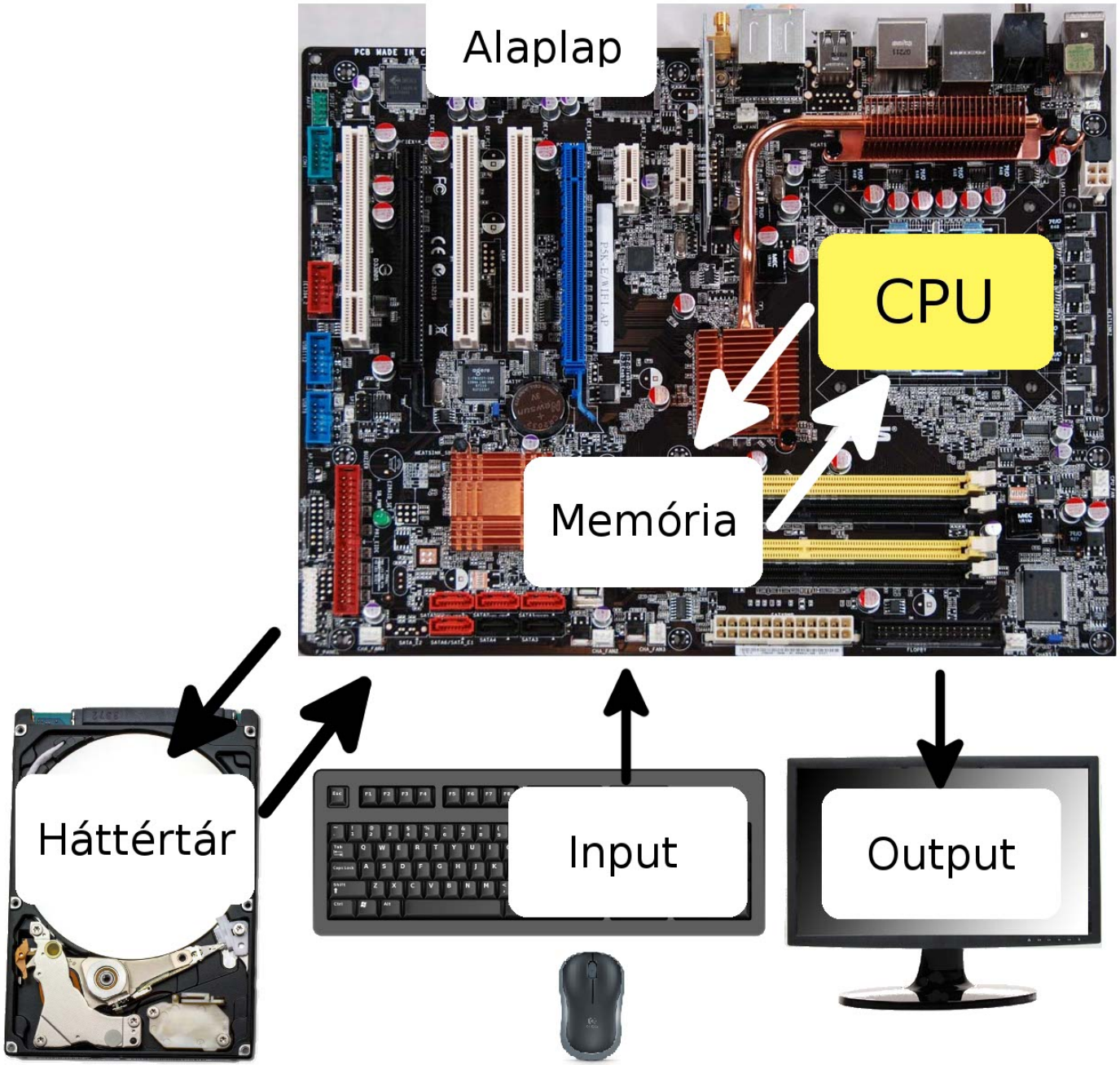
Alaplap
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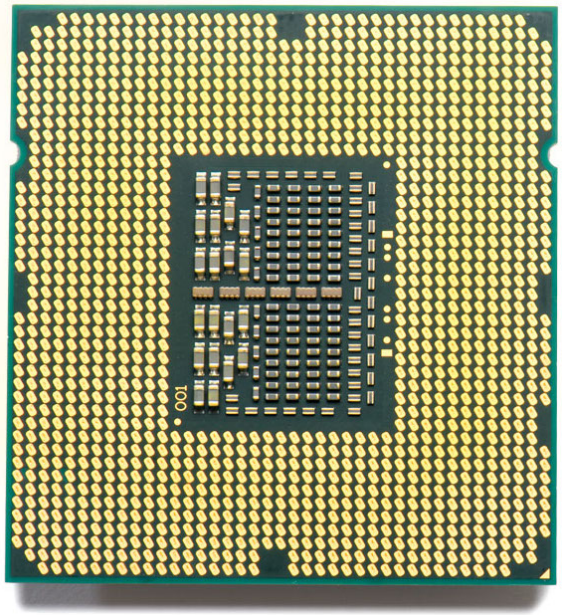

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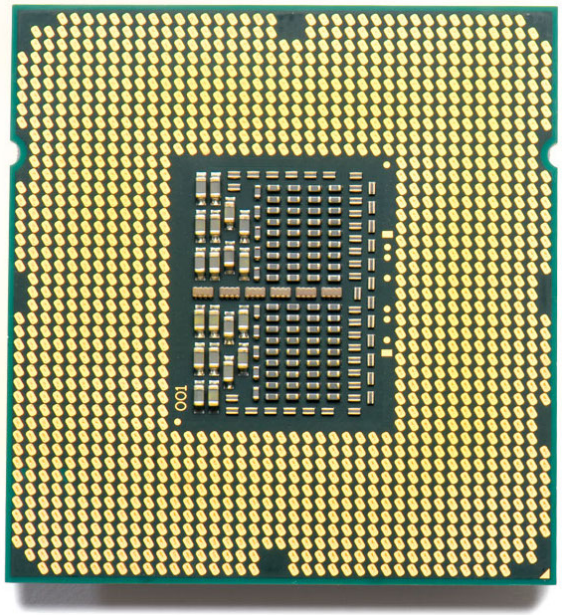

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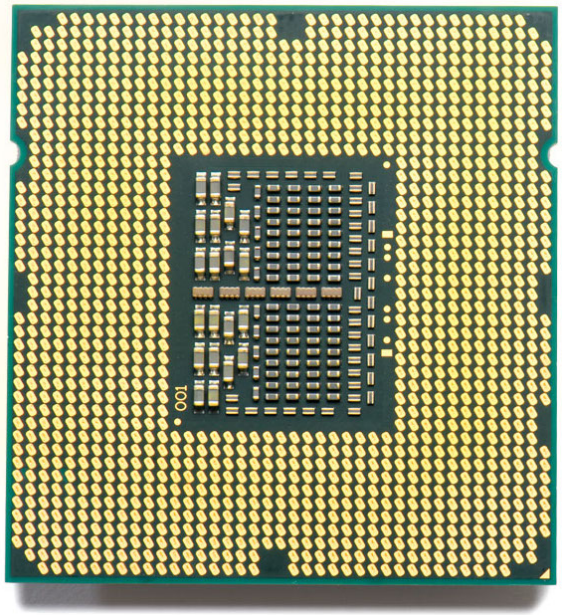

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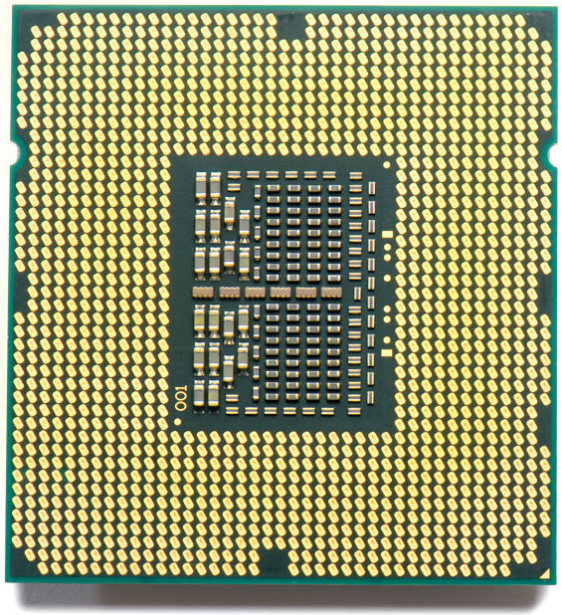

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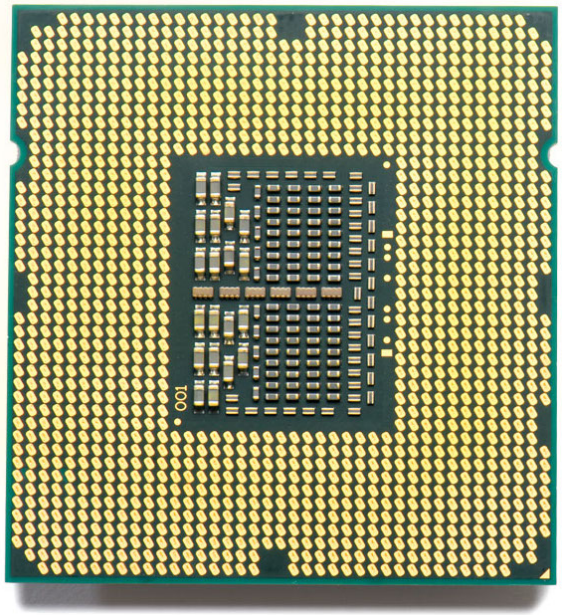

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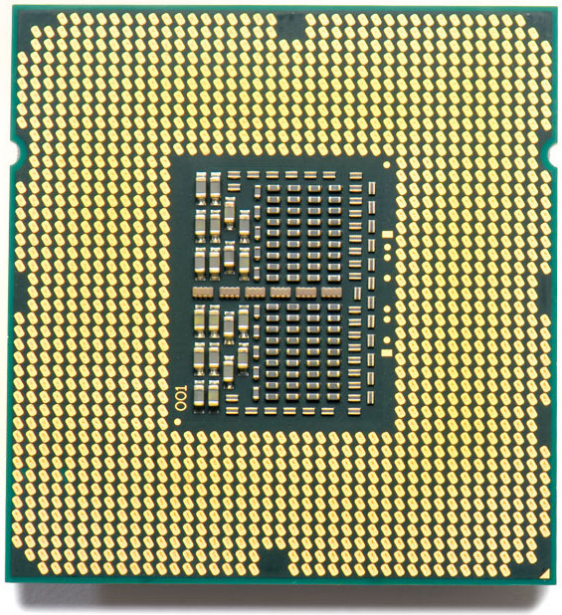
  - More and more features are crammed into a CPU, for example modern processors have integrated graphics processors as well



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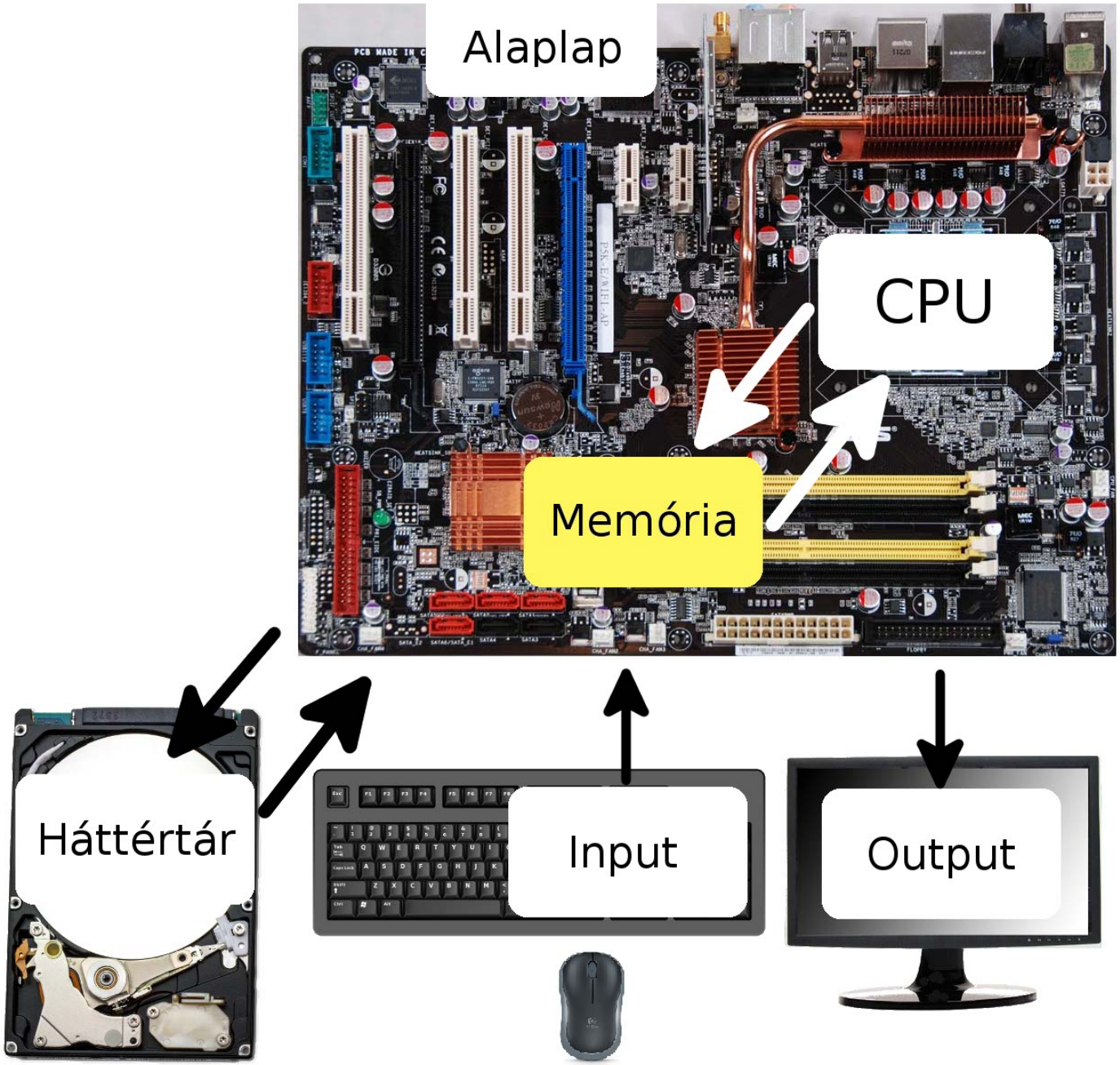
  - Other ones require significant cooling to function

Operation costs

Lets say that addition has a computation cost of 1. Then the cost of other operations is shown in the table (these are just estimates, they vary based on processor, manufacturer, etc.).

	operation	cost
cheap	addition, subtraction, comparison	1
	absolute value	2
	multiplication	4
medium	division (except with power of 2)	10
	remainder (modulo)	10
expensive	power of e	50
	sin, cos, tan	60
	asin, acos, atan	80
	power	100
	root	varies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  - It is a misbelief that the speed of a computer is proportional to the size of its memory.

Units of measurement

SI prefix		Old usage	Binary prefix	
Notation	Value	Value	Notation	Value
kB KB (kilobyte)	$1000^1 = 10^3$	$1024^1 = 2^{10}$	KiB (kibibyte)	2^{10}
MB (megabyte)	$1000^2 = 10^6$	$1024^2 = 2^{20}$	MiB (mebibyte)	2^{20}
GB (gigabyte)	$1000^3 = 10^9$	$1024^3 = 2^{30}$	GiB (gibibyte)	2^{30}
TB (terabyte)	$1000^4 = 10^{12}$	$1024^4 = 2^{40}$	TiB (tebibyte)	2^{40}
PB (petabyte)	$1000^5 = 10^{15}$	$1024^5 = 2^{50}$	PiB (pebibyte)	2^{50}
EB (exabyte)	$1000^6 = 10^{18}$	$1024^6 = 2^{60}$	EiB (exbibyte)	2^{60}
ZB (zettabyte)	$1000^7 = 10^{21}$	$1024^7 = 2^{70}$	ZiB (zebibyte)	2^{70}
YB (yottabyte)	$1000^8 = 10^{24}$	$1024^8 = 2^{80}$	YiB (yobibyte)	2^{80}

$2^{10} = 1024$

$2^{20} = 1048576$

$2^{30} = 1073741824$

$2^{40} = 1099511627776$

$2^{50} = 1125899906842624$

$2^{60} = 1152921504606846976$

$2^{70} = 1180591620717411303424$

$2^{80} = 1208925819614629174706176$

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- Type (socket)

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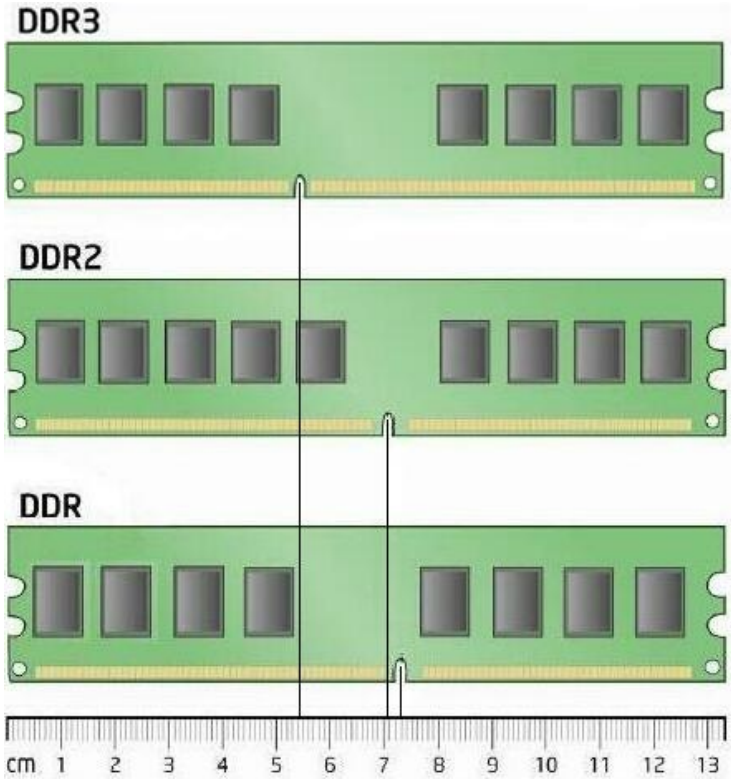
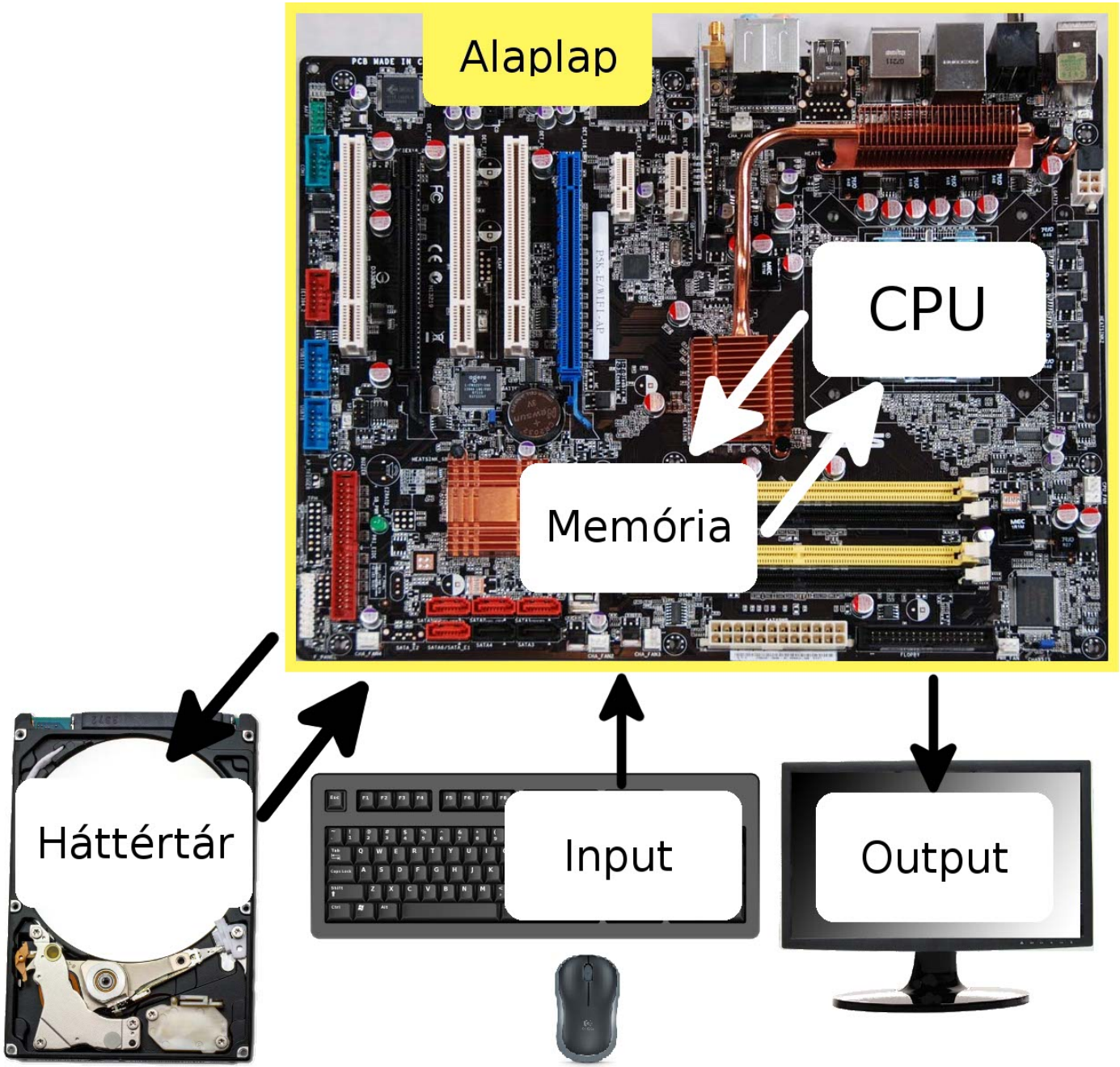
  - The performance of the memory is mainly influenced by the speed of reading and writing data from and to the memory.
  - The clock speed represents this read/write speed
- Capacity (storage space)
  - The amount of data the memory can store
  - Most operating systems use *virtual memory*, this feature uses a part of the mass storage as memory in case the real memory fills up. This is significantly slower, even for an SSD.
  - When the memory fills up the operating system tries to swap the least frequently used parts of the memory to the *virtual memory* (swap).
  - This is the reason why a computer with a really strong CPU can still slow down if it runs out of memory.
- Type (socket)
  - Motherboards have a specific RAM socket, not all types of memories can be placed into a specific motherboard.

Memory sockets

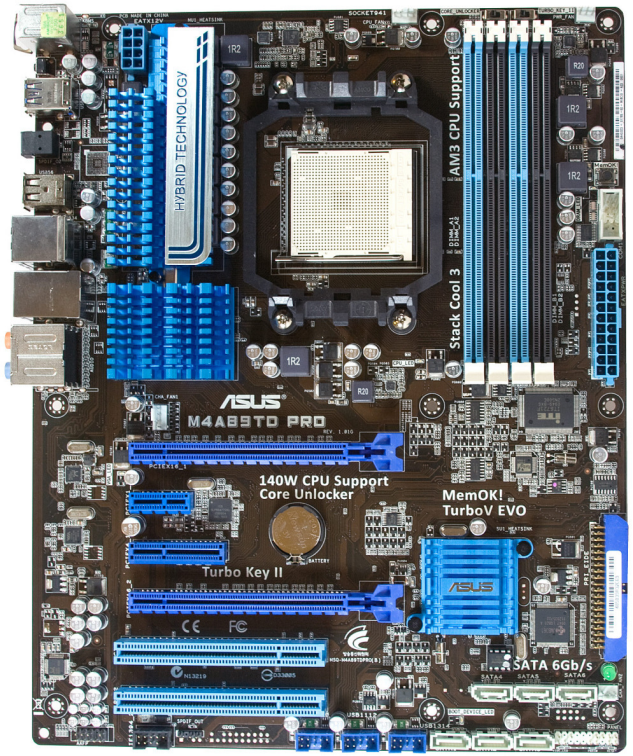
Nowadays every type of motherboard uses the DDR3 socket.




Alaplap
CPU
Memória
Háttértár
Input
Output

Motherboard

- Function



Motherboard

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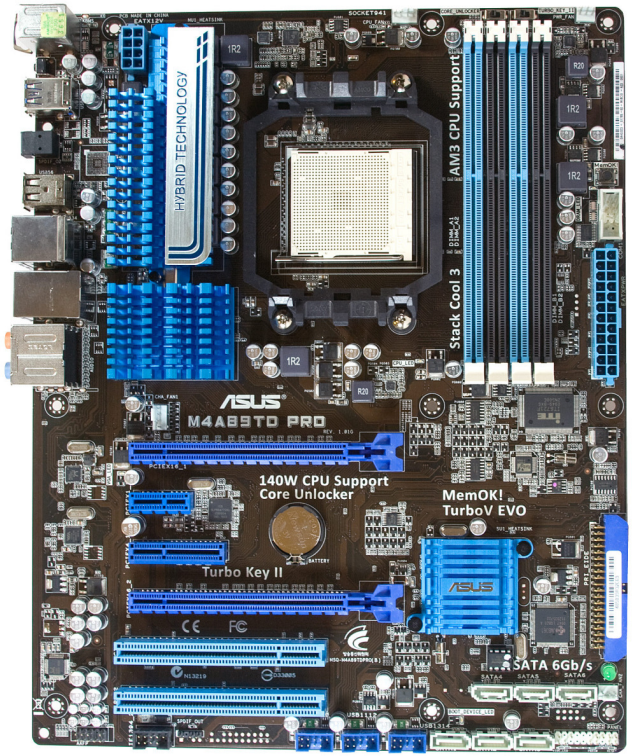
  - Acts as a link between the other components



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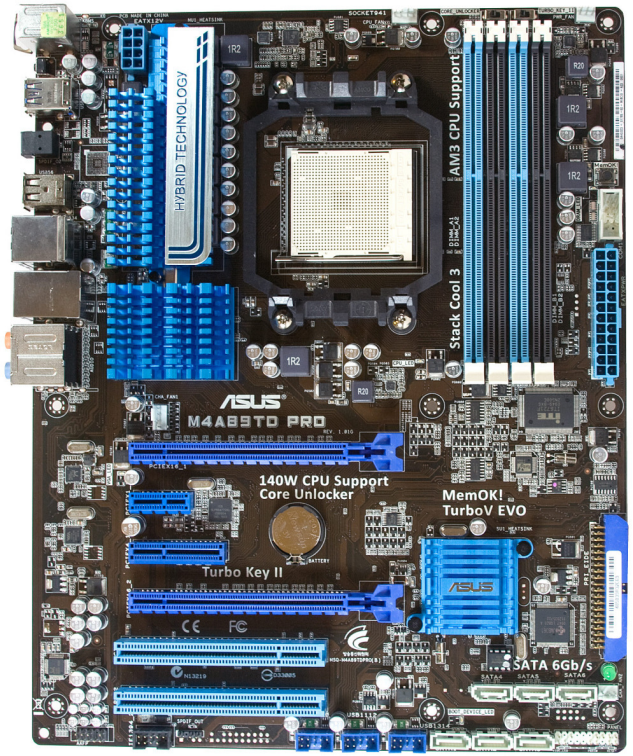

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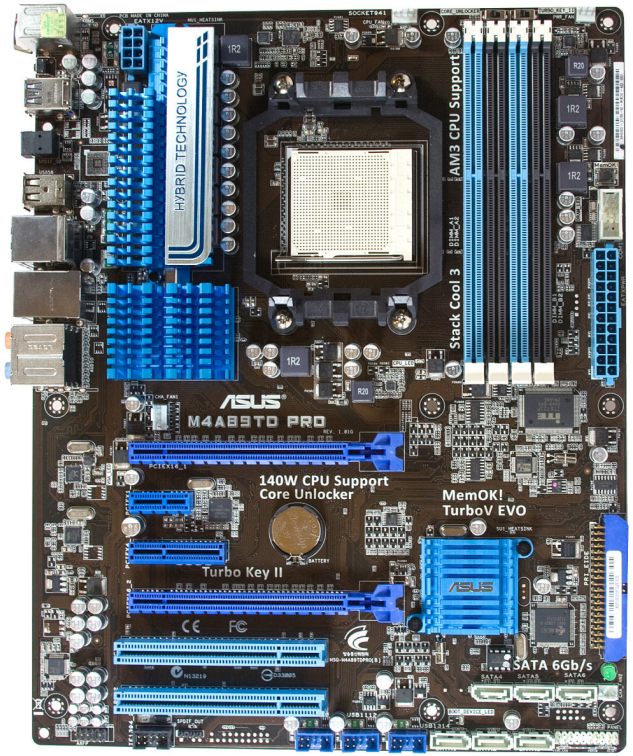

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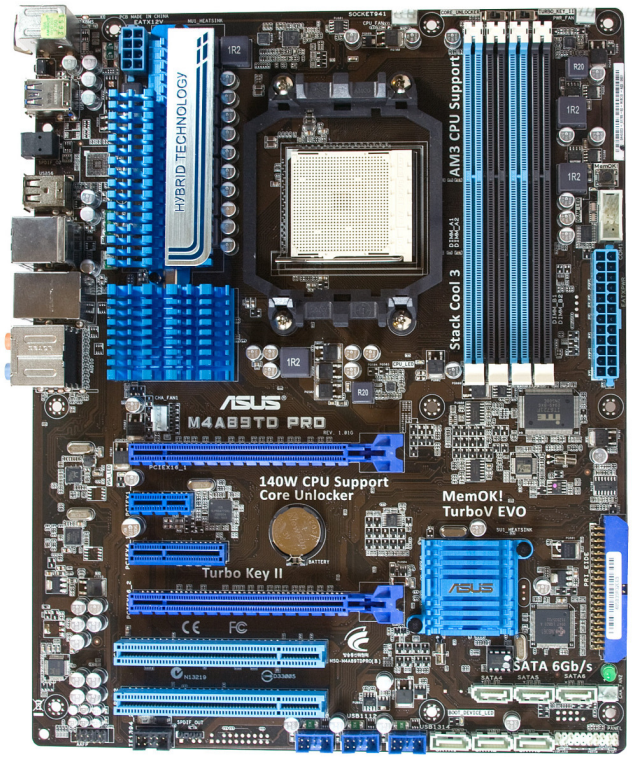

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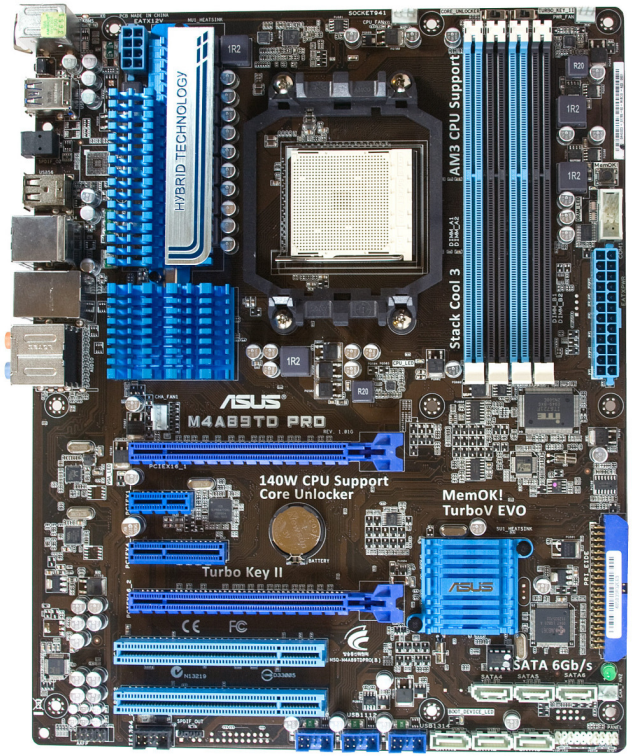

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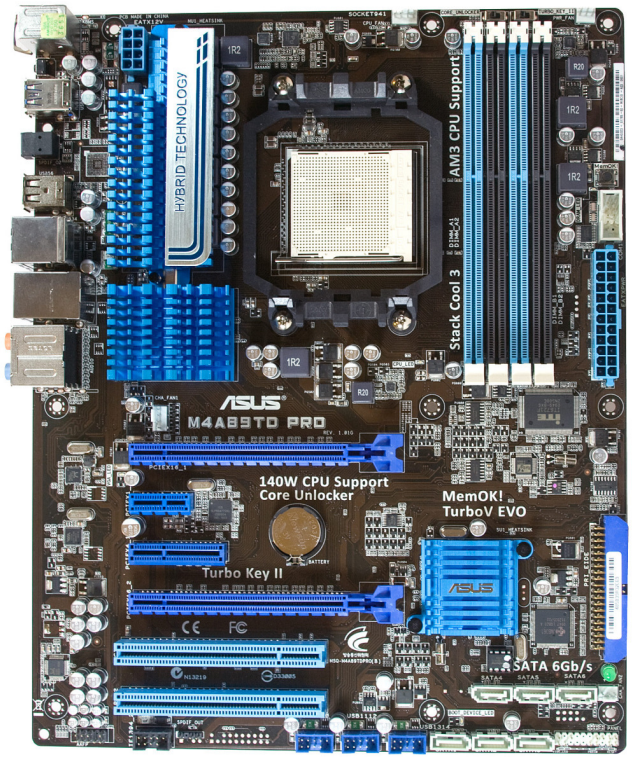

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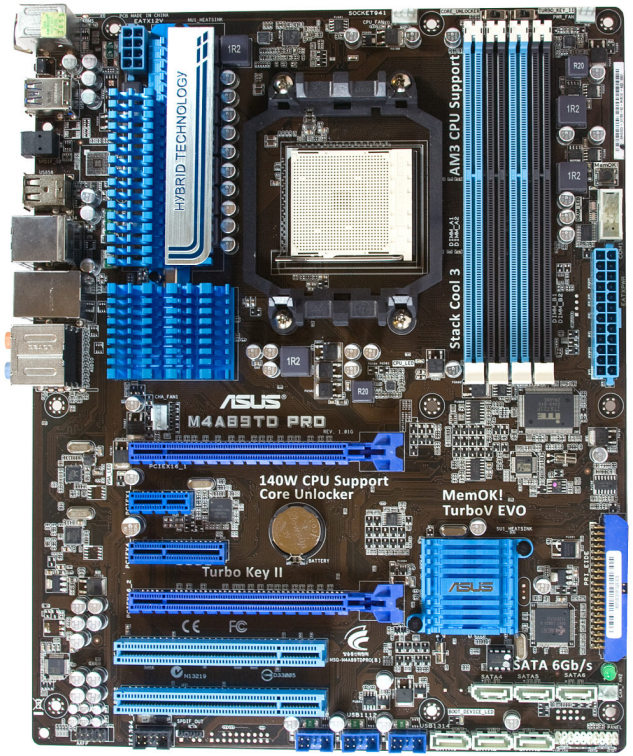

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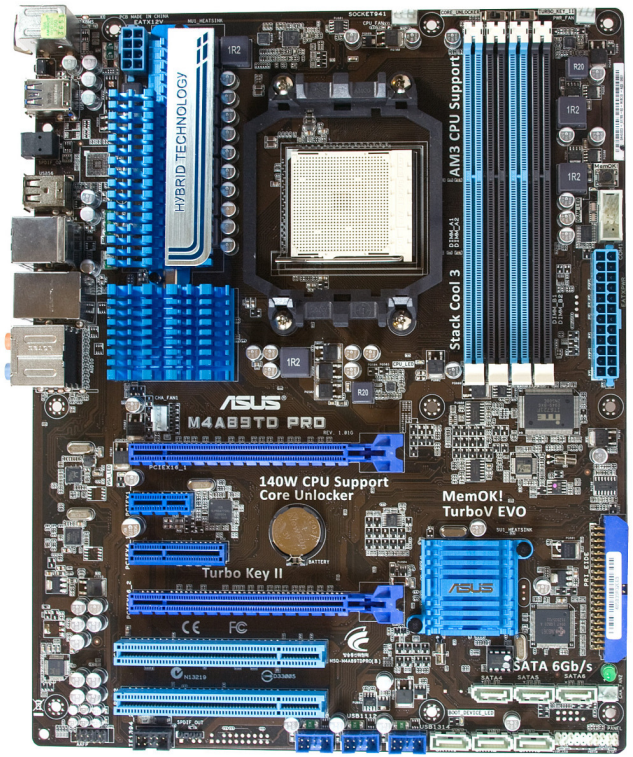

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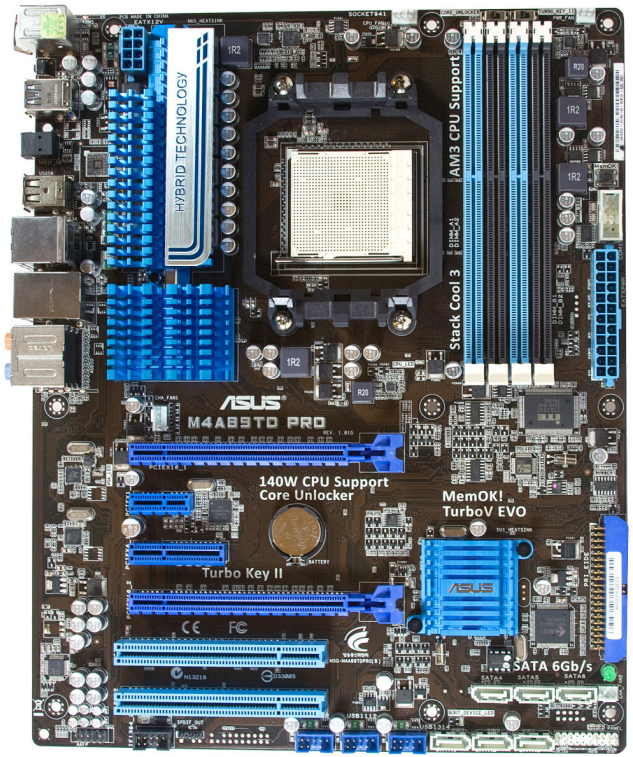
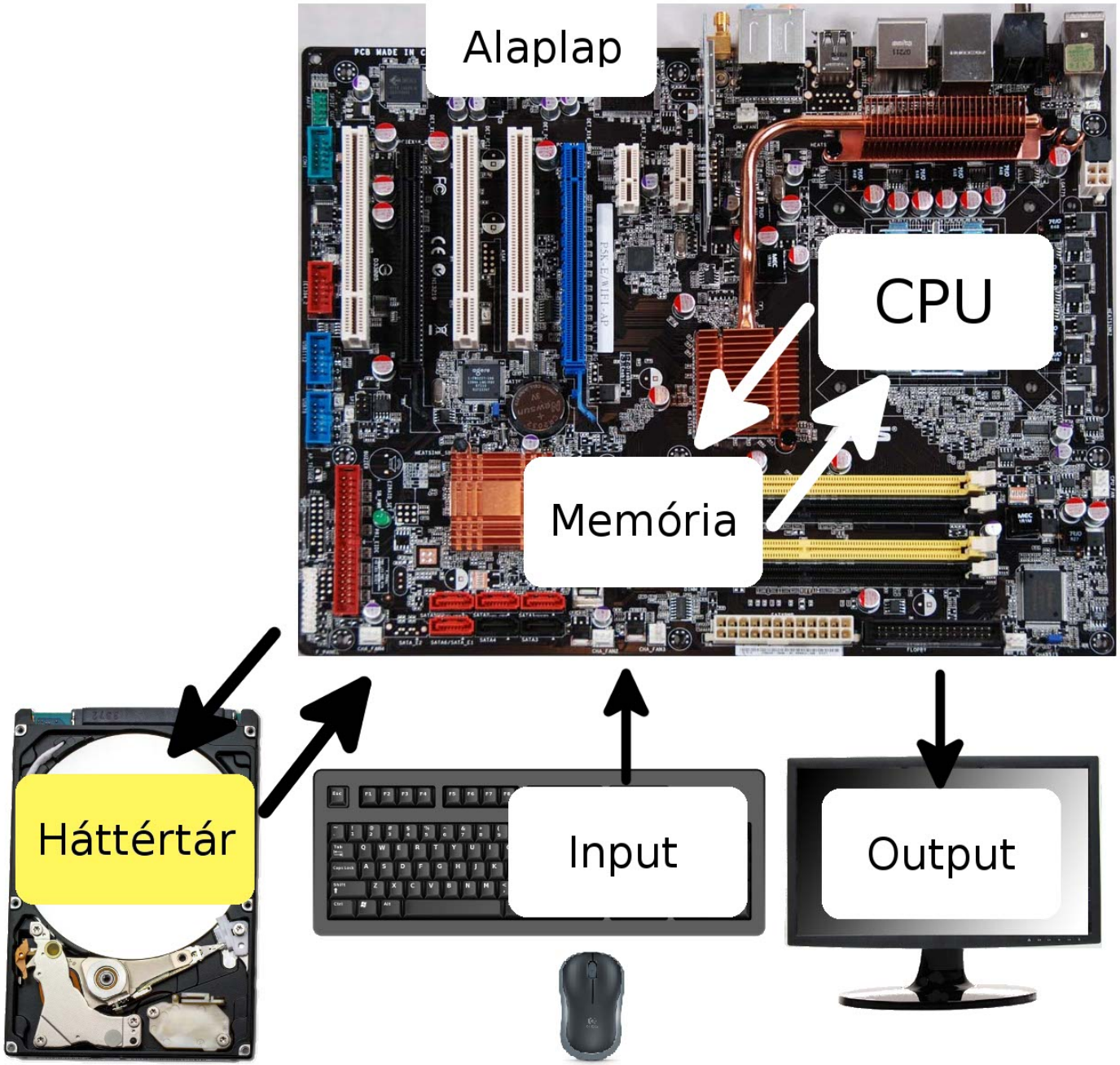
- Interesting facts
  - In theory it is possible that a low quality motherboard slows down a computer, for example if the data transfer rate between the processor and the memory is slow, then even a high end CPU and memory could feel slow.




Alaplap
CPU
Memória
Háttértár
Input
Output

Mass storage

- Function

Mass storage

- Function
  - Long term data storage

Mass storage

- Function
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  - In 1956 16GB (which can be store in a microSD nowadays) could only fit in mass storage structure the size of a 10 story building.

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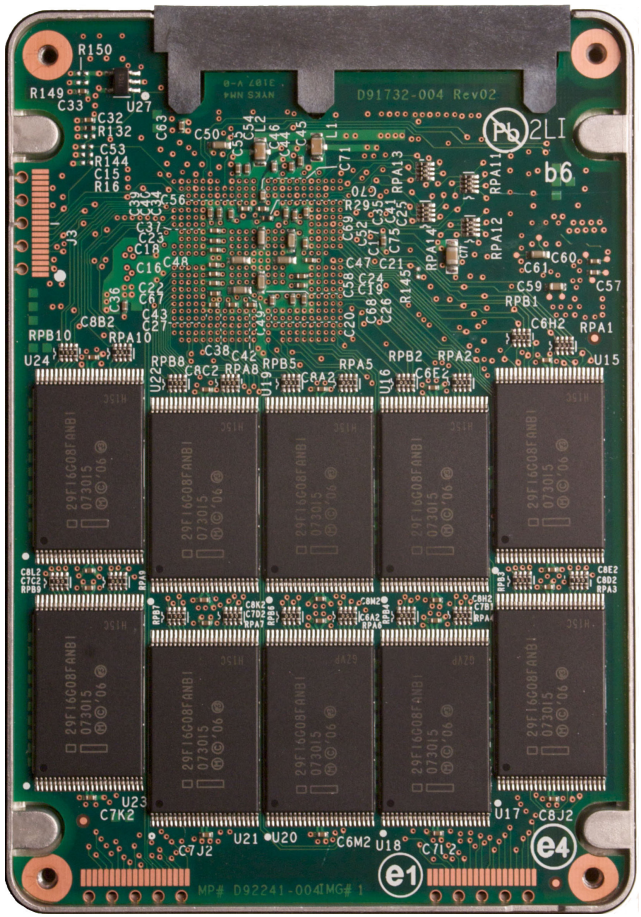
  - In hungarian some people still call mass storage devices *winchesters*, in 1973 this was the codename of a widely used mass storage device.

SSD/HDD

- HDD (Hard Disk Drive)



SSD/HDD

- HDD (Hard Disk Drive)
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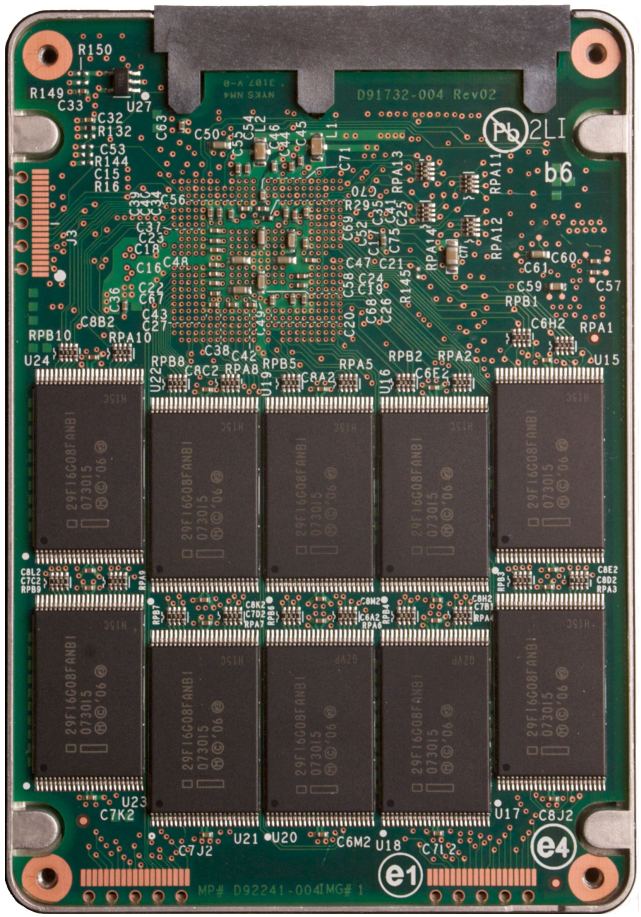

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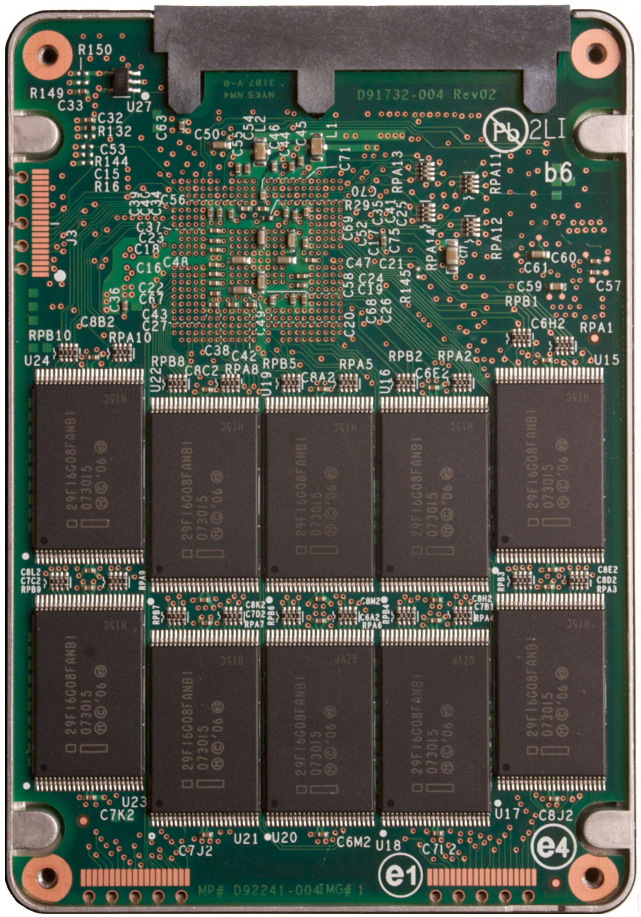

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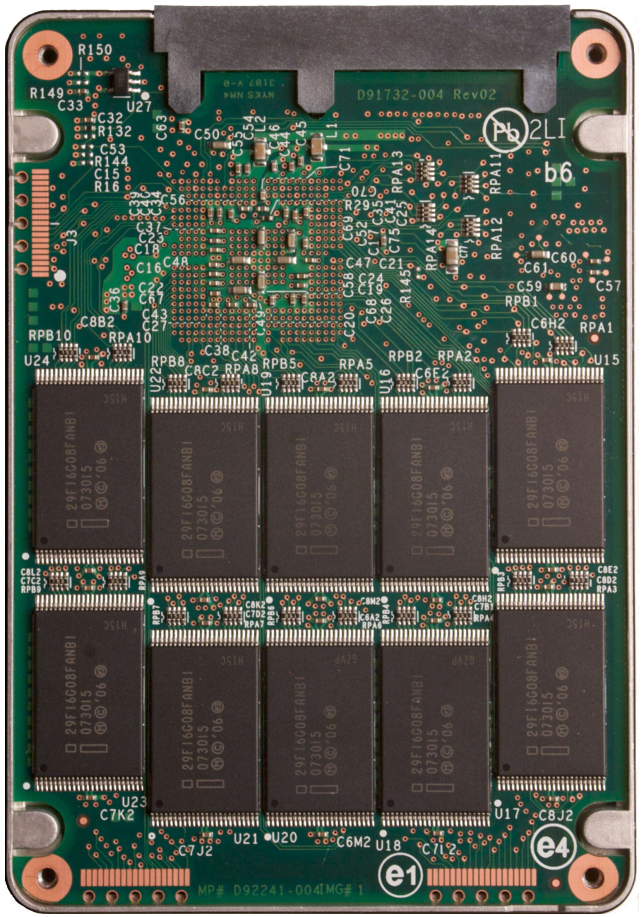

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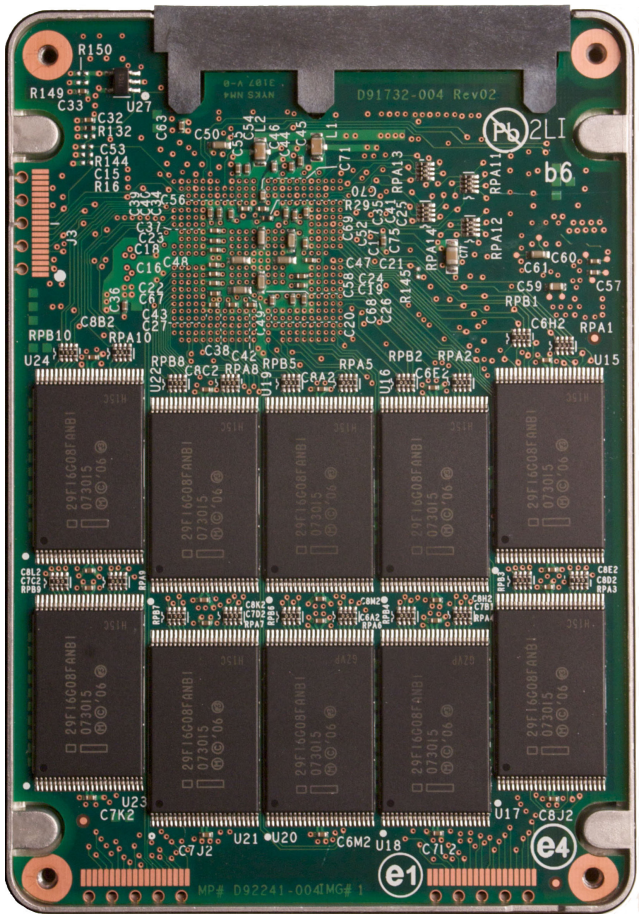

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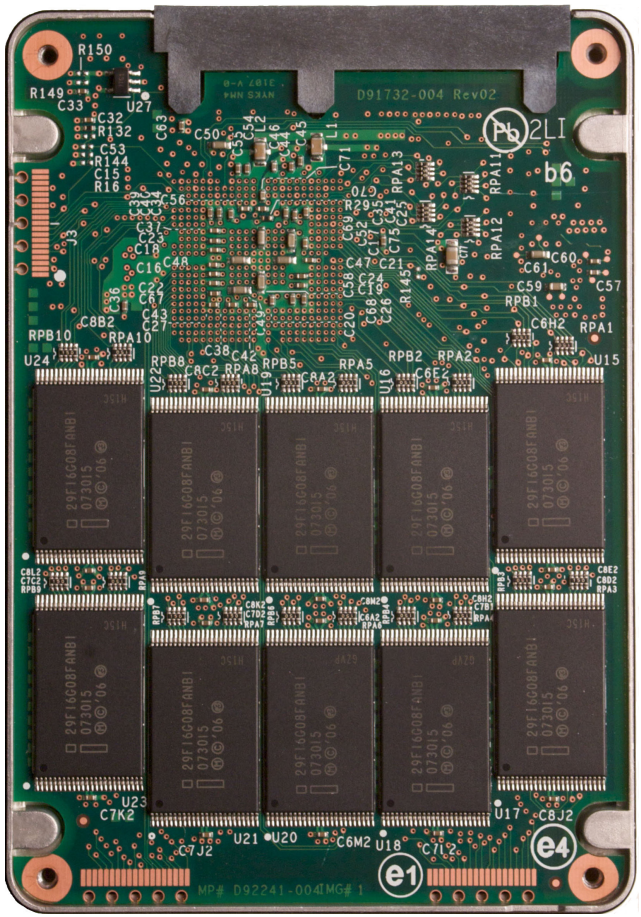

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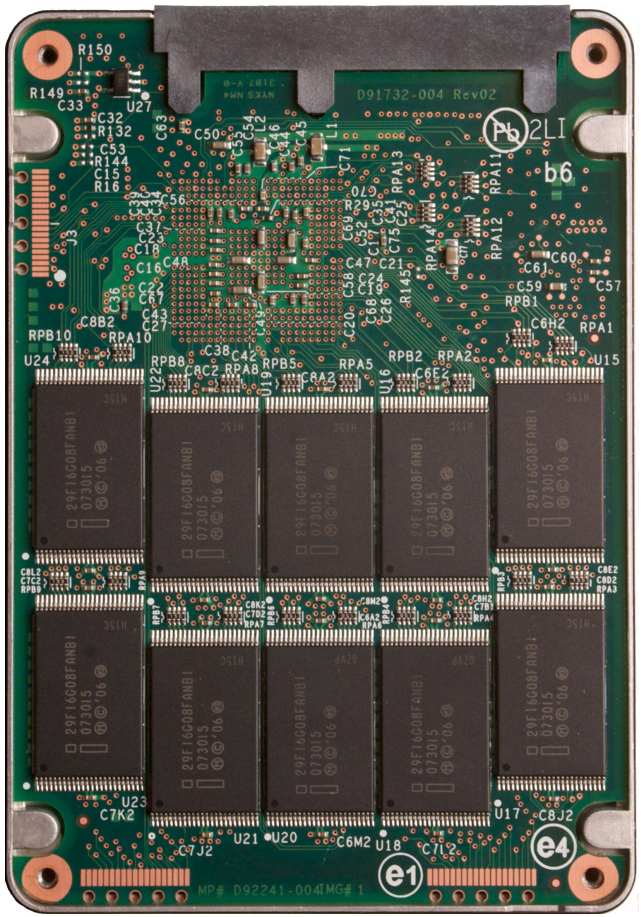

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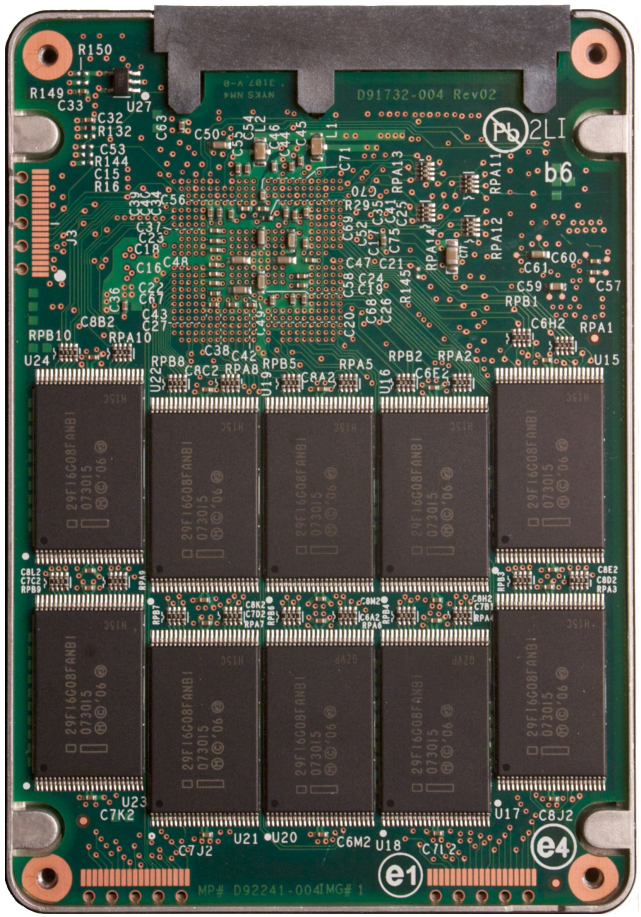

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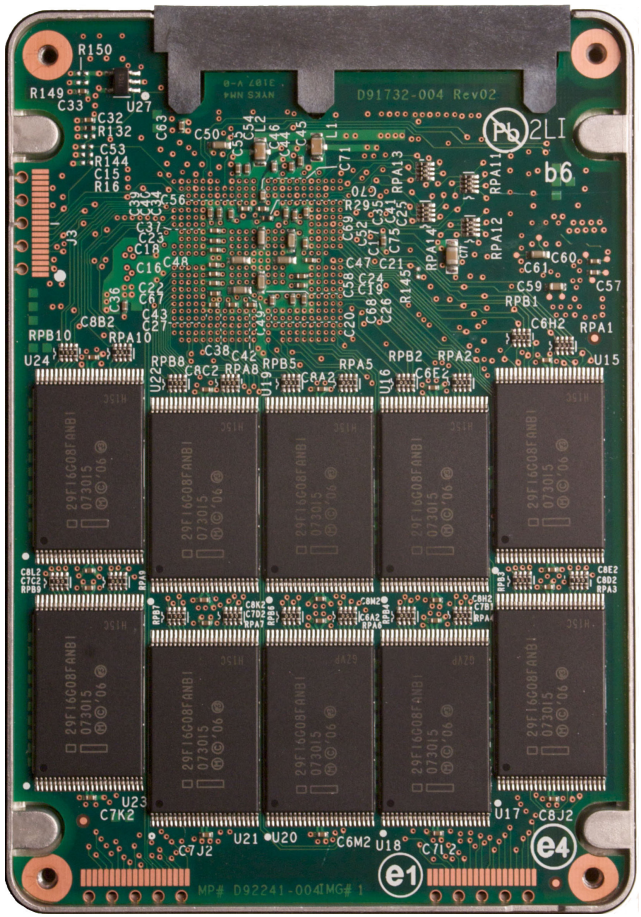

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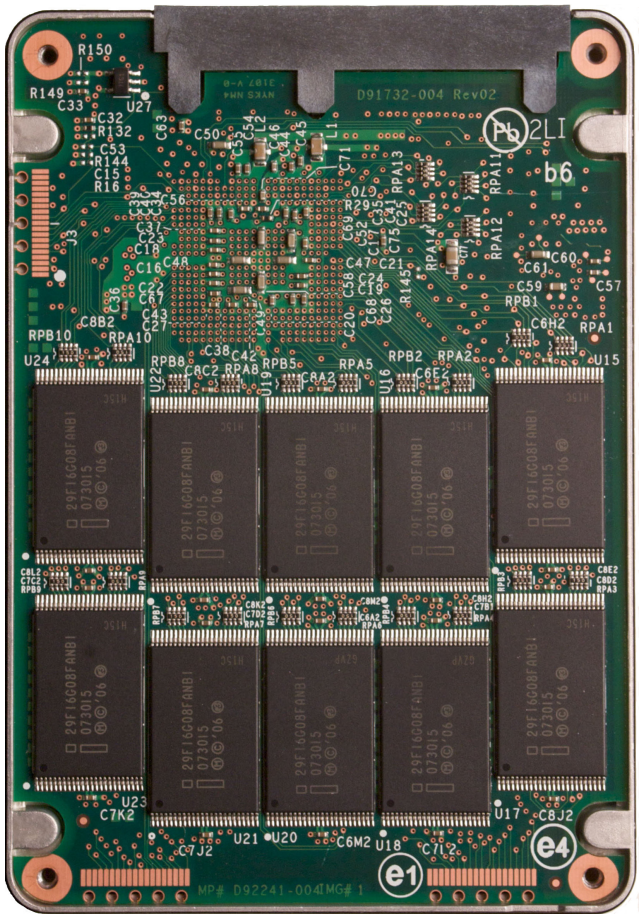
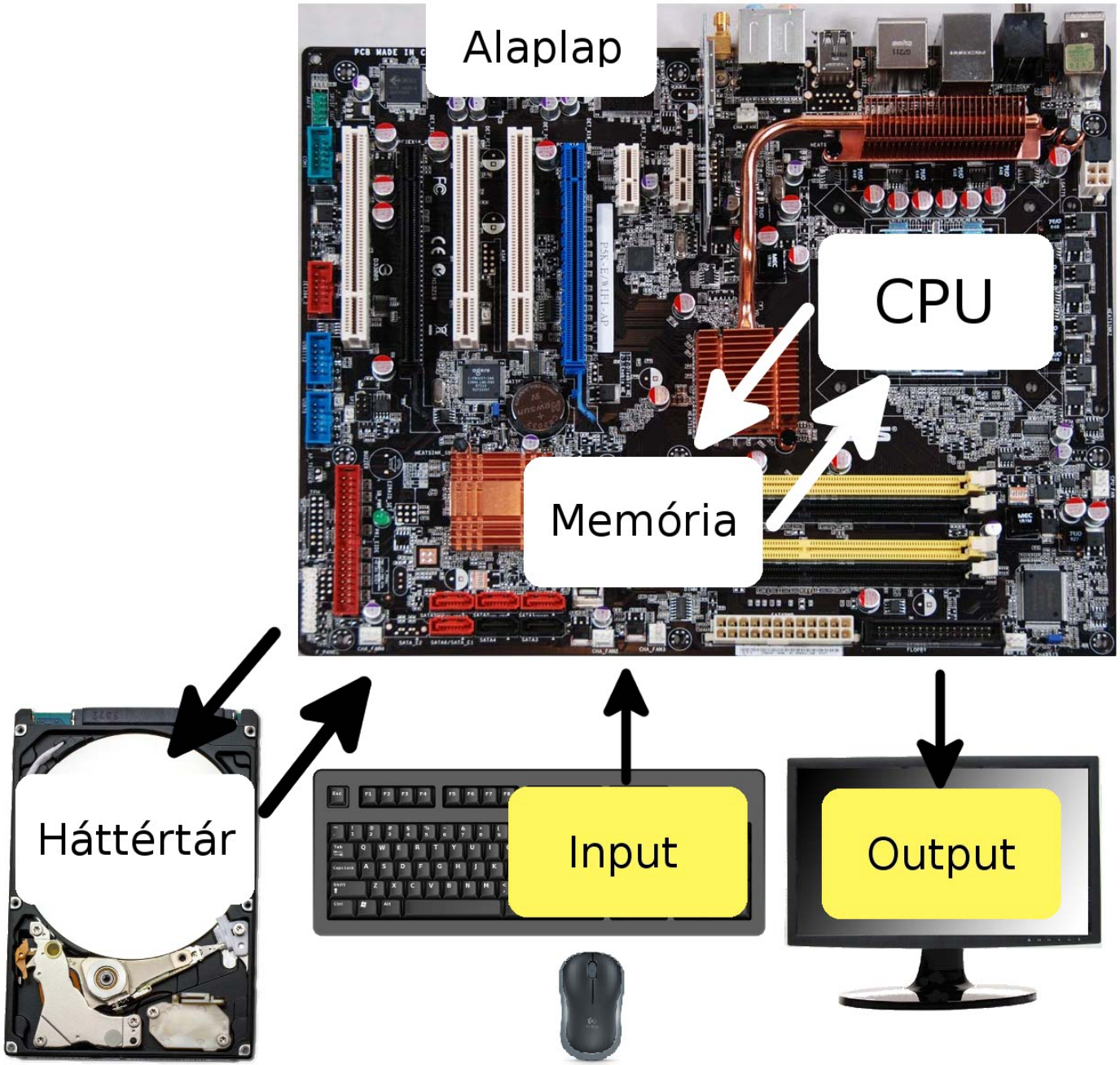
  - If our computer has some SSD storage it is worth to store the operating system there.




Alaplap
CPU
Memória
Háttértár
Input
Output

Peripheries

- Examples of input devices

Peripheries

- Examples of input devices
  - Mouse

Peripheries

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  - Mouse
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  - Speakers
- Interesting facts

Peripheries

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- Examples of output devices
  - Monitor
  - Printer
  - Speakers
- Interesting facts
  - The introduction of USB (Universal Serial Bus) simplified the usage and manufacturing of the different peripheries. For example before the USB, mouses and keyboards had different plugs.

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- What is virtual memory and what is the swap operation?
- What is the difference between an HDD and an SSD?