Computer Memories

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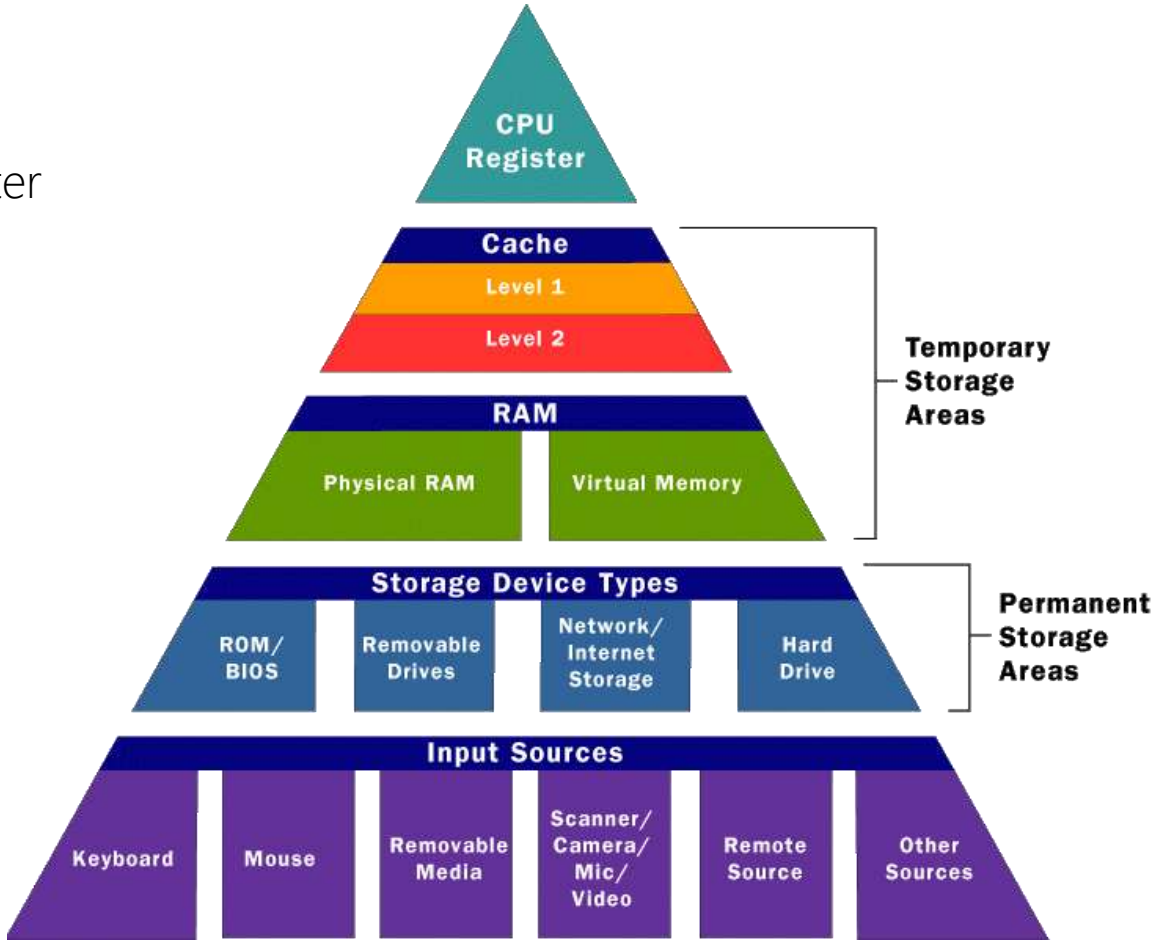
Overview

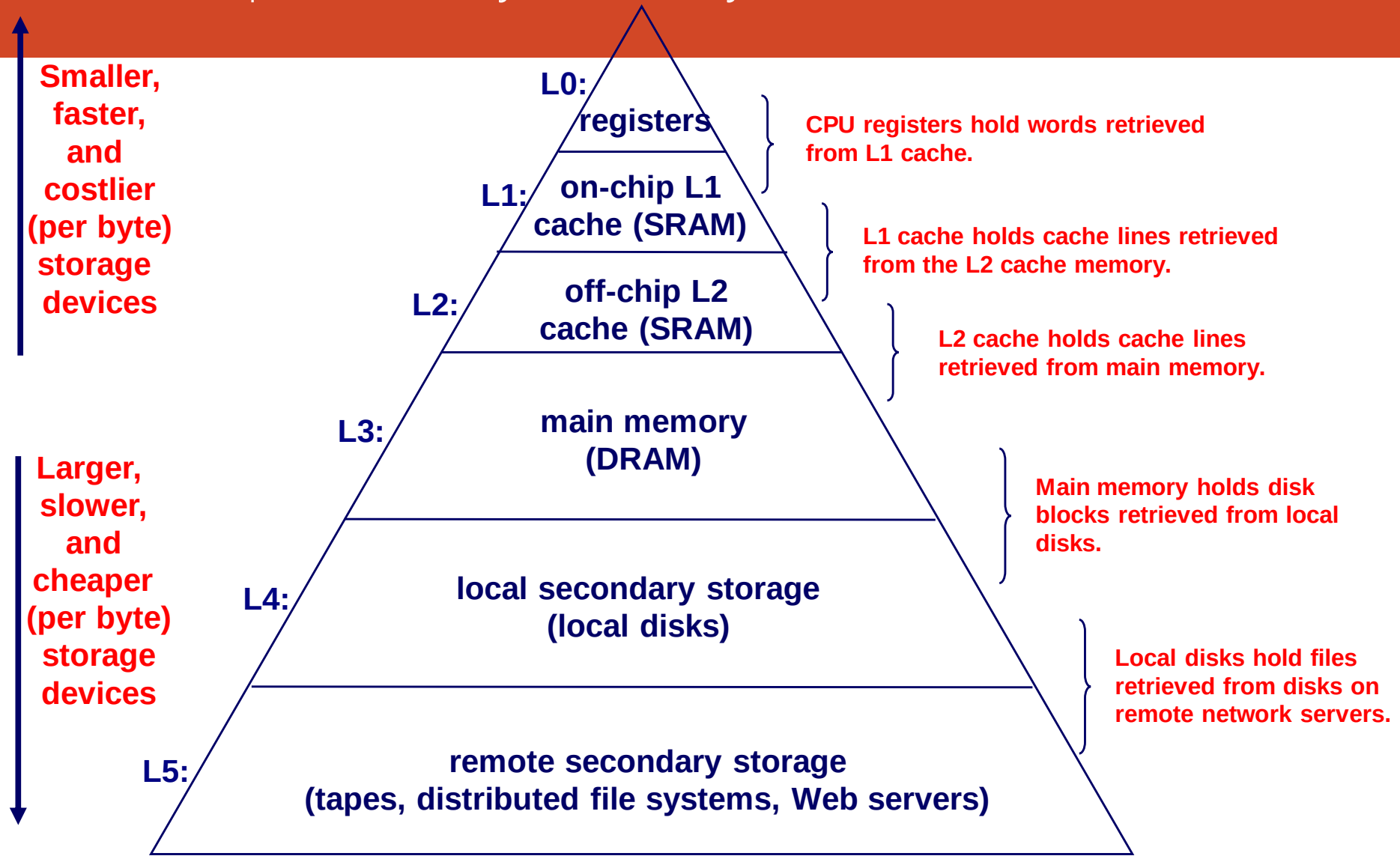
Primary
- storage of intermediate data
- necessary to run the computer
- RAM, Cache

Secondary
- long-term storage of data
- HDD

Tertiary
- CD, DVD, memory card…



An Example Memory Hierarchy



Memory

- In computing **memory** refers to the physical devices used to store programs or data on the temporary or permanent basis for use in a computer or other digital electronic device

- Main memory is divided into two parts :

  - Random Access memory (RAM) should be better known as Read Write Memory

  - Read Only Memory (ROM)

Random Access Memory (RAM)

- Structure :
  A set of memory chips, each of them is an integrated circuit (IC) made of millions of transistors and capacitors

- *Volatile* - their state is lost or reset when power is removed from the system.

- Usage :
  Holds data/application programs from input devices or storages

- Capacity : Determines the number and size of the program can be run at the same time as well as the amount of data that can be processed immediately.

- Bus : processing speed

Types of RAM

Static Random Access Memory (SRAM)

- Semi conductor memory
- Use flip-flop to store each bit of memory so does not need to be periodically refreshed
- Faster and consumes low power
- Expensive and have complex structure (6 transistors) so not use in high capacity applications

Dynamic Random Access Memory (DRAM)

- Store each bit of memory in capacitor in an integrated circuit
- Real capacitors leak charge so capacitors need to be refreshed periodically
- Simple structure (1 transistor and 1 capacitor per bit) so it has very high density

Read only memory (ROM)

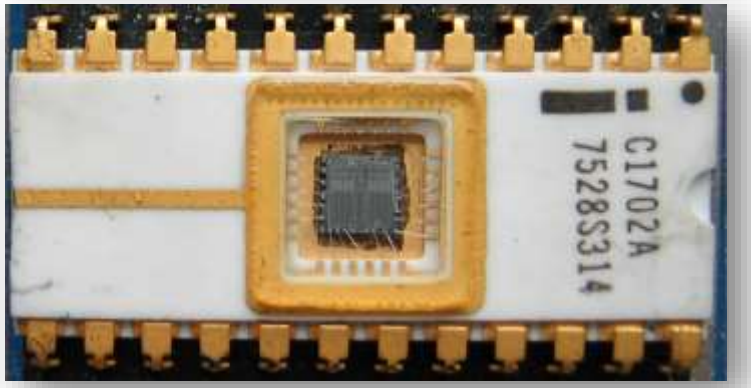
- Has contents which are fixed when the chip is manufactured
- Holds the bootstrap loader part of the operating system
- Retains its data when the computer is switched off

Types of ROM

Programmable ROM (PROM)- Empty of data when the chip is manufactured, can be programmed by the user. Once programmed the data cannot be erased.

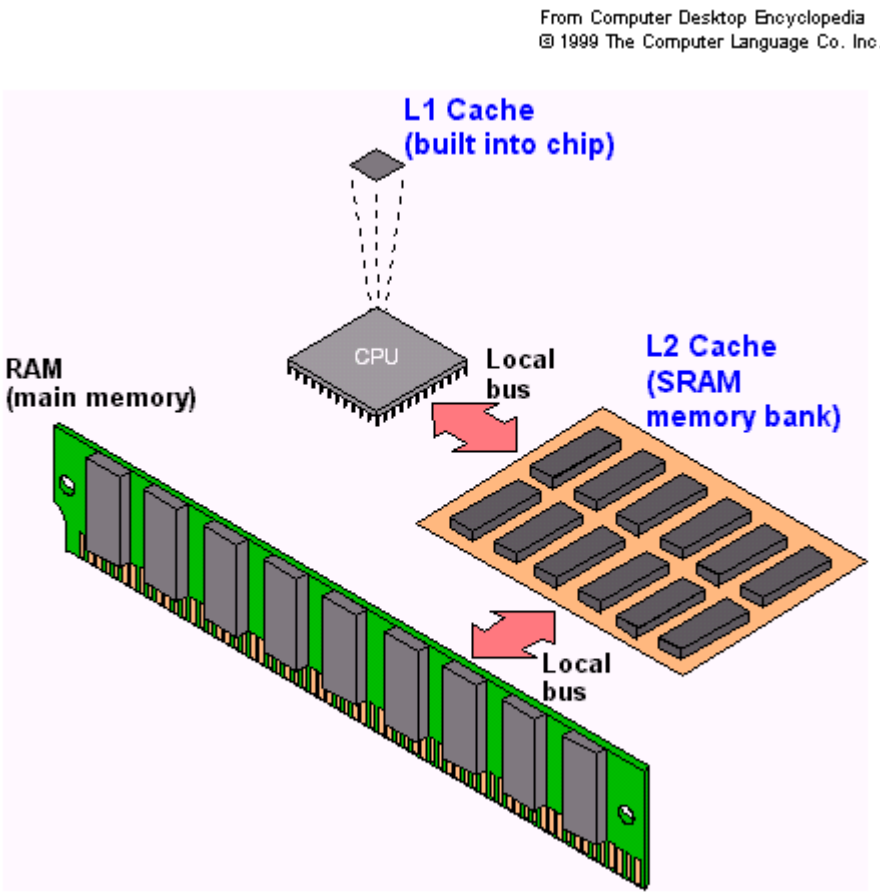
Erasable PROM (EPROM)- Like PROM only the chip can be removed from the computer and the program erased and another stored in its place using ultraviolet light.

Electrically EPROM (EEPROM) - Like EPROM but electricity is used to erase and reprogram selected contents.



Cache memory

- Faster and expensive than RAM
- It improves the computer's performance
- Processor can use it to store frequently accessed data and program instructions
- It is two types :
  - L1 : primary cache (inside the processor)
  - L2 : secondary cache (in the motherboard or near the microprocessor)



Storage

- Storage – any devices that are capable of holding information, even when the power is off (non-volatile).
- *Ex:* Floppy disk drive, hard disk drive, USB flash disk,…
- Offline storage – type of storage that can be removed and can be accessed from any computers when connected.

Types of storage device

- Optical storage devices

- Magnetic storage devices

- Flash memory devices

Optical storage devices

Compact Disc (CD)
Capacity: 700 MB
Available from 1982

DVD
Capacity: 4.7 GB
Available from 1995

Blu-ray Disc
Capacity: 25 GB
Available from 2006

Optical storage devices

Advantages:

- ✓ Small and portable
- ✓ Cheap to produce
- ✓ Large market of music, movies and games
- ✓ Most desktop computers or laptops are equipped with CD/DVD/Blu-ray drive

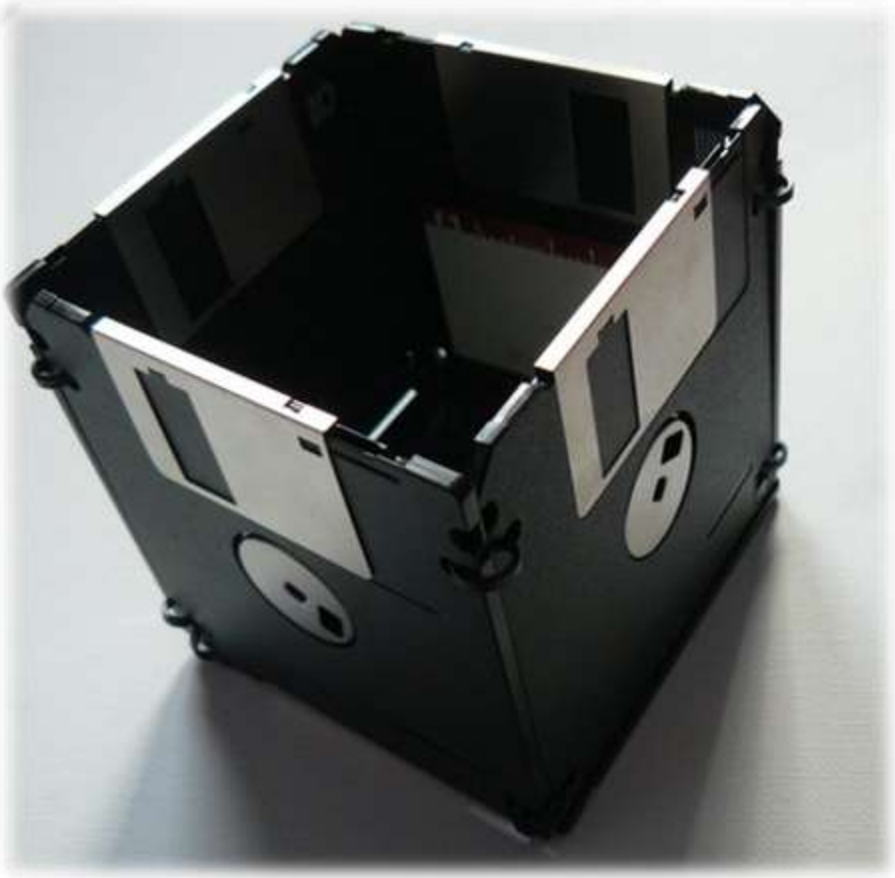
Disadvantages:

- x Fragile, easy to get scratched
- x Slower data transferring rate
- x Required specified drives to write data to the discs
- x Limited number of writes

Magnetic storage devices

Floppy disk

- First available in 1971
- Capacity: 1.44 MB (3 ½-inch floppy disk)
- *Discontinued.*
- Since 2010, no motherboard is still manufactured with the support of floppy disk drive.



Magnetic storage devices

Hard disk drive (HDD)

- First introduced in 1956
  Became dominant in the 1960s

  Capacity keeps increasing
  Max. capacity: 4 TB
  (as of 2013)

- *Continuously improved.*

- Maintained an important position of modern servers and PCs.

Magnetic storage devices

Advantages (HDD):

- ✓ Large and increasing capacity
- ✓ High transferring speed
- ✓ No data loss when power is off (non-volatile)
- ✓ Cheap price compared to other storage media (cost per MB)

Disadvantages (HDD):

- x Possible damages and data loss due to 'head' crash
- x Because of working on mechanism basis, it will be eventually broken
- x In case of internal hard drive, it is not easy to be transferred to another computer
- x High power consumption

Flash memory devices

USB Flash drive

- Commercially available in 2000
- Max. capacity: 1 TB (as of 2013)
- Small size
- Ideal solution for storing small data

Flash memory devices

Solid state drive (SSD)

- First introduced in 1995
- Max. capacity: 1 TB (as of 2013)
- *Very high transferring speed in comparison to normal physical hard disk*

Flash memory devices

Advantages:

- ✓ Large and increasing capacity
- ✓ High transferring speed
- ✓ Small size, portability
- ✓ Low power consumption
- ✓ Work more quietly than physical hard drive

Disadvantages:

- x High price compared to hard disks (cost per MB)
- x Limited number of reads/writes (write endurance rating)
- x Easy to lose because of small size

Thank you