

# Computer Architecture and Organization

CS 115

## Lecture 7

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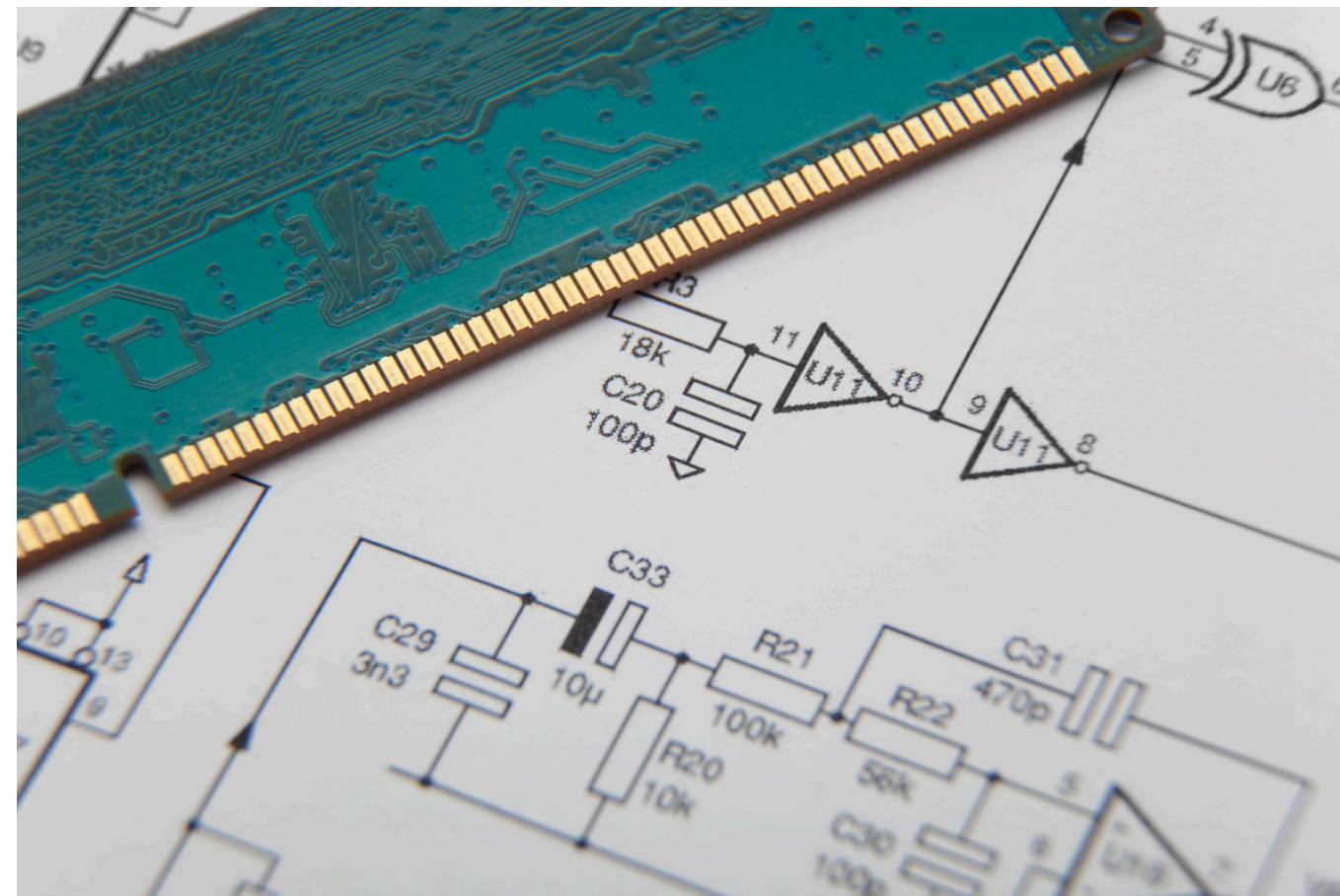
## **Unit V: Memory System Organization and Architecture**

- Memory
- Types of Memory
- The Memory Hierarchy
- Cache Memory
- Virtual Memory

# Memory

# Memory

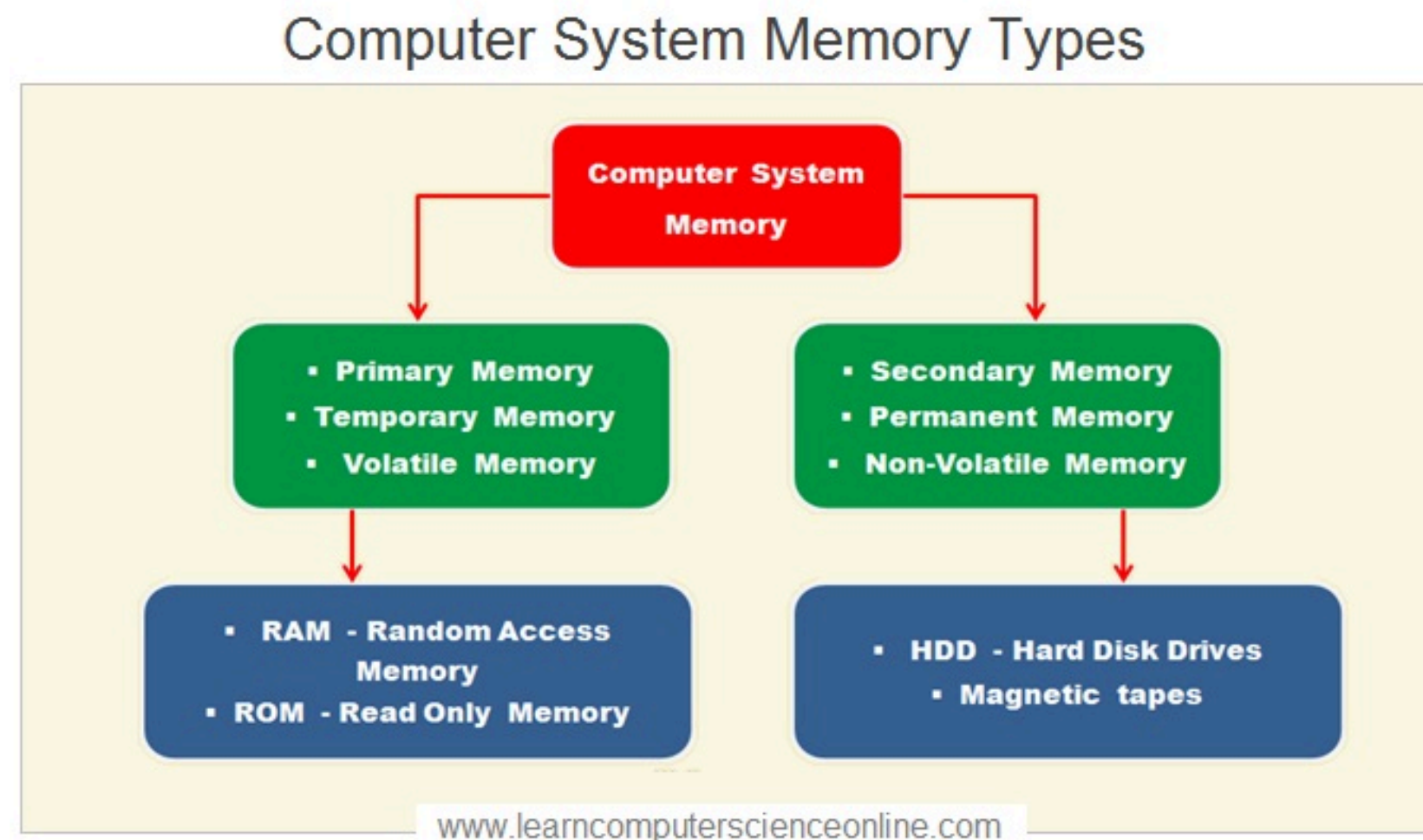
- The electronic holding place for instructions and data that a computer's microprocessor can reach quickly.
- Without memory, a processor would be merely a calculator, capable of processing but incapable of storing the result for future steps.



# Types of Memory

Memory is generally categorized by **volatility** and access method.

- **Volatile** (RAM): Loses data when power is cut. (e.g., DRAM, SRAM).
- **Non-Volatile** (ROM/Flash): Retains data without power. (e.g., BIOS chip, SSD).

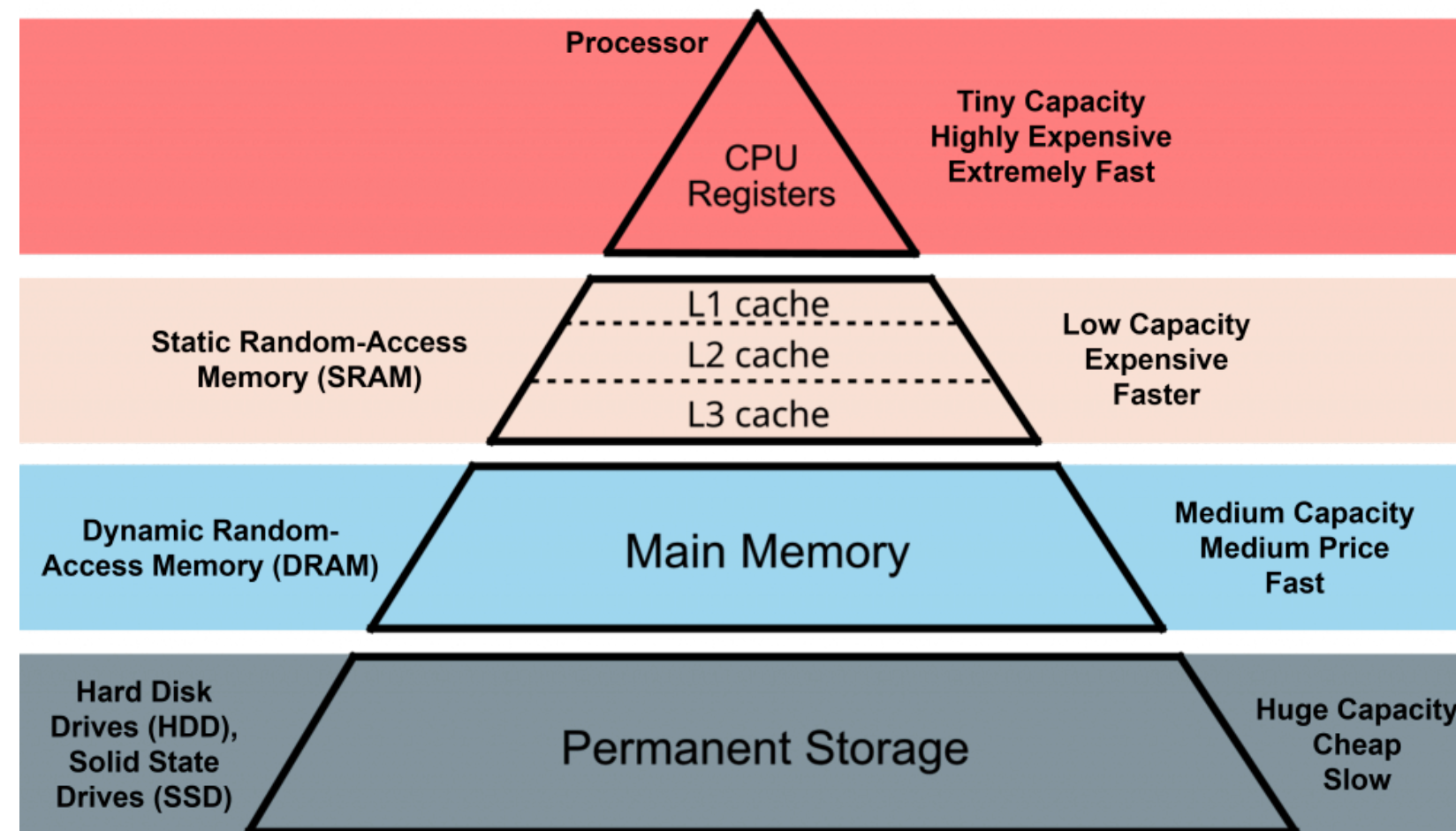


- This is why you must "Save" your Word document (moving it from Volatile RAM to Non-Volatile Disk) before turning off the computer.

# The Memory Hierarchy

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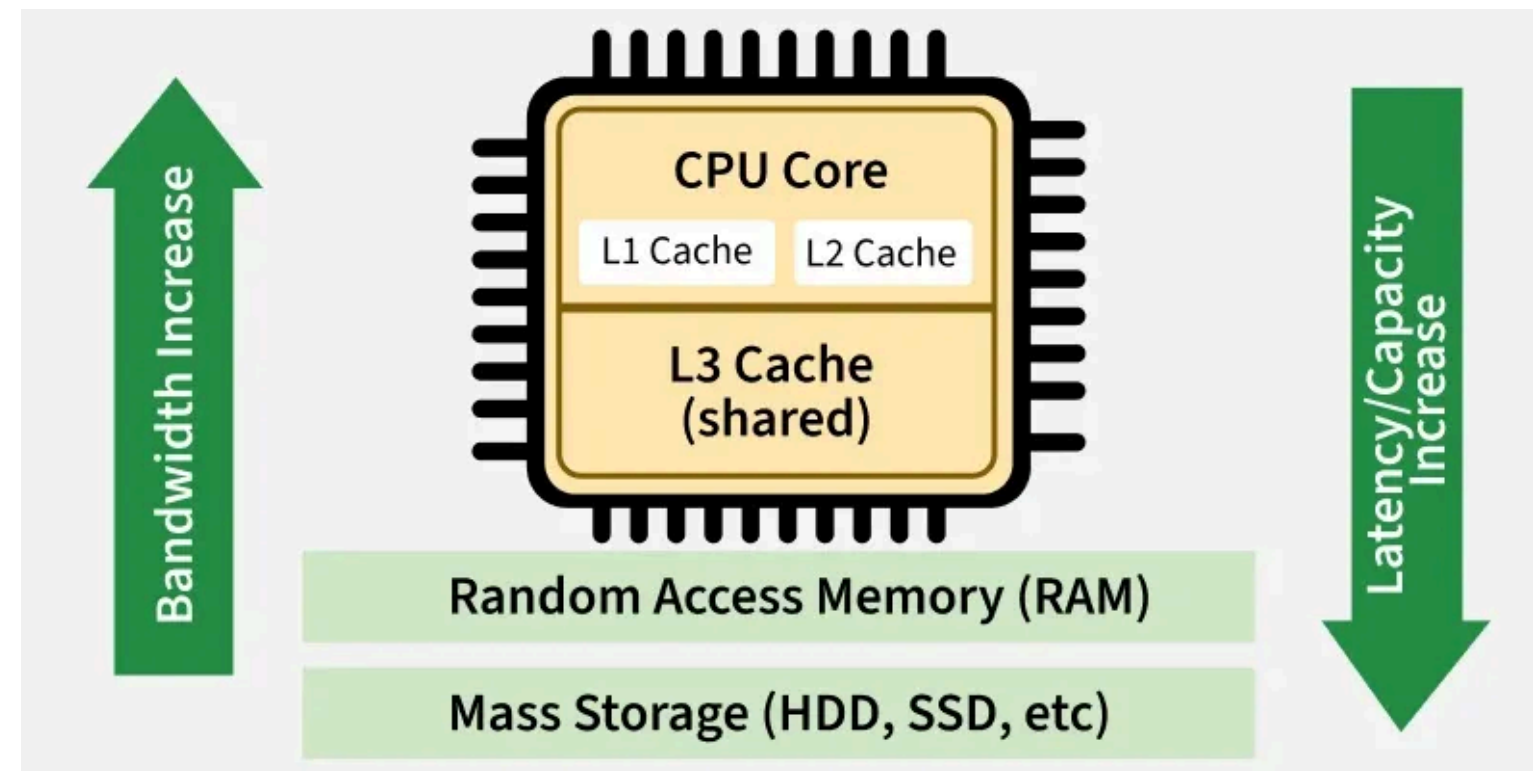
A pyramid structure organizing memory by speed, cost, and size to optimize performance.



- The Levels:
  - Registers:** Immediate CPU data (Fastest, Smallest).
  - Cache:** SRAM close to CPU.
  - Main Memory:** DRAM.
  - Secondary Storage:** HDD/SSD (Slowest, Largest).

# Cache Memory

High-speed static RAM (SRAM) that buffers the speed difference between the fast CPU and the slower Main Memory.



- Relies on Locality of Reference (Temporal: used recently? use again. Spatial: used here? use neighbor).
- Essential for gaming and heavy rendering. A larger L3 cache prevents the CPU from idling while waiting for data from RAM.

# Virtual Memory

An architectural technique that gives the illusion of a memory space larger than the actual physical RAM by using the Hard Drive as temporary storage ("Swap" or "Page file").

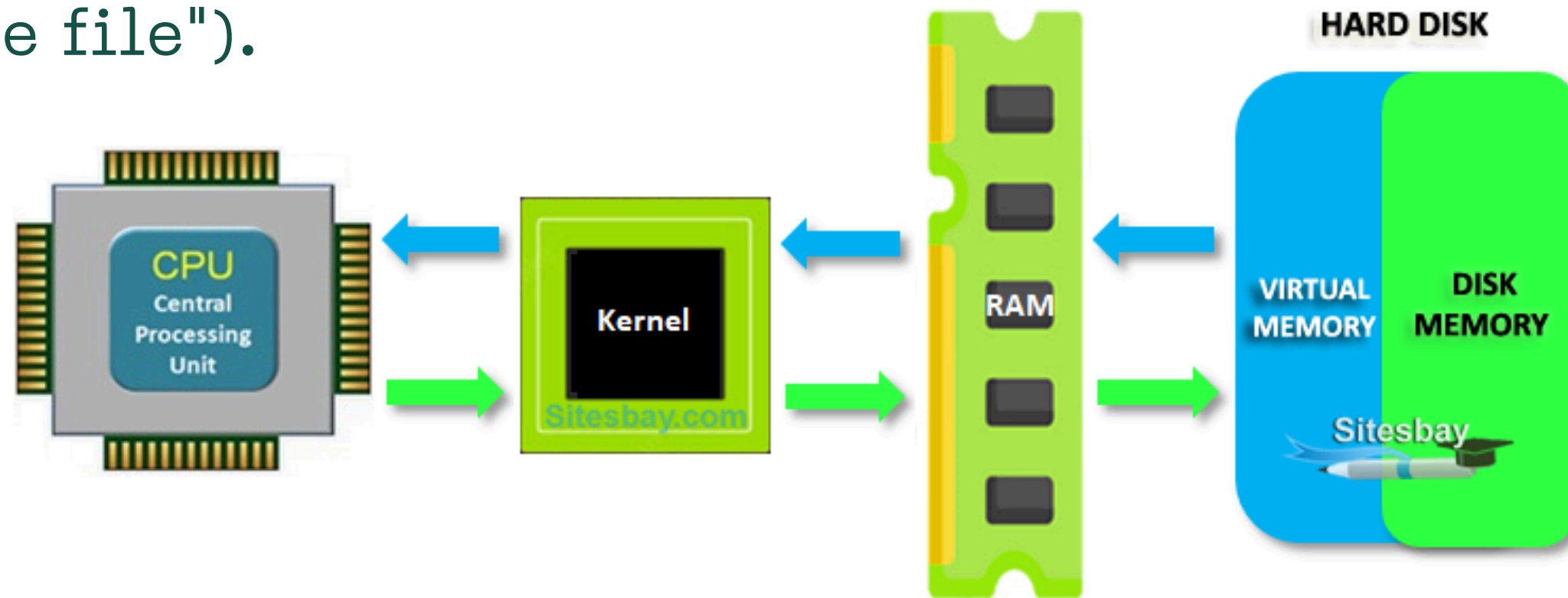


Fig: Virtual Memory in Operating System

- Allows you to run heavy software like MATLAB or modern video games on machines with limited RAM without crashing, though performance slows down ("thrashing") if used too heavily.

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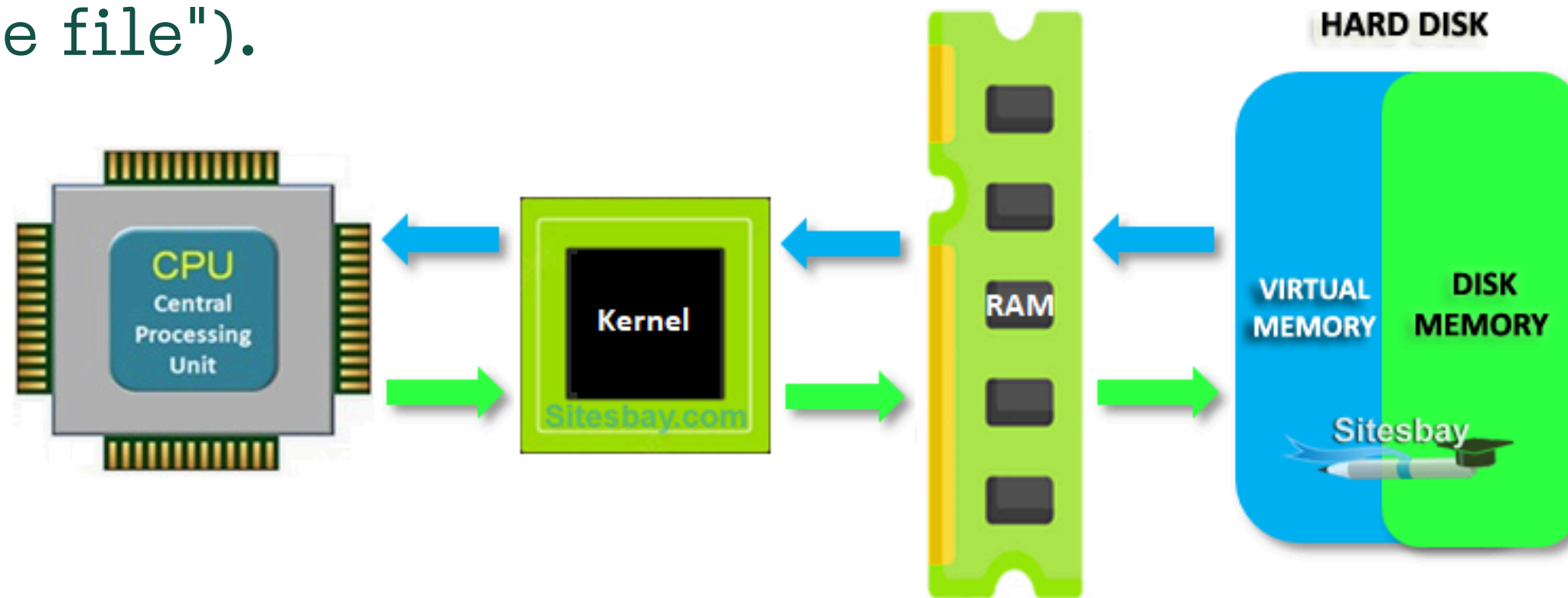


Fig: Virtual Memory in Operating System

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# End of Presentation

## Questions...?



