ANDIJAN STATE PEDAGOGICAL INSTITUTE

Lecture materials · 2026–2027 academic year

SUBJECT

Information Systems and Digital Technologies

Lecture 7 · Primary Memory

Part 1 of 2 · 2 hours

Lecturer: **Ismailov Alisher**

E-mail: alisherismailov1991@gmail.com

Contact: **99-499-73-64**

LECTURE 07 · 2 HOURS · PART 1/2

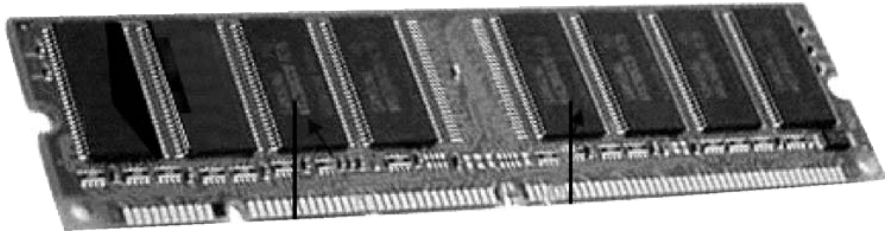
FUNDAMENTALS OF COMPUTERS · CHAPTER 3

Memory

How a computer holds data — for right now, and for later



8 bits = 1 byte = one character (here, the letter 'M')



A RAM module: memory chips (ICs) on a circuit board. Source: textbook Fig. 3.3

Why does a phone advert list two memory sizes?

EXAMPLE PHONE SPEC SHEET

8 GB
RAM

128 GB
Storage

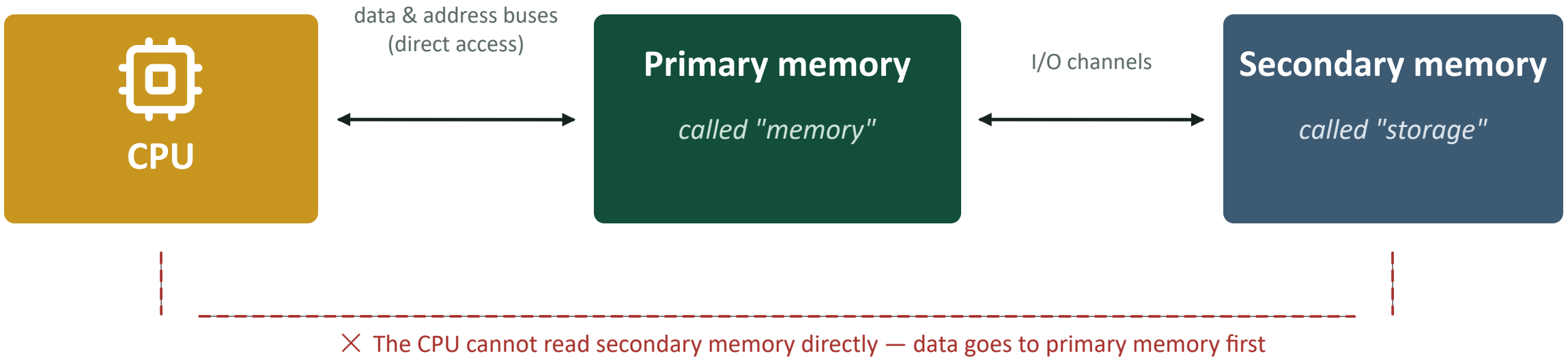
Think – Pair – Share (2 min)

1. Why two different numbers?
2. Which one keeps your photos when the phone is switched off?
3. What happens to an unsaved note if the battery dies?

By the end of this lesson, you can…

1	Classify memory into internal process, primary and secondary memory.
2	Explain bits, bytes, words and addresses, and convert KB, MB, GB and TB to bytes.
6	Explain the purpose of memory and the memory hierarchy.
7	Relate memory size and speed to the performance of software.

Two jobs, so two kinds of memory



Now: holds data the CPU is handling at this moment (temporary).

Later: stores programs and results permanently.

Why does a computer need memory?

Holds the running program

The CPU can only run instructions that are in main memory.

Holds the data in use

The document, photo or game level you are working on.

Keeps results

Intermediate and final results of calculations.

Feeds the CPU fast

Fast memory keeps the processor busy instead of waiting.

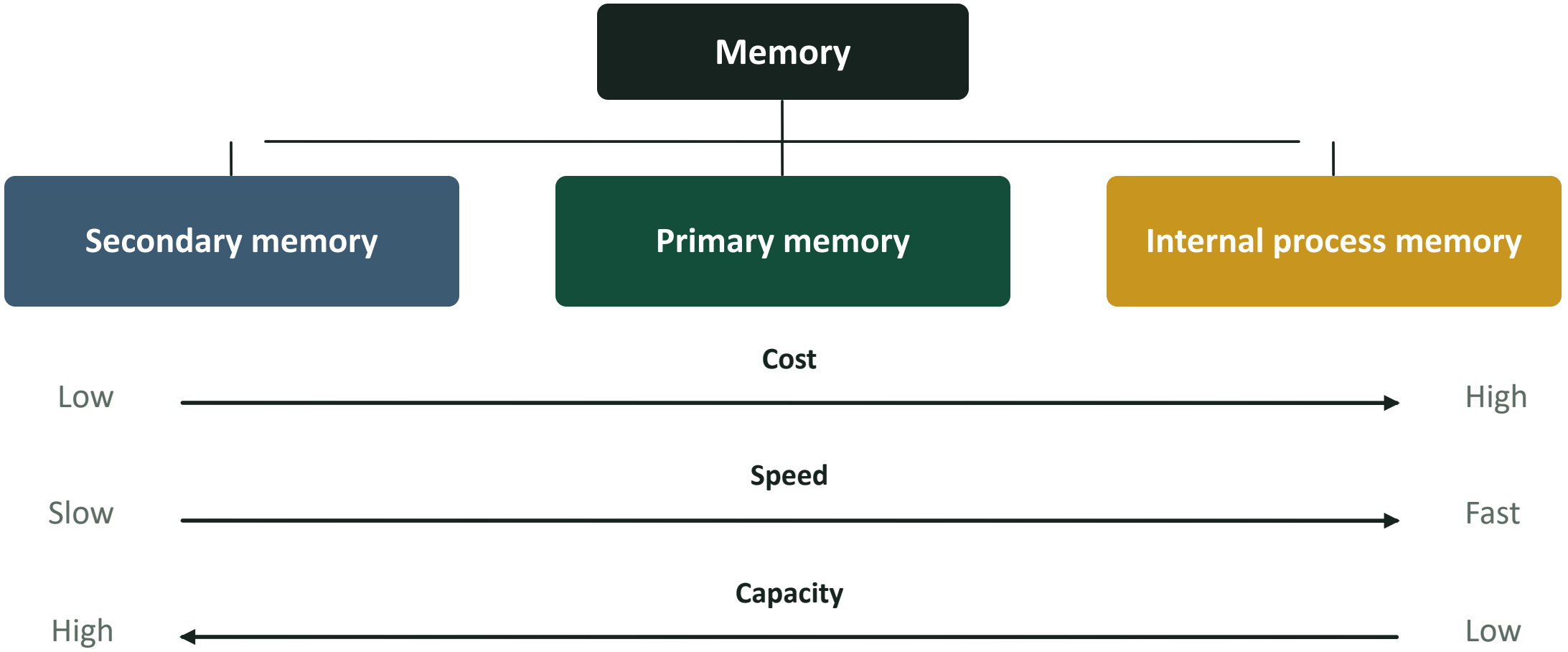
Starts the computer

ROM holds the start-up program (firmware).

Buffers data

Holds data moving between the CPU and I/O devices.

Three categories of memory



Redrawn from textbook Fig. 3.1

What belongs in each category?



Internal process memory

- **Cache memory**
- **Registers**

Inside or near the CPU. Temporary. Accessed directly by the CPU.



Primary memory

- **RAM — volatile**
- **ROM — non-volatile**

Also called main memory. Accessed directly by the CPU.



Secondary memory

- **Magnetic disks**
- **Magnetic tapes**

Also called auxiliary memory. Much larger capacity; permanent until removed.

CHECK FOR UNDERSTANDING

Sort it: which category?

Cache memory

Magnetic tape

RAM

Registers

ROM

Magnetic disk

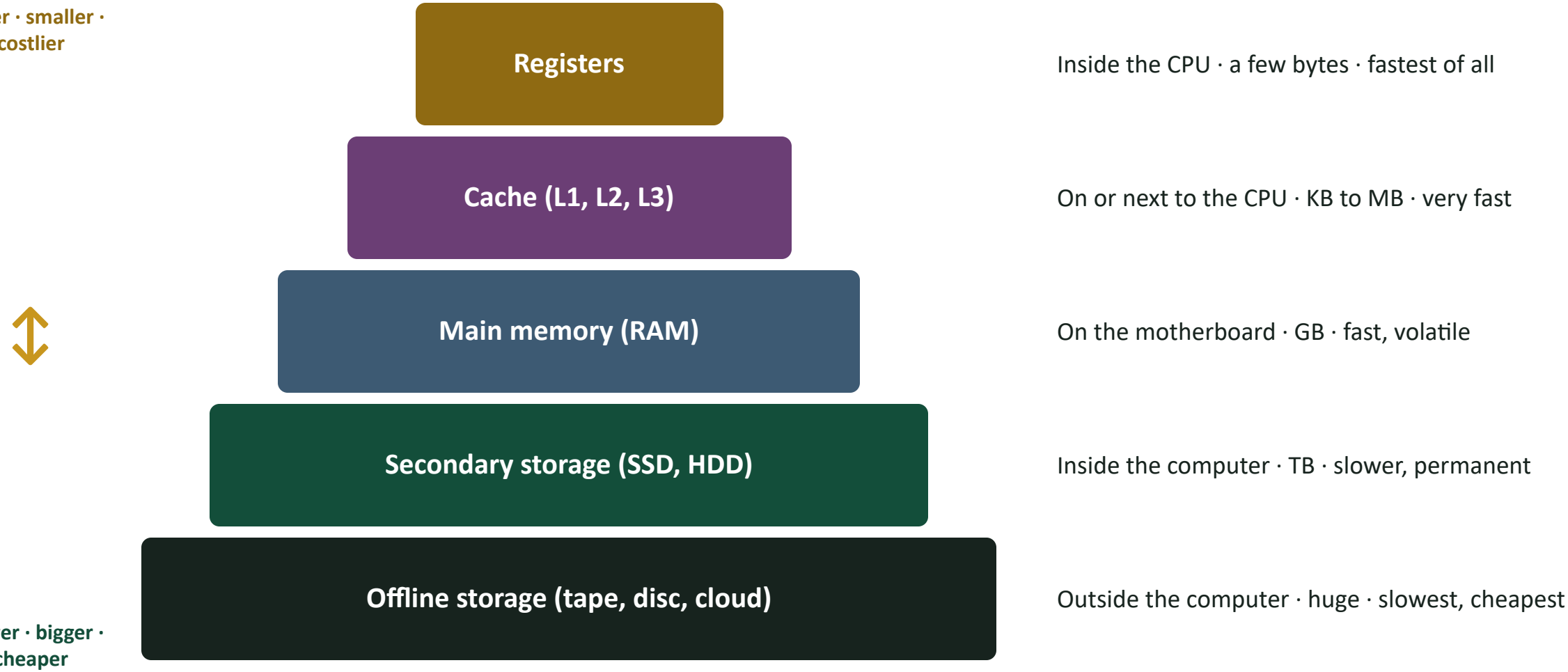
Internal process	Primary	Secondary

Predict

- Which category is fastest?
- Which holds the most data?
- Which ones keep data after power is switched off?

The memory hierarchy

faster · smaller · costlier



Inside the CPU · a few bytes · fastest of all

On or next to the CPU · KB to MB · very fast

On the motherboard · GB · fast, volatile

Inside the computer · TB · slower, permanent

Outside the computer · huge · slowest, cheapest

slower · bigger · cheaper

Speed, size and cost at each level

LEVEL	Typical access time	Typical size	Cost per GB
Registers	under 1 ns	hundreds of bytes	highest
Cache	about 1–10 ns	KB to tens of MB	very high
RAM	about 50–100 ns	4–64 GB	medium
SSD	about 0.1 ms	256 GB – 4 TB	low
HDD	about 5–10 ms	1–20 TB	lowest

Scale: if a register took 1 second, reading from an HDD would take several months.

Why memory matters for software performance

Enough RAM

More programs and tabs stay open without slowing down.

Too little RAM

The OS swaps to disk (virtual memory) — everything slows.

Cache hits

Data found in cache is used at once; a miss means waiting for RAM.

Locality

Programs reuse nearby data, so caching works well.

Fast storage

An SSD loads programs into RAM much faster than an HDD.

Efficient software

Programs that waste memory (memory leaks) slow the whole system.

CHECK FOR UNDERSTANDING

Memory detective

A	Put these in order, fastest first: RAM, registers, SSD, cache.
B	A laptop with 4 GB of RAM crawls when 30 browser tabs are open. Why?
C	The CPU finds the data it needs in L1 cache. What is this called?
D	Why not build all memory from registers?
E	A game loads twice as fast after moving it to an SSD. Why?
F	A program uses more and more memory until the PC freezes. What is the bug?

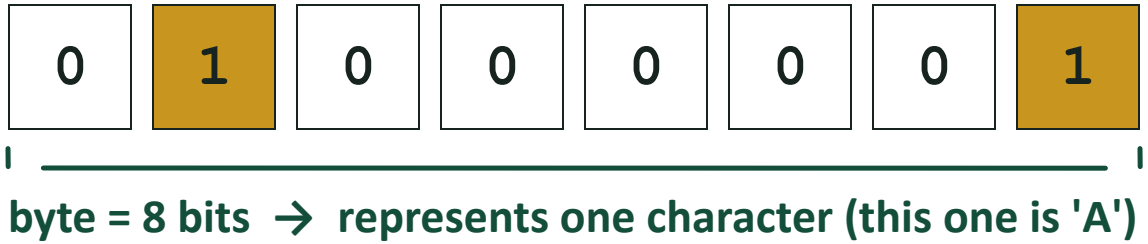
Key words

- hierarchy
- swapping / virtual memory
- cache hit
- cost per byte
- faster storage
- memory leak

Bits, bytes and words

bit

a binary digit: 0 or 1



byte

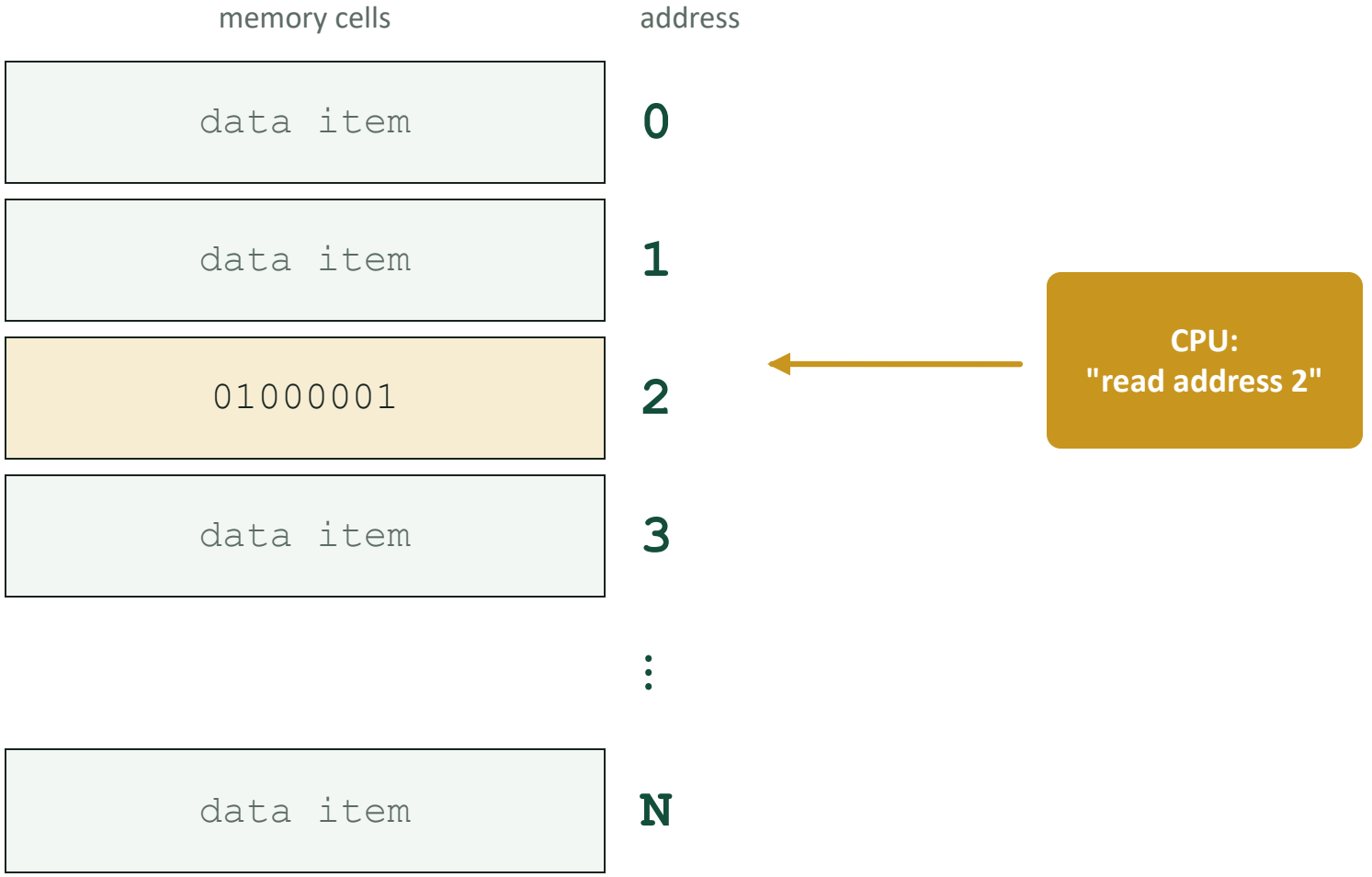
the smallest addressable unit of memory

word

a group of bytes, usually 2 or 4



Every memory cell has an address



Think of numbered lockers

Each cell (data item) gets a unique number — its address. The CPU finds a cell by its address, like an index in an array.

Redrawn from textbook Fig. 3.2

Measuring capacity: each step is × 1,024



Try it

2 KB = ? bytes

1 MB = ? KB

½ GB = ? MB

OPTIONAL MODERN NOTE Drive makers often count 1 KB = 1,000 bytes. The 1,024 version is sometimes written KiB. Use the textbook values in this course.

CHECK FOR UNDERSTANDING

True or false?

1	A byte is the smallest addressable unit of memory.	T / F
2	The CPU can read data directly from secondary memory.	T / F
3	A word is usually a group of 2 or 4 bytes.	T / F
4	Internal process memory is the slowest kind of memory.	T / F

Quick calculation

4 KB = ? bytes

Show your working on a mini-whiteboard.

Review: can you answer these?

01 Name the three categories of memory.

02 Why is RAM called volatile?

03 How many bits are in a byte? What is a word?

04 How many bytes are in 1 MB (textbook value)?

05 Give three reasons why a computer needs memory.

06 Order from fastest to slowest: RAM, registers, SSD, cache.

07 What is a memory address?

08 What happens when a computer has too little RAM?

Exit ticket

Answer on a slip of paper before you leave.

1. Order from fastest to slowest: primary memory, secondary memory, internal process memory.

2. How many bytes are in 1 KB and in 1 GB (textbook values)?

3. There is a cache miss. What does the CPU have to do?

Next lesson: RAM and ROM — their types and where they are used.