ANDIJAN STATE PEDAGOGICAL INSTITUTE

Lecture materials · 2026–2027 academic year

SUBJECT

Information Systems and Digital Technologies

Lecture 8 · Primary Memory

Part 2 of 2 · 2 hours

Lecturer: **Ismailov Alisher**

E-mail: alisherismailov1991@gmail.com

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

LECTURE 08 · 2 HOURS · PART 2/2

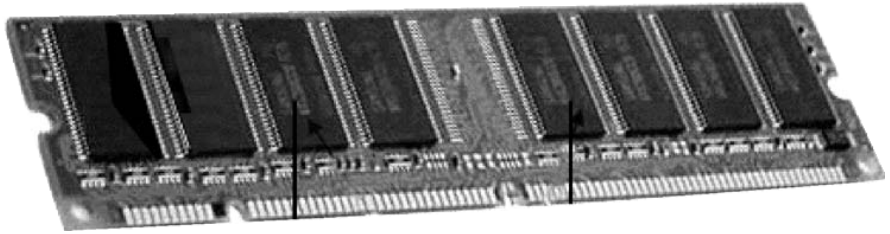
FUNDAMENTALS OF COMPUTERS · CHAPTER 3

Memory

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



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

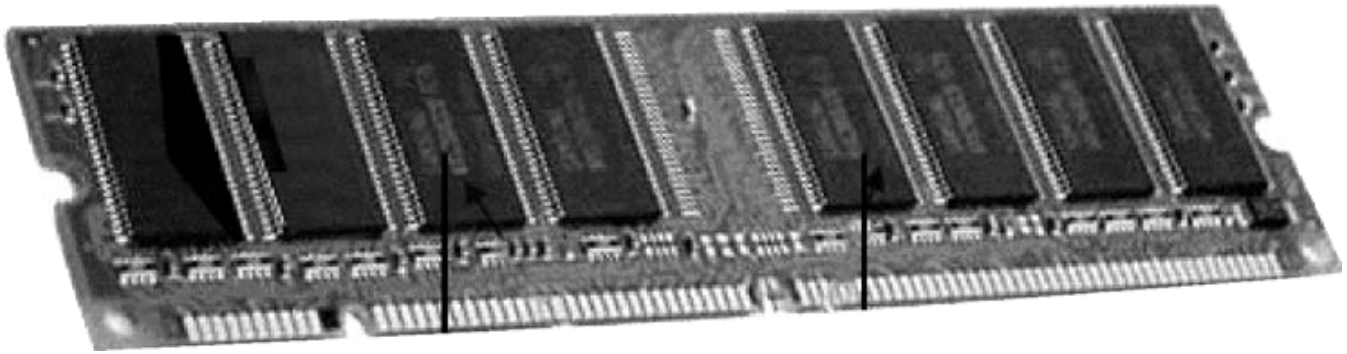


A RAM module: memory chips (ICs) on a circuit board. Source: textbook Fig. 3.3

By the end of this lesson, you can…

3. Compare RAM and ROM using the words volatile and non-volatile.
4. Distinguish SRAM from DRAM and name the types of each.
5. Match each ROM type — PROM, EPROM, EEPROM, Flash — to how it is erased and where it is used.

RAM: the computer’s working memory



Memory chips (ICs) mounted on a printed circuit board — textbook Fig. 3.3

Volatile

Data is lost when power is switched off.

Read / write

Can both read and write data.

Random access

Data can be accessed in any order — fast.

Holds work in progress

Programs and data being used right now.

Compared with secondary storage

SPEED

faster (e.g. than hard disk, floppy disk)

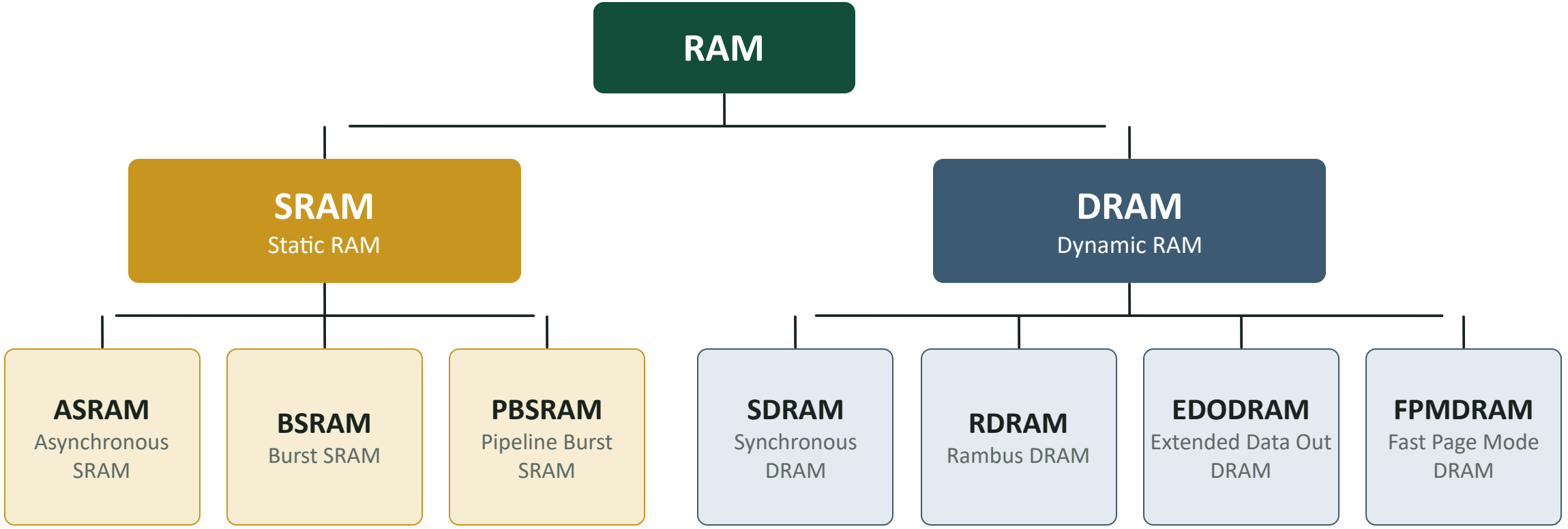
CAPACITY

usually smaller

LOCATION

internal memory of the computer

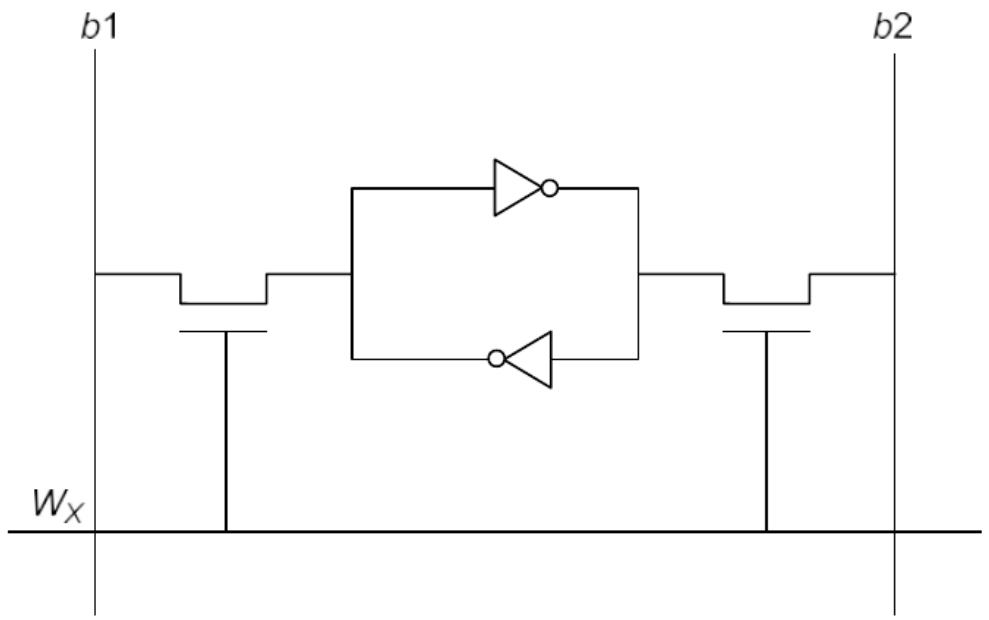
The RAM family



Tip: every name ends in the family it belongs to — …SRAM or …DRAM.

Redrawn from textbook Fig. 3.4

Static RAM (SRAM)



Organisation of data in a cell of SRAM — textbook Fig. 3.5

Uses a number of transistors to store a single bit.

Keeps data as long as the power is switched on.

Cells form a grid of rows and columns.

Word line (Wx) selects a whole row.

Bit lines (b1, b2) reach each column.

Three types of SRAM

ASRAM

Asynchronous SRAM

- Works without the system clock
- Uses 3 signals: Chip Select (CS), Write Enable (WE), Output Enable (OE)
- CS = 0 → memory enabled

BSRAM

Burst SRAM

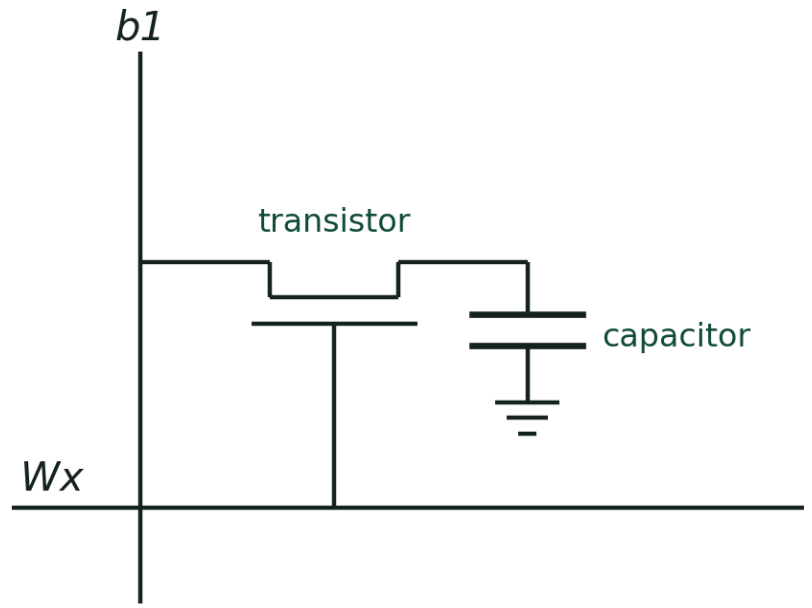
- Works with the system clock — also called synchronous SRAM
- Read/write cycles synced to the processor → less waiting
- Used in high-speed applications

PBSRAM

Pipeline Burst SRAM

- Breaks data into packets sent in sequence through a pipeline
- Handles large amounts of data at very high speed
- Fastest SRAM: bus rates up to 66 MHz

Dynamic RAM (DRAM)



One DRAM cell: bit line b1, word line Wx (redrawn after textbook Fig. 3.6)

- Each cell = one transistor + one capacitor.
- The capacitor slowly discharges (leaks).
- So DRAM must be refreshed continuously.
- Keeps data only a very short time after power off.

Analogy: a leaky bucket — someone must keep topping it up, or the water (data) drains away.

Four types of DRAM

SDRAM

Synchronous DRAM

Works with the processor bus clock. Two internal memory banks. Stores data continuously → more instructions per unit time.

RDRAM

Rambus DRAM

Designed by Rambus Inc. Faster than SDRAM — up to 800 MHz. Not popular: high cost, low compatibility.

EDODRAM

Extended Data Out DRAM

Accesses more than one bit at a time. Starts on the next bit right after getting the first.

FPMDRAM

Fast Page Mode DRAM

Uses paging: picks data by row and column of a matrix. Limited to 66 MHz buses, so reading/writing is slow.

SRAM vs DRAM at a glance

	SRAM (Static)	DRAM (Dynamic)
Stores one bit using	a number of transistors	one transistor + one capacitor
Refreshing	not needed while power is on	must be refreshed continuously
When power goes off	data is lost	data kept only for a very short time
Types	ASRAM, BSRAM, PBSRAM	SDRAM, RDRAM, EDODRAM, FPMDRAM
Speed highlight	PBSRAM — the fastest SRAM	RDRAM — faster than SDRAM

Both are volatile RAM: read/write memory the CPU uses for work in progress.

CHECK FOR UNDERSTANDING

Who am I?

A *“I have one transistor and one capacitor, and I need constant refreshing.”*

I am: _____

B *“I work without the system clock and use CS, WE and OE signals.”*

I am: _____

C *“I was designed by Rambus Inc. and can reach 800 MHz.”*

I am: _____

D *“I break data into packets in a pipeline. I am the fastest SRAM.”*

I am: _____

ROM: memory that remembers



Non-volatile

Keeps data even when the power is switched off.



Read, not change

Data can be read easily but cannot be changed.



Where it is used

Calculators, laser printers and similar devices.

Four types: PROM · EPROM · EEPROM · Flash ROM

THE TEXTBOOK ALSO SAYS

- ROM allows sequential (not random) access of data.
- ROM is less expensive than RAM and than storage such as magnetic disk.

OPTIONAL MODERN NOTE Today's ROM and flash chips can also be read at any address (random access). For exams, use the textbook statement.

RAM vs ROM

	RAM	ROM
Power off	Data lost — volatile	Data kept — non-volatile
Operations	Read and write	Read; data cannot be changed
Access	Random — any order	Sequential (textbook)
Holds	Programs and data in use right now	Data stored permanently
Examples	Main memory of the computer	Calculators, laser printers

Both are primary memory — the CPU can access them directly.

Four types of ROM: how can you change the data?

PROM

Programmable ROM

Written only once

Use a PROM programmer (burner) — "burning the PROM". Used in video games, electronic dictionaries.

EPROM

Erasable PROM

Erased with ultraviolet light

Can be reprogrammed. Floating-gate transistors hold charge with power off.

EEPROM

Electrically Erasable PROM

Erased with electric charge

Written or erased one byte at a time — so it works slowly.

Flash ROM

a type of EEPROM

Erased & reprogrammed easily

Fastest reading of any ROM. Used in memory cards.

Flash ROM: the memory in your pocket

Used in memory cards of…

- Mobile phones
- Digital cameras
- iPods

Data moves by data cable, Bluetooth or infrared — e.g. phone → computer by cable.

Floating-gate cells

SLC Single-level Cell: stores only one bit

MLC Multi-level Cell: stores more than one byte (textbook)

`OPTIONAL MODERN NOTE` In modern terms an MLC cell holds more than one bit (usually 2).

Two kinds of flash

NAND flash

Each cell behaves like a MOSFET with two gates.

NOR flash

Writes using tunnel injection; erases using tunnel release.

CHECK FOR UNDERSTANDING

Which ROM fits the job?

A company writes a game program onto a chip once. It will never change.

A technician erases a chip under ultraviolet light, then reprograms it.

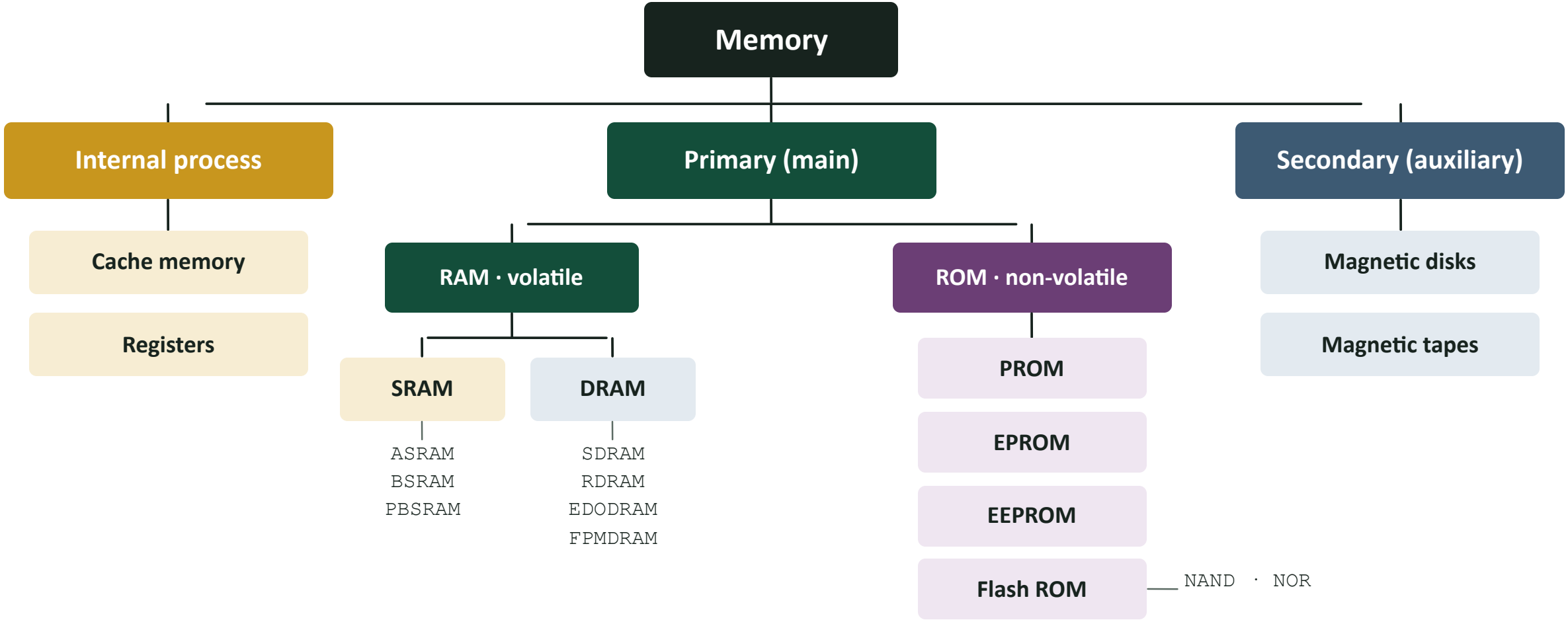
A chip is erased with an electric charge, one byte at a time.

You copy holiday photos from a camera’s memory card to a computer.

Choose from

- PROM
- EPROM
- EEPROM
- Flash ROM

The whole chapter on one map



Faster, costlier, smaller ← internal process · primary · secondary → slower, cheaper, bigger

Memory in the devices around you

TEXTBOOK

Calculator, laser printer

→ **ROM**

TEXTBOOK

Video game, electronic dictionary

→ **PROM**

TEXTBOOK

Camera / phone memory card

→ **Flash ROM**

TODAY

“8 GB RAM” on a phone

→ **RAM · primary**

TODAY

USB pen drive, SD card

→ **Flash memory**

TEXTBOOK

Hard disk in a PC

→ **Magnetic disk · secondary**

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 What two parts make up a DRAM cell? Why must it be refreshed?

06 Which SRAM type is the fastest?

07 How is data erased from EPROM? From EEPROM?

08 Name two devices that use flash ROM.

Exit ticket

Answer on a slip of paper before you leave.

1. Give one difference between RAM and ROM.

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

3. A camera memory card keeps photos with the battery removed. Which ROM type is it — and is it volatile or non-volatile?

Next lesson: storage systems — magnetic, optical and solid-state.