Computer Memory

All About Memory

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Computer Memory

Two Types

1. Volatile
2. Non-volatile

Volatile memory
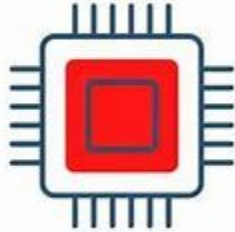
VS

Non - volatile memory

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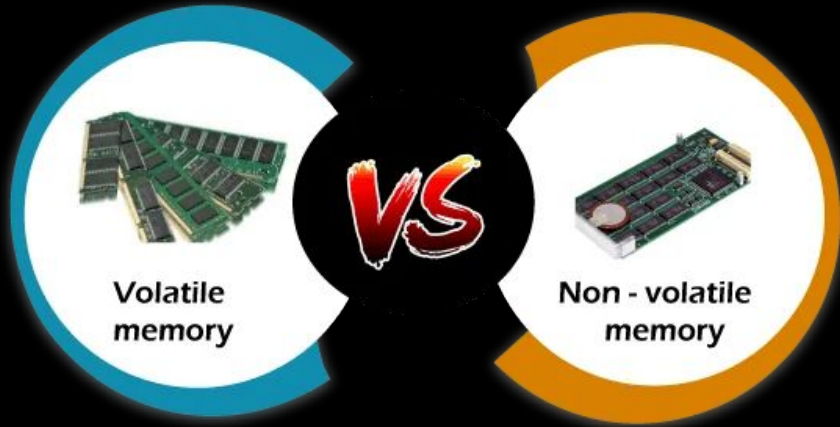
Volatile Memory

What is it

Memory whose data is lost when power is not supplied

Examples of Volatile Memory

RAM Memory

Cache Memory

www.quicklearncomputer.com

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Non-Volatile Memory

Memory that is **retained** even when power is not supplied

Examples of Non-Volatile Memory

floppy disk   compact disc   internal hard drive   external hard drive   flash drive   SD card
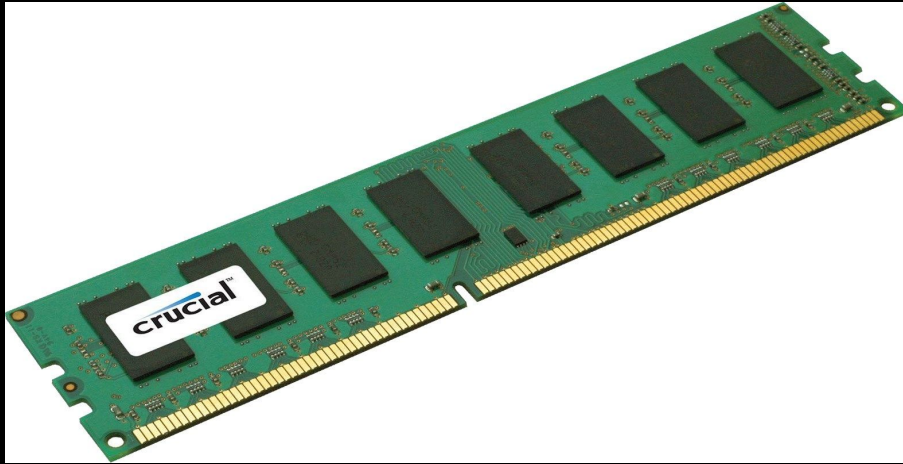
TechTerms.com

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RAM

Most important example of computer volatile memory.
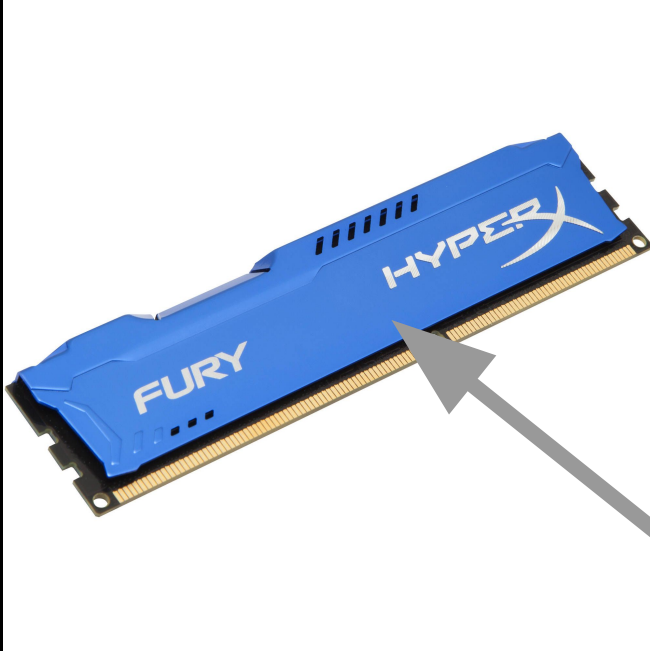
All data must be accessed via RAM.

More RAM=Faster Computer

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RAM

Also called

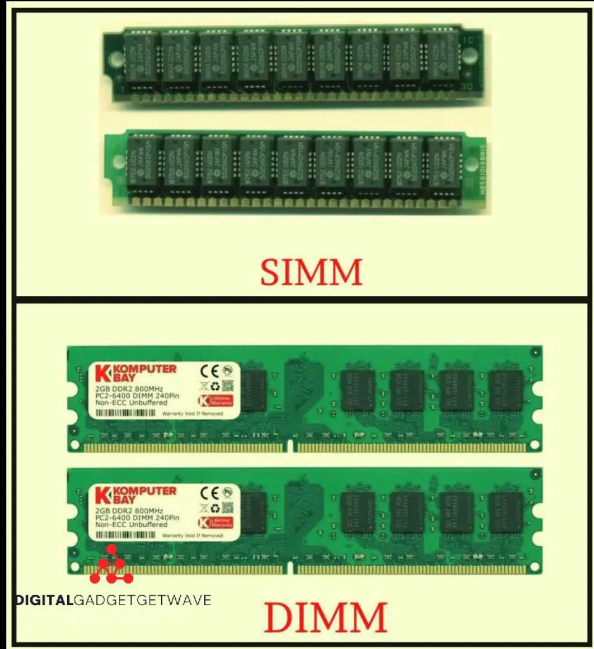**Main** Memory
Primary Memory

Heatsink

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DIMM

Dual inline memory Module

SIMM

DIMM

RAM is stored on long rectangular circuit boards called DIMMS-has gold plated contact pins on both sides while a SIMM has one per side only

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DIMM Pins Count

168
184
240
288

DDR2 DIMM – 240pin

133.35 mm

30 mm

17.8 mm

70.68 mm

10 mm

Voltage Key

Key Features
- 133.35mm x 30mm
- 240 pins
- 1.8V
- Registered/Unbuffered
- x 64 / x 72
- MO-227

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DDR DIMM – 184pin

133.35 mm

30.48 mm

17.8 mm

73.28 mm

10 mm

Voltage Key

Key Features
- 133.35mm x 30.48 mm
- 184 pins
- 2.5V
- Registered/Unbuffered
- x 64 / x 72
- MO-206
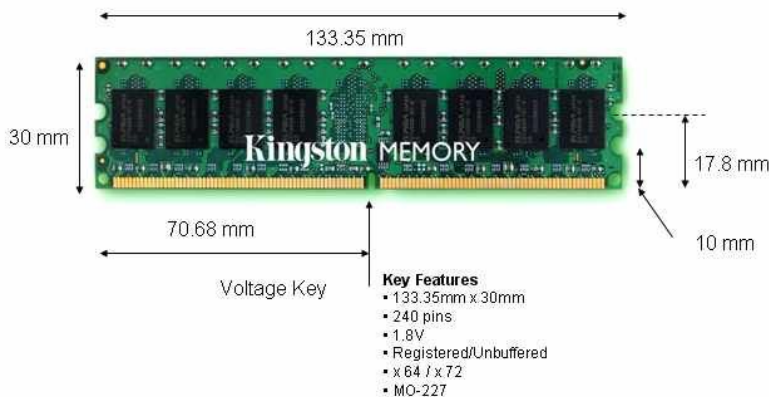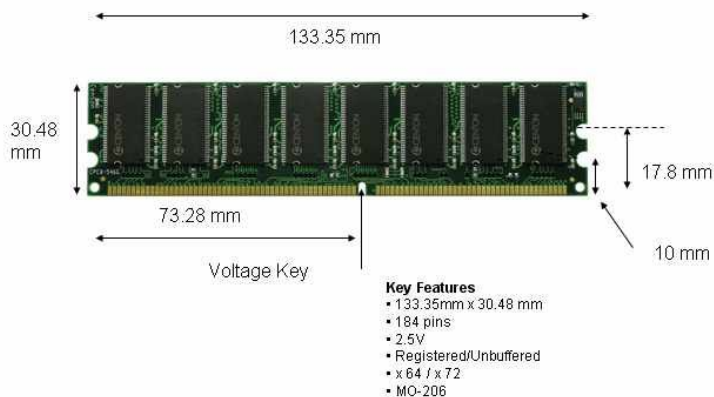
Motherboard Memory Slots

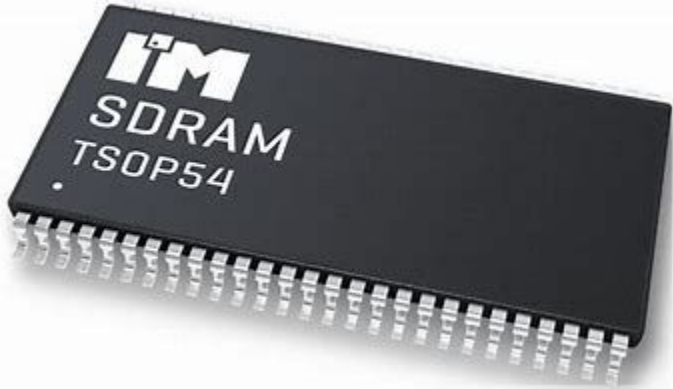You'll normally find
2-4 slots

DRAM

Dynamic RAM Type of RAM that contains capacitors to store signals and must be electrically refreshed to maintain those signals.

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SDRAM

Similar to DRAM (electrically refresh signals) but faster

Synchronous Dynamic RAM

SDRAM TSOP54

Specs

Capacity and Speed of data transfer
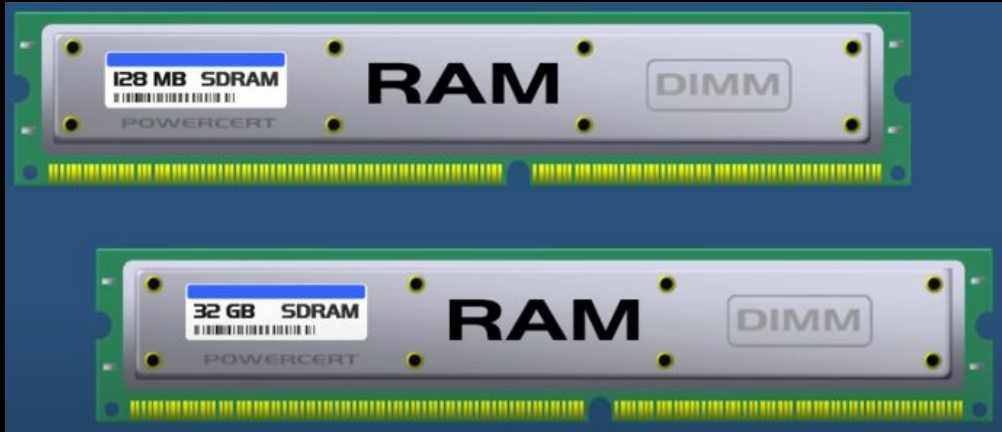
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Data Path

Refers to how many bits/bytes can be transferred into/out of RAM (Bandswidth)

DIMM
Transfers 64 bits at a time.
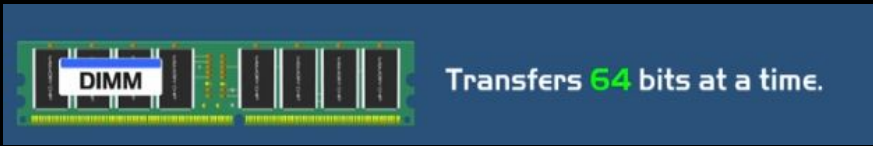
DIMMS-64 Bit(8 Byte) Wide BUS
SIMMS-32 Bit(4 Byte) Wide BUS

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Transfer/Bandwidth Speed

PC-100=
100 Mhz transfer
speed x 8 Bytes
wide bus=800MB/s

PC-100   SDRAM   256MB

Computer Memory

PC-133=133 Mhz x 8 bytes=1066 MB/s

PC-133   SDRAM   256MB

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RIMMs

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Rambus Inline Memory Module
184 pins
2 notches in centre
800 Mhz with 2 byte wide
BUS=1600 MB/s

DDR

Double Data Rate

RAM
Sends 2x data per clock signal as opposed to SDRAM
Normally labelled with clock speed and bandwidth (184 pins)

DDR-333MHz   PC-2700

2GB SDRAM   memory
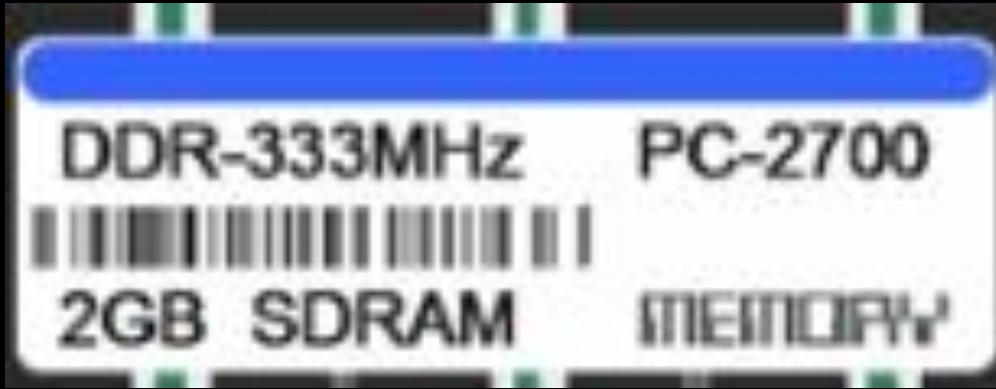
333Mhz x 8 bytes=2700 MB/s

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DDR2 Memory

DDR2-800MHz PC2-6400

2GB SDRAM MEMORY

1. Faster and uses less energy than DDR
2. 240 pins
3. 2 included in label
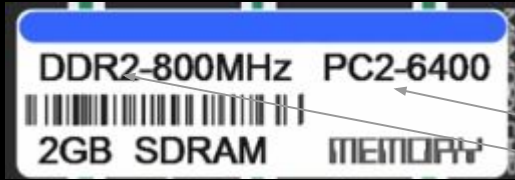
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DDR3

2x faster than DDR2.
Uses less energy.
Different notch
placement.
240 pins.
3 in name

Not cross compatible.

DDR (184 PINS)

DDR2 (240 PINS)

DDR3 (240 PINS)

DDR3-1600MHz   PC3-12800

2GB SDRAM   MEMORY

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DDR4

288 pins

DDR4-4266MHz   PC4-34100

2GB SDRAM   MEMORY
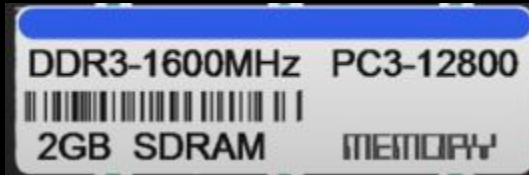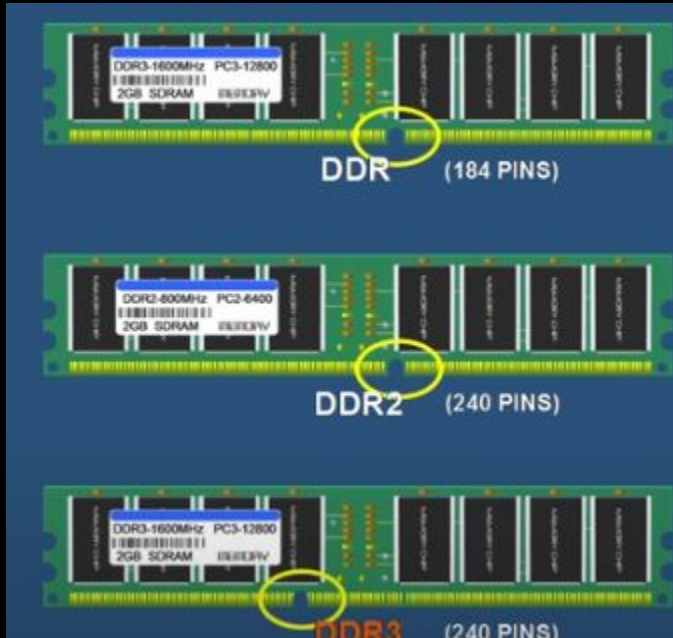
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ECC RAM

Error correction code

Memory with data loss protection.

Used in servers .
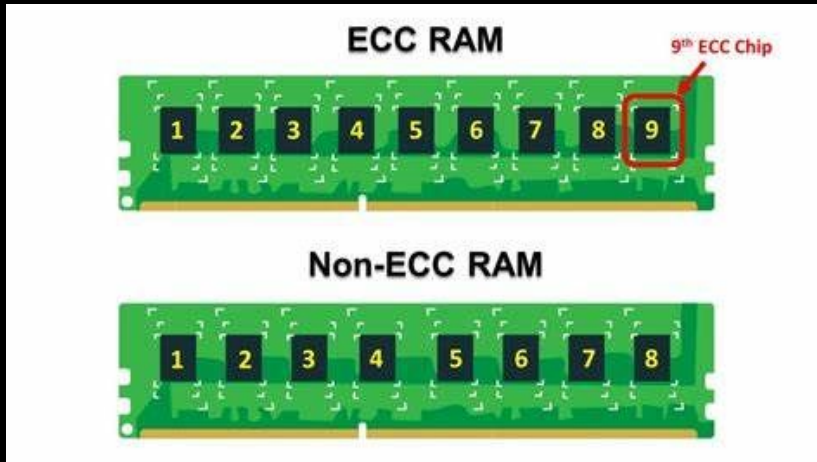
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Other Memory
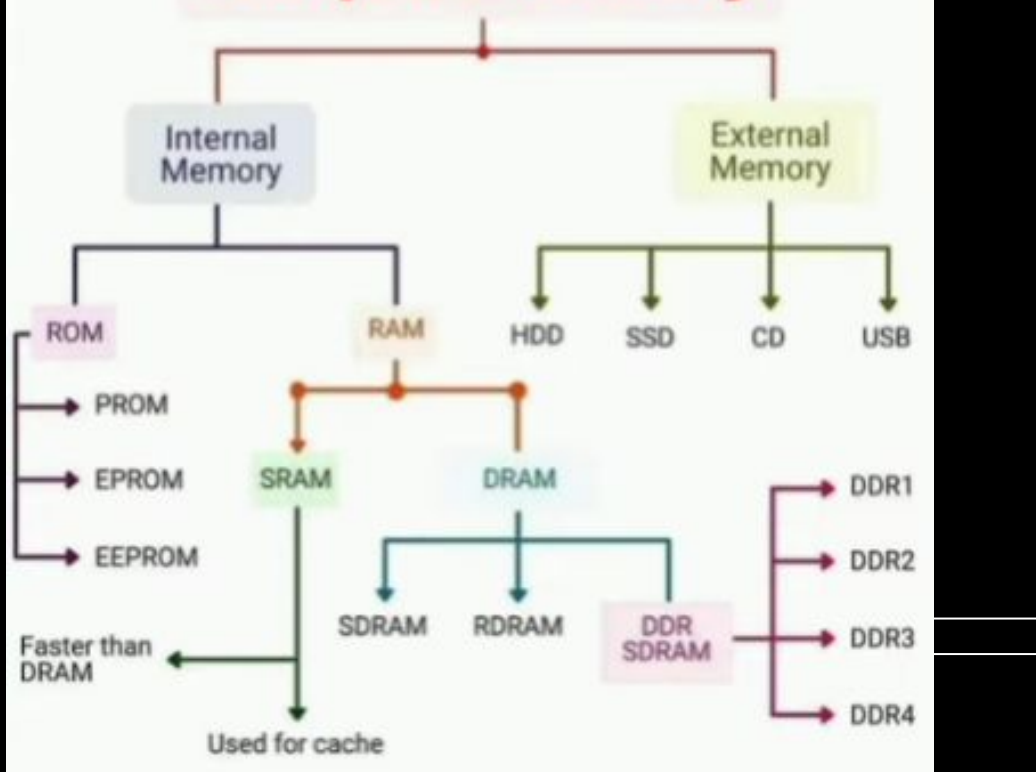
SRAM-static RAM-very fast and expensive-used in CPU cache (memory)

RDRAM-rambus dynamic RAM

ROM-read only memory

PROM-programmable once

EPROM-erasable programmable with complex time consuming process

EEPROM-electrically erasable programmable ROM

Questions and Exercises

1. Do some research on computer registers which is another form of computer memory. Compare and contrast them to cache memory.

Computer registers are ultra-fast, small storage locations within the CPU for immediate data processing, while cache memory is slightly larger and slower, acting as a bridge between RAM and the processor to reduce access time.

2. What is the difference between PROM and EPROM memory?

PROM (Programmable Read-Only Memory) is a one-time programmable memory that cannot be modified after writing, whereas EPROM (Erasable Programmable Read-Only Memory) can be erased using UV light and reprogrammed multiple times.

3. Why might one consider EEPROM a better version of EPROM?

EEPROM is considered a better version of EPROM because it can be erased and reprogrammed electrically without requiring UV light, allowing for easier and more efficient data modifications.

4. What kind of memory is the BIOS: volatile or nonvolatile? Explain.

The BIOS is nonvolatile memory because it retains stored firmware even when the computer is powered off, ensuring that essential startup instructions remain intact.

5. Describe the role of volatile and non-volatile memory in the use of an operating system.

Volatile memory, like RAM, temporarily holds active processes, applications, and OS data for fast access, while non-volatile memory, like SSDs or HDDs, permanently stores the operating system, files, and programs to ensure data persistence after shutdown.

6. Where does an application get stored when you run a program?

When you run a program, the application is loaded from non-volatile storage (HDD/SSD) into volatile memory (RAM) so the CPU can quickly access and execute it.

7. Do some research and explain why we don't just replace RAM memory with cache memory since its much faster?

Cache memory is much faster than RAM, but it is also significantly more expensive to produce and has a much smaller storage capacity due to its complex and high-speed design. Additionally, cache memory is built directly into or very close to the CPU, making large-scale replacement impractical, whereas RAM provides a cost-effective balance between speed and capacity, enabling efficient system performance without excessive costs.

8. Provide some examples of volatile memory.

Examples of volatile memory include RAM (Random Access Memory), cache memory, and registers, all of which lose their stored data when the power is turned off.

9. Provide some example of non-volatile memory.

Examples of non-volatile memory include ROM (Read-Only Memory), EEPROM (Electrically Erasable Programmable Read-Only Memory), flash memory, and hard drives (HDDs) or solid-state drives (SSDs).

10. How many memory banks do most motherboards typically have?

Most motherboards typically have 2 to 4 memory banks, allowing for multiple RAM modules to be installed and expand the system's memory capacity.

11. How is DRAM different from SRAM?

DRAM (Dynamic RAM) stores data in capacitors that need to be periodically refreshed, making it slower but more cost-effective, while SRAM (Static RAM) stores data in flip-flops and does not require refreshing, making it faster but more expensive and power-hungry.

12. Go to CPU Database | TechPowerUp and llok for the Ryzen Threadripper PRO 7995WX. Explain why you think this is a very expensive CPU? Do some research and list its current price.

The AMD Ryzen Threadripper PRO 7995WX is an expensive CPU due to its 96 cores, 192 threads, advanced 5nm Zen 4 architecture, and support for DDR5 memory and PCIe 5.0, making it ideal for high-end professional tasks, with a current price around $9,999.99.

13. Go to 7 Ways to Clear Memory and Boost RAM on Windows and explain how to free up RAM on your computer.

To free up RAM on your Windows computer, you can restart your system, close unnecessary applications, disable startup programs, clear your browser cache, adjust visual effects, increase virtual memory, or add more physical RAM if possible.

Questions and Exercises

14. What is a DIMM?
A DIMM (Dual Inline Memory Module) is a memory module with DRAM chips on both sides, allowing faster data transfer.
15. What happens if you run out of RAM? How does this affect your computer? What is the solution?
If you run out of RAM, your computer uses slower virtual memory on the hard drive, which can significantly slow down performance; adding more RAM or closing unused applications is the solution.
16. What electrical component is associated with DRAM? Why is this important in terms of how DRAM is powered?
DRAM is associated with capacitors, which require constant power to maintain the stored data, making it volatile and prone to data loss without continuous refreshment.
17. What is meant by a DIMM having a 64 bit data path?
A DIMM with a 64-bit data path means it can transfer 64 bits of data at a time between the memory module and the CPU.
18. What does the 100 in the PC-100 RAM module mean?
The "100" in the PC-100 RAM module indicates that it operates at a speed of 100 MHz.
19. Why is DDR RAM faster than non-DDR?
DDR RAM is faster than non-DDR because it transfers data on both the rising and falling edges of the clock signal, effectively doubling the data transfer rate.
20. A DDR-333MHz PC-2700 RAM has what bandwidth?
A DDR-333MHz PC-2700 RAM has a bandwidth of 2.7 GB/s.
21. A DIMM module has a clock speed of 200 Mhz and a bus width of 16 bits. What is its bandwidth?
The bandwidth of a DIMM module with a clock speed of 200 MHz and a bus width of 16 bits is 3.2 GB/s.
22. What are some differences between DDR and DDR2?
DDR2 offers faster speeds, lower power consumption, and greater bandwidth compared to DDR, but is not backward compatible with DDR.
23. What are some differences between DDR2 and DDR3?
DDR3 offers higher speeds, greater bandwidth, and lower power consumption compared to DDR2, while also having a different physical design that makes it incompatible with DDR2 slots.
24. What are some differences between DDR3 and DDR4?
DDR4 offers higher speeds, larger capacities, and lower voltage (1.2V) compared to DDR3, and features a different physical design, making it incompatible with DDR3 slots.
25. Why is ECC important is some RAM? How do you tell if RAM is ECC or non-ECC? Where is ECC memory most often used?
ECC (Error-Correcting Code) is important because it detects and corrects memory errors, improving system stability and reliability; you can tell if RAM is ECC by checking the specifications or labeling, and ECC memory is most often used in servers, workstations, and systems requiring high reliability.
26. Windows Task Manager can inform you what type of RAM you have. Go to your practice computer and bring up the Task manager. Select the Performance tab, click on Memory and list the following info: number of slots, form factor, capacity and speed of your RAM.

Questions and Exercises

27. What is the latest version of DDR Ram?
The latest version of DDR RAM is DDR5
28. What are some of its typical bandwidth?
4.8 GB/s to 8.4 GB/s
29. Visit https://www.kingston.com/en/blog/pc-performance/mts-vs-mhz. Explain MT/s as a measure of the performance of RAM.
MT/s (Mega-transfers per second) measures the number of data transfers a memory module performs per second, and it's a more accurate performance metric than MHz for DDR RAM, which transfers data twice per clock cycle.
30. Look at the tech. Specs of the following motherboard and explain 3 features with regards to its memory: https://rog.asus.com/ca-en/motherboards/rog-strix/rog-strix-b850-a-gaming-wifi/spec/
The ASUS ROG Strix B850-A Gaming WiFi motherboard supports up to 256GB of DDR5 RAM with speeds of up to 8000+ MT/s, includes 4 DIMM slots, and is compatible with both ECC and non-ECC memory, offering AMD's EXPO™ overclocking profiles for improved performance.
31. Go to the following site and describe in point form all the physical differences between DDR,DDR2,DDR3 and DD$ RAM:
https://www.szyunze.com/support/how-to-visually-distinguish-ddr-ddr2-ddr3-and-ddr4/#:~:text=%E2%96%B6%20Methods%20to%20Visually%20Distinguish,DDR2%2C%20DDR3%2C%20and%20DDR4%20Memory&text=Quick%20identification%20methods%20are%20as,It's%20quite%20intuitive!
The physical differences between DDR, DDR2, DDR3, and DDR4 RAM include variations in key notch positions, pin count (184 for DDR, 240 for DDR2 and DDR3, 288 for DDR4), module sizes, and voltage (DDR at 2.5V, DDR2 at 1.8V, DDR3 at 1.5V, DDR4 at 1.2V).