ELEMENTS OF COMPUTING 2

Assignment

**1)WHAT KIND OF MEMORY TECHNOLOGY USED IN IN REGISTERS, RAM, ROM, SECONDARY MEMORY (HARD DISK) AND CACHES?**

**REGISTERS:**

Registers are small, high-speed memory locations located in the central processing unit (CPU) of a computer system. They hold instructions and data that are currently being processed by the CPU. Registers are used to store data temporarily, typically for a few cycles of the system clock, while the CPU is working on it.

There are different types of registers used in computer architecture, including general-purpose registers, special-purpose registers, and control registers. The memory technology used in registers is typically static random-access memory (SRAM), which is a type of semiconductor memory.

SRAM is used in registers because it offers fast access times and low power consumption. SRAM is based on flip-flop circuits, which can store a single bit of data. A flip-flop circuit consists of two cross-coupled inverters that form a feedback loop. When a pulse is applied to the input of the flip-flop, the state of the flip-flop changes. The state is maintained as long as power is applied to the circuit.

SRAM has several advantages over dynamic random-access memory (DRAM), which is another type of semiconductor memory. DRAM is cheaper and denser than SRAM, but it requires periodic refreshing to maintain the stored data. This makes DRAM slower and less power-efficient than SRAM.

Registers typically use a small amount of SRAM, typically a few bytes, to store data that is currently being processed by the CPU. The size of registers varies depending on the architecture of the CPU. The data stored in registers can be accessed faster than data stored in other types of memory, such as cache or main memory.

In conclusion, registers use static random-access memory (SRAM) as the memory technology. SRAM offers fast access times and low power consumption, making it ideal for use in registers. Registers store data that is currently being processed by the CPU and provide fast access to this data. The size of registers varies depending on the architecture of the CPU, but they typically use a small amount of SRAM.

**RAM:**

RAM, or Random Access Memory, is a type of computer memory that allows data to be accessed randomly, rather than sequentially. RAM is used as the primary memory in a computer system, storing data and programs that the CPU needs to access quickly.

There are several different types of RAM technologies, including:

SDRAM: Synchronous Dynamic Random Access Memory is a type of RAM that synchronizes with the system bus, allowing it to run at higher speeds. It is commonly used in modern systems and comes in various speeds, such as DDR (Double Data Rate) and DDR2, DDR3, and DDR4.

DDR SDRAM: Double Data Rate Synchronous Dynamic Random Access Memory is a type of SDRAM that transfers data twice per clock cycle, effectively doubling its bandwidth. It is commonly used in desktop and laptop computers.

SRAM: Static Random Access Memory is a type of RAM that stores data using flip-flop circuits rather than capacitors, making it faster and more expensive than DRAM. SRAM is commonly used in cache memory, which is used to store frequently accessed data.

VRAM: Video Random Access Memory is a type of RAM that is dedicated to graphics processing. It is used to store the frame buffer, which is the image being displayed on the screen. VRAM is typically faster than system RAM and is used in high-end gaming and graphics applications.

DDR2, DDR3, and DDR4 SDRAM: These are newer generations of SDRAM that offer faster data transfer rates and improved power efficiency. DDR2 and DDR3 are still used in older systems, while DDR4 is the current standard.

HBM (High Bandwidth Memory): HBM is a type of RAM that is used in graphics cards and high-performance computing systems. It is designed to provide high bandwidth with low power consumption by stacking memory chips vertically.

Overall, the type of RAM used in a computer system depends on the specific needs and requirements of the system. Different types of RAM offer varying levels of performance, power consumption, and cost.

Manufacturers:

Only a few companies produce RAM chips, and three manufacturers account for about 95% of the market share:

Samsung,

Micron,

and SK Hynix.

cost:

Best RAM Models Price

Corsair Vengeance LPX (CMK8GX4M1D3000C16) 8GB DDR4 7th, 8th Generation Ram ₹2046

Kingston ValueRAM (KVR1333D3S9/ KVR13S9S8/4) DDR3 4GB Laptop RAM ₹1680

G.Skill Trident Z RGB (F4-3200C16D-16GTZR) 8GBx2 DDR4 Ram ₹9741

Kingston ValueRam (KVR24S17S8/8) 8GB DDR4 Laptop Ram ₹2999

**ROM:**

ROM, or Read-Only Memory, is a type of computer memory that is used to store data that cannot be altered or modified once it has been written. ROM is used to store the firmware, or low-level software, that is used to control the hardware components of a computer system.

There are several different types of ROM technologies, including:

PROM: Programmable Read-Only Memory is a type of ROM that can be programmed once by the manufacturer or user. PROM chips are programmed using a special device that burns the data onto the chip. Once programmed, the data cannot be changed.

EPROM: Erasable Programmable Read-Only Memory is a type of ROM that can be programmed and erased multiple times. EPROM chips are programmed using a special device, and can be erased using ultraviolet light. EPROMs are commonly used for firmware development and testing.

EEPROM: Electrically Erasable Programmable Read-Only Memory is a type of ROM that can be programmed and erased electronically. EEPROMs are commonly used to store system configuration data and other small amounts of data that need to be retained even when the system is turned off.

Flash Memory: Flash memory is a type of non-volatile memory that can be programmed and erased electronically. It is commonly used in USB drives, memory cards, and solid-state drives (SSDs). Flash memory is also used to store firmware in some computer systems.

Mask ROM: Mask Read-Only Memory is a type of ROM that is permanently programmed during the manufacturing process. The data is "masked" onto the chip using a photolithographic process, and cannot be changed once the chip has been manufactured.

Overall, the type of ROM used in a computer system depends on the specific needs and requirements of the system. Different types of ROM offer varying levels of flexibility, ease of programming, and cost.

**SECONDARY MEMORY (HARD DISK):**

Hard disk drives (HDDs) are a type of secondary memory used in computers to store data in a non-volatile way. HDDs use magnetic storage technology to read and write data on spinning disks called platters.

The main technology used in HDDs is magnetic recording, where data is written and read using magnetic fields. The platters are coated with a magnetic material, and the read/write heads, which are mounted on an armature, move back and forth over the platters to read and write data.

The read/write heads use magnetic fields to write data onto the platters by aligning magnetic particles in a specific pattern, and to read data by detecting changes in the magnetic fields. The read/write heads are able to access different areas of the platters by moving across them.

HDDs also use various other technologies to improve performance and reliability, such as:

S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) – a system that monitors the health of the drive and predicts when it may fail.

ECC (Error Correction Code) – a system that corrects errors that may occur during data transmission or storage.

Cache – a small amount of fast memory used to temporarily store frequently accessed data.

Spindle motor – a motor that spins the platters at a high speed (typically 5400, 7200 or 10,000 RPM).

Interface – a technology that allows the HDD to connect to the computer, such as SATA, SAS, or SCSI.

Head parking – a mechanism that parks the read/write heads in a safe position when the drive is turned off or not in use, to prevent damage to the heads or platters.

Overall, the technology used in HDDs has evolved significantly over the years, leading to increased capacity, faster read/write speeds, and improved reliability. However, HDDs are still subject to physical wear and tear, and can fail due to various factors such as shock, heat, or age.

**CACHE:**

Cache is a type of fast memory used in computers to temporarily store frequently accessed data, to improve performance by reducing the time it takes to access data from slower memory such as RAM or hard disk.

The technology used in cache memory depends on the type of cache and the specific computer architecture. There are three main types of cache:

Level 1 (L1) Cache: This is the fastest and smallest cache, typically integrated into the processor chip. L1 cache uses SRAM (Static Random-Access Memory) technology, which stores data using transistors arranged in a matrix of rows and columns. SRAM does not require a refresh cycle and can maintain data as long as it has power.

Level 2 (L2) Cache: This is a larger and slower cache, located outside the processor chip but still on the same package. L2 cache can also use SRAM technology, or it can use DRAM (Dynamic Random-Access Memory) technology. DRAM uses capacitors to store data, which require periodic refreshing to maintain their charge.

Level 3 (L3) Cache: This is a larger cache located further away from the processor, usually on the motherboard or in the CPU package. L3 cache can also use SRAM or DRAM technology.

Cache also uses various techniques to improve its efficiency and effectiveness, such as:

Associativity: This refers to how the cache maps data from main memory to cache memory. There are different types of mapping, including direct mapping, set-associative mapping, and fully-associative mapping.

Replacement Policy: This determines which data is removed from the cache when it is full and needs to make room for new data. Popular replacement policies include Least Recently Used (LRU) and Random.

Write Policy: This determines when data is written back from the cache to main memory, and whether writes are performed directly to the main memory or to a write buffer.

Overall, cache technology plays a crucial role in improving computer performance, and its design and implementation continue to evolve as computer architectures become more complex and demanding.

**2)TYPES OF REGISTER AVAILABLE**

Registers are a type of memory component used in computers to temporarily store data or instructions. They are typically very fast and are located inside the processor chip, allowing the processor to quickly access data as it performs calculations and operations.

There are several types of registers available, including:

Program Counter (PC) Register: This register stores the memory address of the next instruction to be executed in the program. The PC is automatically incremented after each instruction is executed, causing the processor to fetch the next instruction from memory.

Instruction Register (IR): This register stores the current instruction being executed by the processor. The IR contains the opcode (operation code) and any necessary operands (data or memory addresses) for the instruction.

Memory Address Register (MAR): This register stores the memory address of the data to be fetched or stored from memory. The MAR is used in conjunction with the Memory Data Register (MDR) to read from or write to memory.

Memory Data Register (MDR): This register temporarily stores the data being read from or written to memory. The MDR is used in conjunction with the MAR to access data in memory.

Accumulator (ACC) Register: This register is used to store intermediate results of arithmetic and logic operations. The ACC is typically used as the primary register for arithmetic and logical operations in the processor.

Status Register (SR): This register contains flags that indicate the current status of the processor. Common flags include the zero flag, carry flag, overflow flag, and interrupt flag.

Index Register: This register is used for indexed addressing, where the memory address of an operand is calculated by adding an offset to the value in the index register.

Stack Pointer (SP): This register stores the memory address of the top of the stack, which is used for storing and retrieving data during subroutine calls and interrupts.

Overall, registers are an essential component of computer architecture, providing fast and efficient access to data and instructions. The design and implementation of registers continue to evolve as computer architectures become more complex and demanding.

**3)INTEL-AMD, INSTRUCTION SET MANUAL:**

Intel and AMD are two major manufacturers of x86 processors, which are widely used in desktop and laptop computers. While both Intel and AMD processors use the same basic x86 architecture, they have some differences in their instruction set manuals (ISAs).

The ISA defines the set of instructions that a processor can execute, along with the encoding and semantics of those instructions. Here are some of the differences between Intel and AMD ISAs:

Extension Sets: Both Intel and AMD have added extensions to the x86 ISA over time, such as Intel's SSE (Streaming SIMD Extensions) and AMD's 3DNow! instructions. However, the specific extensions supported by each manufacturer can differ, with some instructions only being available on one platform or the other.

Floating Point Arithmetic: Intel and AMD have different ways of handling floating-point arithmetic, which can affect performance in certain applications. Intel processors use a separate set of registers for floating-point operations, known as the XMM registers, while AMD processors use a unified set of registers for both integer and floating-point operations.

Optimization Strategies: Intel and AMD may have different optimization strategies for their processors, which can affect how code is compiled and executed. For example, Intel may optimize for single-threaded performance, while AMD may optimize for multi-threaded performance.

Cache and Memory Management: Intel and AMD may have different approaches to cache and memory management, which can affect performance and power consumption. For example, Intel processors may have larger caches, while AMD processors may use a different approach to memory bandwidth management.

Virtualization: Intel and AMD have different approaches to hardware virtualization, which allows multiple operating systems to run on a single physical machine. Intel's virtualization technology is known as VT-x, while AMD's is known as AMD-V.

While there are some differences between Intel and AMD ISAs, in general, most software will run on both platforms without issue. However, software developers may need to take into account these differences when optimizing their code for maximum performance on a particular platform.