**Topic: Interrupts**

Reading Time: 15 mins

**·        Note\* Highlight important/core points while reading**

·        Read the content and write the answers given in the document in your words to get a solid grip on the topic.

**Interrupts**

Interrupts are signals sent to the CPU by hardware or software to indicate that an immediate attention is needed. Interrupts temporarily halt the CPU's current task to execute a higher-priority task. Once the interrupt is handled, the CPU resumes its previous operation.

**Categories of Interrupts**

**1. Types of Interrupts**

* **Hardware Interrupts**: Triggered by hardware devices like a printer, keyboard, or mouse.
  + **Example**: A printer signals when it is out of paper.
* **Software Interrupts**: Triggered by software programs when they require attention.
  + **Example**: A program divides by zero, causing an exception interrupt.

**2. Interrupt Process**

* **Description**: The sequence of steps taken by the CPU to handle an interrupt.
* **Working**:
  1. The interrupt signal is sent to the CPU.
  2. The CPU pauses the current task and saves its state (Program Counter and registers).
  3. The CPU identifies the source of the interrupt.
  4. The interrupt service routine (ISR) is executed.
  5. The CPU restores the saved state and resumes the interrupted task.

**3. Interrupt Priority**

* **Description**: The mechanism to determine which interrupt to handle first when multiple interrupts occur.
* **Working**:
  + Each interrupt has a priority level.
  + Higher-priority interrupts preempt lower-priority ones.
  + For example, a hardware failure interrupt is prioritized over a mouse click.

**4. Advantages of Interrupts**

* **Efficient CPU Usage**: The CPU doesn’t waste time polling for events.
* **Real-Time Responsiveness**: Ensures time-critical tasks are addressed promptly.

**5. Examples of Interrupts**

* **I/O Interrupts**: Triggered by devices like printers or disk drives.
* **Timer Interrupts**: Generated by a system timer to maintain timekeeping or task scheduling.
* **Error Interrupts**: Caused by errors like division by zero or invalid memory access.

**Interrupt Handling Process**

1. **Interrupt Request**: A signal is sent to the CPU.
2. **Pause and Save State**: The CPU halts its current operation and saves the current state.
3. **Service Routine**: The CPU executes the ISR associated with the interrupt.
4. **Restore State**: The CPU retrieves the saved state.
5. **Resume Task**: The interrupted task continues execution.

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| --- | --- |
| **Advantages** | **Challenges** |
| Allows real-time processing. | Requires efficient handling mechanisms. |
| Improves overall CPU efficiency. | High-priority interrupts can delay others. |
| Handles critical errors effectively. | Interrupt storms may overwhelm the system. |

### ****A-Rated Questions/Answers By Examiner****

**Q1**: **What is an interrupt?**

**Answer**: An interrupt is a signal sent to the CPU by hardware or software to request immediate attention and temporarily halt the CPU’s current task.

**Q2**: **How does the CPU handle an interrupt?**

**Answer**: The CPU pauses its current task, saves the state, identifies the interrupt source, executes the interrupt service routine (ISR), and then resumes the paused task.

**Q3**: **What are the two main types of interrupts?**

**Answer**: The two main types are hardware interrupts (triggered by hardware devices) and software interrupts (triggered by software programs).

**Q4**: **Why are interrupt priorities important?**

**Answer**: Interrupt priorities ensure that more critical tasks are handled first when multiple interrupts occur.

**Q5**: **Give an example of a hardware interrupt.**

**Answer**: An example of a hardware interrupt is a printer signaling the CPU when it runs out of paper.

### Write your Answers on your Notebook and Verify it on Next Screen

**Q6:** **What is the role of an Interrupt Service Routine (ISR) in handling interrupts?**

**Q7:** **How does the CPU differentiate between multiple simultaneous interrupt signals?**

**Q8:** **What is the significance of saving the CPU state during an interrupt?**

**Q9:** **Describe a real-world scenario where a timer interrupt is used.**

**Q10:** **What potential issues can arise from interrupt storms, and how can they be mitigated?**

**6. Answer:** The ISR is a specialized program executed by the CPU to address the specific needs of an interrupt, ensuring the interrupt is resolved before resuming the interrupted task.

**7. Answer:** The CPU uses an interrupt priority mechanism and a priority encoder to identify and handle the highest-priority interrupt first.

**8. Answer:** Saving the CPU state ensures that the interrupted task can resume accurately from the point it was paused, preserving system stability and continuity.

**9. Answer:** A timer interrupt is used in task scheduling within an operating system to allocate CPU time to different processes in a time-sharing system.

**10. Answer:** Interrupt storms, caused by an overwhelming number of interrupts, can overload the CPU and degrade system performance. They can be mitigated using mechanisms like interrupt throttling or masking non-critical interrupts.

### ****Kindly Write down your answers on your Note book and than verifiy it with answers given at the end****

Padma opens an application on her computer.

An interrupt is generated to inform the Central Processing Unit (CPU) that the application has been opened.

(a) Give three other examples of when an interrupt signal could be generated.

1 ...........................................................................................................................................

2 ...........................................................................................................................................

3 ........................................................................................................................................... [3]

(b) State what would happen if interrupt signals were not used in a computer.

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