Describe the concept of fault, error, and failure in the context of a computing system

* **Definition**: A fault is an underlying defect or flaw in a component of a computing system. It represents an abnormal condition that has the potential to cause an error. Faults can be hardware-related (e.g., a broken wire or a malfunctioning processor) or software-related (e.g., a bug in the code).
* **Types**:
  + **Permanent Faults**: These faults persist until they are repaired (e.g., a damaged disk).
  + **Transient Faults**: Temporary faults that occur sporadically and are difficult to reproduce (e.g., a bit flip due to a cosmic ray).
  + **Intermittent Faults**: These faults occur irregularly and can disappear on their own, making them challenging to diagnose (e.g., a loose connection that occasionally causes issues).
* **Example**: A short circuit in the power supply unit of a computer.

**2. Error**

* **Definition**: An error is the manifestation of one or more faults. It represents a deviation from the correct state or behavior within a system component. When a fault is activated, it may cause the system to enter an erroneous state, leading to incorrect data or behavior.
* **Relation to Fault**: While a fault is a cause, an error is its effect on the system. Not all faults immediately cause errors; some may remain latent until triggered by specific conditions.
* **Example**: A bit flip in memory due to a hardware fault, causing a variable to have an incorrect value.

**3. Failure**

* **Definition**: A failure occurs when the system as a whole, or a component of it, does not perform its intended function as specified. It is the observable effect when an error propagates to the system's output or affects the system’s external behavior, rendering it unable to meet its requirements.
* **Relation to Error**: A failure is the result of an error that impacts the system's operation or output, leading to incorrect results or a system crash. Not all errors lead to failures if they are detected and corrected in time.
* **Example**: A web server crashes and stops responding to user requests because of an unhandled exception caused by a software error.