CT107-3-M-DPM
Data Protection and Management

Lecture 12
Fault Tolerance

Learning Outcomes

- By the end of this lecture, you should be able to:
  - Explain what is fault tolerance and its objectives
  - Describe types of fault & fault tolerance
  - Describe fault tolerance technique and methods for data protection and management

Key terms

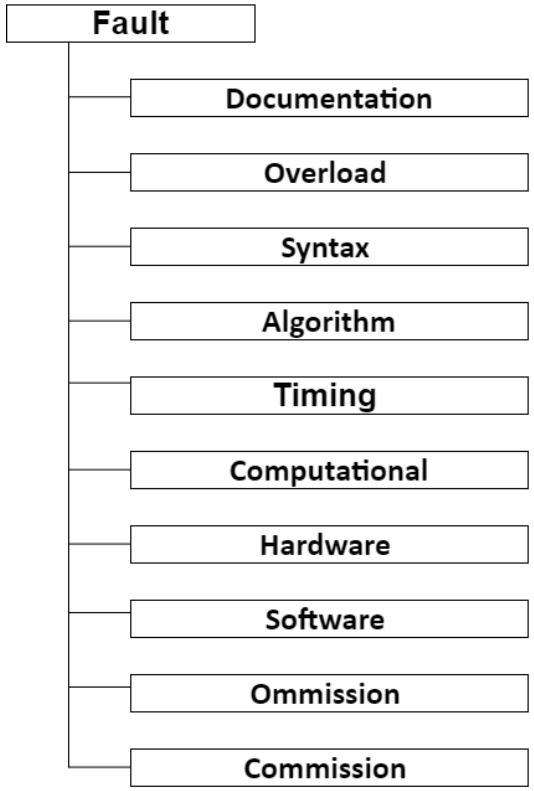
- If you have mastered this topic, you should be able to use the following terms correctly in your assignments and exams:
  - Fault tolerance
  - Hardware fault tolerance
  - Software fault tolerance
  - Cloud fault tolerance

Fault

What is fault?

"It is an improper activity in any process or data definition in information system which is accountable for unintended behavior."

Type of fault in information system



Type of fault

- **Algorithm**: Algorithm or logic does not provide the accurate result for the problem or issue.
- **Computational**: Incorrecct calculated expected result.
- **Syntax**: not following the format of command . It is depend on progamming language.
- **Documentation**: Wrong information, procedure or guideline in the documentation.
- **Overload**: Memory is used beyond the capacity of memory space.

Type of fault

- **Timing**: System is not responding in the expected time.
- **Hardware**: Hardware is not responding according to the request and specification.
- **Software**: Software is not compatible with the operating system.
- **Omission**: When the crucial feature is absent in coding e.g. Varible not declared but were used as crucial feature.
- **Commission**: Usage of wrong statement of expression, i.e. integer is initialized with float.

Discussion

Provide an example for each type of fault and apply it to a real world scenario.

Fault Tolerance

How do you explain about FAULT TOLERANCE?

Fault Tolerance

Definition

Ability of a system (e.g. hardware, software, network, physical servers, cloud servers and etc.) to remain functioning without intermission when one or more of its components fail.

Objective

Is to avoid interruption arising from a failure, guaranteeing the high availability and business continuity.

Technique

Usage of redundant component or object that automatically replace the failed components, making sure no loss of service.

Fault Tolerance vs. High Availability

Fault tolerance is the ability for a system to continue working without interruption during any system components failure.

High availability denote to a system's capability to evade heavy loss of business or profit by zerorizing downtime. That means a system maintain high percentage (ideal situation is 99.999%) of uptime.

Fault tolerance – NO DOWNTIME – ideal uptime 100%

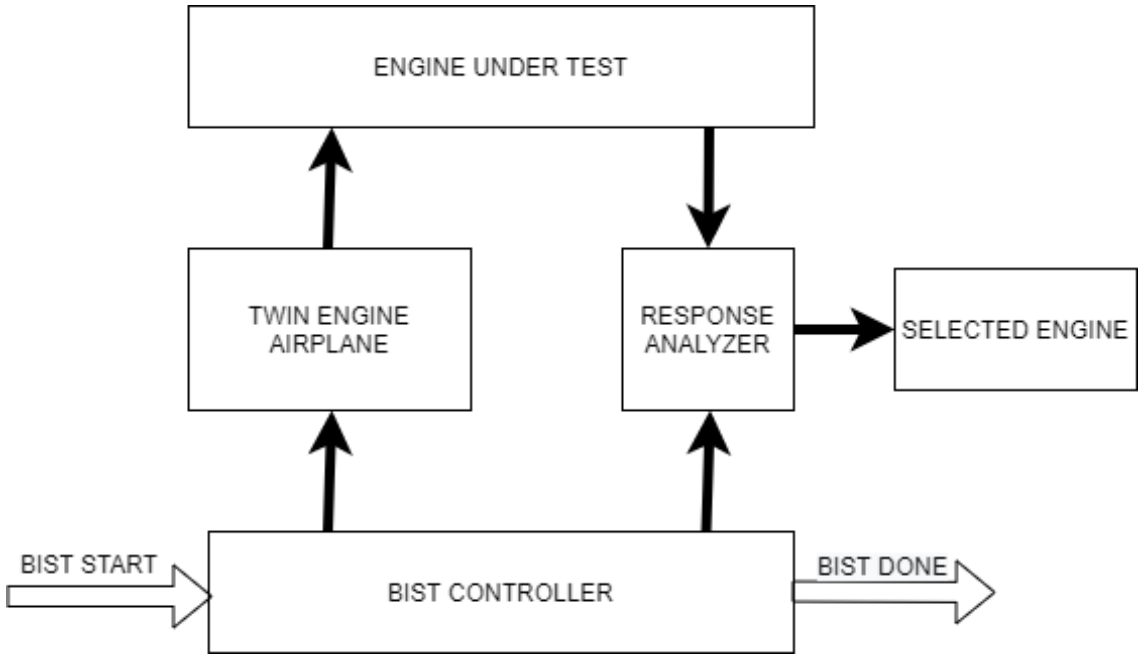
High Avaiability – Have some DOWNTIME but keep minimum Ideal uptime 99.999%

Fault-tolerance Techniques

- Have two levels
  - Hardware fault tolerance
  - Software fault tolenrance
- Hardware fault tolerance is much more easier to deal with than Software fault tolerance.
- Fault-tolerance techniques need extensive knowledge and experiences, of the systems and their functioning. Deployment may involve enormous costs and time.
- It also increase or decrease the size, weight, and design of the system depending on the complexity involved.

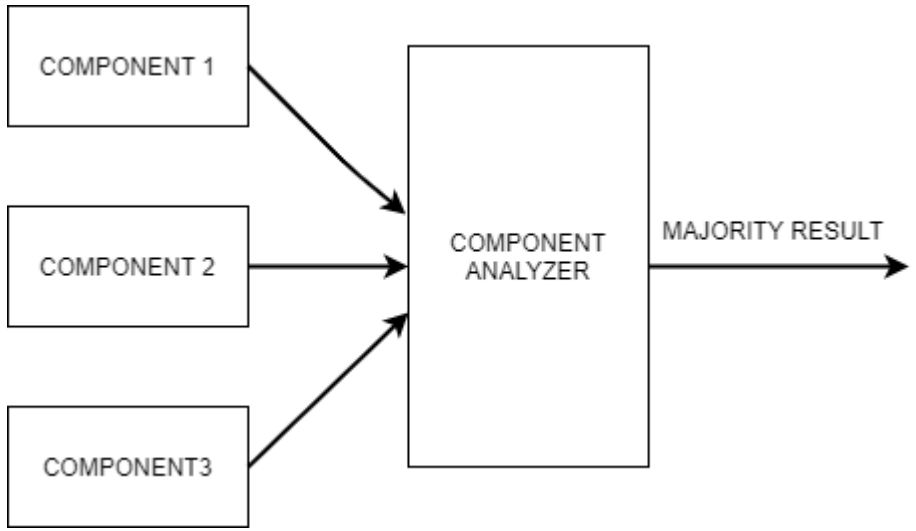
Hardware Fault Tolerance Technique

- BIST (Build in Self-test)
  - This technique permits the system to execute automated self-checking at specific intermissions to identify, measure and trace any faulty propagations. Every time when it trigger any fault, the system automatically stop the services and start the redundant component. (e.g. A twin-engine airplane - when one of the engine fails, the other one will automatically switch on, letting the plane to continue flying



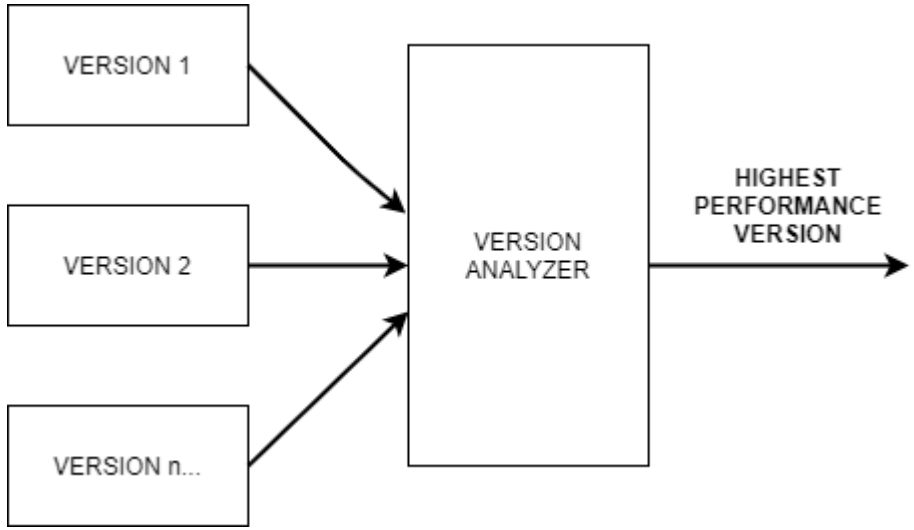
Hardware Fault Tolerance Technique

- TMR (Triple Modular Redundancy)
  - Three redundant component copies of faulty component are generated (from different suppliers) and concurrently tested. Component analyzer will evaluate the performance and the majority result are selected.



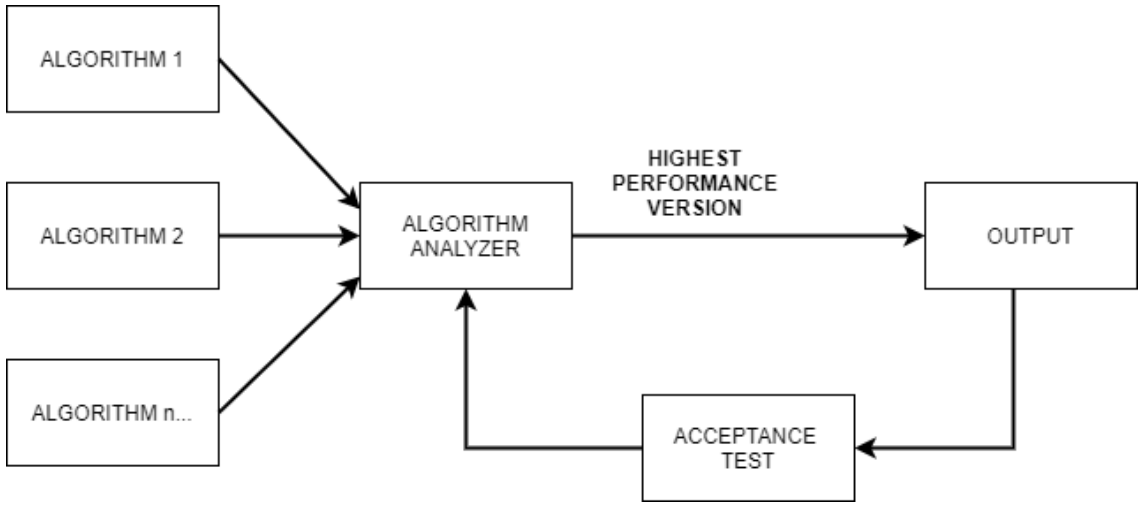
Software Fault Tolerance Technique

- N-Version Programming
  - During implementation (coding) stage multiple (n) versions of a program are developed by different developers. All these copies are executed instantaneously, and select the highest fault tolerance.



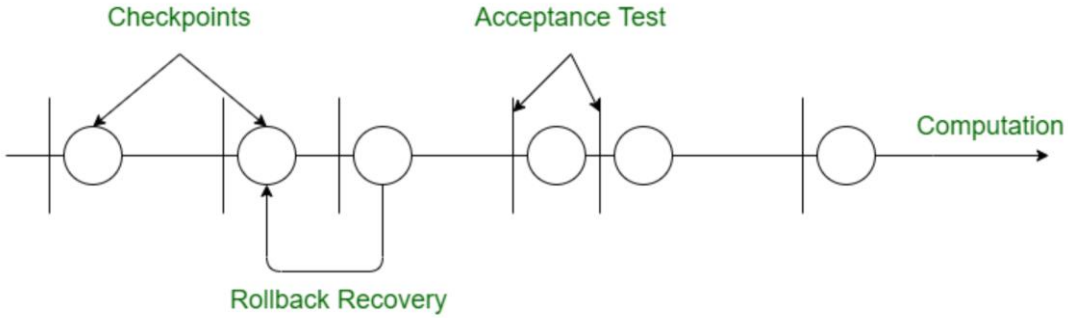
Software Fault Tolerance Technique

- Recovery Blocks
  - This technique, the redundant copies will use different algorithm for the same purpose. Then it will execute the redundant copies individually (one-by-one). It is time consuming.



Software Fault Tolerance Technique

- Check-pointing and Rollback Recovery –
  - With this technique, the system is tested each time when performing some calculation. This technique is suitable when checking processor failure or data corruption.

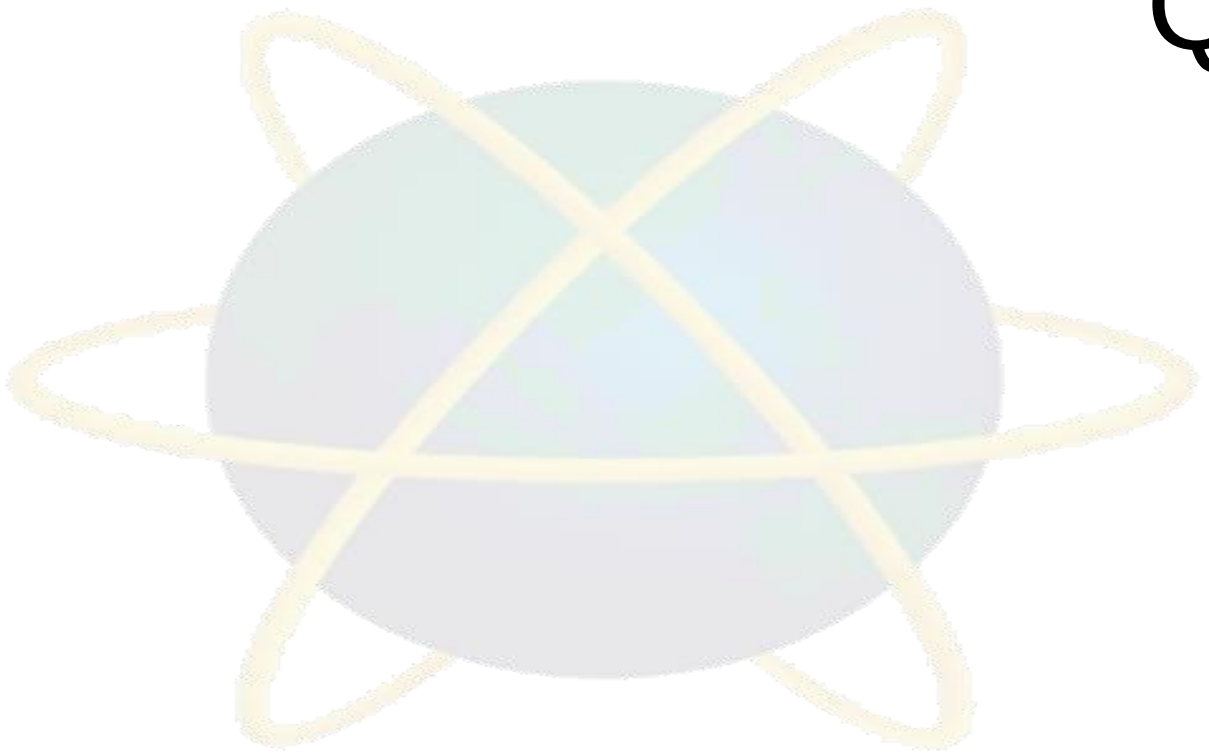


Source: https://www.geeksforgeeks.org/fault-tolerance-techniques-in-computer-system/

Summary

- Type of fault
- Fault tolerance
- Hardware fault tolerance
- Software fault tolerance

Q&A



Next Session

- Data deduplication in Data Backup