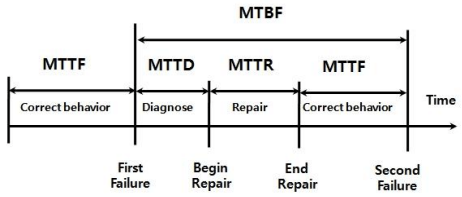
Graduate Operating Systems
(Storage & File Systems)

Fall 2020

Paper "Reliability Issues"

- Survey article
- Reliability vs. reliance
- Reliability & fault tolerance
- **Fault -> Error (state) -> Failure (event)**
- MTBF (MTTF), MTTR, MTTDL, Availability



Paper "Reliability Issues"

- *Can you think of a fault-error-failure example?*
- Repair of error vs. repair of fault
- Error detection & error recovery
- *How are parity bits used for detection/recovery?*

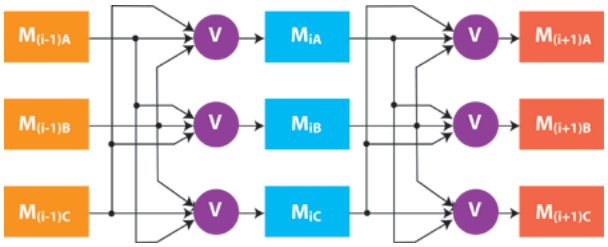
Paper "Reliability Issues"

- Faults:
  - HW, communication, timing, design, …
  - Duration: permanent, transient
  - Extent: localized, distributed
  - Value: fixed, varying erroneous values
  - User error
    - *What can we do to handle user errors?*

Paper "Reliability Issues"

- Fault tolerance vs. fault avoidance
  - *Examples of fault avoidance?*
  - *Examples of fault tolerance?*
- Replication
- *What are atomic actions?*
- Levels of abstractions; interfaces
- Error detection
  - "Sanity check"
  - Consistency check (replication, TMR)
    - *What assumption do we need to make about modules in TMR?*
  - Reversal check
  - Coding (CRC, parity, Hamming, etc.)
  - Interface checking
  - Diagnostic checking

Paper "Reliability Issues"



Triple Modular Redundancy (TMR)

Paper "Reliability Issues"

- Fault treatment
  - Transient faults
  - Finding faults
  - Fault injection
  - Replacement and reconfiguration strategies
  - *What is "graceful degradation"?*
- Damage assessment
- Error recovery
  - Backward error recovery
  - Forward error recovery
  - *Pros/cons of backward & forward recovery?*

Summary "Reliability Issues"

- Fault, error, failure
- Detection errors and recovering from errors
- Redundancy, reconfiguration, backward/forward recovery, …
- Different stages of "handling" errors/failures:
  - Design of system
  - Development of system
  - Testing of system
  - Operation of system
- Real-time systems: not just functionality, but also timing critical!