

# FAULT TOLERANCE

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# Fault Tolerance

- the main objective of designing a fault tolerance system is to insure that the system operate correctly even in presence of faults.

# Component faults

- **The computer is made up of :**
  - Hardware components :processors , memory , I/O devices .
  - Software components : OS , application programs m database .
- Distributed system made up of independent computers connected over the network , can fail due to fault in any of hardware components or software components .

# Component faults : faults classification

- Transient faults
- Intermittent faults
- Permanent faults

# Faults classification :

## Transient faults

- Can occur suddenly , disappear , and may not occur again if the operation is repeated .
- For example ,during heavy traffic condition in network , a telephone call is misroute but if call is retried ,it will reach destination correctly .

# Component faults : faults classification

- Transient faults
- **Intermittent faults**
- Permanent faults

# Faults classification :

## Intermittent faults

- These faults occur often , but may not be periodic in nature .
- For example , the loose connection to network switch may cause intermittent connection problems .such faults are difficult to diagnose. During debugging process , it is possible that the fault may not be detected at all.

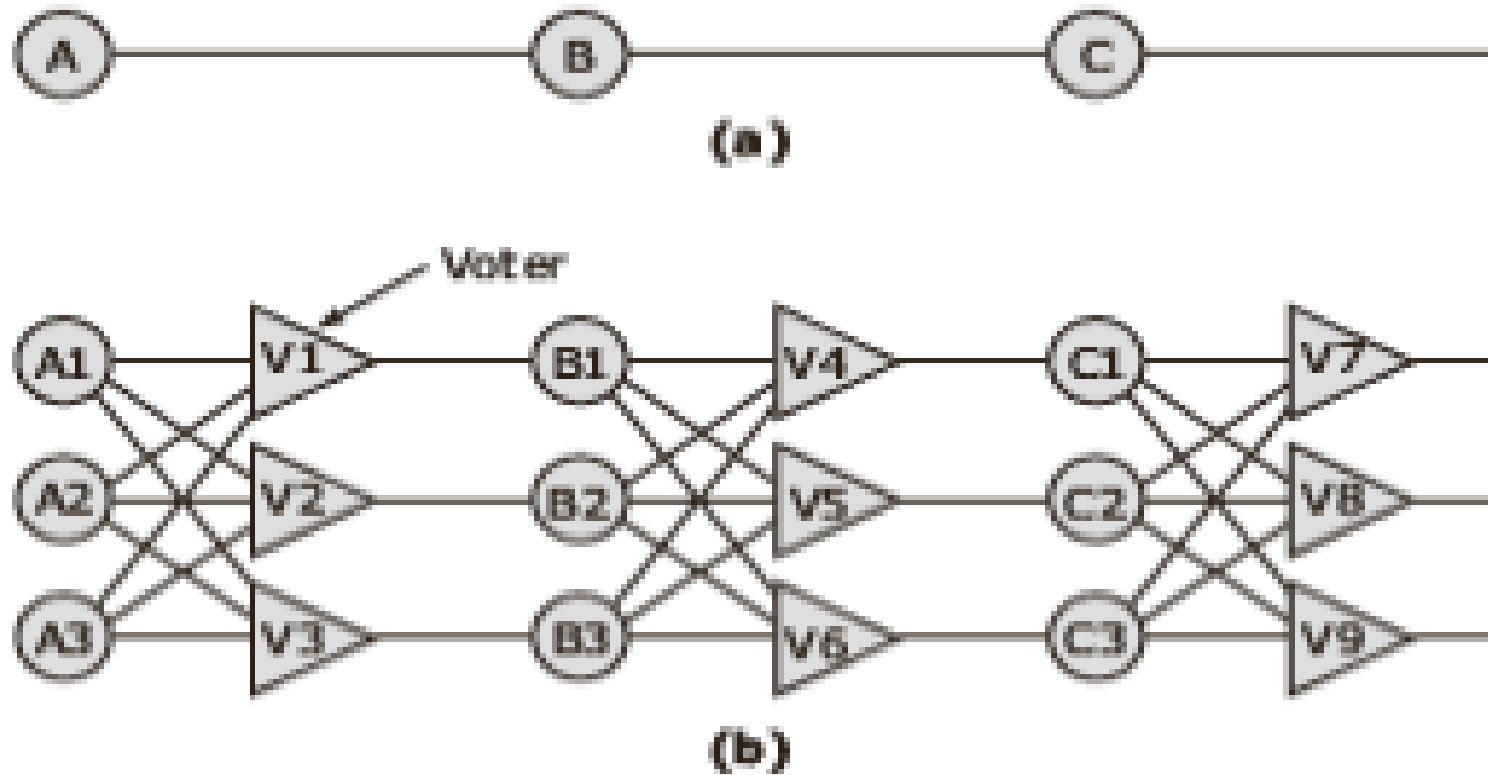
# Component faults : faults classification

- Transient faults
- Intermittent faults
- **Permanent faults**



# Active replication-1

- State machine approach



(TMR -Triple Modular Redundancy)

# Active replication-2

Failed component	Voter's inputs	Status of the voters	Fault masking procedure
A2	V1, V2,V3, two good inputs and one bad input	Correct state	A2 failure is masked. B1, B2 and B3 are such that no fault has occurred
A2, B3, C1	A1: V1, V2, V3 have two good inputs and one bad input	Each stage masks the failure	At each stage, one input is incorrect; fault is masked by three voters
V1	B1 is wrong. B2 and B3 are correct	V4,V5, and V6 are correct	V1 is again masked by other voters

(TMR -Triple Modular Redundancy)

# Primary backup

- Uses two machines :
  - Primary and backup
- Uses limited number of messages such that these messages go only to the primary server and no ordering is required