Fault-Tolerant Computer System Design
ECE 60872

Putting it All Together

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What We Learned

- Fault tolerance techniques
  - Within a node
  - Across nodes
- Fault tolerance techniques
  - Techniques in different levels of the software stack
  - Techniques in hardware
- How to evaluate fault tolerance techniques
  - Combinatorial modeling
    - Series-parallel systems
    - Non-series-parallel systems
  - Stochastic modeling
    - Continuous distributions
    - Markov modeling
    - Stochastic Activity Networks

Techniques We Learned Within A Node

- Coding (in hardware)
- Multi-version programming (in software)
  - N-Version Programming
  - Recovery Blocks
- Robust data structures (in software)

Techniques We Learned Across Nodes

- Within Local Area Nodes
  - Static redundancy or error masking
  - Dynamic redundancy – detection and reconfiguration
  - Process pairs
- Within Wide Area Nodes
  - Replicated processes
    - Broadcast
    - Agreement
    - Checkpoint and recovery
  - Replicated data
    - Active and passive replication
    - Optimistic and pessimistic replication

Techniques about Using Big Data for Dependability

- Adversarial ML attacks
  - Evasion attacks
  - Poisoning attacks
- Defenses
  - Adversarial example detection
  - Metrics for success
- Securing interdependent systems
  - Security investments with cognitive biases
  - Human subject experiments
- Distributed ML security
  - Federated learning: Attacks
  - Federated learning: Defenses