Recitation 02/12: Consistency, Availability and Fault Tolerance

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Distributed Systems

• Nodes connected by links
• What is a node?
• Nodes can act independently, fail independently
• What is a failure?
• What is a system?
• Hiding distribution from the external world
Why do we build systems?

• **Availability**
  • Single most important goal – responsive to clients, other systems and internal components
  • Measure (in %) – The fraction of time a system is available
  • Availability is with the constraint of being consistent

• **Consistency**
  • Systems maintain state and respond to queries based on the state
  • State should be consistent, State and data should not be lost
  • Different interpretations
    • Preserve system guarantees, protect against hazards in critical systems
Failures complicate Availability and Consistency

• Recap – We discussed how nodes can fail and then we discussed our goals of availability and consistency

• How common are some of these failures?
  • Failures every 8 hours in a Google service
  • Probability of any one node failing is high in a big datacenter

• Failures can compromise availability

• Failures can compromise consistency
Consequences of losing availability & consistency

• Availability – You built the system to be available, right?
  • Services can lose millions of dollars if they’re unavailable
  • Unavailability can drive users away
  • five-nines availability

• Consistency – What’s the point if it’s not consistent?
  • System can become non-operational
  • Real-world impact – loss of lives, property
Fault tolerance – Central problem in Distributed Systems

• “Availability and Consistency despite failures”

• Some examples of fault tolerance in real-life:
  • Applying to multiple schools
  • Producing multiple kids (in old times)
  • Portfolio diversification

• Strategies for fault tolerance
  • Replication
CAP – Trade-off b/w consistency and availability in cases of limited failures

• By Eric Brewer, C – Consistency, A – Availability, P – Partition tolerance
• Easy to see that failures can impact A & C
• CAP stresses on the trade-off between maintaining one over the other during failures
• It is a rule of thumb
• What is partition tolerance?