15-440 Recitation 7: The CAP Theorem

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Outline

• Questions on Part 3?
• The CAP Theorem
Acids and Bases

- Classical Distributed systems: ACID semantics
  - Atomic
  - Consistent
  - Isolated
  - Durable

- Modern Internet systems: BASE semantics
  - Basically Available
  - Soft-state
  - Eventually consistent
Consistency matters

- (example)
Availability matters

• Amazon being down for 1 minute = loss of $10,000 in revenue
Partitions happen

• In the Internet

• (prefix hijacking, fiber line cuts, etc.)

• Even in datacenters

• Google, Amazon report network partitions
Can we have it all?

- Strong Consistency
- High Availability
- Partition Tolerance
The CAP Conjecture

• Eric Brewer at Berkeley made the CAP conjecture in 2000

• Conjecture: you can have only two of the three properties
Consistency and Availability

- Examples include:
  - Tightly coupled clusters, databases
  - 2PC, cache consistency protocols abound
Consistency and Partition Tolerance

- Distributed databases, locking, quorums
- Techniques:
  - Strict locking
  - Partitions with minority don’t work
Availability and Partition Tolerance

• Design of many internet services

• Examples: DNS, caches, large-scale key-value stores

• Use TTL/state for eventual consistency, out-of-band conflict resolution
CAP Theorem

- Proven in 2002 by Seth Gilbert, Nancy Lynch

- We’ll go over a part of the proof
In reality

• Systems are a neutral mix of ACID and BASE
• ACID *required* for monetary transactions
• BASE for things like shopping cart, DNS