

Introduction to Distributed Systems

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CS554: Data-Intensive Computing
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Logistics

- Reading assignment (will be covered on Quiz #1)
 - Foreward, by Gordon Bell
 - http://research.microsoft.com/en-us/collaboration/fourthparadigm/4th_paradigm_book_gordon_bell_foreword.pdf
 - Jim Gray on eScience: A Transformed Scientific Method
 - http://research.microsoft.com/en-us/collaboration/fourthparadigm/4th_paradigm_book_jim_gray_transcript.pdf
- NO CLASS on 01/19/2015
- Quiz #1 on 01/21/2015
- Office hours rescheduled today to 5PM-9PM
- Schedule to be posted at:
 - <http://www.cs.iit.edu/~iraicu/teaching/CS554-S15/>
- Piazza discussion forum at:
 - <https://piazza.com/iit/spring2015/cs554/home>

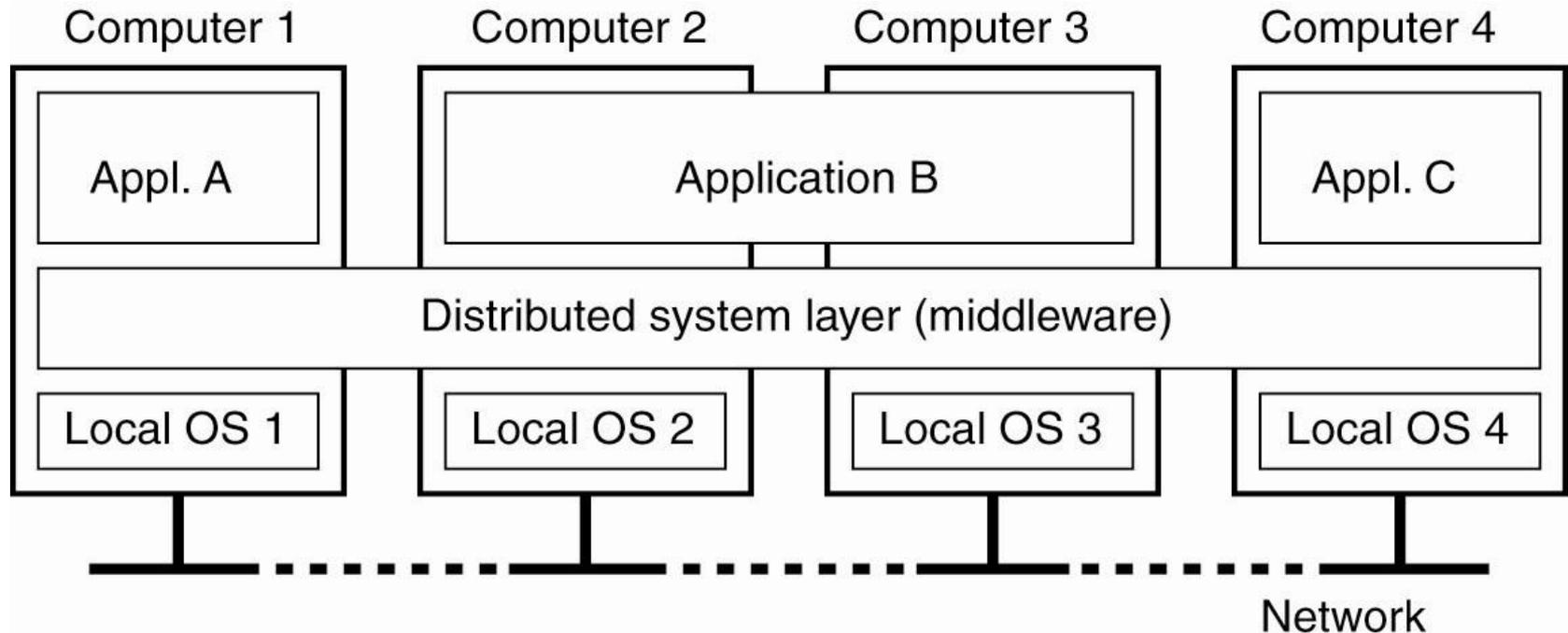
Distributed Systems

- What is a distributed system?

“A collection of independent computers that appears to its users as a single coherent system”

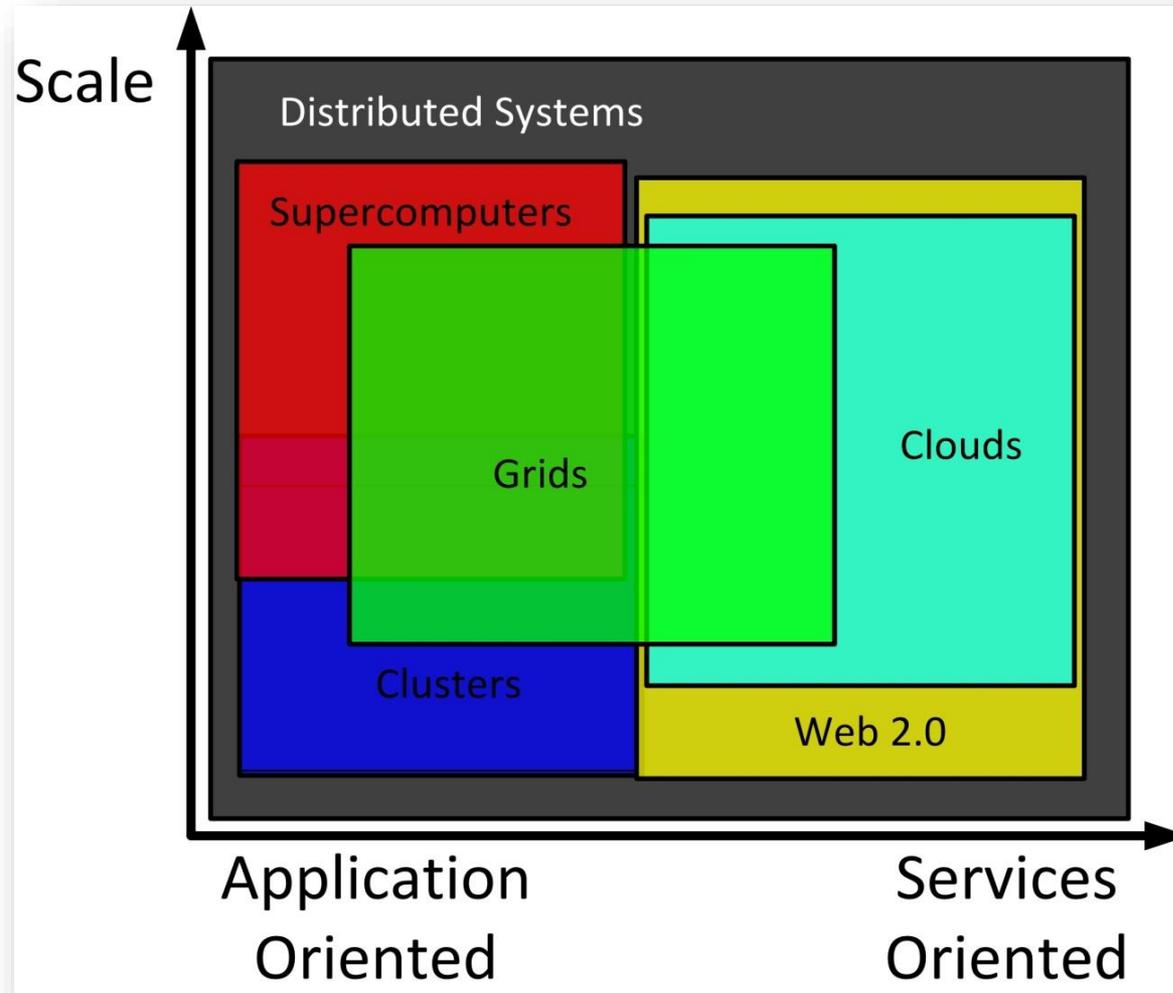
-A. Tanenbaum

Distributed Systems

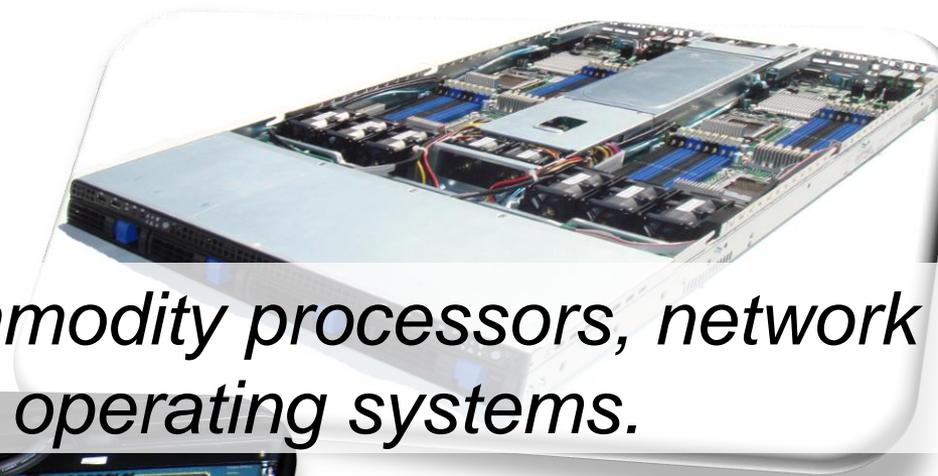


A distributed system organized as middleware. The middleware layer extends over multiple machines, and offers each application the same interface.

Distributed Systems: Clusters, Grids, Clouds, and Supercomputers



Cluster Computing

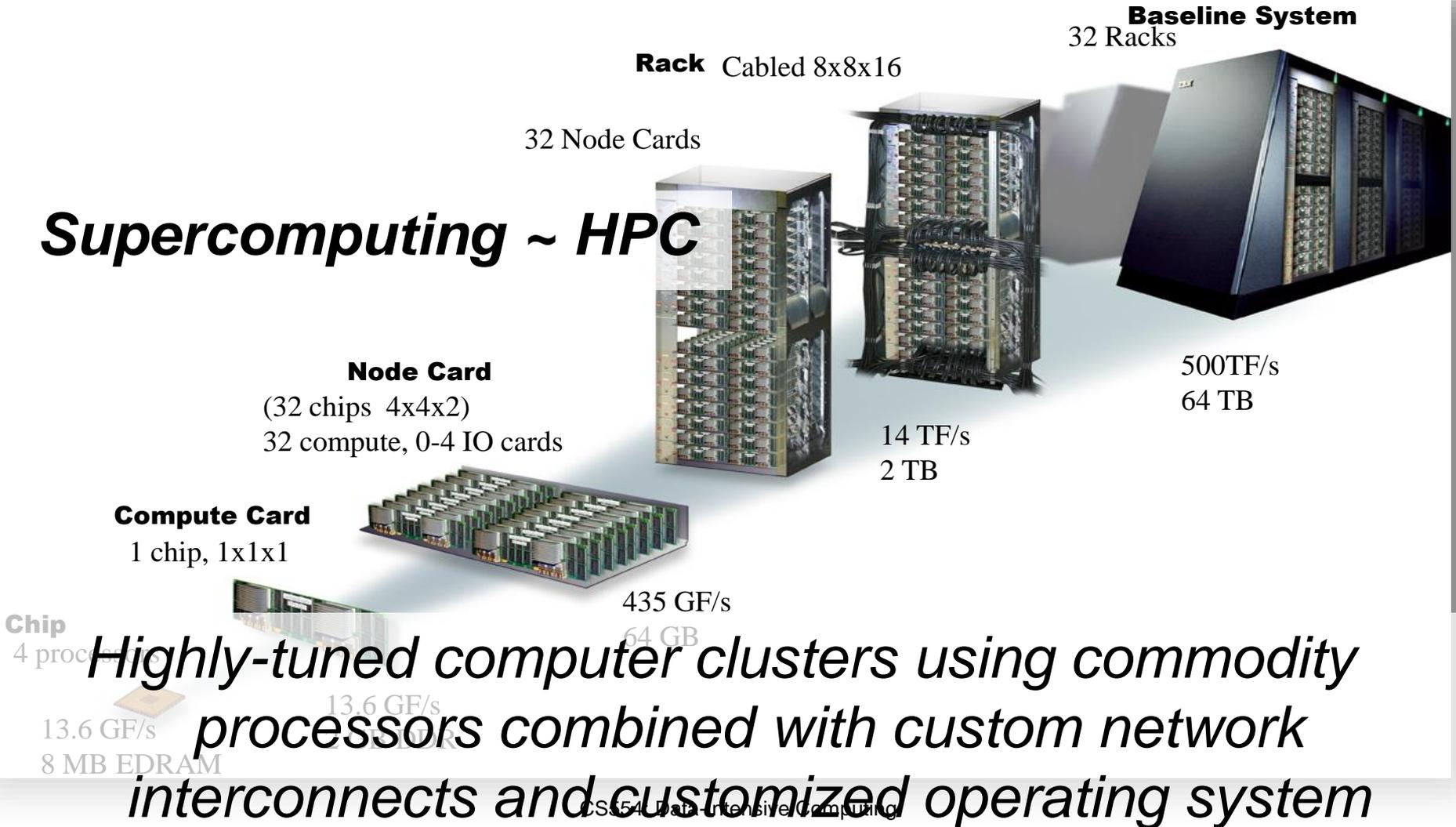


Computer clusters using commodity processors, network interconnects, and operating systems.



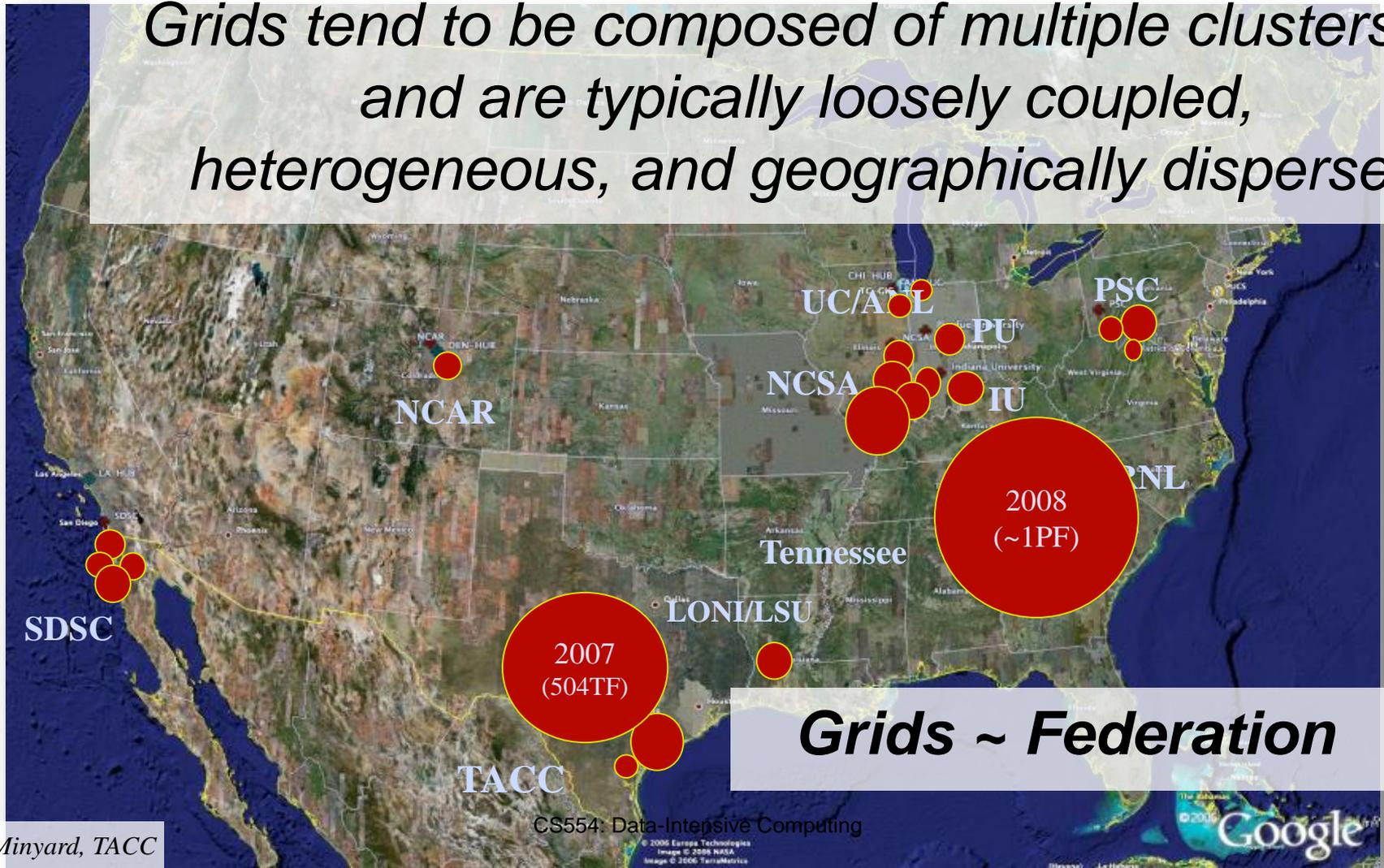
Supercomputing

Supercomputing ~ HPC



Grid Computing

Grids tend to be composed of multiple clusters, and are typically loosely coupled, heterogeneous, and geographically dispersed



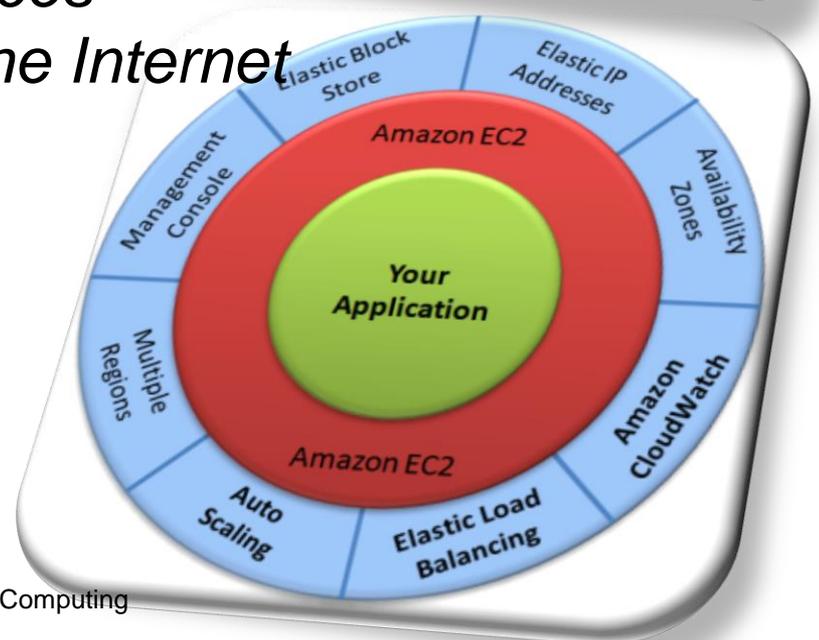
Grids ~ Federation

Cloud Computing

- *A large-scale distributed computing paradigm driven by:*
 1. *economies of scale*
 2. *virtualization*
 3. *dynamically-scalable resources*
 4. *delivered on demand over the Internet*



Clouds ~ hosting



Key Characteristics of Distributed Systems

- Support for resource sharing
- Openness
- Concurrency
- Scalability
- Fault tolerance (reliability)
- Transparency

Concurrency

- In a single system several processes are interleaved
- In distributed systems: there are many systems with one or more processors
 - Many users simultaneously invoke commands or applications
 - Many servers processes run concurrently, each responding to different client request

Scalability

- Scale of system
 - Few PCs servers ->dept level systems->local area networks->internetworked systems->wide area network...
 - Ideally, system and application software should not change as systems scales
- Scalability depends on all aspects
 - Hardware
 - Software
 - networks

Fault Tolerance

- Definition?
- Two approaches:
 - Hardware redundancy
 - Software recovery
- In distributed systems:
 - Servers can be replicated
 - Databases may be replicated
 - Software recovery involves the design so that state of permanent data can be recovered

Pitfalls When Developing Distributed Systems

- False assumptions made by first time developer:
 - The network is reliable.
 - The network is secure.
 - The network is homogeneous.
 - The topology does not change.
 - Latency is zero.
 - Bandwidth is infinite.
 - Transport cost is zero.
 - There is one administrator.

Questions

