

# CSCI 251: Concepts of Parallel and Distributed Systems

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## Cloud Computing

Cloud computing defines a mechanism for hosting and delivering services to applications over the Internet. Cloud services are sold on a “pay as you go” model to give the perception of infinite computing resources. Services typically offered are storage and processing. The cloud consists of a data center’s hardware and software.

### Services

A service is self-contained functional unit that accepts request and returns responses through a well-defined interface. They can be globally distributed across organizations and are typically reuseable. Examples:

- Find account balance
- Credit card validation
- Account lookup

### Definitions

Grid Computing:

- For non-interactive but intensive workloads
- The computers are interconnected over the network, possibly remotely
- Middleware-based approach

- Started by the High Performance Computing community

Cluster Computing:

- Loosely or tightly connected computers in a fast local area network
- Each node in the cluster uses similar hardware, OS, and software

Cloud Computing:

- Provides on-demand network access to a shared pool of computing resources
- Computing resources can be quickly commissioned or decommissioned
- Greater flexibility
- Started by the business community

SaaS: Software as a Service

IaaS: Infrastructure as a Service

PaaS: Platform as a Service

## **Cloud Computing's Motivation**

Cloud computing provides a way to save in capital costs through on-demand operational costs. It provides a robustness to failure and allows for complex resource requirements.

## **Eucalyptus Architecture**

Elastic Utility Computing Architecture for Linking Your Program To Useful Systems

- Allows sites with existing clusters to host a cloud that is interface compatible with Amazon's AWS.
- Enables users to explore new cloud computing functionality with no impact on their existing application development software.

## **Commercial Products**

- Amazon EC2
- Windows Azure
- Google App Engine
- Dropbox (wtf for real my dude?)

## Research Challenges

- Automated service provisioning
- Virtual machine migration
- Server consolidation
- Energy management
- Traffic management and analysis
- Data security
- Software frameworks
- Storage technologies and data management
- Novel cloud architectures

## Virtualization

Virtualization is a computer architectural technique where multiple virtual machines take turns to use the same hardware architecture. Hardware or software resources can be virtualized. Virtualization enhances resource sharing and improves computer performance, resource utilization, and application flexibility.

## Virtualized Systems

Traditionally, computers run with an operating system that was specially tailored for its hardware architecture. In a virtualized system, one or more guest operating systems run on the same hardware. A virtualization layer known as the hypervisor or virtual machine monitor separates the host system from the virtual ones.

The operating system is an abstract layer created between the host OS and the user applications. Virtualization layers live inside the OS, where resources are partitioned. Virtual machines at the OS level have minimal startup/shutdown costs, low resource requirements, and high scalability. Synchronizing state changes is possible when needed. The only disadvantage is the all virtual machines must run on the same OS.

## Reminders

Project 2 details. Let Professor Kumar know if you are working solo or in a group by Monday, November 20th.

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