



ÅBO AKADEMI UNIVERSITY

CLOUD COMPUTING

Assignment 6



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Question 1

What are the main advantages and challenges of cloud computing?

- **From an end-user point of view**
- **From a cloud service provider point of view**

The main advantages of cloud computing from an end-user point of view are:

- Cost efficiency
- Accessibility
- Security
- Reliability
- Performance predictability
- Operational efficiency
- Rapid and flexible deployment
- Compatibility

The main challenges of cloud computing from an end-user point of view are:

- Vendor lock-in
- Data transfer Bottleneck
- Data security and protection
- Interoperability
- Internet connectivity

The main advantages of cloud computing from an cloud service provider point of view are:

- Scalability
- Elasticity

The main challenges of cloud computing from an cloud service provider point of view are:

- Energy and Heat
- Data security and protection
- Financial commitment

Question 2

What are the different layers of a computer system where virtualization can be used? Provide a short description for each.

The different layers of a computer system where virtualization can be used are:

- **Instruction Set Architecture (ISA):** Instruction set virtualization is a processor virtualization technique that enables emulation of the instruction set of one processor on a different processor.
- **Hardware abstraction:** It is the abstraction of computing resources from the software that uses cloud resources.
- **Operating System:** With the Kernel allowing the existence of multiple isolated user spaces instances (containers) that look like real computers from the point of view of programs running in them.
- **Library (user-level API):** Applications can use APIs provided by user-level libraries to access resources, creating execution environments.
- **Application Level:** Many applications run on a virtual machine, by doing this they can run on any hardware and software that has the virtual machine installed. Examples are the JVM (Java Virtual Machine) and BEAM (Erlang Virtual Machine).

Question 3

When you instantiate an instance on AWS, at which layer the virtualization is done?

When you instantiate an instance on AWS the virtualization is done at the Hardware abstraction layer.

Question 4

Provide at least three different type of cloud computing service and provide a short description and few examples for each (“X as a service”)

1. **Infrastructure as a service:** A form of cloud computing that delivers fundamental compute, network, and storage resources to consumers on-demand, over the internet, and on a pay-as-you-go basis. Examples:
 - DigitalOcean.
 - Linode.
 - Rackspace.
 - Amazon Web Services (AWS)
 - Cisco Metacloud.
 - Microsoft Azure.
 - Google Compute Engine (GCE)
2. **Platform as a service:** a category of cloud computing services that allows customers to provision, instantiate, run, and manage a modular bundle comprising a computing platform and one or more applications, without the complexity of building and maintaining the infrastructure typically associated with developing and launching the application(s); and to allow developers to create, develop, and package such software bundles. Examples:
 - AWS Elastic Beanstalk.

- Windows Azure.
 - Heroku.
 - Force.com.
 - Google App Engine.
 - OpenShift.
3. **Software as a service:** Software as a service is a software distribution model in which a cloud provider hosts applications and makes them available to end users over the internet
Examples:
- BigCommerce
 - Google Apps
 - Salesforce
 - Dropbox
 - MailChimp
 - ZenDesk
 - DocuSign
 - Slack
 - Hubspot

Question 5

Can you explain Amdahl's law? Provide and explain the law based on a small example and use graph(s) to illustrate your answer.

Amdahl's law is a formula which gives the increase in speed of execution of a task expected (on paper) when improving the system's resources.

Multicore (using more than one core to perform a task) is an example of using this law. Multicore programming helps to split the system into multiple parallel tasks, which run simultaneously, speeding up the overall execution time.

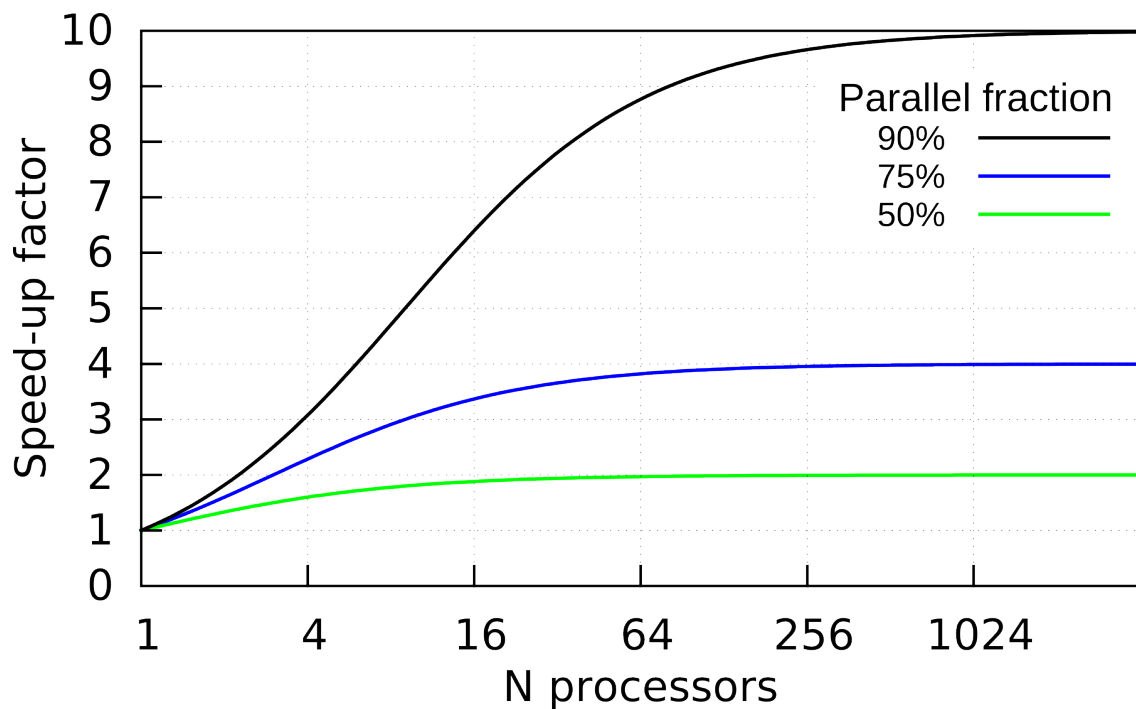


Figure 1

Question 6

Which component of a server typically consume most of the energy? What is a typical power dissipation value for a server?

The component of a server that typically consumes the most energy is the processor. Most servers run today with 20 - 40 percent efficient power supplies that waste over half the electrical power passed through to them. At the typical server level, potential power savings from the change to a 15 percent more efficient power supply can be as great as 100W or more.

Question 7

How can the energy efficiency of a data centre be evaluated? Which metric(s) can be used for it and what are the possible drawback of the used metric(s)?

- Power Usage Effectiveness (PUE)

$$\text{PUE} = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}} = 1 + \frac{\text{Non IT Facility Energy}}{\text{IT Equipment Energy}}$$

Figure 2

One real problem is PUE does not account for the climate within the cities the data centers are built. In particular, it does not account for different normal temperatures outside the data center. For example, a data center located in Alaska cannot be effectively compared

to a data center in Miami. A colder climate results in a lesser need for a massive cooling system.