



Last name:

First name:

Student number:

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## Question 1)

Points: .....

Maximum points: 5+5=10

a) **How long** does it take to transfer 5 PB of data via a 40 Gbit/s network?

b) **How long** does it take to transfer 5 PB of data via a 1000 Mbps Ethernet?

Last name:

First name:

Student number:

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## Question 2)

Points: .....

Maximum points: 7

- a) In which **category** of cloud services is human creativity offered for low cost or donated from volunteers?
  
- b) Why is the term „Cloud Operating System“ **misleading**?
  
- c) In which **category** of cloud services can customers run virtual server instances and even realize virtual data centers?
  
- d) What is a **PaaS**, and what can customers do with it?
  
- e) What software do customers **need to use** software services?
  
- f) What is the **main difference** between Public and Private Cloud services?
  
- g) What is a **Hybrid Cloud**?

Last name:

First name:

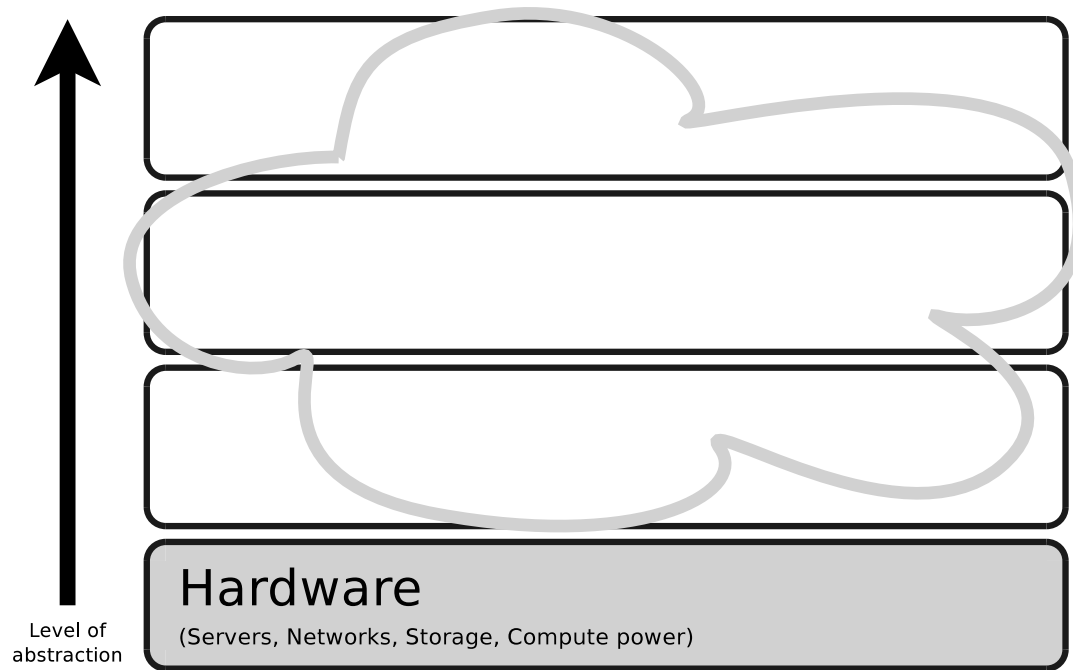
Student number:

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## Question 3)

Points: .....

Maximum points: 6



**Assign** these categories of cloud services to the layers in the figure:

- a) PaaS
- b) Cloud Gaming
- c) Cloud Printing
- d) IaaS
- e) HaaS
- f) SaaS

Last name:

First name:

Student number:

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## Question 4)

Points: .....

Maximum points: 8

- a) What is a **Region** in AWS EC2?
  
- b) What is an **Availability Zone** in AWS EC2?
  
- c) What is the maximum number of Instances, an **EBS volume** can be connected with?
  
- d) According to which principle works the storage service **S3**?  
 block-based storage service       object-based storage service
- e) According to which principle works the service **EBS**?  
 block-based storage service       object-based storage service
- f) Which storage services require the user/customer to choose and deploy a **file system**?  
 block-based storage service       object-based storage service
- g) What is the purpose of the **Access Control List** at S3?
  
  
- h) How can users/customers increase the **availability** of EBS storage?



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Student number:

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## Question 6)

Points: .....

Maximum points: 6

- a) **Google Cloud Print** implements...  
 IaaS       PaaS       SaaS
- b) **Amazon Simple Storage Service (S3)** implements...  
 IaaS       PaaS       SaaS
- c) **Google App Engine** implements...  
 IaaS       PaaS       SaaS
- d) **Amazon Elastic Compute Cloud (EC2)** implements...  
 IaaS       PaaS       SaaS
- e) **AppScale** implements...  
 IaaS       PaaS       SaaS
- f) **Google Cloud Storage** implements...  
 IaaS       PaaS       SaaS
- g) **Microsoft Windows Azure** implements...  
 IaaS       PaaS       SaaS
- h) **HP Cloud Compute** implements...  
 IaaS       PaaS       SaaS
- i) **RedHat OpenShift** implements...  
 IaaS       PaaS       SaaS
- j) **Amazon Mechanical Turk** implements...  
 IaaS       PaaS       SaaS
- k) **eyeOS** implements...  
 IaaS       PaaS       SaaS
- l) **OnLive** implements...  
 IaaS       PaaS       SaaS

Last name:

First name:

Student number:

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## Question 7)

Points: .....

Maximum points: 10

Statement	true	false
The Google App Engine supports all programming languages.		
Applications inside the GAE can use different infrastructure and storage services.		
Free re-implementations of the GAE exist.		
The GAE supports authentication/authorization via Google accounts.		
Objects, stored in the Datastore are erased automatically after 24 h.		
Datastore is a persistent storage service, implemented as a key/value database.		
Datastore provides a query language, which is similar to the SQL (Structured Query Language).		
Memcache is a persistent storage service.		
Memcache uses tape storage to store the data.		
Memcache is a high-performance storage service for temporary data.		
Memcache uses physical main memory to store the data.		
Objects in the Datastore and Memcache can be of any size.		
Applications in the GAE can send and receive emails with any sender address.		
Applications in the GAE can send and receive XMPP messages.		
Applications in the GAE have read and write access to the file system of the physical servers.		
Applications in the GAE can communicate with other web services via all ports.		
The GAE provides support for Python 3.		
Customers of the GAE can upload and run multiple versions of each one of their applications.		
Each customer of the GAE can have an infinite number of applications.		
Application names must be unique inside the GAE namespace.		



Last name:

First name:

Student number:

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## Question 8)

Points: .....

Maximum points: 5

- a) Name a **field of application**, where MapReduce is helpful.
  
  
  
  
  
  
  
  
  
  
- b) What is the advantage of the 64 MB chunk size of the Hadoop Distributed File System (**HDFS**)?
  
  
  
  
  
  
  
  
  
  
- c) What is the drawback of the 64 MB chunk size of the **HDFS**?
  
  
  
  
  
  
  
  
  
  
- d) What kind of data stores the **Namenode**?
  
  
  
  
  
  
  
  
  
  
- e) What kind of data store the **Datanodes**?

Last name:

First name:

Student number:

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## Question 9)

Points: .....

Maximum points:  $1+1+1+1+1+2=7$

- a) By which approach does High Availability Clustering achieve its **objective**?
  
- b) Give an **advantage** of High Performance Clusters, compared with supercomputers (mainframes).
  
- c) Give a **drawback** of High Performance Clusters, compared with supercomputers (mainframes).
  
- d) What is a **Beowulf Cluster**?
  
- e) What is the difference of a **Beowulf Cluster** in contrast to a **Wulpack Cluster**?
  
- f) Can High Throughput Clusters be used to process the same **tasks** as High Performance Clusters? (*Explain your answer in just 1 or 2 sentences.*)

Last name:

First name:

Student number:

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## Question 10)

Points: .....

Maximum points: 4

- a) **Physical resources** are offered in . . .  
 Grids       Clouds
- b) **Virtualized resources** are offered in . . .  
 Grids       Clouds
- c) **Full-automatization** (*industrialized IT*) is an attribute of . . .  
 Grids       Clouds
- d) **Weak automatization** (*traditional IT*) is an attribute of . . .  
 Grids       Clouds
- e) **Virtual Organizations** are implemented in . . .  
 Grids       Clouds
- f) **Resources without centralized control** are usually connected in . . .  
 Grids       Clouds
- g) **Resources under central control** are usually connected in . . .  
 Grids       Clouds
- h) **Consumption-based billing** (Pay-as-you-go principle) is an attribute of . . .  
 Grids       Clouds

Last name:

First name:

Student number:

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## Question 11)

Points: .....

Maximum points: 4

- a) No **centralized services** exist with...
- Centralized P2P       Pure P2P       Hybrid P2P
- b) A **central point of attack** exists with...
- Centralized P2P       Pure P2P       Hybrid P2P
- c) Which architecture causes the biggest **network overhead**?
- Centralized P2P       Pure P2P       Hybrid P2P
- d) Which architecture causes the **lowest network overhead**?
- Centralized P2P       Pure P2P       Hybrid P2P
- e) Which architecture implements a kind of **dynamic, centralized service**?
- Centralized P2P       Pure P2P       Hybrid P2P
- f) **Napster** (1999 - 2001) implemented...
- Centralized P2P       Pure P2P       Hybrid P2P
- g) **Gnutella v0.4** implements...
- Centralized P2P       Pure P2P       Hybrid P2P
- h) **Gnutella v0.6** implements...
- Centralized P2P       Pure P2P       Hybrid P2P

Last name:

First name:

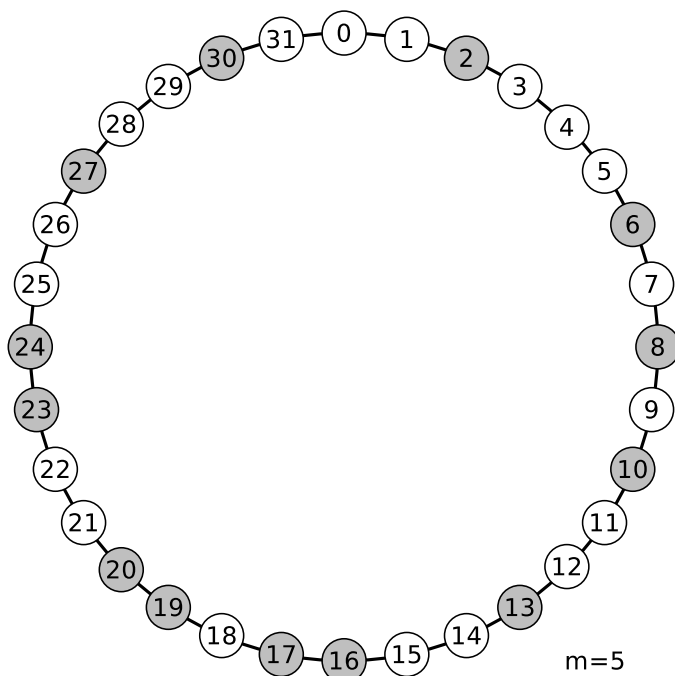
Student number:

# Question 12)

Points: .....

Maximum points: 1+1+1+10+1=14

- a) What is the **drawback** of linear search in the Chord ring?
- b) What way of **searching** in the Chord ring is preferred?
- c) To which node  $n$  gets a key  $k$  **assigned** to?
  - Direct predecessor
  - Direct successor
  - First node (starting from ID 1) without any keys assigned yet
- d) Calculate the **Finger Table** values of node  $n = 20$  and **insert** the correct values into the provided Finger Table.



Finger Table of node  $n = 20$

Entry	Start	Node
1		
2		
3		
4		
5		

The table has 5 entries, because  $m$  contains the length of the ID in bits and  $m = 5$

The Start value of entry  $i$  of the table on node  $n$  is  $(n + 2^{i-1}) \bmod 2^m$

The Node value of entry  $i$  points to the first node, which follows to  $n$  at a distance of at least  $2^{i-1}$

- e) Which node is **responsible** for the key (resource) with ID 11 ?