



Last name:

First name:

Student number:

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# Question 1)

Points: .....

Maximum points: 12

Name four cloud services (only platform and infrastructure services are allowed!) you used for solving the exercise sheets. Also explain in a few words which functionality of these services you used. It should become clear why you used each single service.

Name of service	Sort of service	Explain the functionality you used and also the reason for using the service
	<input type="checkbox"/> PaaS <input type="checkbox"/> IaaS	
	<input type="checkbox"/> PaaS <input type="checkbox"/> IaaS	
	<input type="checkbox"/> PaaS <input type="checkbox"/> IaaS	
	<input type="checkbox"/> PaaS <input type="checkbox"/> IaaS	

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## Question 2)

Points: .....

Maximum points: 7

- a) Think about a scenario, when a service provider creates a new service offering, which allows the customers to deploy virtual machines and specify their network configuration. What sort of cloud offering is this?

*Infrastructure as a Service – IaaS*

- b) Think about a scenario, when a service provider creates a new service offering, which is basically an email client in the browser. What sort of cloud offering is this?

*Software as a Service – SaaS*

- c) Think about a scenario, when a service provider creates a new service offering, which provides a scalable runtime environment for a programming language. What sort of cloud offering is this?

*Platform as a Service – PaaS*

- d) Think about a scenario, when a service provider creates a new service offering, which allows the customers to create virtual block storage devices. What sort of cloud offering is this?

*Infrastructure as a Service – IaaS*

- e) Think about a scenario, when a service provider creates a new service offering, which is basically an office solution in the browser. What sort of cloud offering is this?

*Software as a Service – SaaS*

- f) Think about a scenario, when a service provider creates a new service offering, which allows the customers to store any files as web objects and make them accessible via the internet. What sort of cloud offering is this?

*Infrastructure as a Service – IaaS*

- g) Think about a scenario, when a service provider creates a new service offering, which converts print jobs. The users send print jobs to the service and do not need to install printer drivers locally. What sort of cloud offering is this?

*Cloud Printing*

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## Question 3)

Points: .....

Maximum points: 10

Explain how the odd-even transposition sort algorithm works (in a non-parallel way).

*See MPI Special Challenge 1.*

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## Question 4)

Points: .....

Maximum points: 10

Explain how the odd-even transposition sort algorithm can be implemented in a way that it sorts in parallel by using a cluster system. (*In other words: Which parts of the sorting process can be carried out in parallel by the nodes of a cluster and how is it done and what is the task of the master?*)

*See the solution MPI Special Challenge 1.*

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## Question 5)

Points: .....

Maximum points: 10

Explain one possible way to find prime numbers in parallel by using a cluster system. (*In other words: Which steps of the prime number search can be carried out in parallel by the nodes of a cluster and how is it done and what is the task of the master?*)

*See MPI Special Challenge 2 and the solution of MPI Special Challenge 2.*

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## Question 6)

Points: .....

Maximum points: 10

Explain how matrix multiplication works (in a non-parallel way).

*See MPI Special Challenge 3.*

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## Question 7)

Points: .....

Maximum points: 10

Explain how matrix multiplication can be done in parallel by using a cluster system. (*In other words: Which steps of matrix multiplication can be carried out in parallel by the nodes of a cluster and how is it done and what is the task of the master?*)

*See the solution MPI Special Challenge 3.*





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## Question 9)

Points: .....

Maximum points: 4+8=12

Company X runs 500 computer workplaces.

- Scenario 1: Fat clients (PC)
  - Electrical power rating per desktop: 500 watts
  - Electrical power rating per screen: 100 watts
- Scenario 2: Thin clients
  - Electrical power rating per thin client: 40 watts
  - Electrical power rating per screen: 100 watts
  - Electrical power rating per server blade: 500 watts
  - Each server blade has enough resources to run 30 virtual desktops

What are the electricity costs per year for 24/7 operation when the electricity price is 0,30 €/kWh?

*Scenario 1:*

*Electricity costs per year (including the leap year) for 500 computer workplaces:*

$$0.6 \text{ kW} * 24 \frac{\text{h}}{\text{Day}} * 365.25 \frac{\text{Day}}{\text{Year}} * 0.3 \frac{\text{€}}{\text{kWh}} = 1,577.88 \frac{\text{€}}{\text{Year}} * 500 = 788,940 \frac{\text{€}}{\text{Year}}$$

*Scenario 2:*

*Electricity costs per year (including the leap year) for 500 computer workplaces:*

$$0,14 \text{ kW} * 24 \frac{\text{h}}{\text{Day}} * 365.25 \frac{\text{Day}}{\text{Year}} * 0.3 \frac{\text{€}}{\text{kWh}} = 368,172 \frac{\text{€}}{\text{Year}} * 500 = 184,086 \frac{\text{€}}{\text{Year}}$$

*Electricity costs per year (including the leap year) for the 17 required server blades.*

$$0.5 \text{ kW} * 24 \frac{\text{h}}{\text{Day}} * 365.25 \frac{\text{Day}}{\text{Year}} * 0.3 \frac{\text{€}}{\text{kWh}} = 1,314.9 \frac{\text{€}}{\text{Year}} * 17 = 22,353.3 \frac{\text{€}}{\text{Year}}$$

*Electricity costs per year for the computer workplaces and the server blades.*

$$184,086 \frac{\text{€}}{\text{Year}} + 22,353.3 \frac{\text{€}}{\text{Year}} = 206,439.3 \frac{\text{€}}{\text{Year}}$$