



Computing Infrastructures  
June 12, 2025

Course Section:	<input type="checkbox"/> Prof. Ardagna	<input type="checkbox"/> Prof. Palermo	<input type="checkbox"/> Prof. Roveri
Student ID (Codice Persona):	.....		
Last Name:	..... (LAST NAME IN CAPITAL LETTERS)		
First Name:	..... (FIRST NAME IN CAPITAL LETTERS)		

**Exam Duration: 1hour and 30min**

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**The answers to the *Open Questions* should be written using ONLY the space available on in the boxes within the Answer Sheets.** The answers should be readable by the professor. Unreadable answers will not be considered for the evaluation.

Scores: correct answers take positive points, unanswered questions take 0 points, **wrong answers can have negative points.** An indication of the points is available at the beginning of each section. The final score can be re-modulated at the end of the evaluation.



### True false questions

Correct answer: +1, No answer: 0, Wrong Answer -0.5

*Answers must be given on the ANSWER SHEETS. Any box filled here will be ignored. Pay attention to the position (A or B) of the True/False answers, since they are not always in the same position.*

**Question 1** Cloud architectures can be deployed on-premises, in a public cloud, or in a hybrid environment.

☐ A True

☐ B False

**Question 2** TPUs require specialized software libraries and frameworks to fully utilize their capabilities.

☐ A False

☐ B True

**Question 3** Virtualization is only suitable for running non-critical applications and workloads.

☐ A True

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**Question 4** Blade servers universally reduce hardware expenses, ensuring they cost far less than rack servers in every scenario.

☐ A False

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**Question 5** FPGAs are widely adopted for all large-scale HPC and AI workloads, replacing GPUs in most scenarios.

☐ A True

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**Question 6** Edge computing nodes often cache and compute on locally produced data to reduce latency and congestion.

☐ A False

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**Question 7** Data centers requires specialized fire suppression systems.

☐ A False

☐ B True

**Question 8** DAS storage provides low throughput due to its reliance on a shared network.

☐ A True

☐ B False

**Question 9** Direct open-loop cooling is most suitable for hot, humid climates.

☐ A False

☐ B True

**Question 10** RAID 5 uses parity data to provide fault tolerance.

☐ A True

☐ B False



## Exercises

Correct answer: +2, No answer: 0.

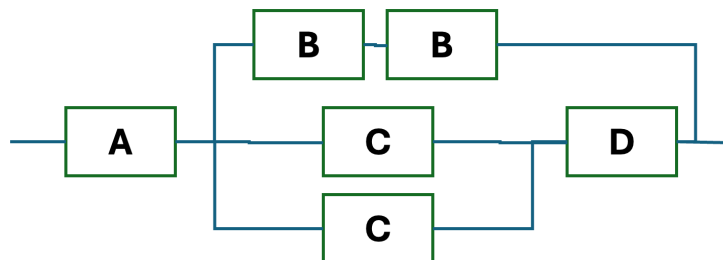
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### Question 12

Suppose we have a computer system composed of 6 different components, and designed to have an RBD as shown in the image below. The four types of components (A, B, C, and D) have different reliability characteristics. We know that the availability of the components B, C, and D are respectively  $Av_A = Av_B = 0.8$ ,  $Av_C = 0.7$ , and  $Av_D = 0.9$ . What is the availability of the entire system? Use always at least 4 decimal digits for each calculation.





### Question 13

A scientific computation uses a server composed of 2 CPUs and 4 GPUs. Knowing that the  $MTTF_{CPU} = 380days$  and  $MTTF_{GPU} = 260days$ , and the computation to work requires both CPUs and one GPU within the server to work properly. What is the reliability value after 1/2 years,  $R(0.5y)$ ? Notes: (i) Use at least 4 decimal digits for all the intermediate calculations; (ii) All the other components within the server can be considered as ideal.

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A video rendering system consists of three components: a GPU Server (GS), which processes rendering tasks, a Model Cache Server (MCS) which manages 3D assets, and a Frame Buffer Server (FBS) which handles output frames. The main data obtained from the logging system are reported below:

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Service time:  $S_{FBS} = 10s$ , Visits:  $V_{FBS} = 80$  visits

Additionally, the system serves  $N=5$  users characterized by a think time  $Z = 600s$

What is the system bottleneck (i.e. GS, MCS or FBS)?



+1/5/56+

### Question 15

Considering the system described in Question 14, compute: a) the maximum system throughput in *jobs/min*, b) the minimum response time in *minutes*.

### Question 16

Given the system described in Question 14, you now have the opportunity to enhance its performance by adding exactly one additional server. However, you can only duplicate one of the three existing servers: GS, MCS or FBS. The new server will be identical to the other of the same type (homogeneous), and you can distribute the workload (visits) evenly between them. Assume that all the other system monitoring metrics remain unchanged. Answer the following: a) which one do you choose? (i.e. GS, MCS, FBS) b) What will be the new minimum response time in *minutes*?



+1/6/55+

### Open Questions

Correct answer: +5, No answer: 0. Points are modulated considering the written text

*Write the answer using ONLY the space available in the boxes on the ANSWER SHEETS. The answers should be readable by the professor. Unreadable answers will be considered wrong.*

#### Question 17

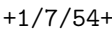
⇒ Deep learning is transforming data-center technology. From a technological standpoint, how would you design a data center purpose-built for deep-learning workloads?

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⇒ In a data-center storage context, focusing exclusively on write performance, under what circumstances would you choose RAID 1+0 and under what circumstances RAID 5? Please explain your reasoning.

**!!!ANY ANSWER PROVIDED ON THIS PAGE WILL BE IGNORED!!!**

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## Answer Sheets (Page 1)



●

## Answer Sheets (Page 2)

⇒ In a data-center storage context, focusing exclusively on write performance, under what circumstances would you choose RAID 1+0 and under what circumstances RAID 5? Please explain your reasoning.







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### Answer Sheets (Page 3)

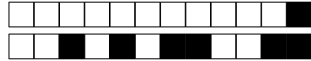
Student ID (Codice Persona): .....

#### True/False Questions

- Question 01 : ☒ A ☐ B
- Question 02 : ☐ A ☒ B
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- Question 04 : ☒ A ☐ B
- Question 05 : ☐ A ☒ B
- Question 06 : ☐ A ☒ B
- Question 07 : ☐ A ☒ B
- Question 08 : ☐ A ☒ B
- Question 09 : ☒ A ☐ B
- Question 10 : ☒ A ☐ B

#### Exercises

- Question 11 : ..... **48 39 23 58 65**
- Question 12 : ..... **0,748**
- Question 13 : ..... **0,358**
- Question 14 : ..... **FBS**
- Question 15 : ..... **0,075 Jobs/min. 56,667 min**
- Question 16 : ..... **FBS. 30min**



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☐ A True

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+2/3/48+

## Exercises

Correct answer: +2, No answer: 0.

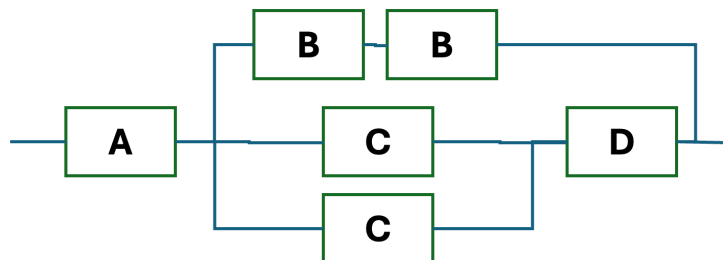
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Additionally, the system serves  $N=7$  users characterized by a think time  $Z = 600s$

What is the system bottleneck (i.e. GS, MCS or FBS)?



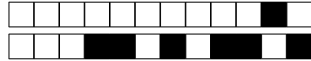
+2/5/46+

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+2/6/45+

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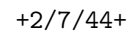
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## Answer Sheets (Page 1)

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[illegible]



●



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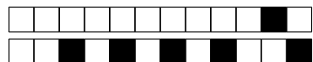
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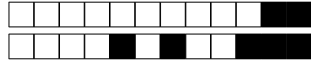
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## Exercises

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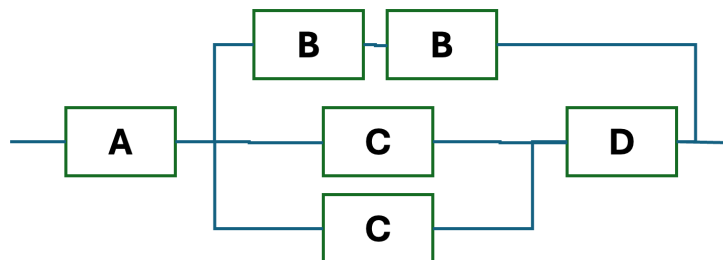
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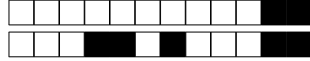
+3/5/36+

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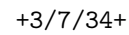
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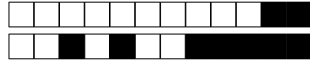
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- Question 03 : ☐ A ☒ B
- Question 04 : ☒ A ☐ B
- Question 05 : ☐ A ☒ B
- Question 06 : ☒ A ☐ B
- Question 07 : ☐ A ☒ B
- Question 08 : ☐ A ☒ B
- Question 09 : ☒ A ☐ B
- Question 10 : ☒ A ☐ B

#### Exercises

- Question 11 : .....  
**58 65 23 39 48**
- Question 12 : .....  
**0,5891**
- Question 13 : .....  
**0,358**
- Question 14 : .....  
**FBS**
- Question 15 : .....  
**0,075 Job/min. 123,333 min**
- Question 16 : ..**FBS... 70 min**.....



**Computing Infrastructures**  
**June 12, 2025**

Course Section:      ☐ Prof. Ardagna      ☐ Prof. Palermo      ☐ Prof. Roveri

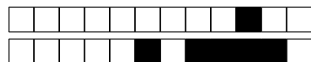
Student ID (Codice Persona): .....

Last Name: .....  
(LAST NAME IN CAPITAL LETTERS)

First Name: .....  
(FIRST NAME IN CAPITAL LETTERS)

⇒ **The remaining part of this page has been intentionally left blank** ⇐

If needed, you can use this page for notes. Any answer written here will be ignored.



Computing Infrastructures  
June 12, 2025

Course Section:	<input type="checkbox"/> Prof. Ardagna	<input type="checkbox"/> Prof. Palermo	<input type="checkbox"/> Prof. Roveri
Student ID (Codice Persona):	.....		
Last Name:	..... (LAST NAME IN CAPITAL LETTERS)		
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**Exam Duration: 1hour and 30min**

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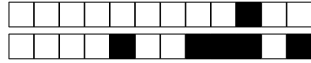
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### True false questions

Correct answer: +1, No answer: 0, Wrong Answer -0.5

*Answers must be given on the ANSWER SHEETS. Any box filled here will be ignored. Pay attention to the position (A or B) of the True/False answers, since they are not always in the same position.*

**Question 1** Data centers requires specialized fire suppression systems.

☐ A True

☐ B False

**Question 2** Edge computing nodes often cache and compute on locally produced data to reduce latency and congestion.

☐ A True

☐ B False

**Question 3** RAID 5 uses parity data to provide fault tolerance.

☐ A True

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**Question 4** DAS storage provides low throughput due to its reliance on a shared network.

☐ A True

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**Question 5** Direct open-loop cooling is most suitable for hot, humid climates.

☐ A False

☐ B True

**Question 6** FPGAs are widely adopted for all large-scale HPC and AI workloads, replacing GPUs in most scenarios.

☐ A True

☐ B False

**Question 7** Blade servers universally reduce hardware expenses, ensuring they cost far less than rack servers in every scenario.

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**Question 9** TPUs require specialized software libraries and frameworks to fully utilize their capabilities.

☐ A True

☐ B False

**Question 10** Cloud architectures can be deployed on-premises, in a public cloud, or in a hybrid environment.

☐ A False

☐ B True





+4/3/28+

## Exercises

Correct answer: +2, No answer: 0.

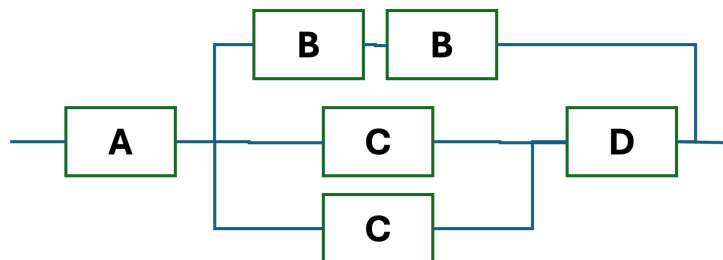
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### Question 12

Suppose we have a computer system composed of 6 different components, and designed to have an RBD as shown in the image below. The four types of components (A, B, C, and D) have different reliability characteristics. We know that the availability of the components B, C, and D are respectively  $Av_A = Av_B = 0.8$ ,  $Av_C = 0.7$ , and  $Av_D = 0.9$ . What is the availability of the entire system? Use always at least 4 decimal digits for each calculation.





### Question 13

A scientific computation uses a server composed of 2 CPUs and 4 GPUs. Knowing that the  $MTTF_{CPU} = 380days$  and  $MTTF_{GPU} = 260days$ , and the computation to work requires both CPUs and one GPU within the server to work properly. What is the reliability value after 1/2 years,  $R(0.5y)$ ? Notes: (i) Use at least 4 decimal digits for all the intermediate calculations; (ii) All the other components within the server can be considered as ideal.

### Question 14

A video rendering system consists of three components: a GPU Server (GS), which processes rendering tasks, a Model Cache Server (MCS) which manages 3D assets, and a Frame Buffer Server (FBS) which handles output frames. The main data obtained from the logging system are reported below:

Service time:  $S_{GS} = 20s$ , Visits:  $V_{GS} = 21$  visits

Service time:  $S_{MCS} = 40s$ , Visits:  $V_{MCS} = 12$  visits

Service time:  $S_{FBS} = 10s$ , Visits:  $V_{FBS} = 80$  visits

Additionally, the system serves  $N=5$  users characterized by a think time  $Z = 600s$

What is the system bottleneck (i.e. GS, MCS or FBS)?



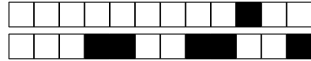
+4/5/26+

### Question 15

Considering the system described in Question 14, compute: a) the maximum system throughput in *jobs/min*, b) the minimum response time in *minutes*.

### Question 16

Given the system described in Question 14, you now have the opportunity to enhance its performance by adding exactly one additional server. However, you can only duplicate one of the three existing servers: GS, MCS or FBS. The new server will be identical to the other of the same type (homogeneous), and you can distribute the workload (visits) evenly between them. Assume that all the other system monitoring metrics remain unchanged. Answer the following: a) which one do you choose? (i.e. GS, MCS, FBS) b) What will be the new minimum response time in *minutes*?



+4/6/25+

### Open Questions

Correct answer: +5, No answer: 0. Points are modulated considering the written text

*Write the answer using ONLY the space available in the boxes on the ANSWER SHEETS. The answers should be readable by the professor. Unreadable answers will be considered wrong.*

#### Question 17

⇒ Deep learning is transforming data-center technology. From a technological standpoint, how would you design a data center purpose-built for deep-learning workloads?

#### Question 18

⇒ In a data-center storage context, focusing exclusively on write performance, under what circumstances would you choose RAID 1+0 and under what circumstances RAID 5? Please explain your reasoning.

**!!!ANY ANSWER PROVIDED ON THIS PAGE WILL BE IGNORED!!!**

If needed, you can use the space hereafter to organize your answer.

+4/7/24+

## Answer Sheets (Page 1)

First Name (CAPITAL LETTERS): .....

Last Name (CAPITAL LETTERS): .....

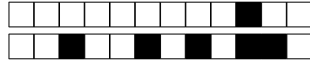
Student ID (Codice Persona): .....

⇒ Deep learning is transforming data-center technology. From a technological standpoint, how would you design a data center purpose-built for deep-learning workloads?



●





## Computing Infrastructures - June 12, 2025

### Answer Sheets (Page 3)

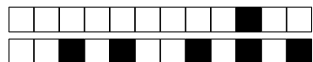
Student ID (Codice Persona): .....

#### True/False Questions

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- Question 02 : ☒ A ☐ B
- Question 03 : ☒ A ☐ B
- Question 04 : ☐ A ☒ B
- Question 05 : ☒ A ☐ B
- Question 06 : ☐ A ☒ B
- Question 07 : ☒ A ☐ B
- Question 08 : ☐ A ☒ B
- Question 09 : ☒ A ☐ B
- Question 10 : ☐ A ☒ B

#### Exercises

- Question 11 : .....  
**48 39 23 65 58 (accepted also 58 65 23 39 48)**
- Question 12 : .....  
**0,748**
- Question 13 : .....  
**0,358**
- Question 14 : .....  
**FBS**
- Question 15 : .....  
**0,075 Job/min. 56,667 min**
- Question 16 : ..**FBS... 30 min**.....



+4/10/21+

**Computing Infrastructures**  
**June 12, 2025**

Course Section:      ☐ Prof. Ardagna      ☐ Prof. Palermo      ☐ Prof. Roveri

Student ID (Codice Persona): .....

Last Name: .....  
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+5/1/20+

## Computing Infrastructures

June 12, 2025

Course Section:	<input type="checkbox"/> Prof. Ardagna	<input type="checkbox"/> Prof. Palermo	<input type="checkbox"/> Prof. Roveri
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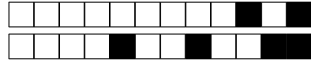
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### True false questions

Correct answer: +1, No answer: 0, Wrong Answer -0.5

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☐ A False

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**Question 9** TPUs require specialized software libraries and frameworks to fully utilize their capabilities.

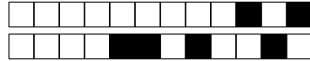
☐ A False

☐ B True

**Question 10** Virtualization is only suitable for running non-critical applications and workloads.

☐ A False

☐ B True



+5/3/18+

## Exercises

Correct answer: +2, No answer: 0.

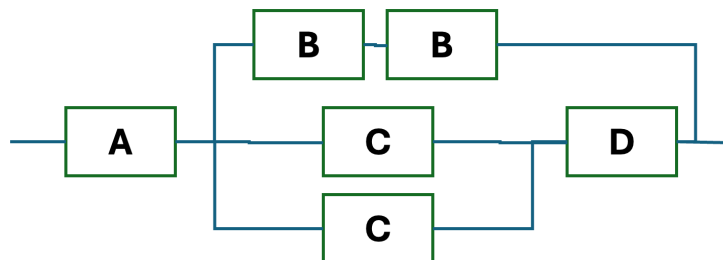
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Additionally, the system serves  $N=7$  users characterized by a think time  $Z = 600s$

What is the system bottleneck (i.e. GS, MCS or FBS)?



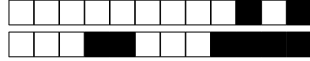
+5/5/16+

### Question 15

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### Question 16

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+5/6/15+

### Open Questions

Correct answer: +5, No answer: 0. Points are modulated considering the written text

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#### Question 17

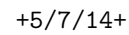
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## Answer Sheets (Page 1)

Student ID (Codice Persona): .....

⇒ Deep learning is transforming data-center technology. From a technological standpoint, how would you design a data center purpose-built for deep-learning workloads?

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.







## Computing Infrastructures - June 12, 2025

### Answer Sheets (Page 3)

Student ID (Codice Persona): .....

#### True/False Questions

- Question 01 : ☒ A ☐ B
- Question 02 : ☒ A ☐ B
- Question 03 : ☒ A ☐ B
- Question 04 : ☐ A ☒ B
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**Computing Infrastructures**  
**June 12, 2025**

Course Section:      ☐ Prof. Ardagna      ☐ Prof. Palermo      ☐ Prof. Roveri

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+6/1/10+

## Computing Infrastructures

June 12, 2025

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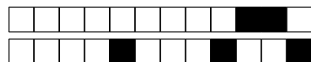
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☐ A False

☐ B True



+6/3/8+

## Exercises

Correct answer: +2, No answer: 0.

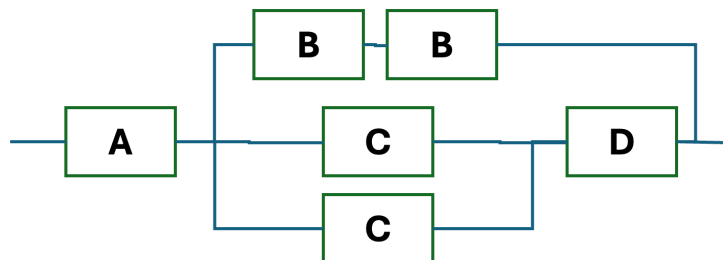
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A video rendering system consists of three components: a GPU Server (GS), which processes rendering tasks, a Model Cache Server (MCS) which manages 3D assets, and a Frame Buffer Server (FBS) which handles output frames. The main data obtained from the logging system are reported below:

Service time:  $S_{GS} = 20s$ , Visits:  $V_{GS} = 21$  visits

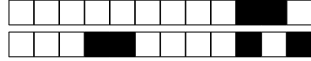
Service time:  $S_{MCS} = 40s$ , Visits:  $V_{MCS} = 12$  visits

Service time:  $S_{FBS} = 10s$ , Visits:  $V_{FBS} = 80$  visits

Additionally, the system serves  $N=5$  users characterized by a think time  $Z = 600s$

What is the system bottleneck (i.e. GS, MCS or FBS)?





+6/6/5+

### Open Questions

Correct answer: +5, No answer: 0. Points are modulated considering the written text

*Write the answer using ONLY the space available in the boxes on the ANSWER SHEETS. The answers should be readable by the professor. Unreadable answers will be considered wrong.*

#### Question 17

⇒ Deep learning is transforming data-center technology. From a technological standpoint, how would you design a data center purpose-built for deep-learning workloads?

#### Question 18

⇒ In a data-center storage context, focusing exclusively on write performance, under what circumstances would you choose RAID 1+0 and under what circumstances RAID 5? Please explain your reasoning.

**!!!ANY ANSWER PROVIDED ON THIS PAGE WILL BE IGNORED!!!**

If needed, you can use the space hereafter to organize your answer.





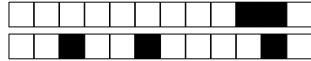


●

## Answer Sheets (Page 2)

⇒ In a data-center storage context, focusing exclusively on write performance, under what circumstances would you choose RAID 1+0 and under what circumstances RAID 5? Please explain your reasoning.





## Computing Infrastructures - June 12, 2025

### Answer Sheets (Page 3)

Student ID (Codice Persona): .....

#### True/False Questions

- Question 01 : ☒ A ☐ B
- Question 02 : ☒ A ☐ B
- Question 03 : ☐ A ☒ B
- Question 04 : ☐ A ☒ B
- Question 05 : ☐ A ☒ B
- Question 06 : ☐ A ☒ B
- Question 07 : ☐ A ☒ B
- Question 08 : ☒ A ☐ B
- Question 09 : ☒ A ☐ B
- Question 10 : ☐ A ☒ B

#### Exercises

- Question 11 : .....  
**58 65 23 39 48**
- Question 12 : .....  
**0,748**
- Question 13 : .....  
**0,358**
- Question 14 : .....  
**FBS**
- Question 15 : .....  
**0,075 Job/min. 56,667 min**
- Question 16 : ..**FBS.. 30 min** .....



+6/10/1+

**Computing Infrastructures**  
**June 12, 2025**

Course Section:      ☐ Prof. Ardagna      ☐ Prof. Palermo      ☐ Prof. Roveri

Student ID (Codice Persona): .....

Last Name: .....  
(LAST NAME IN CAPITAL LETTERS)

First Name: .....  
(FIRST NAME IN CAPITAL LETTERS)

⇒ **The remaining part of this page has been intentionally left blank** ⇐

If needed, you can use this page for notes. Any answer written here will be ignored.