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

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Answers must be given on the Answer Sheets and in English. Any box filled or answer provided on the other sheets will be ignored. Students must use a pen (black or blue) to mark the answers (no pencil).

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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

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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.

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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 B True

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

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

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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.

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Exercises

Correct answer: +2, No answer: 0.

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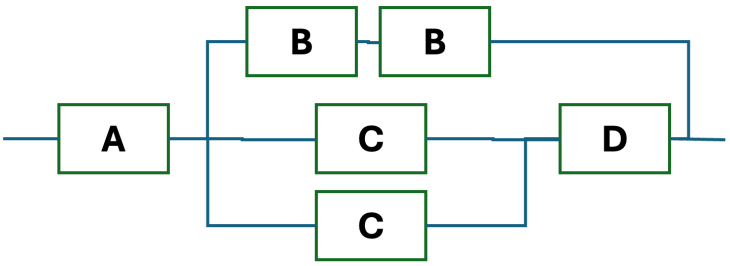
Suppose we have a computer system composed of 6 different components, and designed to have an RBD as shown in the image below. The four types of components (A, B, C, and D) have different reliability characteristics. We know that the availability of the components B, C, and D are respectively $Av_A =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



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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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Additionally, the system serves N=5 users characterized by a think time Z = 600s
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Considering the system described in Question 14, compute: a) the maximum system throughput in *jobs/min*, b) the minimum response time in *minutes*.

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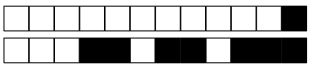
Given the system described in Question 14, you now have the opportunity to enhance its performance by adding exactly one additional server. However, you can only duplicate one of the three existing servers: GS, MCS or FBS. The new server will be identical to the other of the same type (homogeneous), 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*?



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.

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+1/7/54+

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 1)

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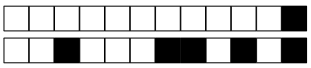

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 2)

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+1/9/52+

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 : **48 39 23 58 65**

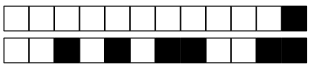
Question 12 : **0,748**

Question 13 : **0,358**

Question 14 : **FBS**

Question 15 : **0,075 Jobs/min.** **56,667 min**

Question 16 : **FBS.** **30min**



+1/10/51+

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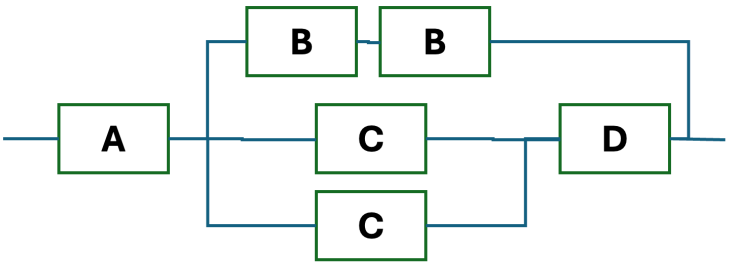

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Additionally, the system serves N=7 users characterized by a think time Z = 600s
What is the system bottleneck (i.e. GS, MCS or FBS)?

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Open Questions

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+2/7/44+

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Answer Sheets (Page 1)

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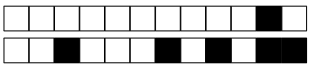

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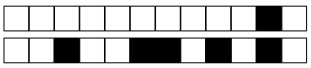

+2/9/42+

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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

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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**

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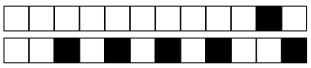
Question 16 : **FBS. 55,333 min**



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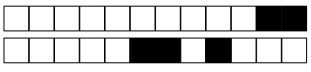

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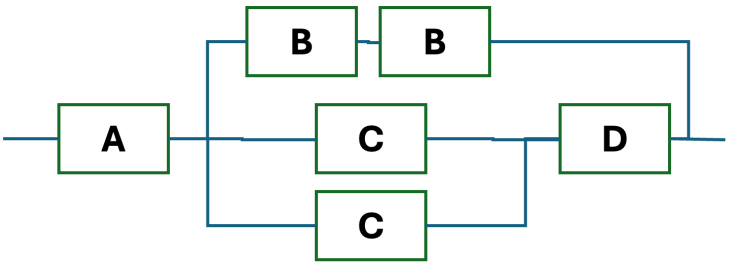

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Question 17

⇒ 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.

+3/7/34+

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 1)

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

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

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

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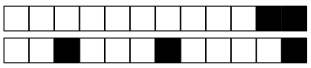

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 2)

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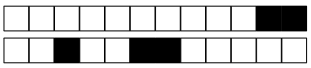

+3/9/32+

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

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Question 11 : **58 65 23 39 48**

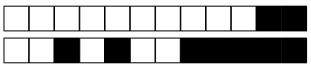
Question 12 : **0,5891**

Question 13 : **0,358**

Question 14 : **FBS**

Question 15 : **0,075 Job/min. 123,333 min**

Question 16 : **FBS. 70 min**



+3/10/31+

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)

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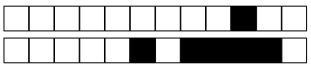

Computing Infrastructures
June 12, 2025

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

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

Last Name: .....
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Exam Duration: 1hour and 30min

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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 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 B False

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

A True B False

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.

A False B True

Question 8 Virtualization is only suitable for running non-critical applications and workloads.

A True B False

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

Exercises

Correct answer: +2, No answer: 0.

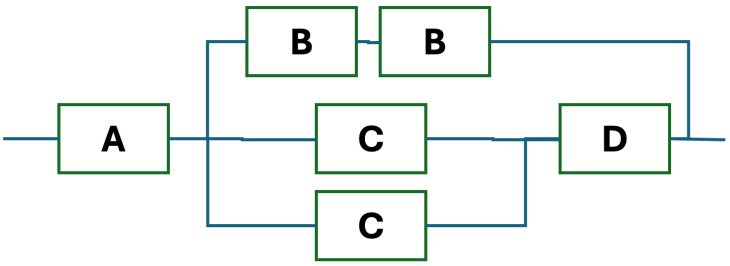
The formulas and procedures used to solve the exercises should be included here close to the question. The numeric answer, and only that, must be given on the ANSWER SHEETS. Any number written only here will be ignored. The correct number is ONLY a necessary condition for a correct answer. If the formulas are not available after each exercise, they will be considered as not answered.

Question 11

Let us consider a set of requests in the disk queue referring to the following cylinders of the disk: 65, 23, 58, 48, 39. Consider the initial position of the disk head at cylinder 53 and it is moving from outside (higher cylinder number) to inside (lower cylinder number). If no further requests arrive, write the order of the served requests (from the first to the last) if the disk head scheduling algorithm adopted is C-SCAN? Use the cylinder number to refer to the request.

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.

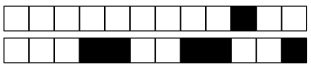


Question 13
A scientific computation uses a server composed of 2 CPUs and 4 GPUs. Knowing that the $MTTF_{CPU} = 380days$ and $MTTF_{GPU} = 260days$, and the computation to work requires both CPUs and one GPU within the server to work properly. What is the reliability value after 1/2 years, R(0.5y)? 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)?

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*?



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.

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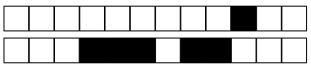

+4/7/24+

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 1)

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

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

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

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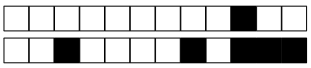

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 2)

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+4/9/22+

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 3)

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

True/False Questions

Question 01 : [x] A [ ] B

Question 02 : [x] A [ ] B

Question 03 : [x] A [ ] B

Question 04 : [ ] A [x] B

Question 05 : [x] A [ ] B

Question 06 : [ ] A [x] B

Question 07 : [x] A [ ] B

Question 08 : [ ] A [x] B

Question 09 : [x] A [ ] B

Question 10 : [ ] A [x] B

Exercises

Question 11 : **48 39 23 65 58 (accepted also 58 65 23 39 48)**

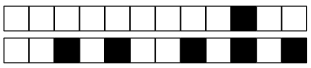
Question 12 : **0,748**

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

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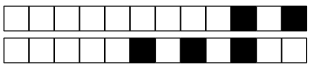

Computing Infrastructures
June 12, 2025

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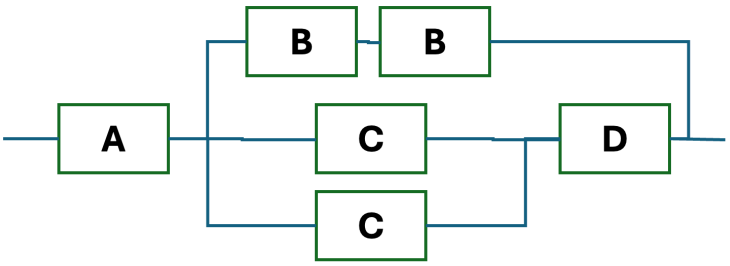

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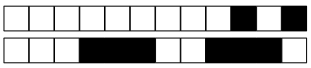

+5/7/14+

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 1)

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

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

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

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Computing Infrastructures - June 12, 2025

Answer Sheets (Page 2)

Question 18

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+5/9/12+

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

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Question 10 : ☑ A ☐ B

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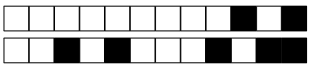
Question 16 : **FBS. 55,333 min**



+5/10/11+

Computing Infrastructures
June 12, 2025

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

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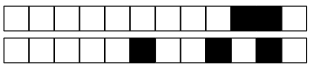

Computing Infrastructures
June 12, 2025

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Answers must be given on the Answer Sheets and in English. Any box filled or answer provided on the other sheets will be ignored. Students must use a pen (black or blue) to mark the answers (no pencil).

Write the LAST and FIRST name in CAPITAL LETTER, and in this order, in all places where requested. **Where it is requested only the STUDENT ID (Codice Persona), do not write your name**.

Check that the first number of the code for the Answer Sheet is the same as for the other sheets. The code can be found in the top-right corner of each page in the form `+NN/KK/XX+`. The parts that should correspond is ONLY the first digit `NN`.

Mark clearly the box corresponding to your answers, without overlapping on other boxes. If you make a mistake on them, circle the word *Question* together with the related number, and write the correct letter to its side.

Numerical exercises require writing the formulas and procedure used to solve the problem just after the question in the left space. Exercises without the procedure used to reach the result will not be considered for the evaluation. Only the numeric answer and its unit should be reported on the corresponding dotted line in the Answer Sheet.

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

A False B True

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

A True B False

Question 3 FPGAs are widely adopted for all large-scale HPC and AI workloads, replacing GPUs in most scenarios.

A True B False

Question 4 Data centers requires specialized fire suppression systems.

A False B True

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

A False B True

Question 6 Direct open-loop cooling is most suitable for hot, humid climates.

A True B False

Question 7 Virtualization is only suitable for running non-critical applications and workloads.

A True B False

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

A False B True

Question 9 Edge computing nodes often cache and compute on locally produced data to reduce latency and congestion.

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

Exercises

Correct answer: +2, No answer: 0.

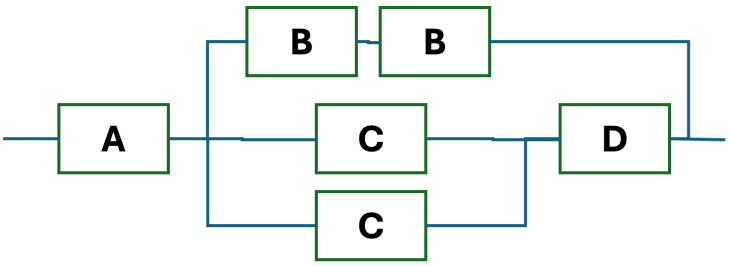
The formulas and procedures used to solve the exercises should be included here close to the question. The numeric answer, and only that, must be given on the ANSWER SHEETS. Any number written only here will be ignored. The correct number is ONLY a necessary condition for a correct answer. If the formulas are not available after each exercise, they will be considered as not answered.

Question 11

Let us consider a set of requests in the disk queue referring to the following cylinders of the disk: 65, 23, 58, 48, 39. Consider the initial position of the disk head at cylinder 52 and it is moving from inside (lower cylinder number) to outside (higher cylinder number). If no further requests arrive, write the order of the served requests (from the first to the last) if the disk head scheduling algorithm adopted is C-SCAN? Use the cylinder number to refer to the request.

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)?

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*?

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

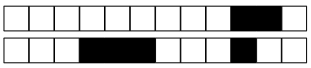
⇒ Deep learning is transforming data-center technology. From a technological standpoint, how would you design a data center purpose-built for deep-learning workloads?

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.



+6/7/4+

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 1)

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

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

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

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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Computing Infrastructures - June 12, 2025

Answer Sheets (Page 2)

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.

Computing Infrastructures - June 12, 2025

Answer Sheets (Page 3)

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

True/False Questions

Question 01 : [x] A [ ] B

Question 02 : [x] A [ ] B

Question 03 : [ ] A [x] B

Question 04 : [ ] A [x] B

Question 05 : [ ] A [x] B

Question 06 : [ ] A [x] B

Question 07 : [ ] A [x] B

Question 08 : [x] A [ ] B

Question 09 : [x] A [ ] B

Question 10 : [ ] A [x] B

Exercises

Question 11 : **58 65 23 39 48**

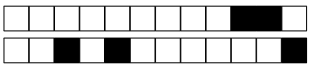
Question 12 : **0,748**

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.