+1/1/60+

Computing Infrastructure
June 15, 2022

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)

Exam Duration: 1hour and 15min

Students are not permitted to use mobile phones and similar connected devices. Course materials and programmable devices (e.g. programmable calculators) cannot be used as well. **Any violation of the rules is considered a cheating action.**

Answers must be given on the Answer Sheet. 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, on the first and last page of the exam. **Do not write your name on the first page of the Answer Sheet**. It is requested only the personal code.

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`

Do not use crosses to mark the answers, **fill clearly the box you selected** 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 to write the formulas and procedure used to solve the problem just after the question in the left space. Only the numeric answer and its unit should be reported on the corresponding dotted line in the Answer Sheet.

The answer to *Question 17* should be written using ONLY the space available on Page 2 of the Answer Sheet. The answer should be readable by the professor. Unreadable answers will be considered wrong.

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.

Multiple choice questions

Correct answer: +2, No answer: 0, Wrong Answer -0.5

Answers must be given on the ANSWER SHEET. Any box filled here will be ignored.

Question 1

Which is the main characteristic of the D-Cell topology for data center network architectures?

- [A] The network is organized in a distributed way
- [B] The network comprises edge, aggregation and core layers
- [C] the network is organized in a recursive way
- [D] the network is organized in a hierarchical way

Question 2

Which of the following is not a feature of a fat tree topology in a data center network architecture?

- [A] It has multiple connections to the core
- [B] None of the others
- [C] It has a recursive organization
- [D] It has a three-tier model

Question 3

What is the Hardware-level virtualization?

- [A] The virtualization layer is placed between the operating system and the applications
- [B] The virtualization layer is above the applications
- [C] The virtualization layer is placed between the hardware and the operating system
- [D] The virtualization layer is placed below the hardware

Question 4

Which aspect is a drawback of data center computing platform?

- [A] Power consumption
- [B] Device independence
- [C] Universal access
- [D] Unlimited storage capacity

True false questions

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

Answers must be given on the ANSWER SHEET. 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 5
Racks shelves are used to store servers and other IT equipments:

A True B False

Question 6
Paravirtualization is a particular type of kernel-level Virtualization that does not relie on a host OS

A False B True

Question 7
In warehouse-scale computers the software running on these systems executes on clusters of hundreds to thousands of individual servers

A False B True

Question 8
In a data center for AI, servers includes both general purpose CPUs and accelerators (such as GPUs, TPUs and FPGAs):

A False B True

Question 9
NVlink is a low-bandwidth connection among Graphical Processing Units:

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 SHEET. 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 10

Consider a server composed of 2 CPUs and a variable number of GPUs. The $MTTF_{CPU} = 350 days$ and $MTTF_{GPU} = 250 days$. Given that the server to work requires that at least 1 CPU and 1 GPU are properly working, what is the minimum number of GPUs that is needed to achieve a reliability value at $t = 80 days$ greater than 0.85? Use at least 4 decimal digits for all the intermediate calculations.

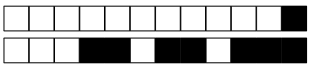
Question 11

A temperature monitoring system within each rack of a Data Center is composed of two redundant sensors, a microcontroller board, and a network device. All components are repairable. We know that each component has an MTTR of 3 days, the MTTF of the sensors is $MTTF_{sen} = 29 days$ and the MTTF of the other two components is $MTTF_{micro} = MTTF_{network} = 19 days$, what is the system availability? Use at least 4 decimal digits for all the intermediate calculations.

Question 12
Consider an HDD with, 4KB as block size, 6ms as average seek time, 0.5 ms as transfer time of 1 block, and a negligible overhead of the controller. Knowing that the average transfer time for a file of 320KB is 568 ms, and the average locality is 40%, what is the rotation speed of the disk?

Question 13
Consider a RAID 6 configuration with 10 disks. How many I/O operations are requested to update one block of a data disk (considering the sum over the entire set of disks)?

Question 14
Consider the following RAID 0+1 setup considering 6 disks, each one with an MTTF equal to 600 days and an MTTR equal to 5 days. Consider a single mirror case for the RAID 1 part. What is the MTTF of the storage infrastructure?



Question 15

A system is composed of different servers. We have the possibility to fully observe only one of them, i.e. S1. It is characterized by a utilization $U_{S1} = 0.6$, an average service time of $S_{S1} = 100$ ms, and the visit count $V_{S1} = 0.5$. What is the throughput of the server S1 (X_{S1})?

Question 16

Consider the same system and situation as in the previous question. Knowing that the average system response time (R_{Sys}) is equal to 5s, what is the average number of jobs within the entire system (N_{Sys})?

Open Question

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

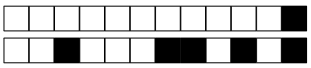
Write the answer using ONLY the space available on Page 2 of the Answer Sheet. The answer should be readable by the professor. Unreadable answers will be considered wrong.

Question 17

⇒ Why are HDDs still widely used in Data Centers even if SSDs provide better performance?

!!!ANY ANSWER PROVIDED IN THIS PAGE WILL BE IGNORED!!!

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



⇒ This page intentionally left blank ⇐

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

+1/9/52+

Computing Infrastructure - Answer Sheet (Page 1)
June 15, 2022

Student id (codice persona): .....

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

Multiple Choice Questions

Question 01 : ☐A ☐B ☐C ☐D

Question 02 : ☐A ☐B ☐C ☐D

Question 03 : ☐A ☐B ☐C ☐D

Question 04 : ☐A ☐B ☐C ☐D

True/False Questions

Question 05 : ☐A ☐B

Question 06 : ☐A ☐B

Question 07 : ☐A ☐B

Question 08 : ☐A ☐B

Question 09 : ☐A ☐B

Exercises

Question 10 : .....

Question 11 : .....

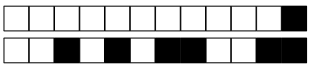
Question 12 : .....

Question 13 : .....

Question 14 : .....

Question 15 : .....

Question 16 : .....



+1/10/51+

Computing Infrastructure - Answer Sheet (Page 2)
June 15, 2022

FIRST NAME and LAST NAME in CAPITAL LETTERS

.....

(LAST NAME) (FIRST NAME)

Question 17

⇒ Why are HDDs still widely used in Data Centers even if SSDs provide better performance?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question	1
1	C
2	C
3	C
4	A
5	A
6	A
7	B
8	B
9	A
10	2 GPU
11	0,739 o 73,9%
12	6000 RPM
13	6 I/O operations
14	4000giorni o 10,96 anni
15	6 Job/sec
16	60 Jobs