Computing Infrastructure
July 13, 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.
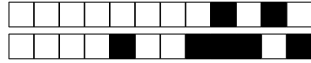
Multiple choice questions

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
One of these levels is NOT part of a typical three-layers network architecture of a data-center?

[A] Core

[B] Cloud

[C] Access

[D] Aggregation

Question 2
What are the benefits of data center virtualization?

[A] All of the other answers listed are correct.

[B] Consolidation and ease of manageability.

[C] Cost savings in power and cooling of the data center.

[D] Flexibility and agility.

Question 3
Which statement about Paravirtualization is correct?

[A] It cannot be used with traditional Operating Systems

[B] Hooks are not required

[C] Guest OS and VMM are independent each other

[D] It is the same of Kernel-level Virtualization

Question 4
When dependability-related requirements must be considered? Select the right answer.

[A] Only during requirements definition

[B] When starting testing/verification activities

[C] When a prototype of the system is available

[D] In every phase of the design flow

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

The program in warehouse-scale computing is a service provided by internet:

A False   B True

Question 6

Traditional data centers can host hardware and software for multiple organizational units or different companies.

A True   B False

Question 7

In the context of SSDs, Pages are the smallest unit that can be read/written

A False   B True

Question 8

The structure (or topology) of a reliability block diagram is always the same as the structure (or topology) of the modeled system

A True   B False

Question 9

All faults occurring in a system cause a failure of the system

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

The analysis of the failure behavior of a two components system reveals that the system is down only when both its components are down. The two components A and B have the following characteristics: $MTTF_A = 200 days$, $MTTR_A = 4 days$, $MTTF_B = 120 days$ and $MTTR_B = 2 days$. What is the reliability of the system at t = 50 days?

Question 11

You have in charge to design a computer system to control the power grid for the NorthEast region of Italy. The effect of a period with your system unavailable creates a lot of problems not only because the lights go off but also considering the block of the productivity of the area and possible civil disorders. Thus, you have set a goal of having a system with an availability level greater than 99.9999. You are constrained to use building block units for your control system having a MTTF of 800 hours and a MTTR of 14 min. How many parallel instances do you have to arrange to meet your goal? Use at least 9 decimal digits for all the intermediate calculations.
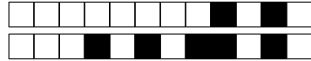
Question 12
Consider an HDD with a data transfer rate of 10 MB/s, a rotation speed of 10000 RPM, a mean seek time of 4 ms, and a negligible overhead controller. What is the minimum locality required to achieve a mean I/O service time of 3.84 ms to transfer a sector of 4 KB?

Question 13
A RAID 4 system uses four 2TB disks to store data and the required parity bits. Considering that each disk has a Sequential Access Speed (Throughput) of 50MB/s and a Random Access Speed (Throughput) of 5MB/s, what is the expected throughput of the RAID 4 considering a sequential write pattern?

Question 14
Consider the following RAID 5 setup considering 5 disks, each one with an MTTF equal to 400 days and an MTTR equal to 20 days. What is the MTTF of the storage infrastructure?
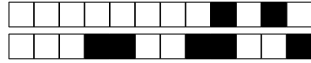
Question 15

Your system initially includes one CPU and one disk and serves 20 users characterised by 20s think time. The CPU demanding time is $D_{CPU} = 100ms$ while the disk demanding time is $D_{DISK} = 300ms$. How many disks do you need to install in your system in a way the response time lower bound is lower than $500ms$? (hint: assume that you can evenly split the disk demand among all the disks you are going to use in your system)

Question 16

Consider the same system and situation as in the previous question. Knowing that the system throughput is $X = 0.8req/s$, which is the system response time (R_{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

⇒ Classify the various types of clouds, while providing a short description of them.

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

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

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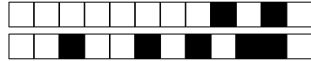
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Multiple Choice Questions

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 : ....

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July 13, 2022

FIRST NAME and LAST NAME in CAPITAL LETTERS

....

(LAST NAME)   (FIRST NAME)

Question 17
⇒ Classify the various types of clouds, while providing a short description of them.

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B
A
A
D

B
A
B
B
A

92,46%
2
50,72%
150MB/s
400 DAYS
1 disk
5 sec