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

Which sentence about Tier Level 4 of datacenter is not correct?

A All cooling equipment is independently dual-powered

B Single non-redundant distribution path serving the IT equipment

C Meets or exceeds all Tier 3 requirements

D Fault-tolerant site infrastructure with availability of 99.995%

Question 2

In the context of data centers, scalability is the ability for the infrastructure _____ without cost, efficiency, and reliability being compromised. Select the correct item to be included in the previous sentence.

A to be enlarged or to handle an increment of the input requests

B to run in a larger building

C none of the others

D to improve the cooling strategy

Question 3

Which is the most appropriate definition for "fault"?

A Any library inconsistency in the Operating System

B Any defect in the silicon caused by dust particles during manufacturing

C Any inappropriate usage of the system

D Any event interfering with the nominal behavior of the system

Question 4

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

A Access

B Aggregation

C Core

D Cloud

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

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

A False B True

Question 6

In datacenter storage context, DAS means Distributed Application Storage:

A False B True

Question 7

In the context of rack servers, 1U is 44.45cm

A True B False

Question 8

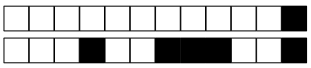
In a reliability block diagram, adding components in series decrease the system reliability with respect to the reliability of the single component

A False B True

Question 9

Warehouse-scale computers run a large number of very small applications

A True B False



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: $MTTF_A = 200days$, $MTTR_A = 4days$, $MTTF_B = 120days$ and $MTTR_B = 2days$. What is the reliability of the system at t = 50 days?

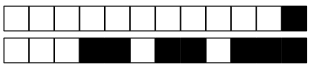
Question 11

You have in charge to design a computer system to control the power grid for the NorthWest 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 1000 hours and a MTTR of 12 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 7500 RPM, a mean seek time of 6 ms, and a negligible overhead controller. What is the minimum locality required to achieve a mean I/O service time of 2.20 ms to transfer a sector of 4 KB?

Question 13
A RAID 5 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 5 considering a random write pattern?

Question 14
Consider the following RAID 0+1 setup considering 8 disks, each one with an MTTF equal to 750 days and an MTTR equal to 12 days. Consider a single mirror case for the RAID 1 part. 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

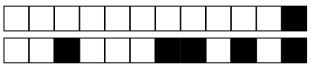
Write the answer using ONLY the space available on Page 2 of the Answer Sheet. The answer should be readable by the professor. Unreadable answers will be considered wrong.

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.

+1/9/52+

Computing Infrastructure - Answer Sheet (Page 1)
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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 : .....

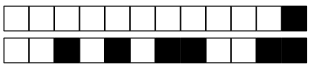
Question 12 : .....

Question 13 : .....

Question 14 : .....

Question 15 : .....

Question 16 : .....



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Computing Infrastructure - Answer Sheet (Page 2)
July 13, 2022

FIRST NAME and LAST NAME in CAPITAL LETTERS

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(LAST NAME) (FIRST NAME)

Question 17

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

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1	B
2	A
3	D
4	D
5	A
6	A
7	B
8	B
9	B
10	92,46%
11	2
12	82,00%
13	5 MB/S
14	1465 DAYS
15	1 disk
16	5 sec