Computing Infrastructures
January 16, 2024

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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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 GPUs (Graphics Processing Units) are primarily used in datacenters for accelerating graphical applications and gaming.

A True B False

Question 2 SANs typically use Fibre Channel or iSCSI to connect servers to storage devices.

A True B False

Question 3 GPUs are generally less expensive to deploy and maintain compared to CPUs in datacenter environments.

A False B True

Question 4 Liquid immersion cooling can damage servers if not done properly.

A True B False

Question 5 TPUs are widely available and can be easily procured for use in most datacenter environments.

A False B True

Question 6 Datacenter tiers are a standardized classification system used to categorize the reliability and availability of a data center.

A True B False

Question 7 Hypervisors are only used in cloud computing environments.

A True B False

Question 8 Cloud architectures rely on service-level agreements (SLAs) to ensure uptime and availability.

A True B False

Question 9 RAID 0 provides basic data redundancy and fault tolerance.

A True B False

Question 10 Open loop (free) cooling refers to the use of cold outside air to either help produce chilled water or directly cool servers.

A True B False

Exercises

Correct answer: +2, No answer: 0.

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Question 11

Suppose we have a computer system consisting of 2 critical components (C_1 and C_2), both of which must work for the whole system to work. They have the same cost and their reliability after 1 year is $R_{C1} = 0.8$, $R_{C2} = 0.92$.

- What is the availability A_{SYS} of the whole system if the MTTR of both components is 1 day? Use 4 decimal digits for all calculations.
- If the objective is to increase the availability of the system, and there is a budget to add two components to the system, would it be better to (A) replace component C_1 with three components in parallel, or (B) replace components C_1 and C_2 each with simple parallel systems (one extra each)?

Question 12

Let us consider a set of requests in the disk queue referring to the following cylinders of the disk: 27, 8, 42, 73, 11. Consider the initial position of the disk head at cylinder 24 and moving from inside (lower cylinder number) to outside (higher cylinder number). Writes the order of the served requests (from the first to the last) if the disk head scheduling algorithm adopted is C-SCAN (Circular SCAN)? Use the cylinder number to refer to the request.

Question 13
Consider an HDD with a data transfer time of 0.4ms for a 2 KB sector, a rotation speed of 12000 RPM, a mean seek time of 6 ms, and a negligible overhead controller. What minimum locality is required to achieve a mean I/O service time of 8 ms to transfer a 10KB file?

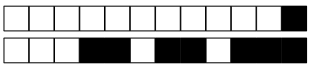
Question 14
In a small enterprise dealing in computer graphics, the main storage solution is a distributed file system. N=8 employees access the file system via a front end server (FS), which takes care of writing to two different storage nodes ($S1$, $S2$). To evaluate the system performance, a two-hour (2h) monitoring phase has been performed. The following data have been collected:

- total number of system completions, $C = 5400$;
- system response time, R= 4 s;
- front end busy time, $B_{FS} = 22.5$ min;
- first storage node utilization, $U_{S1} = 13.5\%$;
- first storage node service time, S_{S1}= 15 ms;
- second storage node service time, S_{S2}= 5 ms;
- visits at the storage layer (i.e., including the two storage nodes only, named SL), $V_{SL} = 32$;
- average population for the storage layer (i.e., the average number of jobs for the two storage nodes), $N_{SL} = 4$.

Compute: the think time during the measurement phase and the average response time of the storage layer (i.e., including the two storage nodes only)

Question 15
Consider the same system and scenario analyzed in *Question 14*, compute: the service demands of all the servers (D_{FS}, D_{S1}, D_{S2}).

Question 16
Consider the same system and scenario analyzed in *Questions 14 and 15*, determine the bottleneck by writing the name of the server determining it and the maximum possible throughput.



Open Questions

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Question 17

⇒ What is the power usage effectiveness (PUE) metric in the context of data centers? Provide the definition, and describe what is the meaning of the different values and their impact.

Question 18

⇒ Which are the main differences between IaaS and PaaS solutions?

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+1/9/52+

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Answer Sheets (Page 3)

Student ID (Codice Persona): SOLUZIONE

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 : 0,9992 B

Question 12 : 27-42-73-8-11

Question 13 : 0,8588 o 85,88%

Question 14 : $Z = 6.66$ sec $R_{SL} = 0,166$ sec

Question 15 : $D_{FE} = 0,25$ sec $D_{SL} = 0,18$ sec $D_{SZ} = 0,1$ sec

Question 16 : FE SERVER $X_{MAX} = 1,11 \frac{Req}{sec}$

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Question 10 RAID 0 provides basic data redundancy and fault tolerance.

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Exercises

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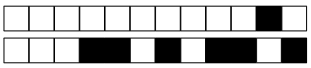

Open Questions

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Question 17

⇒ What is the power usage effectiveness (PUE) metric in the context of data centers? Provide the definition, and describe what is the meaning of the different values and their impact.

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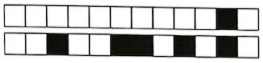

+2/9/42+

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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 : 0,9992 B

Question 12 : 27-42-73-8-11

Question 13 : 0,9111 o 91,11 %

Question 14 : $\bar{z} = 6$ sec $R_{SL} = 0,166$ sec

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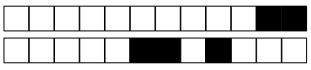
Question 16 : F.E. SERVER $X_{MAX} = 1,345$ $\frac{REQ}{SEC}$



+3/1/40+

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A True B False

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Exercises

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Answer Sheets (Page 3)

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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 : [ ] A [X] B

Question 06 : [X] A [ ] B

Question 07 : [X] A [ ] B

Question 08 : [ ] A [X] B

Question 09 : [X] A [ ] B

Question 10 : [X] A [ ] B

Exercises

Question 11 : 0,9992 B

Question 12 : 37 - 52 - 83 - 12 - 21

Question 13 : 86,67% o 0,8667

Question 14 : $Z = 6$ SEC $P_{SL} = 0,166$ SEC

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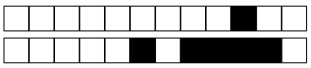

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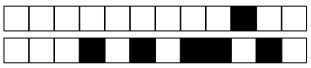

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Question 16
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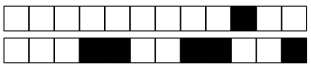

Open Questions

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

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⇒ What is the power usage effectiveness (PUE) metric in the context of data centers? Provide the definition, and describe what is the meaning of the different values and their impact.

Question 18

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+4/9/22+

Computing Infrastructures - January 16, 2024

Answer Sheets (Page 3)

Student ID (Codice Persona): SOLUZIONE

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 : 0,9992 B

Question 12 : [illegible] 27-42-73-8-11

Question 13 : 0,8667 o 86,67%

Question 14 : $Z = 4\,sec$ $R_{SC} = 0,166\,sec$

Question 15 : $D_{FS} = 0,25\,sec$ $D_1 = 0,1\,sec$ $D_2 = 0,11\,sec$

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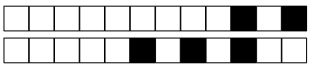

+5/1/20+

Computing Infrastructures
January 16, 2024

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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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

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Question 1 TPUs are widely available and can be easily procured for use in most datacenter environments.

A False B True

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Question 3 Liquid immersion cooling can damage servers if not done properly.

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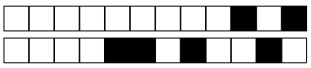

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+5/9/12+

Computing Infrastructures - January 16, 2024

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Question 01 : [X] A [ ] B

Question 02 : [ ] A [X] B

Question 03 : [X] A [ ] B

Question 04 : [X] A [ ] B

Question 05 : [ ] A [X] B

Question 06 : [X] A [ ] B

Question 07 : [ ] A [X] B

Question 08 : [ ] A [X] B

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Exercises

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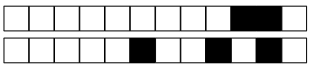

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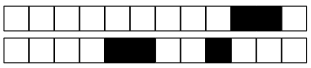

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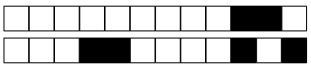

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Computing Infrastructures - January 16, 2024

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