This exam has a maximum duration of 90 minutes.

This exam has a maximum score of **10 points**, equivalent to **3.5 points** of the final grade for the course. It contains questions of theoretical units and lab sessions. Indicate, for each of the following **58 statements**, if they are true (T) or false (F).

Each answer is worth: right= 10/58, wrong= -10/58, empty=0.

Important: **first 3 errors do not penalize**, so they will be equivalent to an empty answer. From the 4th error (inclusive), the decrement for wrong answers will be applied.

THEORY QUESTIONS

A hard real-time system consists of 4 tasks whose characteristics are described in the following table:

Task	Computation Time	Period	Deadline
T1	3	15	10
T2	4	25	15
T3	6	30	18
T4	6	40	30

Assuming that the system is scheduled by fixed-priority pre-emptive scheduling with priorities inverse to its deadline, that is, the task with the shortest deadline has got the highest priority, and assuming that these tasks are independent:

1. ... the response time for task T4 is R4=30.	F
2. if tasks always use the computation time indicated in the table in all their activations, then task T2 will be running on the CPU at time 605.	T
3. ... the response time for task T2 is R2=7.	T
4. ... the system is schedulable.	T

Assuming in this case that the tasks use two semaphores M1 and M2 to synchronize access to their critical sections (CS) whose characteristics are described in the following table, and that these semaphores use the immediate priority ceiling protocol:

Task	Semaphore	Duration of the CS
T1	M1	1
T2	M1	2
T3	M2	4
T4	M2	3

5. ... the blocking factor of task T1 is B1=3.	F
6. ... the blocking factor of task T3 is B3=3.	T
7. ... the priority ceiling of the semaphore M2 is equal to the priority of T4.	F
8. ... the response time of task T3 is lower or equal to its deadline.	F

Regarding replication in distributed systems:

9. Passive replication implies that we will have weak consistency, because the backup replicas will always have a very different state from the state of the primary replica.	F
10. If the premises are given to replicate a service through active replication and we have a message broadcasting protocol that guarantees the delivery of messages to the different replicas in the same order, we can achieve a system with strong consistency.	T
11. Using active replication, if we intend to tolerate Byzantine failures, we can only have an odd number of replicas.	F

Regarding the features of distributed systems:

12. The distribution transparency has several axes: failure transparency, location transparency, replication transparency, etc.	T
13. All distributed systems are concurrent.	T
14. Standardization facilitates interoperability and portability of applications.	T
15. Middleware replaces the Local Operating System.	F
16. Failure transparency implies that in case of failures, the user must be notified of the failure, so that the user can take some action.	F
17. One of the common mechanisms for achieving location transparency is the use of name services.	T

Regarding availability, scalability and security in distributed systems:

18. Timing failures are undetectable.	F
19. Byzantine failures are compound failures.	F
20. The CAP theorem indicates that in the presence of partitions we cannot simultaneously achieve high availability and a strong consistency model.	T
21. To deal with simple undetectable failures we must use passive replication.	F
22. The use of caches is one of the techniques that improve scalability.	T
23. Integrity of the data means providing the guarantee that the service is not interrupted.	F

Regarding the ROI and Java RMI communication mechanisms:

24. We define "remote object" as any object that is defined in a node but can only be invoked from other nodes.	F
25. ROI follows a request/response model, and therefore is synchronous in response.	T
26. Remote objects are passed by value, and local objects by reference.	F
27. RMI is multilanguage and multiplatform.	F

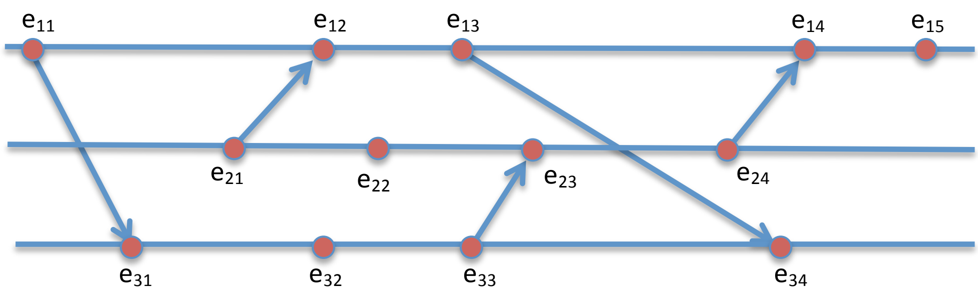
Regarding communication mechanisms, in general, and RESTful web services and Java Message Service in particular:

28. RESTful web services use HTTP status codes in their responses.	T
29. REST provides persistent communication.	F
30. The first step to using JMS is to launch a broker that facilitates communications.	T
31. Java Message Service is a message-oriented middleware that offers a loosely coupled communication.	T
32. Systems that do not provide persistence require sender and receiver to be active simultaneously.	T

Regarding synchronization of physical clocks and usage of logical and vector clocks:

33. Given the logical clocks C(a)=5 and C(b)=12, we can state that a-->b	F
34. Given the vector clocks V(x)=[2,3,6] and V(z)=[1,1,3] we can state that z--> x	T
35. If two events "e" and "f" establish the sending and receiving of the same message "m", respectively, occurring "e" at node N1 and "f" at node N2, and if V(e)=[1,1,2], then V(f)=[1,2,2], independently of the value of the vector clock of node N2 previous to receiving message "m".	F
36. Using clock synchronization algorithms, we can synchronize the physical clock of two computers so that they have a fairly similar value, but not exactly identical, since there will always be a certain error in synchronization.	T
37. A system that uses the Berkeley algorithm to synchronize clocks must also have some leader election algorithm.	T

Given the following temporal diagram of events, we can affirm:



38. $e_{11} \mid\mid e_{22}$.	T
39. $V(e_{14}) = [4,4,3]$	T
40. $e_{12} \dashrightarrow e_{24}$	F
41. $C(e_{34}) = 5$	T
42. If we initiate the capture of the global state in the first node, just after executing the event e_{13} and before executing the event e_{14}, the algorithm will provide a global state that will always include as a "message in transit" the message sent from e_{13} to e_{34}.	F

Regarding the mutual exclusion algorithms, leader election algorithms and consensus algorithms:

43. The leader election algorithm for rings is an example of a consensus algorithm in which the participating nodes agree that the leader is the node of the "participant node" list with the highest identifier.	T
44. In the Bully algorithm, the initiator sends an ELECTION message to all the nodes in the group, in order to detect which nodes are active and which have fallen.	F
45. In the distributed mutual exclusion algorithm, when a node receives a TRY message from another node, and does not want to enter the critical section, it simply responds with an OK message.	T
46. In the distributed consensus algorithm considering failures, the coordinator node has been previously chosen using a leader election algorithm.	F
47. In the distributed consensus algorithm considering failures, at the beginning of each round the nodes send an "estimate" message to the coordinator of the round and, if they are ordinary nodes, they wait for a "propose" message.	T
48. In a system with 7 nodes, the coordinating node of the distributed consensus algorithm considering failures would be blocked if 3 nodes fail.	F
49. In case no failures occur, the number of messages necessary to reach consensus among "n" nodes, is O (n2).	F

PRACTICE QUESTIONS

Regarding practice 4 of Active Directory Domain Services (AD DS):

1. In each domain there are one or more domain controllers, which are machines on which the domain services of that domain are executed.	T
2. Users of a domain must be created within the "Users" container.	F
3. If a domain controller falls, the services of the corresponding domain will stop working.	F

Regarding practice 5 (The object-oriented distributed Chat based on RMI):

4. In the distributed chat application of this practice, the ChatServer object is the only object registered in the rmiregistry name server.	T
5. In the distributed chat application of this practice, the ChatMessage objects are persistent, so if a user connects to a channel he can read the messages sent to this channel previous to his connection.	F
6. When a user sends a ChatMessage message to a channel, the other users of the channel receive the reference to this object (proxy) and they call to a method of this proxy to obtain the text of the message.	T

Regarding practice 6 (Java Message Service):

7. In the chat application using JMS, several CsdMessengerServer can be run at the same time so that JMS automatically manages the replication of the service.	F
8. CsdMessengerClient uses a temporary queue to collect all the responses and communications originated from the CsdMessengerServer or other CsdMessengerClient.	F
9. In the distributed chat, the CsdMessengerServer component uses the queues of users to notify the connection of a new user.	T