

PAPER CODE NO.
COMP212

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of LIVERPOOL

May 2005 EXAMINATIONS

Bachelor of Arts: Year 2
Bachelor of Science : Year 2

Distributed Systems

TIME ALLOWED : Two Hours

INSTRUCTIONS TO CANDIDATES

Answer any **four** questions only.
Each question is worth 25 marks.

If you attempt to answer more questions than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).

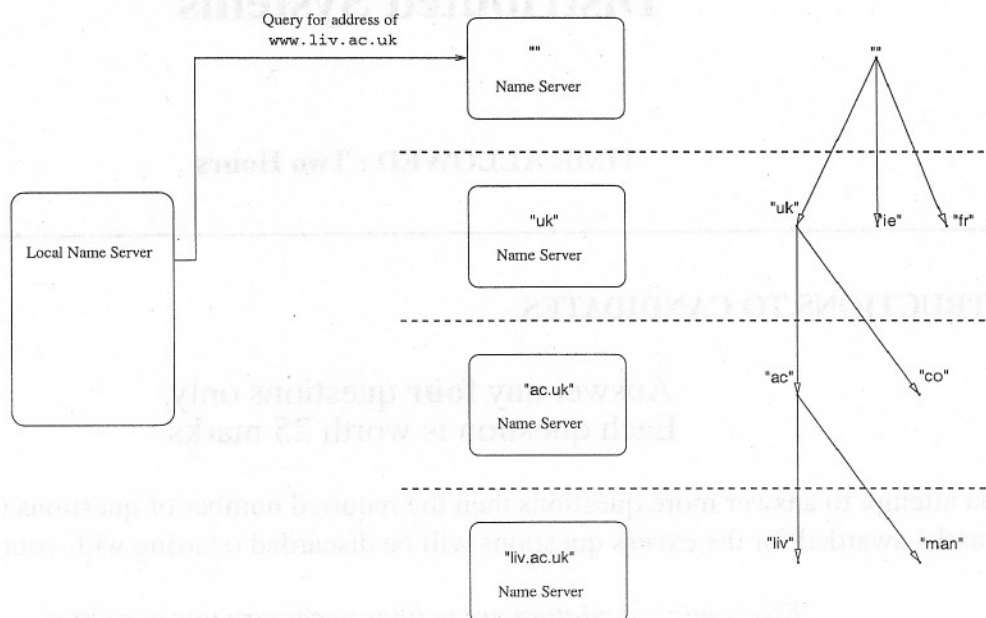
Electronic calculators are neither necessary nor permitted.



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Question I

1. What is a distributed system? **3 marks**
2. Give four examples of resources to be shared in a distributed system. **2 marks**
3. Processes in distributed systems are often divided into two groups: clients and servers.
 - (a) Describe the client-server model. **3 marks**
 - (b) Give a graphical representation of the request-reply interaction between a client and a server. **2 marks**
 - (c) Describe the n-tier architecture. **4 marks**
4. Give two examples of identifiers (here, by the term "identifiers" we mean those identifiers that refer to entities in distributed systems). **2 marks**
5. A local name server performs an *iterative* query for address of `www.csc.liv.ac.uk` starting from a root node. The name hierarchy and name servers are given in the picture.



Assuming that no data can be found in server caches, represent graphically and describe communication between name servers. **7 marks**

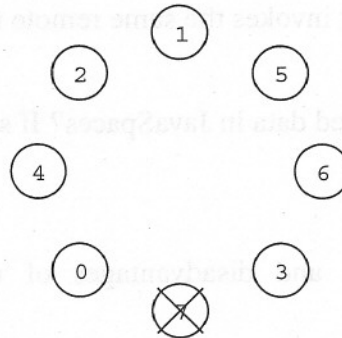
6. Communication in Jini is based on which of: message queueing, Java RMI, or remote procedure calls? **2 mark**



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Question II

1. Give **four** examples of different types of transparency **1 mark each**
2. Why are transport-level communication services often inappropriate for building distributed applications? **3 marks**
3. What is the difference between a vertical tier distribution and a horizontal tier distribution? **3 marks**
4. What is the role of middleware in a distributed system? **4 marks**
5. Consider a group of eight processors numbered 0 to 7. Previously process 7 was the coordinator, but it has crashed.



Process 3 is the first one to notice this, so it initiates a new election by the **bully** algorithm. Apply the algorithm to the described situation, show messages being sent between the processes, and find who will be the new coordinator. **8 marks**

6. What are the most important scalability problems in Jini? **3 marks**

Question III

1. Classify the following protocols: IP, TCP, HTTP according to the ISO OSI classification. **3 marks**
2. Instead of letting a server register itself with a registry as is done in Java RMI, we could also choose to always assign it the same endpoint. That endpoint can then be used in references to objects in the server's address space. What is the main drawback of this scheme? **3 marks**
3. Give an example of a stateless protocol. **2 marks**



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4. In client-server applications supporting user access to databases we can distinguish the following three levels:

- user-interface level;
- processing level;
- data level;

Describe the services offered by each of the three levels. Describe the two most common ways to distribute these three levels between clients and servers in the (physically) two-tiered architecture. **6 marks**

5. Explain what every part of the following URL means:

`jdbc:oracle:thin:@indian.csc.liv.ac.uk:1521:c302` **4 marks**

6. In Java RMI, if a client invokes the same remote method again, does it necessarily use the registry? **3 marks**

7. Does Jini keep formatted data in JavaSpaces? If so, how is it formatted? **4 marks**

Question IV

1. What are advantages and disadvantages of using CGI scripts as compared with JSP? **6 marks**

2. Explain the difference between a hard link and a soft link in UNIX file systems. **4 marks**

3. Distributed file system Coda allows a client to continue working with a shared file even if there is no network connection between the client and the server. Explain how this is made possible. **4 marks**

4. Can one name belong to more than one namespace? **3 marks**

5. Consider a network consisting of 5 computers, *A* (coordinator), *B*, *C*, *D*, and *E*. At 14 : 00 the coordinator decides to synchronise the clock of all computers in the network. At that moment, the clock of every computer in the network shows the following.

Computer	Clock
<i>A</i>	14:00
<i>B</i>	13:57
<i>C</i>	14:05
<i>D</i>	13:58
<i>E</i>	14:05

Apply the Berkley clock synchronisation algorithm to this situation, show the stages of computation, and write what will be the outcome of the synchronisation. The time needed for computation and for network communication is negligible. **8 marks**



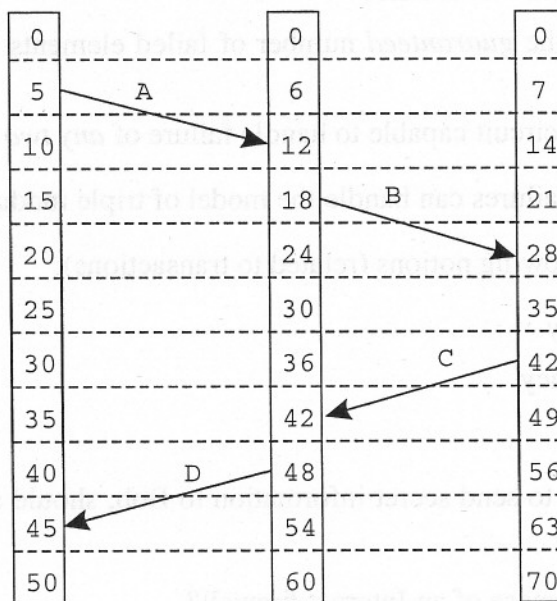
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Question V

1. A clock is reading 12:45:46.0 (hr:min:sec) when it is discovered to be 5 sec fast. Are there any drawbacks in setting it back to the correct time at that point? **3 marks**

2. Define the following notions:
 - (a) Critical section **2 marks**
 - (b) Mutual exclusion **2 marks**
 - (c) Semaphore **2 marks**

3. Consider three communicating processes, P_1 , P_2 , and P_3 , depicted in the figure.



The processes run on different machines, each with its own clock running at its own speed. When the clock has ticked 5 times in process P_1 , it has ticked 6 times in process P_2 and 7 times in process P_3 . Each clock runs at a constant rate, but the rates are different due to, say, differences in the crystals. At time 5 process P_1 sends message A to process P_2 . When it arrives, process P_2 reads 12 and so on for other messages.

Show how the Lamport's algorithm synchronises the clock in the described situation. **8 marks**

4. Are processes using Jini for coordination required to coexist in the same time? Explain why/why not. **4 marks**

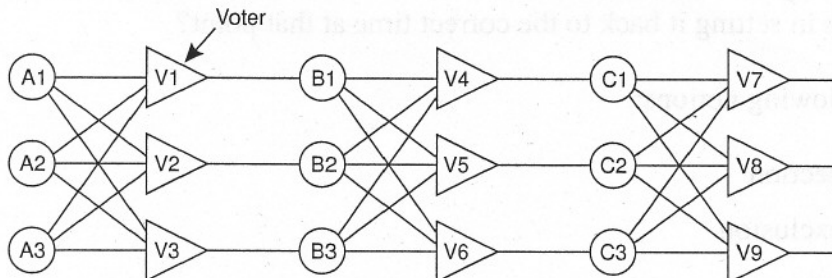
5. Is it possible to describe *semantics* of objects and services in CORBA IDL? **4 marks**



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Question VI

1.



- (a) What is the maximal number of failed elements (devices plus voters) that the circuit given above can handle? **2 marks**
 - (b) What is the *guaranteed* number of failed elements that the circuit given above can handle? **3 marks**
 - (c) Devise a circuit capable to handle failure of *any two* elements. **5 marks**
2. What kind of failures can handle the model of triple modular redundancy? **2 marks**
3. Define the following notions (related to transactions):
- (a) Atomicity **2 marks**
 - (b) Consistency **2 marks**
 - (c) Isolation **2 marks**
4. If Alice wants to send secret information to Bob, should she know Bob's public or Bob's private key? **2 marks**
5. What is the purpose of an Internet firewall? **5 marks**