UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1996

BEng Honours Degree in Computing Part III
BEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part III
BSc Honours Degree in Mathematics and Computer Science Part III
MSc Degree in Computing Science
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the
Diploma of Membership of Imperial College
Associateship of the City and Guilds of London Institute
Associateship of the Royal College of Science

PAPER 3.35 / I3.14

DISTRIBUTED SYSTEMS

Tuesday, April 30th 1996, 10.00 - 12.00

Answer THREE questions

1a In distributed programming languages, what is meant by the terms communication *connection* and communication *transaction*? In each case, what is it that determines the pattern of the connection or transaction?

What patterns of connection are supported by *mailboxes*?

b Outline a simple implementation protocol for the following remote procedure call (request-reply) communication primitives with *mailboxes*.

> *Source:*   **call** mb (request-message, reply-message)
>
> *Destination:*   **accept** request-message **from** mb;
>   <statements>
>   **reply** reply-message;

c A number of *user* processes and a number of *printer* processes execute in a particular distributed system. A simplified printer service is required to permit user processes to print documents. The system is to be set up so that, to print a document, a user gains exclusive access to a printer via its printer process, and then sends page by page of the document to the printer process.

Design the required protocol that would be used by the processes to setup a print session, use the printer and terminate the session (by sending an end of document marker). Outline the structure of the system and the code that would be used by each user and each printer process.

Use the above remote procedure call communication primitives with *mailboxes*, and assume that mailbox names may be included in messages (i.e. name passing).

The three parts carry, respectively, 25%, 25%, 50% of the marks.

2a Describe the main objective of the OMG organisation in promoting the CORBA architecture. Give 5 of the main parts of the architecture, briefly describing the functionality of each.

b Assuming a client and server process are implemented on different types of computers, discuss the problems of passing each of the following as parameter types in calls from the client to the server and indicate possible solutions to the problems:

i)   integer number
ii) real number
iii) procedure
iv) double linked list

The two parts carry, respectively, 50%, 50% of the marks.

/Turn over

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3a   Describe the required system calls and explain the functions performed by a Remote Procedure Call (RPC) system to enable a client to find a remote server and establish a binding to the server.
Describe how the RPC system implements a remote invocation by the client on the server using stub procedures and a dispatcher.

b   *Briefly* discuss the system failures and communication error conditions that a reliable RPC mechanism would have to consider. Mention what the support system can do about each failure.

The two parts carry, respectively, 40%, 60% of the marks.

4   A distributed file system is based on client workstations with small local discs and large files servers connected via a network.
Assume:
All discs have an average seek time of 9 ms.,
Disc transfer rate of 3.5 x10^6 bytes/s.,
Network transmission rate of 10 x10^6 bits/s.,
Remote procedure call (zero length message) round trip delay of 4 ms.
Access time to main memory can be considered = 0 ms.

a   Calculate the total time to read a 7,000 byte disc block from the remote server and discuss the potential problems which may arise from accessing the file on the remote disc.

b   Identify three places where **caching** could take place in a distributed file system. Calculate the access time for each location and discuss the advantages and disadvantages of each place for caching.

c   Explain why client caches should be validated before access. Assuming clients cache complete files, outline a suitable technique for validation of local file cache.

The three parts carry, respectively 20%, 60%, 20% of the marks

5a   A distributed programming system uses a name service which maintains replicated information in a number of servers connected to a large network. An update to the information base can be initiated at any site in the network. Explain what would be entailed in trying to maintain **strong consistency** amongst the replicated information and discuss why a **weak consistency** strategy is better.

b   Assume every processor in the network has a local agent for accessing the name service. Outline the functions the agent performs and describe a suitable method for resolving a hierarchical path name of the form schloss.berlin.gmd.org.de to a machine address in the network.

The two parts carry, respectively, 50%, 50% of the marks.

End of paper