

PAPER CODE NO.  
COMP314

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THE UNIVERSITY  
*of* LIVERPOOL

## SUMMER 2001 EXAMINATIONS

Bachelor of Arts : Year 3  
Bachelor of Engineering : Year 3  
Bachelor of Science : Year 3

### DISTRIBUTED INFORMATION SYSTEMS

TIME ALLOWED : Two Hours

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#### INSTRUCTIONS TO CANDIDATES

Credit will be given for the best **three** answers only

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

**Credit will be given for the best three answers only.**

1a) What is the difference between a two-tier and a three-tier architecture for Distributed Information Systems?

Show, diagrammatically or otherwise, the components of each of the architectures and the communications protocols appropriate for each stage.

Describe the most important characteristics of each for Distributed Information Systems and their advantages and disadvantages.

(12 marks)

b) An estate agent's web site is to be designed that allows potential customers to search for houses by:

Price range

Number of bedrooms

Location, in terms of the first part of the Postcode

or any combination of these parameters.

Show the operations required by a Java application to produce appropriate lists sorted either by price, or location, using Java Database Connectivity (JDBC).

**Note that marks will be awarded for specifying the operations to be performed and the proposed mechanism for building appropriate queries rather than detailed programme code, or a specific table design. You only need to show the fields required to implement your search mechanism.**

(13 marks)

2 A simple election interface provides two remote methods:

*Vote*: with two parameters through which the client supplies the name of a candidate (a string) and the 'voter's number' (an integer used to ensure that each user votes only once). The voter's numbers are allocated sparsely from the range of integers to make them hard to guess.

*Result*: with two parameters through which the server supplies the client with the name of the candidate and the number of votes for that candidate.

- a) Indicate for each parameter used by these two procedures, which is input, and which output. (2 marks)
- b) Define the interface for the election service in Java RMI and CORBA IDL. Note that CORBA IDL provides the type long for 32 bit integers. (10 marks)
- c) Compare the methods in the two languages for specifying input and output parameters. (5 marks)
- d) The election service must ensure that a vote is recorded whenever any user thinks they have cast a vote.

Discuss how this affects the remote calling semantics that should be used.

(8 marks)

3 The Task Bag is an object that stores pairs of (*key* and *value*). A *key* is a string and a *value* is a sequence of bytes. Its interface provides the following methods:

*pairOut*: with two parameters through which the client specifies a *key* and a *value* to be stored

*pairIn*: whose first parameter allows the client to specify the key of a pair to be removed from the Task Bag. The value in the pair is supplied to the client via the second parameter. If no matching pair is available, an exception is thrown.

*readPair*: is the same as *pairIn* except that the pair remains in the Task Bag.

- a) Use CORBA IDL to define the interface of the Task Bag. Define an exception that can be thrown whenever any one of the operations cannot be carried out. Your exception should return an integer indicating the problem number and a string describing the problem. The Task Bag interface should define a single attribute giving the number of tasks in the bag. (12 marks)
- b) Define an alternative signature for the methods *pairIn* and *readPair*, whose return value indicates that no matching pair is available. The return value should be defined as an enumerated type whose values can be *ok* or *wait*. (6 marks)

- c) Discuss the relative merits of the two approaches. Which approach would you use to indicate an error such as a key that contains illegal characters?  
(7 marks)
- 4a) The term "agent" in the context of computer systems has no universally accepted meaning - the term is usually defined by listing attributes that it claimed an agent has. Briefly describe what you understand to be the most commonly mentioned attributes of agency.  
(5 marks)
- b) "Communication in the object and agent worlds is fundamentally different".  
Briefly explain what you understand by this statement.  
(3 marks)
- c) Describe the structure of messages in the FIPA agent communication language.  
(3 marks)
- d) Describe the role of the INFORM and REQUEST performatives in the FIPA agent communication language.  
(4 marks)
- e) The CONTRACT NET protocol is perhaps the most widely used protocol in the multi-agent systems world. Briefly describe:
- i) the characteristics of problems for which the CONTRACT NET is appropriate;  
(3 marks)
  - ii) the different stages of the protocol;  
(4 marks)
  - iii) the main issues that must be addressed when implementing the CONTRACT NET.  
(3 marks)