

R249/316A

DUBLIN INSTITUTE OF TECHNOLOGY
KEVIN STREET, DUBLIN 8.

BSc Information Systems / Information Technology

Stage 3

SUPPLEMENTAL EXAMINATIONS 2007

DISTRIBUTED INFORMATION SYSTEMS

MR. C. O'LEARY
DR. B. O'SHEA
MR. P. LAWLESS

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ATTEMPT 4 QUESTIONS

ALL QUESTIONS CARRY EQUAL MARKS

1. (a) “A distributed system is one in which the failure of a computer you didn't even know existed can render your own computer unusable”

Do you think that this quote from Leslie Lamport is a fair and accurate description of a distributed system? Briefly explain why.

(6 marks)

- (b) Using a clearly worked out example and supporting diagrams, demonstrate how *Lamport Logical Clocks* can be used to achieve event ordering in a multi-process system.

(9 marks)

- (c) Rework your example from part (b) to demonstrate the operation of *Vector Clocks*.
(10 marks)

2. (a) Define the following properties in relation to mutual exclusion algorithms for multi-process systems:

- i. Safety
- ii. Liveness
- iii. Ordering

(6 marks)

- (b) Evaluate, compare and contrast *ring based* and *central server based* algorithms for imposing mutual exclusion in a distributed system.

(9 marks)

- (c) Consider a situation where mutual exclusion applies to sets of processes rather than individual processes.

For each set, the members of the set can agree on the number of processes allowed into the critical section concurrently.

While a process from one set is in the critical section, processes from other sets will not be allowed into the critical section.

Invent and evaluate an algorithm for enforcing this type of exclusion. State all assumptions.

(10 marks)

3. (a) Devise a simple method for encrypting text-based documents, and briefly evaluate the suitability of this method for security in distributed systems. **(6 marks)**
- (b) Alice and Bob wish to exchange a document, but fear that Mallory will interfere with the document as it is being carried across the communication network. Describe clearly one method which Alice and Bob can use to frustrate Mallory's attempt. State any assumptions you make. **(9 marks)**
- (c) Java systems can be characterised by their modularity, mobility and platform independence. Considering this, discuss the importance of security in these systems and the methods employed by Java to provide this security. **(10 marks)**
4. (a) Describe clearly the role of *proxy* or *stub* objects in distributed object systems. **(6 marks)**
- (b) Explain clearly what is meant by *object serialisation* and discuss the relevance of this for distributed object systems. **(9 marks)**
- (c) Present an argument for *and* against the use of XML as a serialisation method for distributed systems. **(10 marks)**
5. (a) What does the *Two-Generals Problem* tell us about distributed systems? **(6 marks)**
- (b) Ethernet uses an optimistic method for managing mutual exclusion for a shared communication system. Identify and briefly describe this method. **(9 marks)**
- (c) Describe and evaluate the effectiveness of the method employed by the *Transmission Control Protocol* (TCP) to coordinate the communication of data across unreliable networks. **(10 marks)**
6. (a) What is meant by the *publish-subscribe* interaction pattern for distributed objects? Use examples to illustrate your answer. **(6 marks)**
- (b) Describe the importance of the matching algorithm in distributed event based systems. Clearly distinguish between the main classes of matching algorithms. **(9 marks)**
- (c) Provide a filtering algorithm for a *stock trading system* which operates with all the standard functionality of an event-based system. **(10 marks)**