



The University of Fiji

Undergraduate Programme
Department of Computer Science and Information Technology
Semester 2 Year 2016

FINAL EXAMINATION PAPER

ITC333: DISTRIBUTED SYSTEMS TECHNOLOGY

Important Instructions to Students:

1. Read the questions, instructions carefully and answer the questions.
2. You are allowed an extra 10 minutes reading time (during this time, you are not allowed to write with pen) and 180 minutes (3 Hours) to complete this paper.
3. Silent, non-programmable calculators are allowed, but not supplied.
4. Write all your answers in the answer booklet provided. If you need extra sheets, please ask from the supervisor. Write your name, course code and student identification number in the answer booklet and in the attendance sheet.
5. This Final Course Examination Paper is worth 100 marks contributes 50% of the total course assessments.
6. This paper contains one (1) section, section A. All questions are compulsory to answer.
7. Write all your answers legibly. The marker has the right to award zero for answers that are not legible.
8. This is a **Closed Book Examination**. The University views plagiarism, cheating and dishonest practice as serious offences and if found, offenders are penalized.

Examination Paper Content (Format):

<u>Section</u>	<u>Question</u>	<u>Content</u>	<u>Marks</u>	<u>Suggested Time</u>
A	1-11	Short answer questions	100	180
		TOTAL	100	180 Minutes

All questions in this section are compulsory

QUESTION 1: CHARACTERIZATION OF DISTRIBUTED SYSTEMS**[10 Marks]**

- A. Give three types of hardware resource and five types of data or software resource that can usefully be shared.
[3 Marks]
- B. A user arrives at a railway station that she has never visited before, carrying a PDA that is capable of wireless networking. Suggest how the user could be provided with information about the local services and amenities at that station, without entering the station's name or attributes. What technical challenges must be overcome?
[1 Mark]
- C. What are the advantages and disadvantages of HTML, URLs and HTTP as core technologies for information browsing? Are any of these technologies suitable as a basis for client-server computing in general?
[2 Marks]
- D. Give an example of a URL. List the three main components of a URL, stating how their boundaries are denoted and illustrating each one from your example. To what extent is a URL location transparent?
[4 Marks]

QUESTION 2: SYSTEM MODELS**[10 Marks]**

- A. Describe and illustrate the client-server architecture of email internet application. Draw a diagram to support your answer.
[3 Marks]
- B. A search engine is a web server that responds to client requests to search in its stored indexes and (concurrently) runs several web crawler tasks to build and update the indexes. What are the requirements for synchronization between these concurrent activities?
[2 Marks]
- C. Suggest some applications for the peer process model, distinguishing between cases when the state of all peers needs to be identical and cases that demand less consistency.
[2 Marks]
- D. List the types of local resource that are vulnerable to an attack by an untrusted program that is downloaded from a remote site and run in a local computer.
[1 Marks]
- E. Give some examples of applications where the use of mobile code is beneficial.
[2 Marks]

QUESTION 3: NETWORKING AND INTERNETWORKING

[8 Marks]

- A. The Internet is far too large for any router to hold routing information for all destinations. How does the Internet routing scheme deal with this issue?
[2 Mark]
- B. What is the task of an Ethernet switch? What tables does it maintain?
[3 Mark]
- C. Can we be sure that no two computers in the Internet have the same IP addresses?
[1 Mark]
- D. Compare connectionless (UDP) and connection-oriented (TCP) communication for the implementation of each of the following application-level or presentation-level protocols:
i) virtual terminal access (for example, Telnet);
[1 Mark]
ii) file transfer (for example, FTP);
[1 Mark]

QUESTION 4: INTERPROCESS COMMUNICATION

[10 Marks]

- A. Is it conceivably useful for a port to have several receivers?
[2 Marks]
- B. Why is there no explicit data-typing in CORBA CDR?
[2 Marks]
- C. Describe the ways in which the request-reply protocol masks the heterogeneity of operating systems and of computer networks.
[2 Marks]
- D. Discuss whether the following operations are *idempotent*:
i) Pressing a lift (elevator) request button;
ii) Writing data to a file;
iii) Appending data to a file.
Is it a necessary condition for idempotence that the operation should not be associated with any state?
[4 Marks]

QUESTION 5: REMOTE INVOCATION

[7 Marks]

- A. The *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 each user votes once only). 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 a candidate and the number of votes for that candidate. Which of the parameters of these two procedures are *input* and which are *output* parameters?
[2 Marks]

- B. Discuss the invocation semantics that can be achieved when the request-reply protocol is implemented over a TCP/IP connection, which guarantees that data is delivered in the order sent, without loss or duplication. Take into account all of the conditions causing a connection to be broken.

[3 Marks]

- C. The Election service must ensure that a vote is recorded whenever any user thinks they have cast a vote. Discuss the effect of maybe call semantics on the Election service. Would at-least-once call semantics be acceptable for the Election service or would you recommend at-most-once call semantics?

[2 Marks]

QUESTION 6: INDIRECT COMMUNICATION

[9 MARKS]

- A. Discuss each of the tasks of encapsulation, concurrent processing, protection, and name resolution, communication of parameters and results, and scheduling in the case of the UNIX file service (or that of another kernel that is familiar to you).

[3 Marks]

- B. Why are some system interfaces implemented by dedicated system calls (to the kernel), and others on top of message-based system calls?

[2 Marks]

- C. Smith decides that every thread in his processes ought to have its own *protected* stack – all other regions in a process would be fully shared. Does this make sense?

[2 Marks]

- D. Discuss the issue of naming applied to shared memory regions.

[2 Marks]

QUESTION 7: OPERATING SYSTEM SUPPORT

[10 Marks]

- A. Describe some of the ways in which conventional email is vulnerable to eavesdropping, masquerading, tampering, replay, denial of service. Suggest methods by which email could be protected against each of these forms of attack.

[3 Marks]

- B. Initial exchanges of public keys are vulnerable to the man-in-the-middle attack. Describe *four (4)* defenses against it as you can.

[2 Marks]

- C. PGP is widely used to secure email communication. Describe the steps that a pair of users using PGP must take before they can exchange email messages with privacy and authenticity guarantees. What scope is there to make the preliminary negotiations invisible to the users?

[3 Marks]

- D. How could email be sent to a list of 100 recipients using PGP or a similar scheme? Suggest a scheme that is simpler and faster when the list is used frequently.

[2 Marks]

QUESTION 8: DISTRIBUTED OBJECTS AND COMPONENTS**[10 Marks]**

- A. Describe the names (including identifiers) and attributes used in a distributed file service such as NFS. **[2 Marks]**
- B. Discuss the problems raised by the use of aliases in a name service, and indicate how, if at all, these may be overcome. **[2 Marks]**
- C. Explain why iterative navigation is necessary in a name service in which different name spaces are partially integrated, such as the file naming scheme provided by NFS. **[2 Marks]**
- D. How does caching help a name service's availability? **[2 Marks]**
- E. Discuss the absence of a syntactic distinction (such as use of a final '.') between absolute and relative names in DNS. **[2 Marks]**

QUESTION 9: WEB SERVICES**[10 Marks]**

- A. Why should UFIDs be unique across all possible file systems? How is uniqueness for UFIDs ensured? **[2 Marks]**
- B. To what extent does Sun NFS deviate from one-copy file update semantics? Construct a scenario in which two user-level processes sharing a file would operate correctly in a single UNIX host but would observe inconsistencies when running in different hosts. **[2 Marks]**
- C. Sun NFS aims to support heterogeneous distributed systems by the provision of an operating system-independent file service. What are the key decisions that the implementer of an NFS server for an operating system other than UNIX would have to take? What constraints should an underlying filing system obey to be suitable for the implementation of NFS servers? **[4 Marks]**
- D. What data must the NFS client module hold on behalf of each user-level process? **[2 Marks]**

QUESTION 10: PEER-TO-PEER SYSTEMS**[8 Marks]**

- A. Why is computer clock synchronization necessary? Describe the design requirements for a system to synchronize the clocks in a distributed system. **[3 Marks]**
- B. Discuss the factors to be taken into account when deciding to which NTP server a client should synchronize its clock. **[3 Marks]**

- C. Discuss how it is possible to compensate for clock drift between synchronization points by observing the drift rate over time. Discuss any limitations to your method.

[2 Marks]

QUESTION 11: SECURITY

[8 Marks]

- A. Is it possible to implement either a reliable or an unreliable (process) failure detector using an unreliable communication channel?
[2 Marks]
- B. If all client processes are single-threaded, is mutual exclusion condition ME3, which specifies entry in happened-before order, relevant?
[2 Marks]
- C. Suggest how to adapt the Bully algorithm to deal with temporary network partitions (slow communication) and slow processes.
[2 Marks]
- D. How, if at all, should the definitions of integrity, agreement and validity for reliable multicast change for the case of open groups?
[2 Marks]

THE END