The University of Melbourne

Cloud Computing and Distributed Systems Laboratory
School of Computing and Information Systems

COMP90015: Distributed Systems

Examination

Semester 2, 2017

Exam Duration: 3 hours
Reading Time: 15 minutes

This paper has 3 pages, including this cover page.

Authorized Materials:

- There is NO special authorized material for this examination.

Instructions to Invigilators:

- Please provide students with standard script books.
- **Please collect the exam paper from students once they finish answering.**

Instructions to Students:

- This examination is worth of 60% of your final mark.
- Answer any 6 out of 8 questions. **Please note only the first 6 answers will be marked.**
- Each question carries 10 marks.
- The numbers in square bracket after each sub-question represents marks allocated to it.
- Start your answer to each question on a new page.
- Make sure your answers are readable. Any unreadable parts will be deemed incorrect.

Question 1:

A) List five types of resources that can usefully be shared in a networked distributed computing environment. Give examples of their sharing as it occurs in distributed systems. [5]

B) Discuss the key challenges that one needs to address in the design and development of distributed systems or applications. [5]

Question 2:

A) Discuss any two architectural models for construction of distributed systems. [5]

B) Describe five types of attacks (on processes, communication channels, services) that might occur in the Internet. [5]

Question 3:

A) Discuss key differences in Socket-based communication using TCP/IP and UDP protocols. [5]

B) Write a multithreaded Java program that responds to remote clients' requests for processing mathematical operations such as "sin, sqrt, and log". If a client program sends a message "sin N" (where N is an integer number) to the server, the server program responds back with the result (as a string). Use Java Sockets (TCP/IP-protocol based) for communication between clients and the server. Write both server and client programs. [5]

Question 4:

A) Write a simple Java RMI program that demonstrates the invocation of remote object services. Implement a service which reverses the input message and sends back. For example, when a client program sends a message "ABC" to the server program, the server program responds back with the result (as a string "CBA"). Write both server and client programs. [5]

B) What is an idempotent operation? Some of the primitive operations for a typical flat file service interface for a Distributed File System are shown below (UFID stands for Unique File Identifier):

- Read(UFID, i, n): Reads up to **n** items from position **i** in the file.
- Write(UFID, i, Data): Writes the data starting at position **i** in the file. The file is extended if necessary.
- Create(): Creates a new file of length 0 and returns a UFID for it.
- Delete(UFID): Removes the file from the file store/system.

Which of the above primitives of the interface are not idempotent? Explain your answer. [5]

Question 5:

A) Discuss various types of services offered by operating systems to support middleware for distributed systems. [5]

B) Discuss the architecture of a microkernel-based operating system. Comment on how well this architectural model supports the creation of extensible operating systems. [5]

Question 6:

A) Discuss two classes of cryptography algorithms and their usage in secure communication in distributed systems. [5]

B) Discuss the secure socket layer (SSL) architecture and its components. [5]

Question 7:

A) Describe three types of navigation schemes that can be used for name resolution in Domain Name Systems. [5]

B) Discuss the model architecture of a distributed file system. Illustrate how comprehensive it is by comparing it to the NFS implementation. [5]

Question 8: Multiple Choice Questions. [10] – each sub-question carries **1** mark.

8.1. Which of the following is a reliable communication and delivery protocol?

a) TCP/IP, b) UDP, c) MPI, d) none of the above.

8.2. Which of the following creates a TCP/IP socket listening on port 123 in Java?

a) new Socket(123), b) new ServerSocket(123), c) new DatagramSocket(123); d) None of these

8.3. In Java Threads, which of the following methods execute threads without blocking?

a) Thread.run(), b) Thread.join(), c) Thread.start(), d) Thread.interrupt()

8.4. Which of the following is **NOT** a fundamental model to formally describe common properties of distributed systems?

a) Interaction Model, b) Failure Model, c) Security Model, d) Super Model

8.5. The kernel design philosophy followed in the Windows NT Operating System is:

a) Monolithic, b) Microkernel, c) Layered d) Hierarchical

8.6. Which of the following is not true?

a) A new thread is spawned via the start method of class Thread.
b) The sleep method of the class Thread is static and it puts the "current" thread to sleep.
c) Two threads can simultaneously execute a synchronized non-static method of different instances of the same Java class.
d) Two threads can simultaneously execute a synchronized non-static method of the same instance of the same Java class.

8.7. Which one of the following is the best definition of “network latency”?

a) The time from the method call of the sending process to the time when the last byte of the message is transferred to the destination.
b) The length of the message being transmitted divided by the bandwidth of the host.
c) The time from the start of message transmission by the sending process to the beginning of its receipt by the receiving process.
d) The number of network hops between the sender and the receiver.

8.8. Which of the following technology supports dynamic negotiation of encryption and authentication algorithms?

a) Kerberos, b) Secure Socket Layer, c) Firewall, d) Certificate Authority

8.9. Domain Name System is organised as a:

a) centralized system, b) hierarchical system, c) master-slave system, d) peer-to-peer system

8.10. Which of the following does not provide an overlay network?

a) Client-server socket applications
b) peer-to-peer file sharing systems (such as Bit torrent)
c) A virtual private network (VPN)
d) Skype peer-to-peer application