CARDIFF UNIVERSITY

EXAMINATION PAPER

Academic Year: 2019-2020

Examination Period: Spring

Module Code: CMT202

Examination Paper Title: Distributed and Cloud Computing

Duration: Three hours

Please read the following information carefully:

Structure of Examination Paper:

There are THREE pages.
There are FOUR questions in total.
There are no appendices.
The maximum mark for the examination paper is **60 marks** and the mark obtainable for a question or part of a question is shown in brackets alongside the question.

Instructions for completing the examination:

Answer **THREE** questions.

Important note: if you answer more than the number of questions instructed, then answers will be marked in the order they appear only until the above instruction is met. Extra answers will be ignored. Clearly cancel any answers not intended for marking.

1 (a) Give two examples of real-world computer systems which use a distributed computing paradigm and explain why these systems would be difficult to implement using a non-distributed computing paradigm. **[5]**

(b) Implementing a distributed system presents a number of additional challenges which do not exist when implementing a non-distributed system. Describe three such challenges and for each describe a potential solution to the challenge in question. **[5]**

(c) In a structured peer-to-peer (P2P) system, the chord algorithm may be used to locate data. Describe the network topology used by this algorithm and the motivation for its use. What are the purpose of shortcut links or connections in this algorithm? **[5]**

(d) Describe a real-world application of edge computing. Explain the benefits of using edge computing in this application relative to using a centralized computing paradigm. **[5]**

2 (a) Describe one advantage of using processes instead of threads in a distributed system and one advantage of using threads instead of processes in a distributed system. Describe a real-world application of threads in a distributed system. What is the benefit of using threads instead of processes in this context? **[5]**

(b) Consider a small online shopping business which takes credit card payments for mail delivered goods. Describe two advantages and two disadvantages of this business using cloud computing. **[5]**

(c) Describe two benefits of using code migration in a distributed system. Describe two challenges to implementing code migration in a distributed system. Describe a real-world example of code migration in a distributed system. **[5]**

(d) Describe the purpose of a name server in a distributed system and give a real-world example of a name server. A name server provides distribution transparency in a distributed system; explain and justify this statement. **[5]**

3 (a) Describe a real-world situation where it is necessary to ensure mutual exclusion access to a shared resource. Ensuring mutual exclusion access to a shared resource can be achieved using a token-ring algorithm. Describe two disadvantages of using this algorithm. **[5]**

(b) Distribution transparency is an important concept in distributed systems. Briefly describe a method for achieving location transparency, a method for achieving concurrency transparency and a method for achieving failure transparency. **[5]**

(c) Consider an online banking system where individuals deposit and withdraw money from banking accounts. If this system was implemented as a distributed system, describe a potential unwanted consequence of clock drift in the system. **[5]**

(d) Describe what is meant by the term blocking system call. Describe a situation where a blocking system call can occur in a distributed system, a potential issue this may cause and a potential solution to this issue. **[5]**

4 (a) Interception, interruption, modification and fabrication are four types of security threats. Briefly describe a real-world example of each of these types of security threat. **[5]**

(b) Mary and John have regular face-to-face meetings in a location where their conversations cannot be overheard. Mary and John want to set up a secure channel for communication outside of these meetings. Why, in this context, is using a symmetric (secret-key) cryptosystem a suitable solution? **[5]**

(c) A hash function is a function with a number of properties including the property that if two messages are not equal, their hash values are not equal. That is, if $M \neq M'$ then $H(M) \neq H(M')$ where M and M' are messages and H is a hash function. Give an example of a function which does not have this property. **[5]**

(d) Describe an example of how process replication can support fault tolerance in a distributed system. Describe an example of how data replication can increase availability in a distributed system. **[5]**