THE UNIVERSITY OF MELBOURNE

Student Number_____

Faculty/Dept. Computing and Information Systems

Subject Number COMP90024

Subject Name Cluster and Cloud Computing

Writing Time **2** **hours**

Reading Time **15** **minutes**

Open Book Status Closed Book

Number of pages (including this page) 3

Authorised Materials: None

Instructions to Students: This examination is worth 50% of your final mark
Answer 5 out of any 7 questions. Please note that only the first 5 questions will be marked.
Each question carries 10 marks.
The number in square brackets after each sub-question represents the marks allocated to it.

Instructions to Invigilators: Please provide students with standard script books
No calculators are allowed
This paper is NOT to be made available in the library after the examination

Paper to be held by Baillieu Library:
Indicate whether the paper is to be held with the Baillieu Library.

Yes ☐ ☐ No X

Extra Materials required (please tick & supply)
☐ Graph Paper ☐ Multiple Choice form ☐

Question 1:

A) Discuss the major trends in research and research computing over the last 20 years that have led to the emergence of Cloud computing. [6]
B) How has the evolution of service-oriented architectures supported Cloud computing? [2]
C) A HTTP method can be *idempotent*.
   - What is meant by this italicized term? [1]
   - Give an example of an idempotent ReST method. [1]

Question 2:

A) According to Wikipedia "*Cloud Computing is a colloquial expression used to describe a variety of different types of computing concepts that involve a large number of computers that are connected through a real-time communication network (typically the Internet). Cloud computing is a jargon term without a commonly accepted non-ambiguous scientific or technical definition*".
   a. Is this justified? Your answer should cover:
      i. public, private and hybrid Cloud computing models and their advantages and disadvantages; [4]
      ii. the different flavours of "*X as a Service (XaaS)*" models including their associated advantages and disadvantages. [4]
   b. Outline some of the practical challenges in supporting Cloud interoperability? [2]

Question 3:

A) What is Flynn's Taxonomy? [2]
   a. What have been the implications of Flynn's taxonomy on modern computer architectures? Give examples of its consequences on modern multi-core servers and clusters of servers such as the University of Melbourne Edward HPC facility. [4]
B) What features does the Edward HPC facility offer to allow utilization of multiple servers (nodes)? [2]
C) Why is the accuracy of the wall time estimate important to Edward end users? [2]

Question 4:

A) Define Gustafson-Barsis' law for scaled speed-up of parallel programs. [2]
B) A parallel program takes 128 seconds to run on 32 processors. The total time spent in the sequential part of the program is 12 seconds. What is the scaled speedup? [2]
C) According to Gustafson-Barsis' law, how much faster could the application *theoretically* run if it ran across all 32 processors compared to running on a single processor? [3]
D) Why is theoretically italicized in the above? [3]

Question 5:

A) Discuss the advantages and disadvantages of unstructured (noSQL) databases such as CouchDB for dealing with "big data" compared to more traditional databases, e.g. relational databases such as MySQL. Your answer should cover challenges with data distribution, traditional database ACID properties, heterogeneity of data and large-scale data processing. [6]
B) Apache Hadoop is a software framework that enables processing of large data sets.
   a. Explain the role of Hadoop Distributed File System (HDFS) in supporting the Apache Hadoop framework. [2]
   b. Describe the process by which Apache Hadoop supports fault tolerant data processing. [2]

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Question 6:

A) The Internet2 Shibboleth technology as currently supported by the Australia Access Federation provides *federated authentication* and *single sign-on*.
   a. Explain what is meant by the italicized terms [2].
   b. Explain the role of *trust* and *public key infrastructures* in supporting the Internet2 Shibboleth model. [2]
   c. What are the advantages and disadvantages of the Shibboleth approach for security? [4]
   d. Why isn't Shibboleth used to access Cloud-based systems more generally? [2]

Question 7:

A) Define the following terms and their relevance to Cloud Computing:
   a. Hypervisor [1]
   b. Virtual machine [1]
   c. Machine image [1]
   d. Object Store [1]
   e. Volume Store [1]
   f. Key-pair [1]

B) Applications can be deployed across Clouds either through creation and deployment of virtual images (snapshots) or through scripting the installation and configuration of software applications.
   a. What are the benefits and drawbacks of these approaches? [2]
   b. Discuss the mechanisms used to support these approaches. You may refer to specific tools used to support these processes. [2]

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