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) Explain what is meant by the terms:
- Grid Computing [1]
- Cluster Computing [1]
- Cloud Computing [1]

B) Current Cloud Computing systems do not solve many key challenges of large-scale distributed systems. Discuss. [7]

Question 2:

A) Define Amdahl's law and discuss the challenges of its practical implementation. [2]
B) The actual performance as experienced by users of shared-access HPC facilities such as the Edward cluster at the University of Melbourne can vary – where here performance can be considered as the throughput of jobs, i.e. from the time of first job submission to the time of last job completion.
- Explain why this can happen. [2]
- Explain how the Edward cluster has been set up to minimize this. [2]
- Explain what users can do to optimize their throughput (use) of the Edward cluster. [2]
- Describe some of the challenges with application benchmarking on HPC facilities. [2]

Question 3:

A) Explain the consequences of Brewer's CAP theorem on distributed databases. [4]
B) Describe which aspects of the CAP theorem are supported by the following database technologies:
- non-SQL (unstructured) databases such as CouchDB. [2]
- relational databases such as PostGreSQL. [2]

Describe the advantages of MapReduce compared to other more traditional data processing approaches. [2]

Question 4:

A) Compare and contrast Representational State Transfer (ReST) based web services and Simple Object Access Protocol (SOAP)-based web services for implementing service-oriented architectures. [8]
B) Explain the differences between ReST-based PUT and POST methods and explain when one should be used over another. [2]

Question 5:

A) Explain what is meant by the following terms:
- Virtual Machine Monitor/Hypervisor [1]
- Full virtualization [1]
- Para-virtualization [1]
- Shadow page tables [1]
- Explain how hardware virtualization and software virtualization can differ in their treatment of shadow page tables. [2]
- Explain the advantages and disadvantages of virtual machines. [2]
- Describe the typical steps that are required to support live migration of virtual machine instances using a Cloud facility such as the NeCTAR Research Cloud. [2]

Question 6:

A) Explain what is meant by the following security terms:
   - single sign-on [1]
   - public key infrastructures [1]
   - certification authority [1]
   - registration authority [1]
   - identity provider (IdP) [1]

B) Discuss the challenges in supporting fine-grained security in Cloud environments. You may refer to the importance and/or role of (some of) the terms in part A) of this question. [5]

Question 7:

A) Many research domains are facing "big data" challenges. Big data is not just related to the size of the data sets. Explain. [5]

B) What capabilities are currently offered or will be required for Cloud Computing infrastructures such as the NeCTAR Research Cloud to tackle these "big data" challenges. [5]
You may refer to specific research disciplines, e.g. life sciences, astrophysics, urban research (or others!) in your answer to part A) and B) of this question.

--- END OF EXAMINATION ---