Student Number .....

The University of Melbourne

Semester 2 Assessment 2013

Computing and Information Systems

COMP 90024 Cluster and Cloud Computing

Reading Time 15 minutes

Writing Time 2 hours

Open Book Status Closed Book

This paper has 2 **pages (not including this page).**

Authorised Materials:
The following items are authorised: (list here) ☐
OR
Students may have unrestricted access to all materials ☐
OR
No materials are authorised ☑

Paper to be held by Baillieu Library: Indicate whether the paper is to be held with the Baillieu Library.
☑ Yes ☐ No

Instructions to Invigilators:
- Please provide students with standard script books
- No calculators are allowed

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.

Extra Materials required (please tick & supply)

☐ Graph Paper ☐ Multiple Choice form ☐ Other (please specify)

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 ---