

National College of Ireland

MSc in Cloud Computing – Full-time – Year 1 – MSCCLOUD
MSc in Cloud Computing – Full-time – Year 1 – January Start – MSCCLOUDJANO

Semester One Examinations – 2017/18

Friday 5th January 2018
10.00am – 12.00pm

Cloud Architecture

Dr Ted Scully
Dr Horacio González-Vélez

Answer ALL questions

Duration of exam: 2 hours

Attachments: None

Required: Calculator

- For a given computer program, 99.8% of its code is parallelisable, i.e. 0.2% of the code is sequential/serial. Assume that the program is to be executed on the #1 supercomputer in the Top500 Jun17 List, i.e. the Sunway TaihuLight - Sunway MPP with 10,649,600 cores. Assume that the application will use from 100 up to 10 million cores as specified below. Note that all cores execute at the same speed without overheads.

[25 marks]

- Based on the canonical Amdahl's law, what is the parallel speedup on:

- 100;
- 10,000;
- 1,000,000; and
- 10,000,000 cores.

[16 marks; 4 marks per result]

- If the serial part is subsequently reduced to 0.02%, what is the parallel speedup on 10 million cores? What is then the *optimal* number of cores to be used for this code? N.B. In this context, *optimal* refers to the maximum number of cores which can be used to maintain scalability.

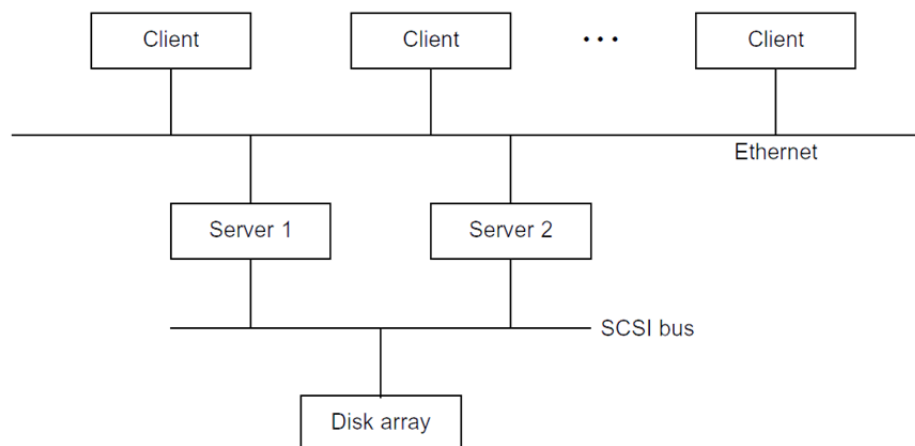
[9 marks]

- Define and provide an advantage/disadvantage to the 5 Levels of virtualisation (4 marks per level).

[Total 20 Marks]

- Consider in figure below with a server-client cluster with an active-takeover configuration between two identical servers. The servers share a disk via a SCSI bus. The clients (PCs or workstations) and the Ethernet are fail-free. When a server fails, its workload is switched to the surviving server.

[25 marks]



- Assume that each server has an MTTF of 200 days and an MTTR of five days. The disk has an MTTF of 800 days and an MTTR of 20 days. In addition, each server is shut down for maintenance for one day every week, during which time that server is considered unavailable. Only one server is shut down for maintenance at a time. The failure rates cover both natural failures and scheduled maintenance. The SCSI bus has a failure rate of 2 percent. The servers and the disk fail independently. The disk and SCSI bus have no scheduled shutdown. The client machine will never fail.

- a. The servers are considered available if at least one server is available. What is the combined availability of the two servers?. **[20 marks]**
 - b. In normal operation, the cluster must have the SCSI bus, the disk, and at least one server available simultaneously. What are the possible single points of failure in this cluster? **[5 marks]**
4. Explain the advantages and disadvantages of static and dynamic scheduling policies and suggest methods to amend the problems. **[10 marks]**
5. Define HDFS and highlight at least two key characteristics. **[20 marks]**
- [10 marks definition; 5 marks per key characteristic up to 10 marks]**