

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATIONS BCS Level 6 Professional Graduate Diploma in IT

DISTRIBUTED & PARALLEL SYSTEMS

28th April 2008, 2.30 p.m.-5.30 p.m.

Answer THREE questions out of SIX. All questions carry equal marks.

Time: THREE hours.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

Calculators are NOT allowed in this examination.

1.
 - a) Distinguish between heavyweight and lightweight processes. **(5 marks)**
 - b) Distinguish between blocking and non-blocking inter-process communication mechanisms. **(5 marks)**
 - c) Distinguish between pre-emptive and non pre-emptive approaches to thread scheduling. **(5 marks)**
 - d) What is the purpose of the distributed garbage collector in RMI? How is it implemented? **(10 marks)**

2.
 - a) A sequential program has three principal sections. The input section takes 10% of the total time. Processing section takes 70% of the total time. The output section takes the remaining 20%. What is the maximum attainable speedup if only the processing part can be parallelized? **(5 marks)**
 - b) Briefly describe a scenario that might lead to super-linear speedup. **(5 marks)**
 - c) Distinguish between the terms *scalability* and *granularity* in the context of parallel applications. **(5 marks)**
 - d) Outline the advantages and disadvantages of cluster computing in contrast to conventional high performance supercomputing. **(10 marks)**

Turn over]

- 3.
- a) Briefly describe the role of NFS in a distributed system. **(5 marks)**
 - b) Briefly describe the role of NIS in a distributed system. **(5 marks)**
 - c) A colour videoconferencing application requires 3 bytes per pixel (RGB), operates at a spatial resolution of 320×200 pixels, and a temporal resolution of 10 frames per second. What are the data rate requirements for this item of traffic if transmitted in a raw (uncompressed) format? **(5 marks)**
 - d) What are the three quality-of-service (QoS) parameters? Explain how these will be configured differently for videoconferencing application in contrast to a file transfer application? **(10 marks)**
- 4.
- a) Briefly describe two methods of avoiding deadlock in a transaction and concurrency control system. **(5 marks)**
 - b) Describe the *lost update problem*? **(5 marks)**
 - c) Briefly describe the central server mutex algorithm. **(5 marks)**
 - d) Briefly describe the role of *names* in distributed systems, using three examples to illustrate their usage. **(10 marks)**

- 5.
- a) A parallel algorithm is to be implemented to perform a brute-force search for prime numbers. Describe how data partitioning would be undertaken to promote load balancing.
(7 marks)
 - b) We have implemented the algorithm above on a computer cluster. Sketch a graph to show the expected performance (speedup) as the number of processing elements is increased, assuming that the workload is held constant.
(6 marks)
 - c) The efficiency of a parallel algorithm reflects how well it exploits the additional processing elements made available (i.e., $\text{speedup} \div \text{number of processing elements}$). Sketch a graph of expected efficiency as the number of processing elements is increased.
(6 marks)
 - d) Suggest three guaranteed ways that the speed of the prime-search algorithm could be improved.
(6 marks)

6. For a job interview, you have been asked to make a 30 minute presentation on the following topic:

Security in Distributed Systems: How is it accomplished?

Sketch out approximately 8 content-rich presentation slides, with associated notes, that you would use for your talk.

Please note: your answer will be assessed for its quality of approach, accuracy of content, clarity of expression, range of discussion, and depth of argument.

(25 marks)