

A30844

No calculator permitted in this examination

UNIVERSITY OF BIRMINGHAM

School of Computer Science

Third Year – BSc Artificial Intelligence and Computer Science
First Year - First Year – UG Affiliate Computer Science/Software Engineering
First Year - First Year – UG Affiliate Electronic and Electrical Engineering
Third Year – BSc Computer Science
Third Year – MSci Computer Science
Third Year – MEng Computer Science/Software Engineering
First Year - First Year – UG Affiliate Science without Borders Computer Science
Fourth Year – BSc Computer Science with Year in Industry
Third Year – MEng Computer Science/Software Engineering with Year in Industry
Fourth Year – BSc Artificial Intelligence and Computer Science with Year in Industry

06 26945

Distributed and Parallel Computing

Summer Examinations 2015

Time allowed: 1 hour 30 minutes

[Answer ALL Questions]

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1. Parallel computing

- (a) Compare and contrast the key features of CPU versus GPU architectures. [10%]
- (b) What is a CUDA **warp**? [5%]
- (c) Suppose that we have a **shared** memory $A[]$ on a GPU of size 16 and we want to “rotate” it by a fixed offset $K < 16$ (e.g. if $K=2$ then $a[0]$ becomes $a[2]$, $a[1]$ becomes $a[3]$, ..., $a[14]$ becomes $a[0]$, $a[15]$ becomes $a[1]$). Write CUDA code to achieve this. Explain why your code is correct and efficient. [15%]

2. Distributed computing 1

- (a) What is Leadership Election in a distributed system and what are two of its typical applications? [5%]
- (b) Describe the basic leader election algorithm in an arbitrary synchronous network. Briefly argue its correctness and give its complexity. [10%]
- (c) Consider an arbitrary synchronous network in which each node is only allowed to send one message per round.
 - (i) Describe a leader election algorithm. [10%]
 - (ii) Briefly argue its correctness. What do we need to know about the network? [5%]
 - (iii) Give the time and message complexity. [5%]

3. Distributed computing 2

- (a) Describe the GPU process architecture as a distributed system. What is the synchrony model? What is the communication model? What is the fault model? [10%]
- (b) Describe the Two Generals problem and its solution. [10%]
- (c) If the likelihood of message loss is 5% and the cost of a message is constant, which of the two protocols (in a synchronous network) below is a) cheaper on average and b) less likely to lead to false agreement. Which protocol would **you** prefer in this case and why? [15%]

PROTOCOL 1:

Round 0: P1 sends a message.

Round 1: If the message arrives, P2 responds with an acknowledgment and declares consensus.

Round 3: If the message arrives, P1 declares consensus.

PROTOCOL 2:

Round 0: P1 sends two messages and declares consensus.

Round 1: If at least one message arrives, P2 declares consensus.