UNIVERSITY OF BIRMINGHAM

School of Computer Science

Dependable and Distributed Systems

SAMPLE EXAM PAPER

Time allowed: 2 hours

[Answer all questions]

Note

Answer ALL questions. Each question will be marked out of 20. The paper will be marked out of 60, which will be rescaled to a mark out of 100.

Question 1

Assume a complete, undirected network with N nodes. The network must be capable of tolerating stop failures.

(a) Define the distributed consensus problem. **[5 marks]**

(b) Develop an algorithm that solves the distributed consensus problem in a synchronous network. State any assumptions. **[5 marks]**

(c) Analyse the communication complexity of your algorithm. **[5 marks]**

(d) A number of links are removed from the network, hence it is no longer complete. Propose how your algorithm could be adapted to work when the network is not complete. If no adaptation is necessary, explain why this is the case. **[5 marks]**

Question 2

(a) Define the leader election problem. **[5 marks]**

(b) Develop an algorithm that solves leader election in a synchronous unidirectional ring network. State any assumptions. **[5 marks]**

(c) Analyse the time complexity of your algorithm. **[5 marks]**

(d) The network is modified so that it permits bidirectional communication. Explain the implications of the network permitting bidirectional communication for the algorithm you have developed. You should state whether your algorithm solves the leader election problem in the modified network. **[5 marks]**

Question 3

(a) Explain what it means for a set of clocks to be well-synchronised. **[5 marks]**

(b) Explain Cristian's algorithm for clock synchronisation. **[5 marks]**

(c) Explain the Berkeley algorithm for clock synchronisation. **[5 marks]**

(d) The Berkeley algorithm can operate successfully in the absence of an accurate time source. Explain whether you agree or disagree with this statement. **[5 marks]**

End of Paper

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> # Do not complete the attendance slip, fill in the front of the answer book or turn over the question paper until you are told to do so

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Important Reminders

- Coats/outwear should be placed in the designated area.

- Unauthorised materials (e.g. notes or Tippex) <u>must</u> be placed in the designated area.

- Check that you <u>do not</u> have any unauthorised materials with you (e.g. in your pockets, pencil case).

- Mobile phones and smart watches **<u>must</u>** be switched off and placed in the designated area or under your desk. They must not be left on your person or in your pockets.

- You are <u>not</u> permitted to use a mobile phone as a clock. If you have difficulty seeing a clock, please alert an Invigilator.

- You are <u>not</u> permitted to have writing on your hand, arm or other body part.

- Check that you do not have writing on your hand, arm or other body part – if you do, you must inform an Invigilator immediately

- Alert an Invigilator immediately if you find any unauthorised item upon you during the examination.

Any students found with non-permitted items upon their person during the examination, or who fail to comply with Examination rules may be subject to Student Conduct procedures.