COMPUTER SCIENCE TRIPOS Part IB – 2021 – Paper 5

7 Concurrent and Distributed Systems (djg11)

(a) Explain what happens to the state space, the possible behaviours and the reachable state space when two automata are coupled.   [3 marks]

(b) The Banker's Algorithm can be viewed as a predicate over shared state. What state does it operate over and does this include the program counter of the participating threads? When does it return true or false?   [6 marks]

(c) What is the difference between strict and non-strict isolation in a transaction processing system? What do both approaches ensure? Which can lead to a transaction abort being forced by the system and why?   [3 marks]

(d) "Increment and decrement operations are freely commutable" — what two assumptions are required for this statement to hold? Is it true that the effects of transactions containing increment and decrement operations are always serialisable?   [3 marks]

(e) Customers interact with a transaction processing system over a web interface but confirmations are also sent by email, such as 'please collect from your local branch'.

Should the email message be generated before, during, or after the process of committing the order transaction? What are the advantages and disadvantages of different approaches? Fully justify at least two design decisions in terms of system complexity and durability over a system crash.

[5 marks]