

A Bank has implemented a computerised fire detection system. All the fire detectors within the Bank are connected to a computer (Computer A). Upon receiving a fire signal, computer A will send a "fire!" message to the computer at the local fire station (Computer C), and also to another computer in the Bank (Computer B) that will activate water sprinklers. Computer B is connected to sensors that inform B only if the fire is put out. If the fire is put out then B will deactivate sprinklers and send a "fire out!" message to computer C. Fire-detectors, sprinklers, sensors and computers within the Bank are adequately fire-proofed and can be regarded to be reliable.

Any message sent is received within a maximum period of d time units and d is known.

Also known is e - the maximum time that can elapse between Computer B activating sprinklers and the sensors informing B if the fire has indeed been put out.

Coursework 1 Continued

T2

The fire station will send the fire engines to the Bank only if no “fire out!” message comes within $(2d+e)$ time after a “fire!” message has been received.

Figure (a) shows a case which does not require fire engines to be sent. Figures (b) and (c) show cases where fire engines need to be sent.

In Figure (b), two fire-detectors signal A and the fire is not put out by the water sprinklers,

In Figure (c) a second fire starts after the first one has been put out and it cannot be put out by the water sprinklers.

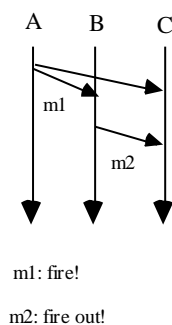


Fig. (a)

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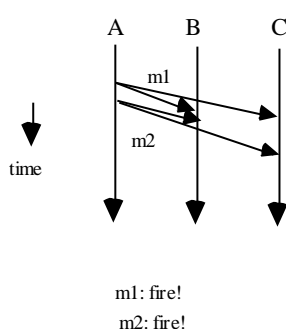


Fig. (b)

fig. (b)

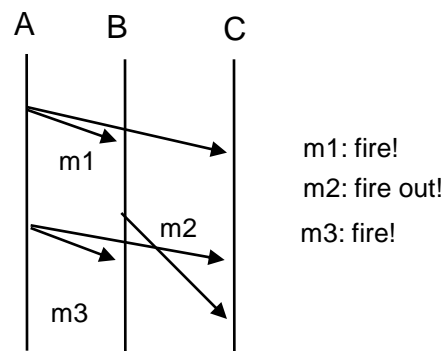


fig. (c)

Coursework 1 - Questions

T3

(i) The system is said to be designed correctly if it is guaranteed that fire engines are sent to the Bank whenever a fire cannot be put out by the sprinklers, and not in any other circumstances. Argue that the system design is flawed. (2 marks, 1 Page max)

(ii) Produce a correct system design in which

1. A and B use logical clocks and timestamp their messages as per their logical clocks;
2. C only receives messages from A and B, i.e., C does not send any message to A or B; and,
3. B only receives messages from A, i.e., B does not send any message to A.

(4 marks, 3 pages max)

(iii) Discuss the conditions under which your answer to (ii) will be correct if A and B use physical clocks instead of logical clocks. Assume that the physical clocks are synchronized within a known bound ϵ . (2 Marks, 2 pages max)

Submission & Mark Scheme

T4

- **Submission Format:**
 - Word or PDF,
 - Pages refer to A4 size, 1- or 2- columned
 - Page limit includes figures, appendices and any references.
 - Submission in NESS by the prescribed deadline
 - You do not have to refer to transparencies in lecture handouts
- **General Mark Scheme** (for each sub-question):
 - 50% for **correctness** and 50% for **clarity** of write-up given that solutions are correct
 - Totally incorrect answers receive no marks however well presented
- **Notes:**
 - There is no one correct answer, even though there is certainly one most common and correct answer.
 - Your answer will be judged based only on its own merit – that is, how correct it is and how well it is presented
 - It will NOT be judged based on how close it is to the common correct answer
 - Each submission will be marked by the module leader, not by demonstrators.

Learning and Skills Outcomes

T5

- **Learning Outcomes:**
 - Deeper understanding of 'happened before' relation in a distributed system
 - Importance of logical clocks and their use
 - Significance of clock error in synchronized physical clocks
 - Merits/shortcomings of logical/physical clocks
 - Foundations for Coursework 2
- **Skills Outcomes:**
 - Analytical
 - Presentational (writing)