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DISTRIBUTED SYSTEMS II

A POLYNOMIAL LOCAL SOLUTION TO MUTUAL EXCLUSION

Doorways

- Doorway is a separation mechanism of two areas.
- Processes which pass a doorway at time T prevent neighbor processes entering the same area at a greater time than T until exiting the doorway.

Asynchronous Dorway

Enry Code

$(\forall q \in N_p$: **wait until** $L_{pq} \neq m_1)$;
broadcast message m_1 to neighbours;

Exit Code

broadcast a message different from m_1 to neighbours;

m1 is the I am going in message

Behaviour

Note that process q_i, $0 \leq i \leq l$, do not block p after leaving the doorway even if q tries straight after leaving to enter the same doorway again. In the worst case scenario q_i and p enter the doorway at the same time, since p considers only processes which passed the doorway before it starts trying. For the same reason any other neighbour process r cannot prevent p from passing the doorway when r passes the doorway, after p checked the state of its neighbours.

Problem with the Asynchronous Doorway

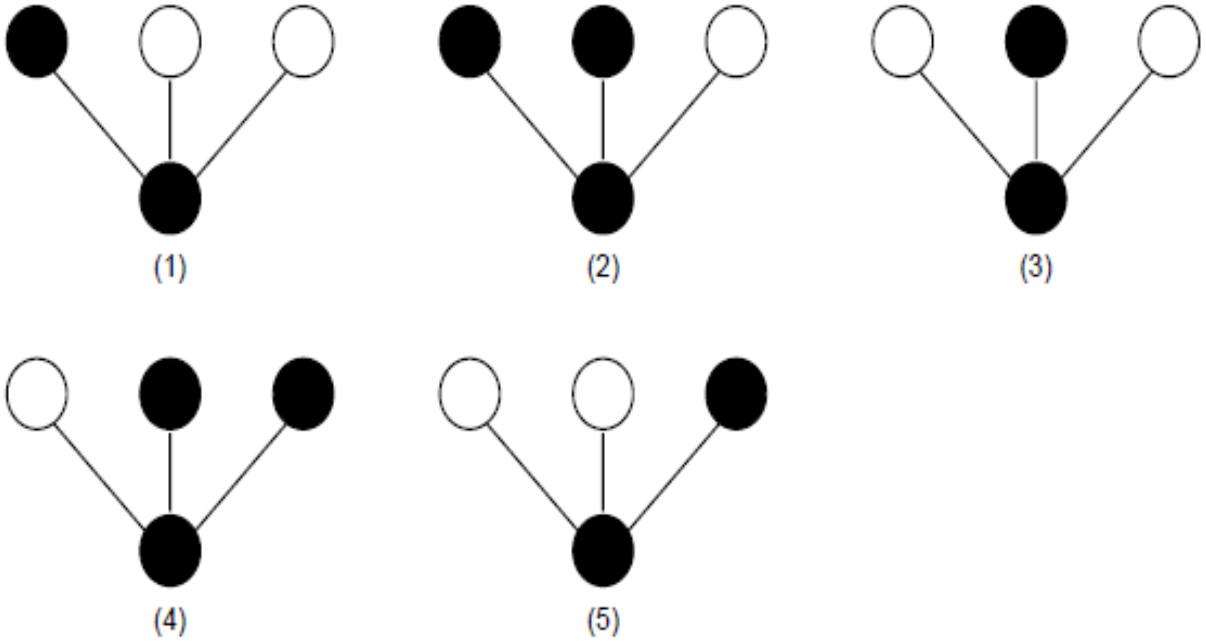


Figure 5.4: Example of a process being successively blocked in the doorway by its neighbours. The filled circles denote processes which have entered the doorway. Note that processes which enter the doorway in (2) and (4) must have been waiting for some other processes leaving the doorway.

Synchronous Doorway

- A process which desires to enter a synchronous doorway is required to wait for a situation in which all its neighbors are outside the doorway. This is implemented by checking for a process the states of its neighbors before it enters the doorway.

Entry code:

wait until $(\forall q \in N_p: L_{pq} \neq m_2)$;
broadcast message m_2 to neighbours;

Exit code:

broadcast a different message from m_2 to neighbours;

What Can Go Wrong?

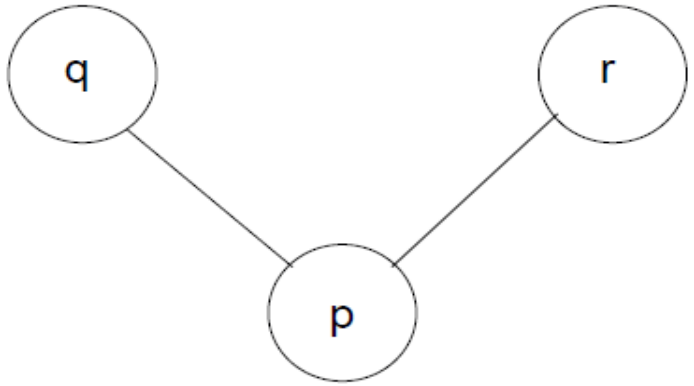
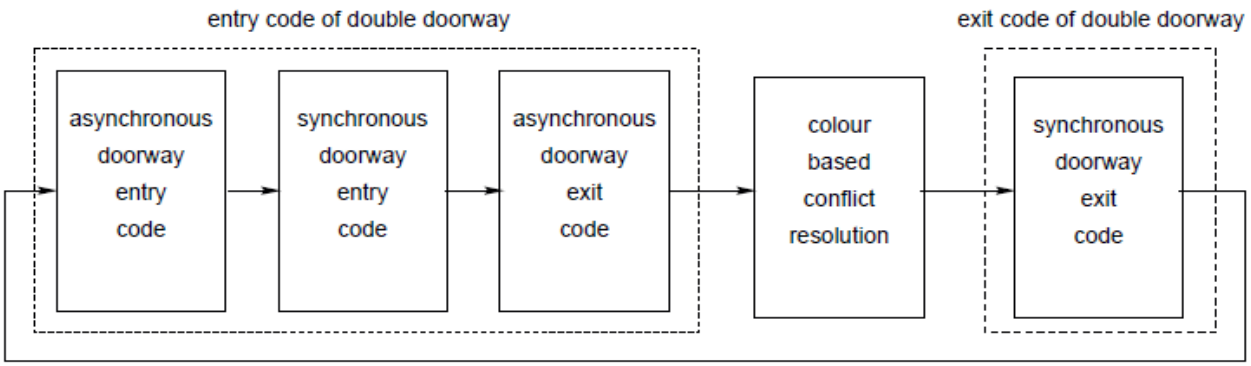


Figure 5.6: Example of a graph structure where two processes q, r can hinder process p from entering a synchronous doorway when either p or q will be inside the doorway.

What if We Combine?



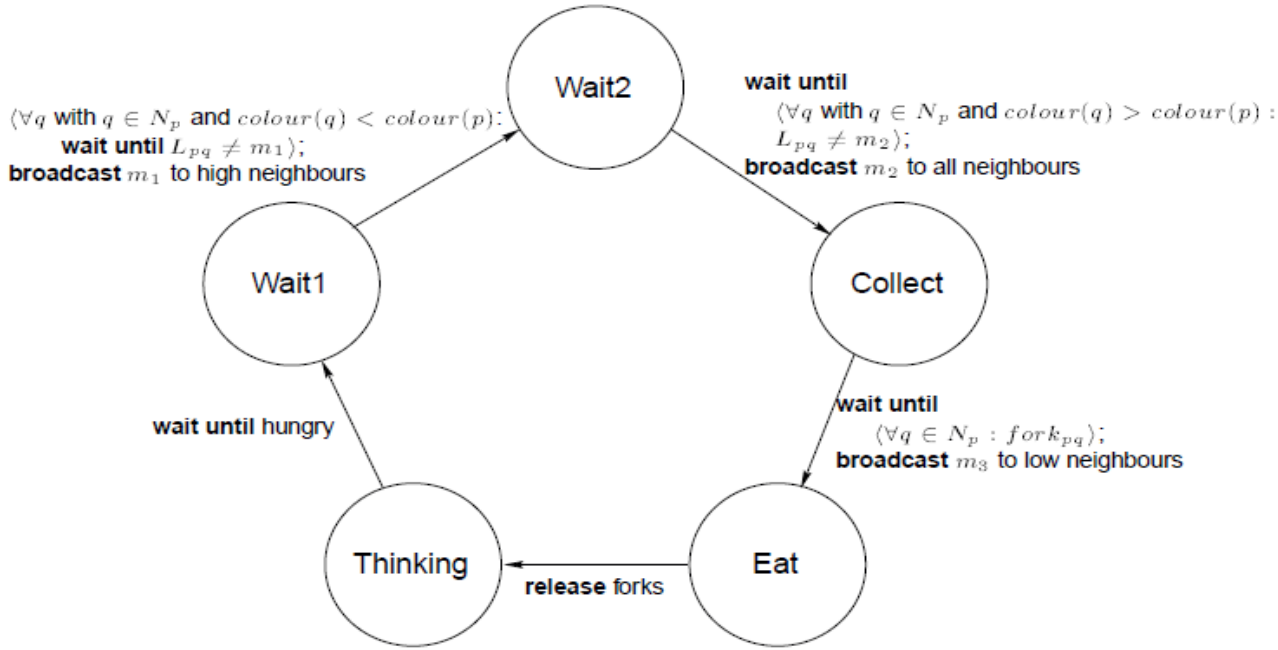


Figure 5.8: The state diagram of an algorithm with fault tolerance δ