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Exercise Sheet 4

1. Happens Before in Shared Memory

Consider n processors and m shared variables. Every processor can access every shared variable with atomic read and write operations (i.e., a process can either read from or write to a shared variable and the system guarantees that such accesses of different processes to the same variable happen atomically). Define a happens before relation similar to the one for message passing.

2. Unique Maximal Cut Preceeding a Given Cut

Given a schedule S with a cut C. Show that there is a unique consistent cut C' of S which precedes the cut C.

3. Happens Before Relation

Let S be a schedule with events a, b, and c. Show that if $a \not\Rightarrow_S b$ and $a \not\Rightarrow_S c$ holds, then there exists some causal shuffle S' of S in which b and c occur before a.

4. Logical Clocks

You are given a clique graph on n nodes. Find two executions A and B, in which each node sends exactly one message to every other node, such that

- the largest Lamport clock value in A is as small as possible, and
- the largest Lamport clock value in B is as large as possible.