Theory Assignment 2

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# 1 Question 1: Reliability

## 1.1

As each link must work well to guarantee the network reliability for Daisy Chain. As that there're 2 links. Therefore, the probability should be $(1-p)^2$.

## 1.2

For Fully connected topology, it's not necessary to make all lines work well in the cycle. Only one route that get all nodes together is enough. Thus, the probability should be $(1-p)^3 + p * (1-p)^2 * 3$.

## 1.3

According to previous questions, for the daisy chain, the reliability probability should be 0.999998. For the connected network, the probability is 0.99999997. It's evident to purchase the fully connected network.

# 2 Question 2: Vector Clock

| Event | Vector Clock at Process Before the Event | Vector Clock in the Message (either received or sent) | Action Taken by Process | Vector Clock at Process After the Event |
|---|---|---|---|---|
| A | (0,0,0) | (1,0,0) | A2 | (1,0,0) |
| B | (0,0,0) | (1,0,0) | A2 | (1,0,0) |
| C | (0,0,0) | (1,0,0) | A2 | (1,0,0) |
| D | (1,0,0) | (1,1,0) | A2 | (1,1,0) |
| E | (1,0,0) | (1,1,0) | A2 | (1,1,0) |
| F | (1,1,0) | (1,1,1) | A2 | (1,1,1) |
| G | (1,0,0) | (1,1,1) | A2 | (1,1,1) |
| H | (1,1,1) | (1,1,0) | A1 | (1,1,1) |
| I | (1,1,0) | (1,2,0) | A2 | (1,2,0) |
| J | (1,1,1) | (1,2,0) | A3 | (1,2,1) |
| K | (1,1,1) | (1,2,0) | A3 | (1,2,1) |
| L | (1,2,0) | (1,1,1) | A3 | (1,2,1) |

According to the definition of A2 above, these update and overwrite operations are simple. For A3, in the events J, K, L, their vector clock before the event and vector clock in the messages include outdated and new states at the same time, therefore, the merge action is required here. The only A1 operation in the event H is adopted in terms of outdated message.

# 3 Question 3: Distributed Transactions

## 3.1

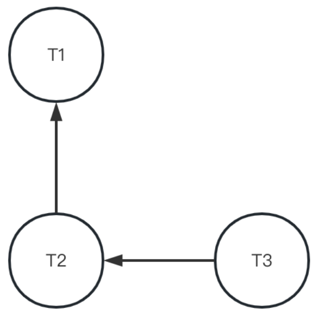


Figure 1: node1

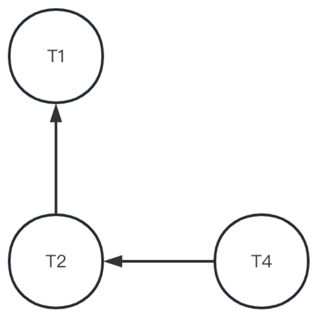


Figure 2: node2

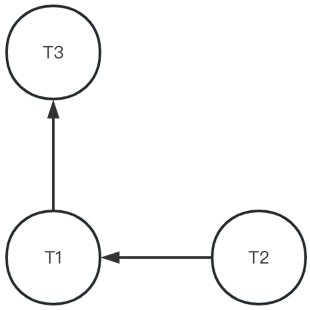


Figure 3: node3

As these graphs are acyclic, there's no deadlock.

## 3.2

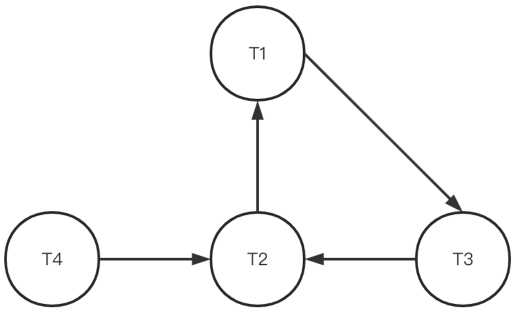


Figure 4: global waits-for graph

As the graph is not acyclic, there's a deadlock.

### 3.3

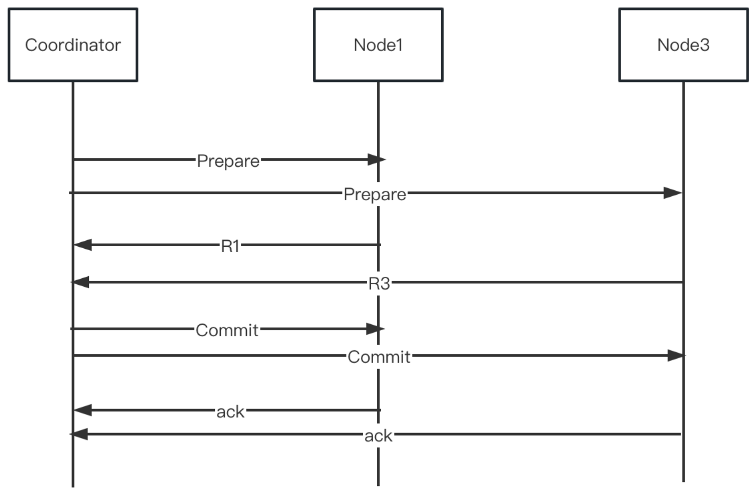


Figure 5: Two-Phase Commit

To prevent deadlock, T2 should be aborted. As T4 belongs to T2, it's also aborted. Consequently, T3 can be committed. The relevant steps are listed in the above graph. When T1 and T3 both vote "yes", then the coordinator will send commit. These messages from the coordinator will be recorded by the local log of T1 and T3. The prepare, commit and end will be recorded by coordinator's log as well.

"Q1(1): Good.
Q1(2): Good.
Q1(3): Good.

Q2: 1

Q3(1): There is a local deadlock in Node 2: T1's R(D) waits-for T4's W(D)
Q3(2): Yes but there is also a second cycle with the correct version of Node 2
Q3(3): You are on the right track, but note that transactions do not send or receive a response. It is the nodes (and coordinator) that hold the logs and send and receive responses.

Grade: 92/100"