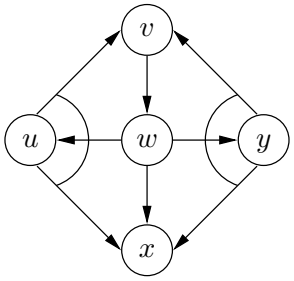
Exam Distributed Algorithms

Vrije Universiteit Amsterdam, 30 May 2018, 8:45-11:30

(You may use the textbook Distributed Algorithms: An Intuitive Approach. *Use of slides, handouts, laptop is* not *allowed.)*

(The exercises in this exam sum up to 90 points; each student gets 10 points bonus.)

1. Let node u initiate a deadlock detection run in which the following wait-for graph is computed.



   Give one possible computation of the Bracha-Toueg deadlock detection algorithm on this wait-for graph. (12 pts)

2. Consider the Gallager-Humblet-Spira minimum spanning tree algorithm. Suppose that a process p receives a message $\langle \textbf{test}, fn, \ell \rangle$ through channel pq, where p's fragment has a different name than fn and at least level ℓ. Explain why p can send an **accept** message to q without fear that p and q are in the same fragment. (12 pts)

3. Argue that there is no Las Vegas algorithm for election in anonymous rings of unknown size. (10 pts)

4. Consider the Bracha-Toueg k-crash consensus algorithm for $k < \frac{N}{2}$. Let $N - k$ be even. Is a decision for $b \in \{0, 1\}$ possible if exactly $\frac{N-k}{2}$ processes choose the value b in the initial configuration? (12 pts)

5. Explain in detail how the Dijkstra-Scholten algorithm can be used to detect termination in the Chandy-Misra routing algorithm. (12 pts)

6. Consider the Ricart-Agrawala algorithm with the Carvalho-Roucairol optimization. Let processes p_0, p_1, and p_2 become privileged, in this order. Next p_0 and p_1 concurrently want to become privileged again, and send requests with the same logical time stamp. Give a computation where p_0 and a computation where p_1 becomes privileged first. (12 pts)

7. Give an example in which the rollback procedure of the Peterson-Kearns algorithm would roll back a certain event if Lamport's clock were used, but this event is not rolled back with the vector clock. (10 pts)

8. Let $n = 8$, and let 0 1 0 0 1 0 1 0 be the random initial values of the successive qubits at Alice. She randomly decides to apply the Hadamard transform on the second, third and sixth qubits, while Bob applies it on the first, second and sixth qubits.

   (a) What is the private key computed by Alice and Bob? (3 pts)

   (b) Suppose Eve measures the second qubit and then passes it on to Bob. How can this introduce errors at both Eve and Bob? (7 pts)