Exam Distributed Algorithms

VU University Amsterdam, 18 December 2013, 12:00-14:45

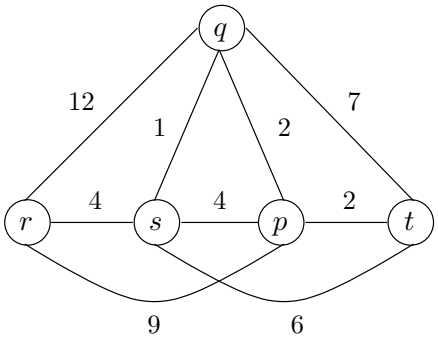
(Answers can be given in English or Dutch. You may use the textbook Distributed Algorithms: An Intuitive Approach. *Use of slides, handouts, laptop is* not *allowed.)*

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

1. Suppose that Rana's algorithm is adapted as follows: Only quiet processes that have been quiet from some logical time $< t$ (instead of $\leq t$) onward can take part in a wave tagged with time stamp t. Give an example of a finite computation for which termination would not be detected. (12 pts)

2. Show, using the technique to reduce garbage collection algorithms to termination detection algorithms, that indirect reference counting gives rise to Dijkstra-Scholten termination detection. (12 pts)

3. Run the Merlin-Segall algorithm on the following undirected weighted network, to compute all shortest paths toward process t. Give a computation that takes four rounds before the correct sink tree has been computed.



(12 pts)

4. Argue that in the Gallager-Humblet-Spira algorithm, any fragment at a level ℓ always contains at least 2^ℓ processes. (10 pts)

5. Apply the Itai-Rodeh ring size algorithm to an anonymous directed ring of size four. Give a computation in which all processes compute ring size three. (10 pts)

6. Suppose we adapt the Chandra-Toueg algorithm k-crash consensus for $k < \frac{N}{2}$ as follows. If the coordinator p_c receives at least (instead of more than) k positive acknowledgments **ack**, then p_c decides for its value. Give an example to show that this could lead to inconsistent decisions. (12 pts)

7. Let $N = 5$ and $k = 1$, and let the general g be Byzantine. Suppose that in pulse 1, g sends the value 1 to two lieutenants, and the value 0 to the other two lieutenants. Give a computation of $Broadcast_g(5, 1)$ (including a definition of the *majority* function) such that all lieutenants decide for 0. (12 pts)

8. Give an example of a computation of Dijkstra's token ring with $N = K = 4$ that takes as long as possible before it reaches a correct configuration. (10 pts)