Università degli Studi dell'Aquila

Distributed Systems: Mid-term Evaluation

Tuesday, November 6th, 2018 – Prof. Guido Proietti

Write your data ⟹	Last name: ..... First name: ..... ID number:	Points
EXERCISE 1		
EXERCISE 2		
TOTAL		

EXERCISE 1: Multiple-choice questions (20 points)

Remark: Only one choice is correct. Use the enclosed grid to select your choice. A correct answer scores 3 points, while a wrong answer receives a -1 penalization. You are allowed to omit an answer. If you wrongly select an answer, just make a circle around the wrong $\times$ (i.e., in the following way $\otimes$) and select through a $\times$ the newly selected answer. A question collecting more than one answer will be considered as omitted. The final score will be given by summing up all the obtained points (0 for a missing answer), and then normalizing to 20.

1. Let $f(n)$ and $g(n)$ denote the message complexity of the *Hirshberg & Sinclair* algorithm in the best and in the worst case, respectively. Which of the following asymptotic relations is wrong?
   *a) $f(n) = \Theta(g(n))$ b) $f(n) = o(g(n))$ c) $f(n) = O(g(n))$ d) $g(n) = \Omega(f(n))$
2. In the last phase of the *Hirshberg & Sinclair* algorithm, how many messages are sent, at most?
   a) $n/2$ b) n c) $2n$ *d) $4n$
3. Let be given a synchronous, non-anonymous, non-uniform ring with 6 processors, with minimum identifier equal to 2. In the worst case, the most efficient *leader election* algorithm will terminate after a number of rounds equal to:
   a) 6 b) it does not exist *c) 12 d) 7
4. Let us consider the asynchronous version of the *Prim* algorithm. Which of the following claim is true?
   a) In each phase, each node sends more than a single *Report* message
   *b) In each phase, each node having incident basic edges sends and then receives at most a single *Test* followed by an *Accept*
   c) In each phase, each node receives a single *Search_MOE* message
   d) In each phase, each node sends a single *Connect* message
5. Let $f(n)$ and $g(n)$ denote the message complexity of the asynchronous versions of the *Prim* and the *GHS* algorithm, respectively, when executed on a sparse graph, i.e., with $m = \Theta(n)$. Which of the following asymptotic relations is correct?
   *a) $f(n) = O(g(n) \cdot n)$ b) $f(n) = O(g(n))$ c) $f(n) = \Theta(g(n) \cdot \log n)$ d) $f(n) = o(g(n))$
6. Let us consider the synchronous version of the *GHS* algorithm. Which of the following claim is false, in general?
   a) In each phase, each node sends $O(n)$ *Reject* messages
   *b) In each phase, each node sends $O(1)$ *Test* messages
   c) In each phase, each node receives $O(n)$ *Test* messages
   d) In each phase, each node sends and then receives at most a *Test* message followed by a *Reject*
7. The first randomized algorithm we have done for finding a *maximal independent set* running on a graph with n nodes and with maximum degree $\Theta(\log n)$, with high probability has a number of phases in the order of:
   *a) $O(\log^2 n)$ b) $O(1)$ c) $O(\log n)$ d) $\Theta(n \log n)$
8. The Luby algorithm for finding a *maximal independent set* running on a graph with n nodes and with maximum degree $\Theta(n)$, with high probability has a number of phases in the order of:
   a) $O(\log n)$ b) $O(1)$ c) $\Theta(n \log n)$ *d) $O(\log^2 n)$
9. Which of the following claim is true for the $(\Delta + 1)$-coloring algorithm:
   a) It terminates within $O(\Delta \log \Delta \log n)$ rounds;
   *b) It terminates within $O(\Delta \log \Delta \log n)$ rounds w.h.p.;
   c) It terminates within $O(\log \Delta \log n)$ rounds w.h.p.;
   d) It terminates within $O(\Delta \log n)$ rounds w.h.p.
10. Which of the following claim is true for the 2Δ-coloring algorithm:
    a) It terminates within $\log n$ phases with probability at least $1 - 1/n$;
    *b) It terminates within $2 \log n$ phases with probability at least $1 - 1/n$;
    c) It terminates within $\log n$ phases with probability at least $1 - 1/n^2$;
    d) It terminates within $\log n$ phases with probability 1.

Answer Grid

	Question									
Choice	1	2	3	4	5	6	7	8	9	10
a										
b										
c										
d										

EXERCISE 2: Open question (10 points)

Remark: Select at your choice one out of the following two questions, and address it exhaustively.

1. Describe and analyze the Chang & Roberts algorithm for the *leader election* problem.
2. Describe and analyze the asynchronous version of the Gallager, Humblet e Spira (GHS) algorithm for the *minimum spanning tree* problem.