

System and device programming

17 September 2012

Programming part

Time: 1h 45min. Textbooks and/or course material allowed.

*(18 marks) The final mark is the sum of the 1st > 8 and the 2nd part > 10
The final mark cannot be refused, it will be registered (no retry for marks >= 18)*

Write a C program using Pthreads to implement an election algorithm that elects a leader thread.

The main thread generates **N>8** threads with associated an integer rank value generated random (in the range **1-N**), the threads loop doing nothing but are ready to receive and handle a **SIGUSR1** signal.

The main thread decides to begin an election campaign at random times (in range 2-5 seconds). It selects randomly **N-3** threads and sends to them an election signal (**SIGUSR1**).

The threads **cannot communicate with the main thread**, and a thread **cannot access the rank value of other threads**, i.e., you cannot use a global array to store the rank value of the selected threads, you can keep in global variables only the identifier of the thread that has currently the best rank value, and its value (**best_rank**).

Each thread must compare its own rank value with the current value in **best_rank** to decide if it is the leader or not, but it must synchronize with all the other threads to be sure that they have updated the value of **best_rank**.

When each thread has obtained the rank value of the leader thread it simply prints:

- its identifier and its rank value,
- the leader thread identifier and its rank value.

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Theory part

Time: 45 min. No textbooks and/or course material allowed.

(15 marks) The final mark is the sum of the 1st > 8 and the 2nd part > 10

The final mark cannot be refused, it will be registered (no retry for marks >= 18)

1. (3.0 points) Plot the typical behaviour of the page fault frequency function. What you put in the x axis? What is the interesting point in this curve?
2. (3.0 points) The head of a disk having 200 tracks is currently at track 50. Given the following sequence of track requests
122 71 130 52 89 8 180 15 29 56 71 10
in which sequence the track requests will be served according to the **CSCAN** strategy?
3. (3.0 points) Describes the main features of heaps in the Windows environment. When and how is it possible to use multiple heaps?
4. (3.0 points) Discuss how to perform exception handling in the Windows systems.
5. (3.0 points) N threads have to access a common file in the Windows environment. Describe the main characteristics, advantages and disadvantages of using file locking, critical sections, mutexes, and semaphores to synchronize the threads.