SE assignment **Univ. Rennes 1**

More about Semaphores

The two following exercises are based on two little fictions that may not use much of the computer science vocabulary. However, do not hesitate to think of semaphores, deadlocks, resource allocation graphs, as well as of the Banker's algorithm, when attempting to solve the proposed problems. It will be necessary to write no algorithms.

Exercise 1

A famous pop star is about to organize a big event at *Le Liberté* music hall of Rennes. The day before the planned event, she's welcoming local journalists for interviews, but since she soon gets bored of answering journalist's questions, she asks to see some of her local fans at the same time. This request gives some troubles to the organizing stuff, because the journalists are undoubtedly going to have a hard time interviewing the pop star when several of her fans will be around.

Question 1

As a member of the local stuff, and with your fresh Master degree in Computer Science in your pocket, you are asked to find a valid solution to this problem. The main organizers would like you to come up with a ticket system capable of controlling the number of interactions that the pop star is supposed to have in parallel. Tickets will be distributed to journalists and fans at the entrance, and collected when they will leave. It will be required that maximum 5 fans can see the pop star at the same time, and that, when a journalist is present, this constraint decreases to 2. How to develop this system?

Question 2

Your system seems to satisfy the main organizers, and it actually works fine for the first hour of pop star meetings with fans and journalists. However, the number of fans keeps growing with the time during the day, while the number of journalists remains the same and, after some time, it seems they are all stuck outside and no longer able to get access to the room where to meet the pop star. Can you explain what is going on?

Question 3

One journalist, who was waiting for his turn since long time, decides to cheat the system by moving to the fan line in order to get his tickets. After him, several journalists start to do the same. Is this behavior dangerous for your system?

Question 4

The system crashes after a while. All tickets are assigned to somebody, but nobody has the right to enter. Who are these people that hold the tickets? Journalists or fans? You start wondering whether, when distributing the tickets, it was necessary to verify the identity of the person asking for them.

Exercise 2

A startup is working on the prototype of a new processor where the access to the cache memory is controlled in order to avoid the typical problems arising in concurrent programming with shared memory. The main idea is to introduce an internal mapping where every cache block is associated to a running program. In this way, in fact, every program can ask to have an exclusive use of a subset of blocks during the execution. The reservation system of the cache is based on a unique semaphore capable to distribute as many permits as the total number of blocks.

Let's indicate the total number of cache blocks by n. Let's suppose that n programs are currently running, and that they all need to have independent access to 2 cache blocks. We are asked to study some of the possible states for the reservation system, and to construct the corresponding resource allocation graph. In order to detect deadlocks, do not hesitate to replace the unique n-permit semaphore with n 1-permit semaphores in your graph representation, if you find this useful.