Programación de Sistemas y Concurrencia
(Systems Programming and Concurrency)

Lab. nº 5.1. Mutual exclusion

1. Implement in Java the Producer/Consumer problem using a circular buffer with N elements.

- There is a single thread that represents the producer. This thread produces integer items at irregular intervals.
- There is a limited circular buffer shared between producer and consumer, i.e. where the producer puts items and consumer takes items. This buffer contains the following attributes:
    o items: array with the items stored in the buffer.
    o p: the index of the array where the producer will put the next item.
    o c: the index of the array from where the consumer will take the next item.
    o nItem: current number of items stored in the buffer.

- There is a single consumer that displays the items produced into the buffer.

2. We want to simulate the water level in a lake. Two rivers fall into this lake (which makes the level to increase), and the level can be decreased by means of two dams, as shown in the figure. We want to model this system using busy waiting, having in mind:
- Each river must be modelled as a thread. The same applies for each dam. The water level of the lake is modelled as a class that contains an integer variable.
- We want to control exactly the water level in the lake in order to prevent flooding. Any level variation (increments or decrements) must be performed with mutual exclusion.
- No additional threads can be used to achieve mutual exclusion.
- Each river will increase 1000 times the water level, 1 unit in each access to the critical section with mutual exclusion.
- Each dam will decrease 1000 times the water level, 1 unit in each access to the critical section with mutual exclusion.
- If the water level is 0, then a dam cannot decrease the level.
- It is not allowed to use any pause or sleep among increments or decrements of the water level.
- Each time any process changes the water level, it must display a message to report the action performed and the current level of the lake.
- If a dam tries to decrease the water level when the lake is dry, then it must display a message to report such a situation.

  The main program has to display the water level at the end of the threads' execution (the final level must be 0 after 1000+1000 increments and 1000+1000 decrements).