Problem Set 4, Part b

Due: Thursday, October 31, 2013

Readings:
Chapter 9 (skim); Sections 10.1-10.8 in detail, 10.9 (skim); Chapter 11 (skim).

Next week: Chapter 12; Sections 13.1, 13.2.

Problems:

1. (Based on Exercises 10.2 and 10.3.)
   Consider Dijkstra’s mutual exclusion algorithm.
   (a) Show that it is not lockout-free; that is, describe a fair execution of the algorithm in which a particular process is locked out.
   (b) Show that, if we remove the second phase of the algorithm (where the flag is raised to 2 and the other processes’ flags are tested), then the resulting algorithm does not satisfy mutual exclusion.

   Note that we are not assuming that the users eventually return the resource—if we did, then an ordinary mutual exclusion algorithm would also satisfy the stronger progress condition needed for $k$-exclusion. In writing your code, you may use either sequential-style pseudocode like that on p. 284, or I/O-automata-style pseudocode like that on p. 285-286.

3. Exercise 10.22.

4. Consider the 2-exclusion problem, which is a special case of the $k$-exclusion problem defined in Exercise 10.13. Thus, we assume a new exclusion condition, which says that no more than two processes can be in the critical region at the same time. Also, we assume a new progress condition, which guarantees that, in a fair execution, if the critical region is occupied by at most one process, and another process is trying, then another trying process must eventually enter the critical region.
   (a) Use techniques like those in Section 10.8 to prove that three processes cannot solve the 2-exclusion problem using just one read/write shared variable.
   (b) Extra credit: Prove that three processes cannot solve the 2-exclusion problem using two read/write shared variables.

5. Write your project proposal. It should be on a separate sheet from the rest of the homework assignment. The proposal should be only a page long (or two at most).
   Say who is working on the project. Say which type of project (of the three we mentioned earlier—reading project, theoretical research project, or experimental research project) you are planning to carry out. Describe, as clearly as possible, what you are planning to do. Include relevant references.