Problem Set 4, Part b

Due: Thursday, November 3, 2011

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:
5. Exercise 10.2.
   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 pseudocode in the style used on p. 284, Tempo-style pseudocode like that on p. 285-286, or real Tempo code.
7. (Based on Exercises 10.23 and 10.24)
   Consider a weaker read/write shared-memory model, in which read and write operations on shared variables are no longer instantaneous, but have duration. Suppose that the shared registers are guaranteed only to be safe, that is, a read operation is guaranteed to yield the correct value in the absence of concurrent write operations, whereas a read operation that overlaps a write may yield any value of the variable's type.
   (a) Does the Bakery algorithm work correctly in this weaker model? Prove that it does or give a counterexample.
   (b) Does the Burns algorithm work correctly in this weaker model? Prove that it does or give a counterexample.
8. Use techniques like those in Section 10.8 to prove that 3 processes cannot solve the 2-exclusion problem using just a single read/write shared variable.
   The 2-exclusion problem is defined in Exercise 10.13. Thus, we assume a new exclusion condition, which says that no more than 2 processes can be in the critical region at the same time. Also, we assume a new progress condition, which guarantees that, if the critical region is occupied by at most one process, then another trying process must eventually enter the critical region. We do not assume any high-level fairness condition.
9. Exercise 10.31. You should state and prove separately for each property (mutual exclusion and progress) whether the algorithm satisfies the property.
   Optional: Rewrite the code using Tempo and try Peter Musial's Tempo simulator to help test the properties.