Randomised Mutual Exclusion (SPIN 2009/STTT)

AVACS S3
Phase 2

July 28, 2011

In the randomised mutual exclusion protocol [2] several processes try to enter a critical section. We consider the protocol with two processes $i = 1, 2$. Process i tries to enter the critical section with probability p_i, and with probability $1 - p_i$ it waits until the next possibility to enter and tries again. The model is a Parametric Markov Reward Model (PMRM) with parameters p_i. A reward with value 1 is assigned to each transition corresponding to the probabilistic branching p_i and $1 - p_i$. We consider the expected number of coin tosses until one of the processes enters the critical section the first time. A plot of the expected number is given in Figure 1. This number decreases with both p_1 and p_2, because the chance to enter the critical section increases for both processes. We implemented a model, consisting of 77 states and 201 non-zero transitions, in $PARAM$ 2.0α [1]. The computation took 98 seconds and 5 MB of memory was used. Converting the transition rewards to state rewards and subsequent strong bisimulation minimization lead only to a minimal reduction in state and transition numbers and did not reduce the analysis time.

References

[1] Ernst Hahn, Holger Hermanns, and Lijun Zhang. Probabilistic Reachability for Parametric Markov Models. *STTT*, pages 1–17, 2010.

[2] Amir Pnueli and Lenore Zuck. Verification of multiprocess probabilistic protocols. *Distrib. Comput.*, 1(1):53–72, 1986.
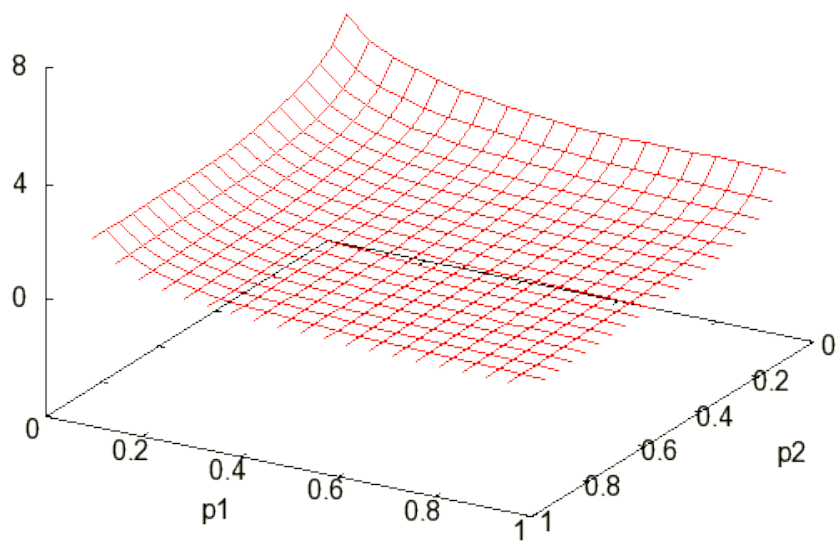
Figure 1: Number of steps until one process reaches the critical section