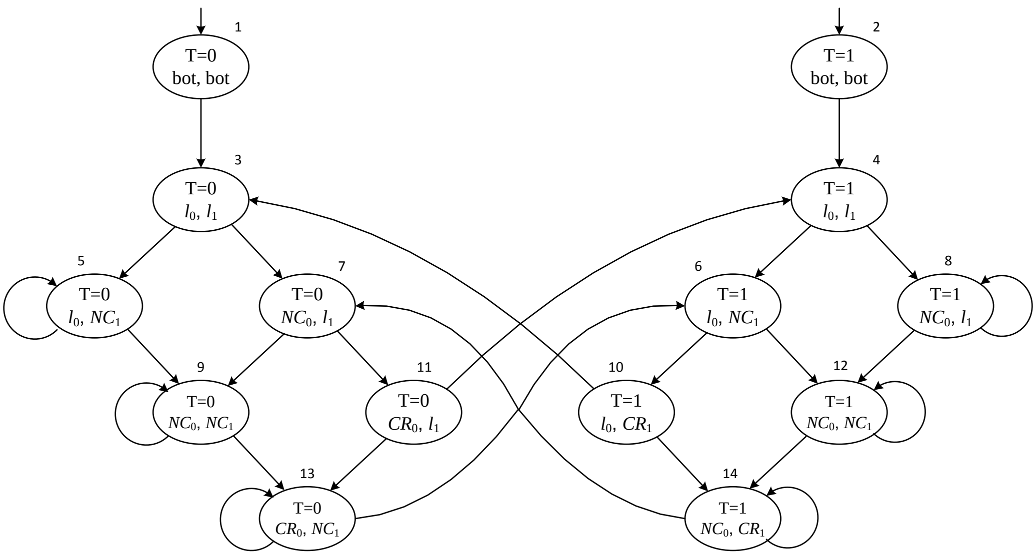
Homework Assignment #2

Note

This assignment is due 2:20PM Wednesday, October 9, 2019. Please write or type your answers on A4 (or similar size) paper. Late submission will be penalized by 20% for each working day overdue. You may discuss the problems with others, but copying answers is strictly forbidden.

Problems

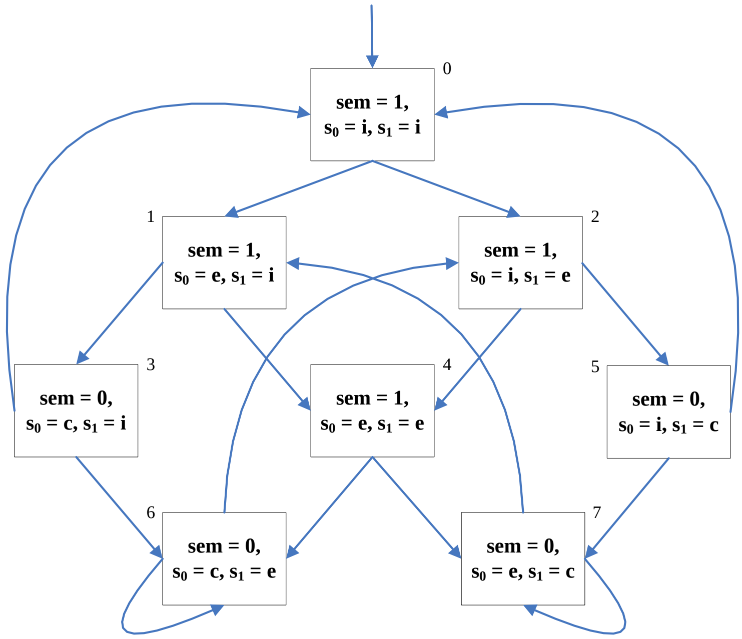
1. (60 points) Consider model checking the CTL property $\mathbf{AG}((at\ l_0) \rightarrow \mathbf{AF}(at\ CR_0))$ (using the CTL model checking procedures in Chapter 4.1 of [CGP]) against the following Kripke structure which represents a two-process mutual exclusion algorithm using an atomic read/write variable.



(Source: redrawn from [CGP, Fig 2.2])

Please illustrate the steps of labeling the states with sub-formulae during the execution of the model checking algorithm. As you will see, the property does not hold (i.e., there is possibility of starvation). What fairness constraints should be added?

2. (40 points) Consider another two-process mutual exclusion algorithm via the arbitration of a binary semaphore. The Kripke structure representing this system is as follows.



Check if the system at state 1 satisfies the LTL formula $\mathbf{A}((s_0 = e)\ \mathbf{U}\ (s_0 = c))$ (using the LTL model checking procedures in Chapter 4.2 of [CGP]). Please illustrate the model checking steps by giving the closure of the formula, relevant parts of the product graph (composed from the Kripke structure and the implicit tableau), etc.