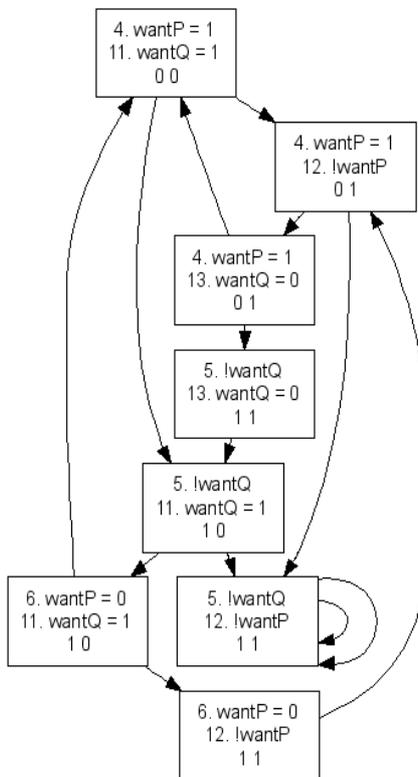


`dot` program of GraphViz is called to layout the graph.

Here is the diagram generated *automatically* by SpinSpider for the “third attempt” to solve the critical section problem [2, Section 3.7]; the potential for deadlock is instantly apparent in the state near the bottom of the diagram, and the reason for the deadlock is easy to explain using the visualization:



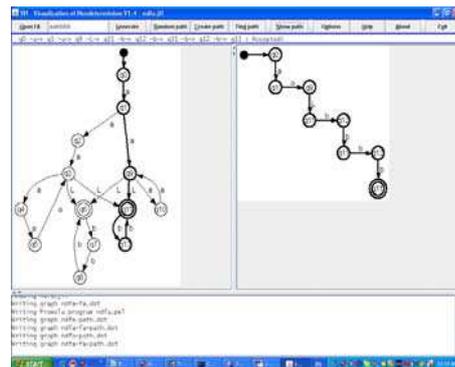
5. VN: Visualization of Nondeterminism

Nondeterminism appears in several contexts such as nondeterministic finite automata (NFA) and nondeterministic algorithms. Students find it difficult to understand the definition of acceptance of a string by an NFA—the string is accepted iff there *exists* an accepting computation; this mathematical definition is at odds with the intuition of a machine that searches for a solution, for example, by backtracking.

The specification of VN was worked out in collaboration with Michal Armoni. VN is a software tool that leverages the nondeterministic execution of a Promela program by Spin and the graph layout capabilities of GraphViz to enable the student “experience” the nondeterminism of an NFA. VN can run in three modes: (1) random resolution of nondeterminism to emphasize that the result of a single computation of an NFA is arbitrary; (2) interactive resolution of nondeterminism which demonstrates that a “magic coin” can guide the NFA to an accepting computation; (3) verification mode to find an accepting computation if one exists, demonstrating that an accepting computation can be found by an exhaustive deterministic search. VN can also find all accepting computations of all inputs of a given length, and for deterministic automata, it can compute the partition of the input strings accepted at each node.

The input to VN is the description of an NFA created by JFLAP and a string entered by the user. VN generates a Promela program which is then executed by Spin in one of the above modes. A `dot` file is generated and the `dot` program of GraphViz is called to layout the graph.

Here is the visualization of an accepting computation of an NFA, where the path within the NFA is shown in bold in the left pane, while the full path (including repetitions) is shown in the right pane:



6. Resources

The software tools I developed can be downloaded from:

<http://stwww.weizmann.ac.il/gcs/benari/home/software.html>

or from:

<http://sourceforge.net/projects/pcdp>

The tools are written in Java and are available under the GNU GPL. The other tools that are needed (Spin, Graphviz, a C compiler, JFLAP) can also be freely downloaded.

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