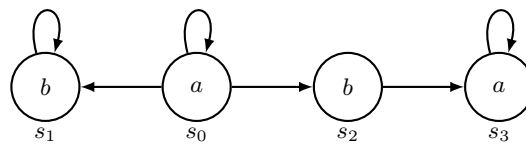


VU Programm- und Systemverifikation

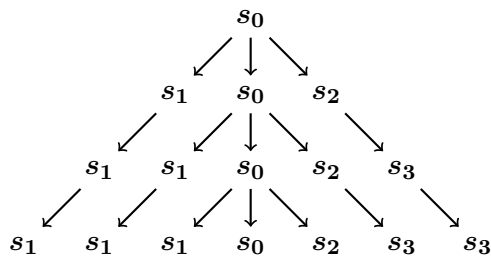
Solutions: Temporal Logic and Model Checking

June 5, 2017

Consider the following Kripke Structure:



- Fix s_0 as the initial state and give the computation tree for three steps.



- Describe the following formulas in natural language. For each formula, in which states of the Kripke structure does it hold? (Note that we do not consider s_0 as special initial state here.)

- (a) $b \wedge \mathbf{X} a$

For all paths b holds in the initial state, and in all direct successors of the initial state a holds.

$\{s_2\}$

- (b) $\mathbf{AG}(a \mathbf{U} b)$

Along all paths a holds until b holds.

$\{s_1, s_2\}$

- (c) $\mathbf{E}(\mathbf{G} b)$

There is a path where b always holds.

$\{s_1\}$

- (d) $\mathbf{A}(\mathbf{GF} a)$

In all paths a holds infinitely often.

$\{s_2, s_3\}$

3. Encode the following statements in temporal logic using the propositions given in quotes:

- (a) In all runs, a process is “scheduled” infinitely often.

G F “scheduled”

- (b) There is a run in which from some point on the light is “red” forever.

E F G “red”

- (c) There is a run where the speaker “beeps” at least five times in a row.

EF (“beeps” \wedge EX “beeps” \wedge EX EX “beeps” \wedge EX EX EX “beeps” \wedge EX EX EX EX “beeps”)

- (d) In all runs, if the submarine “dives”, it later “surfaces”.

G (“dives” \rightarrow F “surfaces”)

- (e) The plane never “crashes”.

G \neg “crashes”