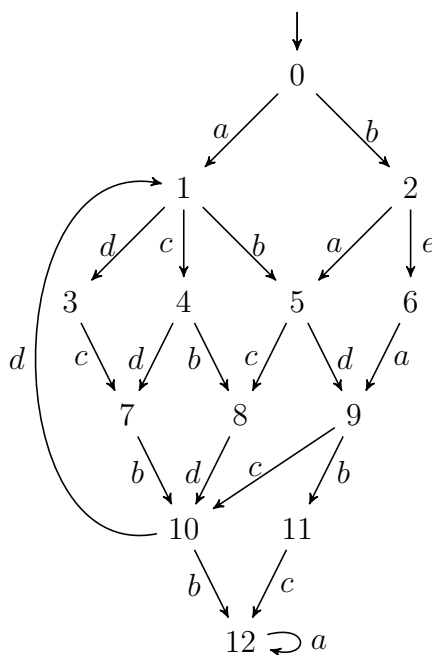


Model Checking – Exercise sheet 7

Exercise 7.1

Consider the following Kripke structure $\mathcal{K} = (S, A, \rightarrow, 0, AP, \nu)$, where $A = \{a, b, c, d, e\}$, $AP = \{p\}$, $\nu(6) = \{p\}$, and $\nu(s) = \emptyset$ if $s \neq 6$.



- (a) Write down the independence relation $I \subseteq A \times A$.
- (b) Write down the invisibility set $U \subseteq A$.
- (c) Compute a reduction function red that satisfies the ample set conditions C0–C3. Whenever possible, choose $red(s)$ such that it is a proper subset of $en(s)$, for each state s .
- (d) Use red to construct a reduced Kripke structure \mathcal{K}' that is stuttering equivalent to the original Kripke structure \mathcal{K} .

Exercise 7.2

Consider the following Promela model

```

1 byte g;
2
3 active proctype m() {
4     byte x;
5     m0: x++;
6     m1: x++;
7     m2: g = x;
8 }
9
10 active proctype n() {
11     byte y;
12     n0: y++;
13     n1: y++;
14     n2: atomic { (g>0) -> g = g-y }
15 }
16
17 active proctype p() {
18     p0: atomic { (g>0) -> g-- }
19 }

```

and the following properties:

- a) The value of `g` will eventually become one.
- b) The process `n` cannot finish before the process `m` reaches `m1`.

For each property, define a labeled Kripke structure with actions extracted from program statements. Determine the independence relation and the invisibility set, and construct a reduced Kripke structure using the ample sets method.