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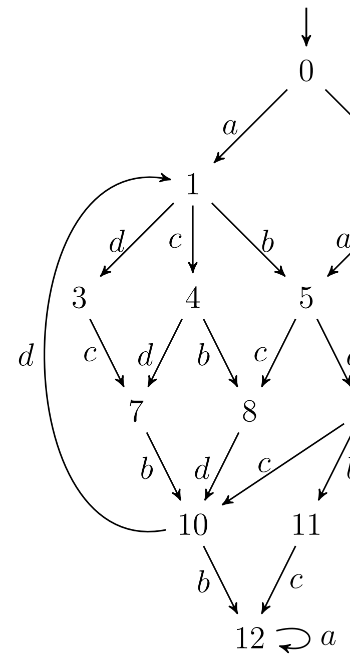
Model Checking – Exercise sheet 7

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

```
byte g;

active proctype m() {
  byte x;
  m0: x++;
  m1: x++;
  m2: g = x;
}

active proctype n() {
  byte y;
  n0: y++;
  n1: y++;
  n2: atomic { (g>0) -> g = g-y }
}

active proctype p() {
  p0: atomic { (g>0) -> g-- }
}
```

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.