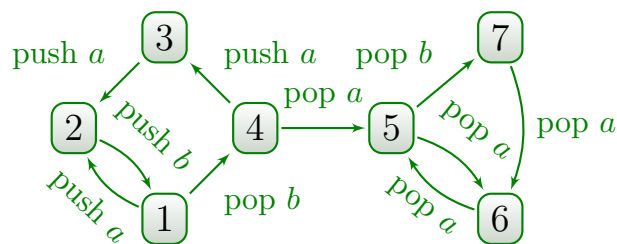


Model Checking – Exercise sheet 12

Exercise 12.1

Consider the pushdown system below, with stack alphabet $\Gamma = \{a, b\}$ where $\textcircled{1} \xrightarrow{\text{push } a} \textcircled{2}$, indicates the presence of transitions $1a \leftrightarrow 2aa$ and $1b \leftrightarrow 2ab$, and $\textcircled{4} \xrightarrow{\text{pop } a} \textcircled{5}$, indicates the presence of transition $4a \leftrightarrow 5$.



- Let $L = 7b^* = \{7, 7b, 7bb, 7bbb, \dots\}$. Construct the \mathcal{P} -automaton accepting $\text{pre}^*(L)$.
- Give the minimal automaton accepting the language of all stacks w such that $1w \in \text{pre}^*(L)$.

Exercise 12.2

Consider the following recursive program, where ? denotes a nondeterministic Boolean value:

```

    procedure main;
m0:   if ? then
        call a;
        else
        call b;
m1:   return;

    procedure a;
a0:   if ? then
        call b;
a1:   call b;
        else
        call a;
        end if;
a2:   return;
    
```

```

    procedure b;
b0:   if ? then
        call a;
b1:   if ? then
        call a;
        end if;
    end if;
b2:   return;

```

- (a) Model the program with a pushdown system.
- (b) Compute all configurations that can reach the program label `m1`.

Exercise 12.3

Consider the following recursive program with a global variable `g` and a local variable `l`:

```

    boolean g;

    procedure main(boolean l);
m0:   if l then
        call a;
    end if;
m1:   assert(g == l);
m2:   return;

    procedure a();
a0:   g := not g;
a1:   if not g then
        call a;
a2:   call a;
    end if;
a3:   return;

```

- (a) Model the program with a pushdown system, where the values of `g` and `l` are not initialized.
- (b) Compute all configurations that can reach the program label `m2`.
- (c) ★ Compute all configurations that are reachable from the program label `m0`.