Technische Universität München (I7) **Summer Semester 2020**
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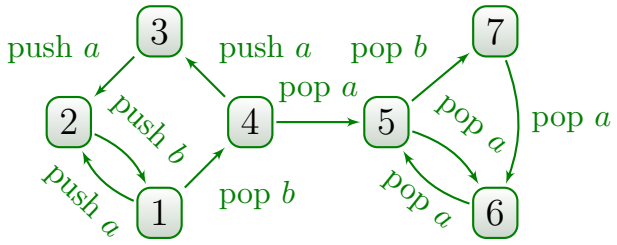
Model Checking – Exercise sheet 12

Exercise 12.1

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



(a) Let $L = 7b^* = \{7, 7b, 7bb, 7bbb, \ldots\}$. Construct the $\mathcal{P}$-automaton accepting $\text{pre}^*(L)$.

(b) 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`.