**Assignment 1** Consider the linear recursive specification

$$\begin{aligned} S &= a.T + \mathbf{1} \\ T &= b.S + b.U \\ U &= a.S + a.T + a.U \end{aligned}$$

a) Construct, by transformation of the underlying recursive specification, a total and deterministic automaton that is language equivalent to the automaton $\mathcal{M}(S)$. (15 pts.)

b) For $IA_\tau(\mathcal{N})$ we have the following result: If $x \approx y \cdot x + z$ then $x \approx y^* \cdot z$. Use the result to calculate an iteration expression for $\mathcal{L}(S)$.
(Hint: make use of deterministic equivalent of the given specification constructed for item a).) (15 pts.)

**Assignment 2**

a) Give the additional operational rules for the sequential operator $\cdot$ and the iteration operator $*$ of the process algebra $IA_\tau$, in total five rules. (5 pts.)

b) Give the definition of (strong) bisimulation for processes of $IA_\tau$. (5 pts.)

c) Prove the law $x^* \leftrightarrows x \cdot x^* + \mathbf{1}$ for $IA_\tau$ by showing a suitable relation $R$ on $IA_\tau$ to be a bisimulation relation. Give an explicit definition of $R$. (15 pts.)

**Assignment 3**

a) Formulate the Pumping Lemma for push-down languages. (10 pts.)

b) Prove, using the Pumping Lemma for push-down languages, that the language $L$ given by
$L = \{ w \in \{a^n b^n c^n \mid n \geqslant 0 \}$
is not push-down. (15 pts.)

**Assignment 4** Let the domain $D \subseteq \{ 0, 1, + \}^*$ be given by

$$D = \{ w{+}v \mid w, v \in \{0,1\}^*,\ |w| = |v| \}$$

Construct a Turing machine that computes binary addition on $D$, i.e. the function on $D$ that has the binary representation of $w + v$ as its output for input strings $w$ and $v$, interpreted as binary numbers of an equal number of digits. (20 pts.)

The end mark is the total of accredited points divided by 10.