Homework 1 of CS520 Theory of Programming Languages
Deadline: 6:00pm on 5 October (Monday)

Submit your solutions in KLMS. (Reminder: We adopt a very strict policy for handling dishonest behaviours. If a student is found to copy answers from fellow students or other sources in his or her homework submission, she or he will get F.)

The numbers in the questions refer to exercise questions in the textbook of the course, i.e. "Theories of Programming Languages" by John C. Reynolds.

Question 1

Solve 1.5(a), 1.5(b) and 1.5(c).

Question 2

Solve 1.7(a) and 1.7(b) only for the case that p there is an integer expression. You may assume the following slightly simpler grammar for integer expressions in your answer.

$$\langle \text{intexp} \rangle ::= 0 \mid 1 \mid, \ldots \mid \langle \text{var} \rangle \mid -\langle \text{intexp} \rangle \mid \langle \text{intexp} \rangle + \langle \text{intexp} \rangle \mid \langle \text{intexp} \rangle * \langle \text{intexp} \rangle$$

Hint: Use the structral induction that we discussed in the lectures.

Question 3

Consider the domain $(2^{\mathbb{Z}}, \subseteq)$ of subsets of $\mathbb{Z}$ with the subset order. Let $(P, \sqsubseteq)$ be a predomain. We say that a function $f : 2^{\mathbb{Z}} \to P$ is *finitely generated* if for all $A \in 2^{\mathbb{Z}}$, the set

$$\{f(A') \mid A' \text{ is a finite subset of } A\}$$

has the least upper bound in A and this least upper bound is equal to $f(A)$. Prove that f is continuous (in the domain-theoretic sense) if and only if it is finitely generated.

Question 4

Solve 2.2(a), 2.2(b) and 2.2(c).

Question 5

Solve 2.6.

Question 6

Solve 2.9.