

# CSC 501 - Assignment #1

version 7.0

Due Tuesday 9/29/09 in Class

## Problems

1. Given the production

$$C ::= \text{skip} \mid x := A \mid C ; C \mid \text{if } B \text{ then } C \text{ else } C \mid \text{while } B \text{ do } C$$

give an inductive definition of set **Com**, the set of all well formed commands. You can assume that the productions for non-terminals A and B give rise to the inductively defined sets **Aexp** and **Bexp**, respectively.

2. Compute the semantic value of  $ae \equiv 2 * v$ , where  $ae \in \mathbf{Aexp}$  with  $v \in \mathbf{Loc}$  and  $2 \in \mathbf{I}$ . Assume the initial state  $\sigma_0 \in \Sigma$ .
3. Compute the semantic value of  $c \equiv x := 3; \text{if } x \leq 5 \text{ then } x := 0 \text{ else } x := 10$ , where  $c \in \mathbf{Com}$ ,  $x \in \mathbf{Loc}$ , and  $0, 3, 5, 10 \in \mathbf{I}$ . Assume the initial state  $\sigma_0$ .
4. Let  $a_0 \equiv 1 + 1$  and  $a_1 \equiv 2$ , where  $a_0, a_1 \in \mathbf{Aexp}$ . Prove that  $a_0 \sim a_1$ .
5. Given the syntax and semantics for the language IMP discussed in class, extend the syntax of this language with the construct **do**  $c$  **while**  $b$  where  $c \in \mathbf{Com}$  and  $b \in \mathbf{Bexp}$ . The informal specification of this command is that  $c$  is executed as long as  $b$  remains **true**. Provide a set of semantic rules that define the behavior of this construct formally and demonstrate that your rules work with a simple example.
6. Let  $\sigma : \mathbf{Loc} \rightarrow \mathbb{I}$  be some state  $\sigma \in \Sigma$ , show that  $\sigma[2/x] = (\sigma[1/x])[2/x]$  for some  $x \in \mathbf{Loc}$ . (**Hint:** use extensional equality of functions.<sup>1</sup>)

Where not stated explicitly otherwise, show your computations based on the operational semantics rules covered in class.<sup>2</sup>

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<sup>1</sup><http://en.wikipedia.org/wiki/Extensionality>

<sup>2</sup>Typewritten work is preferred :)