

# CSC 330 Principles of Programming Language

## Assignment II

1. (2 points) Consider a language of words, where each word is a string of dots and dashes. The following grammar describes this language:

$$\langle \text{word} \rangle = \langle \text{dot} \rangle \mid \langle \text{dash} \rangle \langle \text{word} \rangle \mid \langle \text{word} \rangle \langle \text{dot} \rangle$$

$$\langle \text{dot} \rangle = \cdot$$

$$\langle \text{dash} \rangle = -$$

- (a) Write all three-character strings that are in this language.
- (b) Write a seven-character string that contains more dashes than dots and is in the language. Explain by leftmost derivation.

2. (1 point) Give informal descriptions of pushdown automata for the languages

$\{ w \mid \text{the length of } w \text{ is odd and its middle symbol is a } 0 \}$ .

Is your pushdown automata deterministic or not?

3. (2 points) Using the given rules, draw the derivation tree for the statement.

if iszero succ pred pred 0 then if true then false else false else true

<p><b>Syntax</b></p> <p><b>t ::=</b></p> <p>    true</p> <p>    false</p> <p>    if t then t else t</p> <p><b>v ::=</b></p> <p>    true</p> <p>    false</p>	<p><b>terms:</b></p> <p>constant true</p> <p>constant false</p> <p>conditional</p> <p><b>values:</b></p> <p>true value</p> <p>false value</p> <p><b>Evaluation</b></p> <p><math>t \rightarrow t'</math></p> <p>if true then <math>t_2</math> else <math>t_3 \rightarrow t_2</math> (E-IFTRUE)</p> <p>if false then <math>t_2</math> else <math>t_3 \rightarrow t_3</math> (E-IFFALSE)</p> <p><math display="block">\frac{t_1 \rightarrow t'_1}{\text{if } t_1 \text{ then } t_2 \text{ else } t_3 \rightarrow \text{if } t'_1 \text{ then } t_2 \text{ else } t_3}</math> (E-IF)</p>
<p><b>New syntactic forms</b></p> <p><b>t ::=</b> ...</p> <p>    0</p> <p>    succ t</p> <p>    pred t</p> <p>    iszero t</p> <p><b>v ::=</b> ...</p> <p>    nv</p> <p><b>nv ::=</b></p> <p>    0</p> <p>    succ nv</p>	<p><b>New evaluation rules</b></p> <p><math>t \rightarrow t'</math></p> <p><math display="block">\frac{t_1 \rightarrow t'_1}{\text{succ } t_1 \rightarrow \text{succ } t'_1}</math> (E-SUCC)</p> <p>pred 0 <math>\rightarrow</math> 0 (E-PREDZERO)</p> <p>pred (succ <math>nv_1</math>) <math>\rightarrow</math> <math>nv_1</math> (E-PREDSUCC)</p> <p><math display="block">\frac{t_1 \rightarrow t'_1}{\text{pred } t_1 \rightarrow \text{pred } t'_1}</math> (E-PRED)</p> <p>iszero 0 <math>\rightarrow</math> true (E-ISZEROZERO)</p> <p>iszero (succ <math>nv_1</math>) <math>\rightarrow</math> false (E-ISZEROSUCC)</p> <p><math display="block">\frac{t_1 \rightarrow t'_1}{\text{iszero } t_1 \rightarrow \text{iszero } t'_1}</math> (E-ISZERO)</p>