

Assignment 4
CSCI 3136: Principles of Programming Languages
Due Mar 25, 2019

Assignments are due on the due date before 23:59. All assignments must be submitted electronically via the course SVN server. Plagiarism in assignment answers will not be tolerated. By submitting your answers to this assignment, you declare that your answers are your original work and that you did not use any sources for its preparation other than the class notes, the textbook, and ones explicitly acknowledged in the answers. Any suspected act of plagiarism will be reported to the Faculty's Academic Integrity Officer and possibly to the Senate Discipline Committee. The penalty for academic dishonesty may range from failing the course to expulsion from the university, in accordance with Dalhousie University's regulations regarding academic integrity.

Submission instructions: Create a directory a4 at the top level of your SVN repository. Place a single PDF file named a4.pdf containing your answers into this directory and submit it via `svn commit`.

For both of the following languages, provide a grammar that generates it, an intuitive explanation why this grammar generates this language, and a graphical representation of a push-down automaton that recognizes this language.

- (a) The language of properly nested sets of parentheses over the alphabet $\{(\,)\}$. Note that the string $((()())())$ belongs to this language, while the string $((()))()$ does not because the third closing parenthesis does not have a matching opening parenthesis. Provide a parse tree and a leftmost derivation of the string $((()())())$.
- (b) The language of all strings over the alphabet $\{a, b, c\}$ that are *not* palindromes, that is, are not of the form $\sigma\alpha\sigma^R$, where σ^R is the reversal of string σ and $\alpha \in \{a, b, c, \varepsilon\}$. Thus, the string abb belongs to this language, while the string $abcba$ does not. Provide a parse tree and a rightmost derivation for the string $abacbba$.