CS 181 Spring 2018 Homework Week 8

Due Monday 28 May 4:00pm online

0. [4 points] Give a PDA for the following language over ∑ = { (,), [,], a, # } with end-mark "#":

   L_0 = **{** w# **|** w is a string over { (,), [,], a } consisting of lists of zero or more a's between balanced parentheses of two types **}**

   E.g., L_0 contains: #, ()#, (a)#, [a a]#, [](a)#, ([a])()#, [([a a a])]#, etc.

   E.g., L_0 does not contain: ε , a#, #(), (]#, ()a#, ((a)#, [#]#, [](( ) a)#, (a])()#, [[a a a])]#, etc.

   Scoring: 3 points for correct PDA + 1 point if your PDA is deterministic.

1. Consider the following CFG G = (V, ∑, R, P), where:

   V = { P, Type, Pl, Pl1, Body, St, Else }

   ∑ = { main , (,) , int , char , void , { , } , **;** , **,** , **=** , if , exp , else , id }

   R = **{** P - > Type main (Pl) { Body }

   Type - > int | char | void

   Pl - > ε | id Pl1

   Pl1 - > **,** id Pl1 | ε

   Body - > St **;** Body | St **;**

   St - > id **=** exp

   St - > if (exp) St Else | if (exp) { Body } Else

   Else - > else St | else { Body } | ε

   }

   This grammar describes a very small portion of the syntax of a programming language similar to the C programming language.

   1.a. [1 points] Show a derivation tree in G for the string:

   void main () { if (exp) id = exp ; if (exp) id = exp else id = exp ; }

   1.b. [1 points] Show a left-most reduction in G for the same string, and underline the handle at each step as shown in class.

   Some groups of production rules describe particular language features. E.g., the rule:

   " P - > Type main (Pl) { Body } "

   describes the overall structure of programs. The rules for variables Pl and Pl1 describe parameter lists. The rules for variables St and Else describe the assignment statement and if statements. Some of these language features could be represented using only a DFA or equivalent model; while some features can only be described correctly using the Context Free Grammar (CFG) model.

   1.c. [2 points] Identify the language feature(s) which require the CFG model and very briefly explain why they require a CFG to define them.

2. [4 points] Consider the following language over ∑ = { 0, 1 }:

   L_2 = **{** $0^r\ 1\ 0^s\ 1\ 0^t$ **|** r, s, t ≥ 0 and r < s > t **}**

   Prove that L_2 is not context free using the Pumping Lemma for context free languages.

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