CSE 34151 Theory of Computing: Homework 4
CFGs and PDAs

Version 1: Feb. 23, 2018

Instructions

- Unless otherwise specified, all problems from "the book" are from Version 3. When a problem in the International Edition is different from Version 3, the problem will be listed as V3:x.yy/IE:x.zz, where x.zz is the equivalent number. When Version 2 is different, it will be listed as V3:x.yy/V2:x.zz. If either IE or V2 do not have a matching number, the problem text will be duplicated.
- You can prepare your solutions however you like (handwriting, LaTeX, etc.), but you must submit them in **legible PDF**. You can scan written solutions on the printer in the back of the classroom, or using a smartphone (with a scanner app like CamScanner). It is up to you to ensure that submissions are legible. REMEMBER THAT IF WE CAN"T READ IT OR SCAN IS CUT OFF, YOU DON"T GET A GRADE FOR IT.
- The problems marked as "TEAM" may be solved in a collaborative fashion with up to 2 other students. In such cases, your submission should have the word "TEAM" at the start of the problem, followed by the names of your collaborators (must be other students in this class). When such problems are graded, the first submission encountered by the grader for the team will be used for a common grade for all identified team members.
- Please give every PDF file a unique filename.
  - If you're making a complete submission (all problems), name your PDF file `netid-hw#.pdf`, where `netid` is replaced with your `NetID` and # is the homework number.
  - If you're submitting some problems now and other problems later, name your file `netid-hw-1-2-3.pdf`, where `1-2-3` is replaced with just the problems you are submitting now. This may be useful for team submissions.
  - If you use the same filename twice, only the most recent version will be graded.
  - The time of submission is the time the most recent file was uploaded.
- If you use LaTeX and want to draw something like a state diagram, consider using the `tikz` package. A reference document is on the website under "Assignments".
- You may also find the website http://madebyevan.com/fsm/ a useful tool for drawing state diagrams via drop and drag. It will output both .png image files and latex in the tikz format.
- Submit your PDF file in Sakai to the appropriate directory. Don't forget to click the Submit (or Resubmit) button!

Practice Problems

These problems are from the book, and most have solutions listed for them. They are listed here for you to practice on as needed and any answers you generate **should not** be submitted. You are free to discuss these with others, but you are not allowed to post solutions to any public forum.

1. 2.1 Parse trees and derivations
2. 2.3 Parts of a CFG
3. 2.6 a,c
4. 2.8 different derivations

Book Exercises

These problems are found in the text book and are to be answered and submitted by each student. **If they are not marked as "TEAM," you are to solve them individually.** If they are marked as "TEAM" you may submit the same answer as the others in your team. In any case, use of solution manuals from any source or shared solutions is a violation of the ND Honor Code. You are also not allowed to show your solutions to another student not part of your TEAM.

1. (10pt) Book 2.4 b,e Creating CFGs
2. (10pt TEAM) 2.6 d Creating CFG
3. (5pt TEAM) 2.5e. Creating a PDA. There will be some non-determinism to guess the middle, and whether the string is even or odd in length. Draw the state machine.

Non-book Problems

The following problems are not found in the text book. **If they are not marked as "TEAM," you are to solve them individually.** If they are marked as "TEAM" you may submit the same answer as the others in your team. Use of any resource you used other than the text book or class notes must be cited. You are also not allowed to show your solutions to another student.

For these problems, assume P is the language of matching parenthesis, i.e. $P = \{w | w = w_1...w_i...w_{2n} | n \geq 0, \Sigma = \{(,)\}$, (the empty string ε is included), where in any prefix substring $w_1...w_k$ there are never more ")" than "(", and in the whole string the numbers of "(" and ")" are equal (n each).}. Examples include "(()()(()))" but not ")()(".

4. (5pt) For the CFG of Example 2.4, draw a parse tree for $(a\ +a\ +a)\ x\ (\ a\ +\ a)$. Feel free to abbreviate the non-variables as E, T, F.
5. (10pt TEAM) Create a CFG for P, and show a left-most derivation for (()(())).
6. (10pt) Create a PDA for P. You do not need to use the CFG for this. Show the stack as a string at each step in the derivation of (()(())).