Homework 7: Lectures 13 & 14

CS 440: Programming Languages and Translators, Spring 2020

Due Mon Mar 16, 11:59 pm ~~Fri Mar 13, 11:59 pm~~

3/8 p.1, 3/10, p.2, 3/12 p.1, 3/15 p.2

What to submit

There's no programming assignment, so just submit your written work. Remember the new requirements: If you work alone, please say so in your submission. If you work in a group but aren't the person submitting the solution, then create a short file with the names of everyone in your group (including yourself), and submit that to Blackboard (in the HW 7 folder). These new requirements will make it easier for us to detect if someone forgot to put names down on the submission or didn't do the homework.

Problems [50 pts]: Lectures 13 & 14: LL(1) Parsing

1. [14 points] Below is a grammar for expressions with function calls and its *Predict* table for it. It uses `x` as a generic identifier name.

   a. [7 points] Write out all the steps of a leftmost derivation of [3/8] `x(x*x,x)`. If you want to abbreviate *Ttail*, *Ftail*, and *Atail* to something like *Tt*, *Ft*, and *At*, go ahead; just say you're doing that before you start.

   b. [7 points] Write a trace of how the LL(1) parsing algorithm works on the input from part (a). (See Example 1 of Lecture 13 for an idea of the format to use.)

Rules

Rule #	Rule
1	*S* → *E* $
2	*E* → *T Ttail*
3	*Ttail* → + *T Ttail*
4	*Ttail* → ε
5	*T* → *F Ftail*
6	*Ftail* → * *F Ftail*
7	*Ftail* → ε
8	*F* → x *PArgs*
9	*F* → (*E*)
10	*PArgs* → (*Args*)
11	*PArgs* → ε
12	*Args* → *E Atail*
13	*Args* → ε
14	*Atail* → , *E Atail*
15	*Atail* → ε

***Predict*(*X*, x)**

NonT	x	*	+	(	$	,	)
S	1			1			
E	2			2			
Ttail			3		4	4	4
T	5			5			
Ftail		6	7		7	7	7
F	8			9			
PArgs		11	11	10	11	11	11
Args	12			12			13
Atail						14	15

[3/12] Repaired Ftail row

2. [36 points] Study the grammar below.

   a. [8 points] Write out the *First* set for the grammar.

   b. [8 points] Write out the *Follow* set for the grammar.

   c. [8 points] Write out the *Predict* table for the grammar. (You don't have to include your reasoning but if you do it might be worth partial credit.) You should find that the grammar is LL(1).

   d. [12 points] Write out a trace of the LL(1) parsing algorithm for the input [3/15] `s u v r s p` (was ~~`u u v v s r r s p s t t`~~)

Rules

Rule #	Rule
0	$S' \rightarrow S$ `$` [3/8]
1	$S \rightarrow P\ S$ [3/8] ~~`t`~~
2	$S \rightarrow \varepsilon$ [3/10] ~~`s`~~
3	$P \rightarrow$ `p`
4	$P \rightarrow Q\ R$ `s` P
5	$R \rightarrow$ `r` R
6	$R \rightarrow \varepsilon$
7	$Q \rightarrow$ `u` Q `v`
8	$Q \rightarrow \varepsilon$

