

Homework 7: Lectures 13 & 14

CS 440: Programming Languages and Translators, Spring 2020

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

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

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	$S \rightarrow E \$$
2	$E \rightarrow T \textit{Ttail}$
3	$\textit{Ttail} \rightarrow + T \textit{Ttail}$
4	$\textit{Ttail} \rightarrow \epsilon$
5	$T \rightarrow F \textit{Ftail}$
6	$\textit{Ftail} \rightarrow * F \textit{Ftail}$
7	$\textit{Ftail} \rightarrow \epsilon$
8	$F \rightarrow x \textit{PArgs}$
9	$F \rightarrow (E)$
10	$\textit{PArgs} \rightarrow (\textit{Args})$
11	$\textit{PArgs} \rightarrow \epsilon$
12	$\textit{Args} \rightarrow E \textit{Atail}$
13	$\textit{Args} \rightarrow \epsilon$
14	$\textit{Atail} \rightarrow , E \textit{Atail}$
15	$\textit{Atail} \rightarrow \epsilon$

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

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

[3/12] Repaired Ftail row

2. [36 points] Study the grammar below.
- [8 points] Write out the *First* set for the grammar.
 - [8 points] Write out the *Follow* set for the grammar.
 - [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).
 - [12 points] Write out a trace of the LL(1) parsing algorithm for the input [3/8] s u v r s p s
(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] ⊢
2	$S \rightarrow \epsilon$ [3/10] ⊢
3	$P \rightarrow p$
4	$P \rightarrow Q R s P$
5	$R \rightarrow r R$
6	$R \rightarrow \epsilon$
7	$Q \rightarrow u Q v$
8	$Q \rightarrow \epsilon$