Homework 9: Lectures 17 – 19

CS 440: Programming Languages and Translators, Spring 2020

Due Fri Apr 3, 11:59 pm

What to submit

There's no programming assignment, so just submit your written work. Remember the new requirements: Include the names of everyone in your group in the submission (if you work alone, please say so); group members who don't submit should add a short file with the names of everyone in your group (including themselves), and submit that to Blackboard (in the HW 9 folder).

Problems [50 pts]

Lecture 17: LR Parsing pt 1: Bottom-Up and Shift-Reduce Parsing [5 points]

1. [5 pts] List the LR(0) items for the grammar below.

   $$0: S' \to S\ \texttt{\$},\ 1: S \to D,\ 2: D \to \texttt{d}\ E,\ 3: D \to E,\ 4: E \to \texttt{e},\ 5: E \to \varepsilon$$

   We didn't cover ε-rules in detail until Lecture 19; the items for rule 5 are 5a: $E \to \bullet\ \varepsilon$, and 5b: $E \to \varepsilon\ \bullet$. (Note: Since you can reduce an ε-rule without using any input, items 5a and 5b are actually equivalent.)

Lecture 18: LR Parsing pt. 2: LR(0) and SLR(1) Parsers [15 points]

2. In Problem 1, we started the task of writing an SLR(1) parser for the grammar below by listing the LR(0) items for it

   $$0: S' \to S\ \texttt{\$},\ 1: S \to D,\ 2: D \to \texttt{d}\ E,\ 3: D \to E,\ 4: E \to \texttt{e},\ 5: E \to \varepsilon$$

   a. [9 pts] Show the SLR(1) action/go-to-table for the grammar. Use the notation from Example 2 of Lecture 18.

      We didn't cover ε-rules in detail until Lecture 19, so here's how to handle rule 5: Add item 5b to states that include *nonterminal* → … • *E* …, and reduce rule 5 if the next symbol is in Follow(*E*). We don't need to add item 5a anywhere because it's equivalent to 5b.

   b. [6 = 2 * 3 pts] Show traces of the parses of (1) `d $` and (2) `e $`.

Lecture 19: LR Parsing pt. 3: Full LR(1) Parsers; ε-Rules [30 points]

3. Write an LR(1) parser for the grammar

   $$0: S' \to S\ \texttt{\$},\ 1: S \to B,\ 2: S \to D,\ 3: B \to \texttt{i}\ B\ \texttt{e}\ B,\ 4: B \to \texttt{s},\ 5: D \to \texttt{i}\ B\ \texttt{e}\ D,\ 6: D \to \texttt{i}\ S$$

   a. [8 pts] List the LR(1) items for the grammar. (Don't forget the lookaheads.) Use the notation from Lecture 19.

b. [10 pts] Show the LR(1) action/go-to-table for the grammar. The states get fairly large, so if you want to just list the state item names instead of the full list of items, go ahead. E.g., 0a, 1a, 2a, 3a, 4a, 5a, 6a instead of {0a: 0: $S' \rightarrow \bullet\ S\ \$$, ...}.

c. [3 + 4 + 5 pts] Show traces of the parses for (1) `i i s`, (2) `i s e i s e s`, (3) `i i s e s e s`.

