## To-Do

Lecture 8 covered LL(k) grammars and the notions of left-recursion, left-factoring, and ambiguity. Before the end of the week, do the following.

- 1. *Start HW-2.* Be sure to get the starter code and carefully read through the instructions.
- 2. Do the practice questions below. The following practice problems concern LL(k) grammars. Similar questions will be on quizzes and exams. Solutions are provided on the last page.

## Practice Questions

Answer the following questions regarding LL(k) grammars. An answer key is provided on the last page.

- 1. Determine whether the following grammar is LL(k). If it is LL(k) give the k value. If it is not, explain why not.
  - $S \rightarrow \mathbf{a} R \mid \mathbf{b} R \mid \varepsilon$
  - $R \to \mathbf{c} S \mid \mathbf{d} S \mid \varepsilon$
- 2. Determine whether the following grammar is LL(k). If it is LL(k) give the k value. If it is not, explain why not.
  - $S \rightarrow \mathbf{a} R \mid \mathbf{b} R \mid \varepsilon$
  - $R \to S \mathbf{a} \mid R \mathbf{b} \mid \varepsilon$
- 3. Determine whether the following grammar is LL(k). If it is LL(k) give the k value. If it is not, explain why not.

$$\begin{split} E &\to I \, V \mid I \, V + E \\ I &\to \mathbf{a} \mid \ldots \mid \mathbf{z} \\ V &\to I \, V \mid \varepsilon \end{split}$$

- 4. Determine whether the following grammar is LL(k). If it is LL(k) give the k value. If it is not, explain why not.
  - $S \rightarrow \mathbf{a} S \mid \mathbf{b} R$
  - $R \rightarrow \mathbf{c} R \mid S \mathbf{c} \mid \varepsilon$
- 5. Rewrite the following grammar so that it is LL(1).

 $S \to F \mid P \mid A$ 

$$F \to T [T]$$

$$P \to T \cdot T(\cdot T)^*$$

$$A \to T = T$$

$$T \to \mathbf{a} | \dots | \mathbf{z}$$

6. Rewrite the following grammar so that it is LL(1).

$$E 
ightarrow E \cdot P \mid P$$
  
 $P 
ightarrow \mathbf{a} \mid \ldots \mid \mathbf{z}$ 

## Answer Key

- 1. YES: k = 1
- 2. NO: R is left recursive
- 3. NO: V can be of arbitrary length (so no fixed k to check for +)
- 4. YES: k = 1. For R, if next symbol is **c**, pick first R-rule. If next symbol is **a** or **b**, pick second R-rule. Otherwise, pick last R-rule.
- 5.  $S \rightarrow T S'$   $S' \rightarrow [T]$   $S' \rightarrow . T (. T)^*$   $S' \rightarrow = T$  $T \rightarrow a | ... | z$

6. 
$$E \rightarrow P E'$$
  
 $E' \rightarrow . E \mid \varepsilon$   
 $P \rightarrow a \mid ... \mid z$