

Due in class on Thursday, November 16th, 2006

1. Write a CFG for strings containing 0 and 1 such that all strings generated by your grammar contain the same number of 0's and 1's. Show parse trees for the strings 001101 and 0110.
2. Show that the following grammar (where the last production is an epsilon production and lower-case symbols are terminals) is ambiguous

$$\begin{aligned} S &\rightarrow a S b S \\ &\rightarrow b S a S \\ &\rightarrow \epsilon \end{aligned}$$

3. Informally, $\text{FIRST}(A)$ is defined to be the set of tokens that can begin some string of tokens derived from A . Compute $\text{FIRST}(Stmt)$ for the following grammar fragment:

$$\begin{aligned} Stmt &\rightarrow LabeledOpt Loop \\ Stmt &\rightarrow \text{indent} := Expr \\ LabeledOpt &\rightarrow \text{number} : \\ LabeledOpt &\rightarrow \epsilon \\ Loop &\rightarrow \text{while} Condition \{ StmtList \} \\ Loop &\rightarrow \text{do} \{ StmtList \} \text{until} Condition \end{aligned}$$

4. (a) Remove left recursion from the following grammar:

$$\begin{aligned} IdList &\rightarrow IdListPrefix ; \\ IdListPrefix &\rightarrow IdListPrefix , id \\ &\rightarrow id \end{aligned}$$

- (b) Perform left factoring on the following:

$$\begin{aligned} Stmt &\rightarrow id := Expr \\ &\rightarrow id (ArgumentList) \end{aligned}$$

5. Formally prove that the following grammar (solution to the last quiz problem) is LL(1) using first and follow sets:

$$\begin{aligned} S &\rightarrow (L) \\ &\rightarrow a \\ L &\rightarrow S Ltail \\ Ltail &\rightarrow , L \\ &\rightarrow \epsilon \end{aligned}$$