1. Consider the following grammar:

1. $E \rightarrow E \mid T$
2. $E \rightarrow T$
3. $T \rightarrow TF$
4. $T \rightarrow F$
5. $F \rightarrow "(" E ")"$
6. $F \rightarrow "i"$
7. $F \rightarrow F \ast$

(This grammar defines all regular expressions. The “$|$” in the first production is a terminal not the meta-symbol “or” used in a CFG. Therefore, the first production has only one alternative.)

(a) Revise the grammar so as to eliminate all left recursions using the rule in Slide 240.

(b) Construct the FIRST sets for all production right-hand sides for the revised grammar.

(c) Construct the FOLLOW sets for all nonterminals for the revised grammar.

(d) Construct the SELECT sets for all productions for the revised grammar.

(e) Construct an LL(1) parsing table for the revised grammar.

(f) Show the moves of the parser on the following expressions:

$(i \mid i)^{\ast}$
$ii(^{*}$

2. Consider the grammar abstracting the dangling-else problem:

$S \rightarrow \text{if} (E) S \mid \text{if} (E) S \text{ else} S \mid s$

$E \rightarrow e$

By eliminating the common prefix on $S$, we get the grammar:

$S \rightarrow \text{if} (E) SQ \mid s$
$Q \rightarrow \text{else} S \mid \epsilon$
$E \rightarrow e$

Show that the revised grammar is still ambiguous by building two different parse trees for the statement:
if ( e ) if ( e ) s else s

3. Our usual expression grammar

\[
E \rightarrow E + T \mid E - T \mid T
\]
\[
T \rightarrow T * F \mid T / F \mid F
\]
\[
F \rightarrow i \mid (E)
\]

cannot be used in a predictive top-down parser because it has left recursions. Someone had the idea that the left recursions can be eliminated by changing the grammar to:

\[
E \rightarrow T + E \mid T - E \mid T
\]
\[
T \rightarrow F * T \mid F / T \mid F
\]
\[
F \rightarrow i \mid (E)
\]

Show that this is not such a great idea by:

(a) drawing parse trees for \(a - b - c\) using both the original and the revised grammar, and

(b) using the trees as a guide to determine the results of the corresponding computations if \(a = 3\), \(b = 5\) and \(c = 8\).