ECE 468 & 573
Problem Set 2: Context-free Grammars, Parsers

1. For the following sub-problems, consider the following context-free grammar:

$$S \rightarrow A\$ \quad (1)$$
$$A \rightarrow xBC \quad (2)$$
$$A \rightarrow CB \quad (3)$$
$$B \rightarrow yB \quad (4)$$
$$B \rightarrow \lambda \quad (5)$$
$$C \rightarrow x \quad (6)$$

   (a) What are the terminals and non-terminals of this language?

   (b) Describe the strings are generated by this language. Is this a regular language (*i.e.*, could you write a regular expression that generates this language)?

   (c) Show the derivation of the string $xyyx$ starting from S (specify which production you used at each step), and give the parse tree according to that derivation.

   (d) Give the first and follow sets for each of the non-terminals of the grammar.

   (e) What are the predict sets for each production?

   (f) Give the parse table for the grammar. Is this an LL(1) grammar? Why or why not?

2. for the following sub-problems, consider the following grammar:

$$S \rightarrow AB\$ \quad (7)$$
$$A \rightarrow xB \quad (8)$$
$$A \rightarrow \lambda \quad (9)$$
$$B \rightarrow xyA \quad (10)$$
$$B \rightarrow w \quad (11)$$

   (a) Describe the strings generated by this language.

   (b) Is this language LL(1)? Why or why not?

   (c) Build the CFSM for this grammar.

   (d) Build the goto and action tables for this grammar. Is it an LR(0) grammar? Why or why not?

   (e) If we add the production

$$B \rightarrow x$$

   to the grammar, is it an LR(0) grammar? Why or why not?

(f) Considering the original grammar, suppose we replaced rule 10 with the rule $B \to xA$. Argue that this grammar cannot be parsed at all by any LL or LR parser (hint: is the grammar ambiguous?).