**CS4121 Homework Assignment #1 (Total: 66 points)**

*Due Date*: Wednesday, Feb. 4, 2015 at *9:05am*

**(Please submit your work through Canvas)**

1. (10 points) Show the sequence of stack changes when parsing the input `id * id + id * id` using the LR parsing algorithm (slide 8) and the parse table (slide 10) from the notes, "Bottom-Up Parsing", in class (My example, "LR parsing example", is on Canvas).

2. (18 points) For each of the following grammars, construct the set of LR(0) items, the SLR parse table and state whether the grammar is SLR or not.

   (a)
   $S \rightarrow abS \mid ab$

   (b)
   $$\begin{array}{lcl} S & \rightarrow & AaAb \mid BbBa \\ A & \rightarrow & c \\ B & \rightarrow & c \end{array}$$

   (c)
   $$\begin{array}{lcl} S & \rightarrow & ASB \mid ab \\ A & \rightarrow & a \\ B & \rightarrow & b \end{array}$$

3. (38 points) Given the following grammar that accepts a prefix expression,

   $$\begin{array}{lcll} 1. & S' & \rightarrow & E \\ 2. & E & \rightarrow & +EE \\ 3. & & \mid & \sim E \\ 4. & & \mid & F \\ 5. & F & \rightarrow & id \\ 6. & & \mid & num \end{array}$$

   where $+$, $\sim$, *id* and *num* are terminals, answer the questions below. The terminal *id* is a sequence of lower-case English letters and the terminal *num* is a sequence of decimal digits.

   (a) (5 pts) Derive $+ + \sim 5\ 12\ cy$ using right-most derivation.

   (b) (6 pts) Construct a CFSM for the grammar.

   (c) (5 pts) Find the first and follow sets for all non-terminals.

   (d) (5 pts) Draw the parse table based on your answers in (b) and (c).

   (e) (8 pts) Show the rules/actions sections of Flex and Bison specifications for the grammar to interpret the language where *num* is interpreted as a decimal integer and *id* as a base-26 number. A value of a letter is based on its alphabetic order, a=0, b=1, ..., and z= 25. The unary operator $\sim$ means negation. For example, the result of $+ \sim d\ 9$ is 6.

   (f) (6 pts) Based on the grammar and the parse table in (d), show parse process of the input in (a). Annotate each terminal and non-terminal on the stack with its attribute value based your answer in (e).

   (g) (3 pts) How is the parsing process in (f) related to the derivation in (a)?