2023 NCKU CSIE Compiler Final Exam

1. (20 %) Please write down the names of the instructor and three teaching assistants for this course.

2. (30 %) Consider the following grammar:

$$\begin{aligned} E &\rightarrow (L) \mid a \\ L &\rightarrow EL \mid E \end{aligned}$$

   (a) Construct the DFA of LALR(1) items by propagating the lookaheads through the DFA of LR(0) items.
   (b) Construct the LALR(1) parsing table.
   (c) Show the parsing stack and the actions of an LALR(1) parser for the input string $((a)a(aa))$.

3. (25 %) Show that the following grammar is LR(1) but not LALR(1):

$$\begin{aligned} S &\rightarrow aAd \mid bBd \mid aBe \mid bAe \\ A &\rightarrow c \\ B &\rightarrow c \end{aligned}$$

4. (25 %) Write an attribute grammar for the floating point value of a decimal number given by the following grammar. (Hint: Use a count attribute to count the number of digits to the right of the decimal point.)

$$\begin{aligned} dnum &\rightarrow num.num \\ num &\rightarrow num\ digit \mid digit \\ digit &\rightarrow 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9 \end{aligned}$$

5. (30 %) Consider the following grammar for simple Pascal-style declarations:

$$\begin{aligned} decl &\rightarrow var\text{-}list : type \\ var\text{-}list &\rightarrow var\text{-}list , id \mid id \\ type &\rightarrow integer \mid real \end{aligned}$$

   (a) Write an attribute grammar for the type of a variable.
   (b) Draw dependency graphs corresponding to each grammar rule for the attribute grammar, and draw a dependency graph for the declaration $x, y, z : real$.

6. (20 %) Give the sequence of three-address code instructions corresponding to each of the following arithmetic expressions:
   (a) $2 + 3 + 4 + 5$
   (b) $2 + (3 + (4 + 5))$