CPSC 510: Fall Midterm Exam

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October 28, 1998

This exam is worth 10% of the course and 20% of the examination credit.

Consider the following grammar whose non-terminals are written in lower case and whose terminals are written in upper case:

```
start -> declaration_list

declaration_list -> declaration SEMI declaration_list
                  | \epsilon

declaration -> var_declaration | fun_declaration

var_declaration -> identifier COLON type

identifier -> identifier LPAR NUM RPAR
            | ID

type -> INT | BOOL

fun_declaration -> ID LPAR arg_list RPAR BODY

arg_list -> arg_list1 | \epsilon

arg_list1 -> arglist1 COMMA var_declaration
           | var_declaration
```

There are 50 marks available: answer all the questions below.

1. (10 points)

   Describe the main stages of a compiler and the inputs and outputs of each stage.

2. (20 points)

   Calculate the vital statistics of the above grammar:

   (a) Which non-terminals are nullable?

   (b) Which non-terminals are endable?

   (c) What are the first sets of each non-terminal?

   (d) What are the follow set of each non-terminal?

   Explain why this grammar is not LL(1). Transform this grammar to remove left recursion. Is this transformed grammar LL(1)?

3. (20 points)

   Consider the following grammar

   ```
   a -> LPAR b RPAR | A
   b -> a b | a
   ```

   (a) Construct the DFA of LR(0) items for this language.

   (b) Construct the SLR(1) parsing table,

   (c) Show (using this table) how the shift-reduce parsing of

   ```
   LPAR LPAR A RPAR A LPAR A A RPAR RPAR
   ```

   proceeds.