CPSC 510: Fall Midterm Exam

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October 27, 2000

This exam is worth 30% of the examination credit for this course.

Consider the following grammar (which was suggested for recognizing labelled statements in a small language) whose non-terminals are written in lower case and whose terminals are written in upper case:

```
stmts -> stmts label stmts stmt SEMICOLON
       |.

label -> LABEL COLON
       |.

stmt -> ID ASSIGN r_expr.

r_expr -> ID params
        | NUM.

params -> LPAR arglist RPAR
        |.

arglist -> r_expr arglist_end
         |.

arglist_end -> COMMA r_expr arglist_end
             |.
```

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

1. (10 points)

   Describe the following:

   (a) The main stages of a compiler,

   (b) The inputs and outputs of each stage,

   (c) The complexity of each stage,

   (d) The difference between a syntax tree and a parse tree,

   (e) The stage at which register allocation happens.

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)? Why would you *not* use this grammar in a compiler?

3. (20 points)

   Consider the grammar above with start state `stmt` (i.e. ignore the productions above this):

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

   (a) Is this grammar LR(0)?

   (b) Is this grammar SLR(1)?

   (c) Is this grammar LALR(1)?

   (d) Is the grammar LR(1)?