CPSC 411: Winter Midterm Exam

Robin Cockett

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This exam is worth 25% of the credit for this course. There are 50 marks available: answer all the questions below.

1. (10 points)

   (a) (5 points) Describe the main stages of compiling a program, the datatypes involved in these steps, the complexity of each step, and the stages which can generate errors. Also indicate where the symbol table is used.

   (b) (1 point) What is the difference between a parse tree and an (abstract) syntax tree?

   (c) (1 point) Why are unambiguous grammars important for compiling?

   (d) (1 point) How difficult is it to decide whether a grammar is ambiguous?

   (e) (1 point) How difficult is it to determine whether two regular expressions recognize the same language?

   (f) (1 point) How difficult is it to determine whether two context free languages recognize the same language?

2. (15 points)

   Given the following grammar:

```
s -> A B x
     | A y.
x -> x A A
     |.
y -> y A A
     | A B A
     |.
```

   (a) Give three examples of strings recognized by this grammar.

   (b) Calculate the vital statistics of the grammar: that is

      i. Which nonterminals are nullable?

      ii. What are the first sets of each nonterminal?

      iii. What are the follow sets of each nonterminal?

      iv. Which non-terminals are endable?

      v. Which nonterminals are left recursive?

   (c) Explain why this grammar is not LL(1).

   (d) Transform this grammar to remove left recursion. Is your transformed grammar LL(1)? Is it a recursive descent grammar?

3. (15 points)

   Consider the following grammar:

```
s -> A s t B
   |.
t -> C t s D
   |.
```

   (a) Calculate the vital statistics: is the grammar LL(1)?

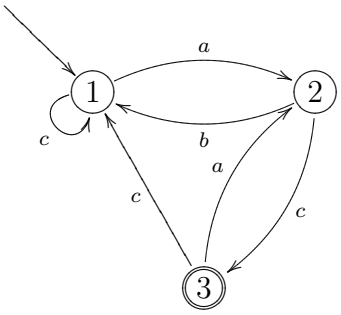
   (b) Construct the LR(0) item automaton for this language.

   (c) Is the grammar LR(0)? Indicate all the shift/reduce and reduce/reduce conflicts.

   (d) Is the grammar SLR(1)?

4. (10 points)

   Is the following automata deterministic? Is it minimized?



   Derive a regular expression for the language recognized by the above automaton.