

# T-106.4200 Introduction to Compiling

## Exam Jan. 9, 2009

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No written material is allowed in this exam. Submit at least one answer sheet, even if an empty one! Write on *each* answer sheet you submit the code of the course, the date, your name, and your student ID number. There are six problems in this exam.

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1. Answer shortly to the following questions:

- (a) What does the letter R stand for in LR(1)?
- (b) In compiling, what does dynamic mean?
- (c) What is a hole in scope?
- (d) What is BNF?

(4 p)

2. Consider the following regular expression:

$$(y^*x \mid yz)$$

- (a) Make an NFA for the regular expression by using *Thompson's construction*. Number states starting from zero. (3 p)
- (b) Build a DFA from the NFA. Name the states by capital letters starting from A. (3 p)

3. Give a context-free grammar for the regular expression

$$z(xx \mid y \mid zyx)^*zx(y \mid xz)^+$$

It is not allowed to use operators of regular expressions on the right-hand sides of the productions. (4 p)

4. Transform the following grammar to an LL(1) grammar:

$$\begin{aligned} S &\rightarrow A \\ A &\rightarrow aBC \mid aA \\ B &\rightarrow Bd \mid b \\ C &\rightarrow cA \mid c \end{aligned}$$

(4 p)

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5. Consider the following augmented grammar:

$$S' \rightarrow E$$

$$E \rightarrow \mathbf{id}(L) \mid \mathbf{id}$$

$$L \rightarrow E, L \mid E$$

(a) Make the collection of LR(0) sets of items and the corresponding state transition function for the grammar. (3 p)

(b) Based on (a), build an SLR(1) parsing table for the grammar. Present also the FOLLOW sets. Is the grammar an SLR(1) grammar? (4 p)

6. Translate the following structured statement to three-address code:

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repeat
  x=5*x+1;
  y=y-3;
until y<0;
```

(5 p)