Computer Science Comprehensive Exam—Spring 2003
Compiler Construction

Instructions: Do *not* put your name on the exam, please answer all the questions directly on the exam itself. Answer **all** the questions. Explain answers as fully as possible, give examples or define terms, if appropriate.

1. What is the relationship between the set of languages recognized by LR(1) parsers and the set of languages recognized by LL(1) parsers? Circle the best response.

   (a) LR(1) is a subset of LL(1)

   (b) LL(1) is a subset of LR(1)

   (c) Their intersection is non-empty

   (d) Their intersection is empty

   (e) They are the same

2. What is the relationship between the set of languages generated by ambiguous grammars and the set of languages recognized by LR(1) parsers? Circle the best response.

   (a) ambiguous grammars are a subset of LR(1)

   (b) LR(1) is a subset of ambiguous grammars

   (c) Their intersection is non-empty

   (d) Their intersection is empty

   (e) They are the same

3. What is the relationship between the set of languages recognized by LR(1) parsers and the set of languages recognized by LALR(1) parsers? Circle the best response.

   (a) LR(1) is a subset of LALR(1)

   (b) LALR(1) is a subset of LR(1)

   (c) Their intersection is non-empty

   (d) Their intersection is empty

   (e) They are the same

4. Compilers need to take advantage of the capabilities of the computer being targeted. Name several ways in which the architecture of computers support the execution of high-level programming languages.

5. Consider the following augmented grammar over the alphabet $\{a, b, c\}$.

$$
\begin{array}{ll}
0 & S \to A\,\$ \\
1 & S \to cb\,\$ \\
2 & A \to aAb \\
3 & A \to B \\
4 & B \to c
\end{array}
$$

(a) Compute nullable, FIRST, and FOLLOW for all nonterminals of the grammar.

	nullable	FIRST	FOLLOW
S			
A			
B			

(b) Is this grammar LL(1)?

(c) Give the SLR(1) automaton for the grammar. (Draw the graph.) Is the grammar SLR(1)?

(d) Give the LR(1) automaton for the grammar. Give the LR(1) parse table. Is the grammar LR(1)?

(e) Give the LALR(1) automaton for the grammar. Is the grammar LALR(1)?