

- ✓ 1. [10] Eliminate left recursion from the grammar

$$S \rightarrow Aa \mid b$$

$$A \rightarrow Sc \mid Ad \mid e$$

$$A \rightarrow bcA' \mid eA'$$

$$A' \rightarrow acA' \mid dA' \mid \text{epsilon}$$

$$S \rightarrow Aa \mid b$$

2. Consider the following grammar G:

$$E' \rightarrow E$$

$$E \rightarrow (L) \mid a$$

$$L \rightarrow EL \mid E$$

- ✓ (a) [10] Construct the collection of the sets of LR(0) items
- ✓ (b) [10] When constructing the action table of SLR parser of G, what are the rules to determine the parsing actions? That is, what is the rule for a shift action at state  $i$ ? What is the rule for a reduce action at state  $i$ ?
- ✓ (c) [10] Construct the SLR parsing table of G. Please specify clearly how every shift or reduce action is determined

3. Consider the following grammar G

$$S \rightarrow ABd$$

$$A \rightarrow aA \mid e$$

$$B \rightarrow b \mid cA$$

- ✓ (a) [5] What is the language generated by G  $a^*(blca^*)d$
- ✓ (b) [10] Write down the FIRST and FOLLOW sets for all nonterminals of G
- ✓ (c) [10] Show the predictive parsing table of G

	FIRST	FOLLOW
S	{a}	{ \$ }
A	{a}	{ b, c, \$ }
B	{ b, c }	{ d, \$ }

4. Consider the following grammar G

$$S \rightarrow iEtS \mid iEtSeS \mid a$$

$$E \rightarrow b$$

where S and E are nonterminals and i, t, e, a, and b are terminals

- ✓ (a) [10] Is G LL(1)? If yes, why? If not, why? 不是，有ambiguous
- ✓ (b) [10] Is G SLR(1)? If yes, why? If not, why? 不是，有conflict

5. Consider the grammar G

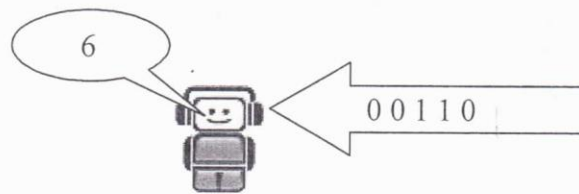
$$S' \rightarrow S$$

$$S \rightarrow L = R \mid R$$

$$L \rightarrow * R \mid id$$

$$R \rightarrow L$$

- (a) [10] Build the goto graph of the sets of LR(1) items
- (b) [10] Construct the LALR(1) parsing table of G



6. iRobot only knows binary digits: **0** and **1**. After he hears a sequence of binary digits, he will convert the binary number into a decimal value. For example, it computes the decimal value of the binary number 0 0 1 1 0 is 6.

Our goal is to use LEX and YACC to write a compiler that will perform the following tasks:

- (1) scan and parse the binary digits,
  - (2) generate a Java bytecode program that computes the decimal value, and
  - (3) print iRobot's answer.
- (a) [15] Write a LEX program and a YACC program that will work together to scan and parse iRobot's input.
- (b) [10] Extend your YACC program so that it will generate a sequence of Java bytecode instructions that convert a binary number into its decimal value.
- (c) [10] Use your compiler to translate the sequence binary digits 0 0 1 1 0 into a Java bytecode program.

For your reference,

**PRINT Statements** *print expression;*

The PRINT statements in *sC* are modeled by invoking the *print* method in *java.io* package using the following format

```
getstatic java.io.PrintStream java.lang.System.out
... /* compute expression */
invokevirtual void java.io.PrintStream.print(java.lang.String)
```

if the type of *expression* is a string. Types *int* or *boolean* will replace *java.lang.String* if the type of *expression* is integer or boolean.