

**Massachusetts Institute of Technology**  
**Department of Electrical Engineering and Computer Science**

6.035, Fall 1999

Quiz I

Monday, September 20

**1) Regular Expressions****15 pts**

If the following descriptions define a regular language then write the corresponding regular expression. Otherwise indicate that the language is not regular. Note that only elegant and compact solutions will receive the full 3 points.

- I All strings of 0's and 1's representing the binary numbers which are powers of 2.
- II All Binary Coded Decimal (BCD) numbers. A BCD number is a binary representation of a decimal number where each decimal digit is encoded using a 4 bit representation of its binary value. For example the BCD of 2509 is 0010010100001001.
- III All strings of 0's and 1's where at each 0, the number of consecutive 1's following that 0 is higher than the number of consecutive 1's preceding that 0.
- IV All strings of 0's and 1's that do not have more than 3 consecutive 1's in it.
- V All strings of 0's and 1's with an even number of 0's and an even number of 1's.

/ 15	+	/ 10	+	/ 15	=	/ 40
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**2) Grammar for ìScheme:****10 pts**

can have integer numbers, few keywords and variables which we will call primitives. The syntax of the language is very simple and as follows:

- A single primitive is a well formed string from the ìScheme language.
- A combination is a well formed string. A combination is defined as a list of combinations or primitives within a pair of matching parentheses.

Examples of few valid ìScheme programs are:

```
82
(+ 8 2 3)
(func ( ) (+ 3 4) 5)
```

The tokens in the language are **number**, **keyword**, **left\_paren** or “(“ and **right\_paren** or “)”.

Write a grammar for ìScheme.

**3) Parser Construction****15 pts**

You are given the following grammar with the terminal symbols ( , ) and **term** and non-terminals **S**, **E** and **L**.

S E \$ (1)

E **term** (2)

E ( L ) (3)

L å (4)

L E L (5)

I If the terminal **term** accepts the character **X**, write 3 well formed strings in this grammar.

a)

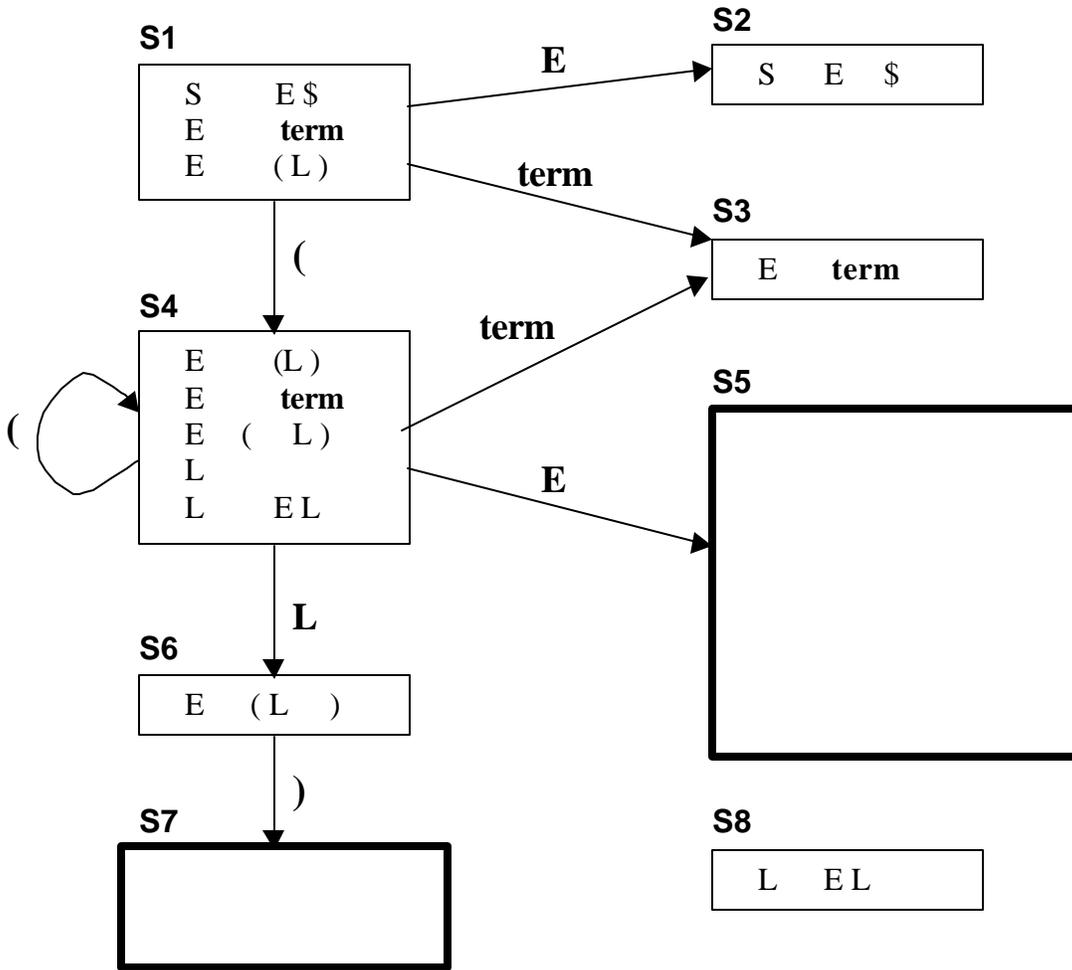
b)

c)

II What are the LR(0) items of the 3<sup>rd</sup> production?

III On the next page an LR(0) state diagram and a parse table for the above grammar is given. However the information for the states 5 and 7 are missing.

- Fill in the state diagram by adding items, and creating outgoing edges with labels.
- Fill the appropriate entries in the parse table.



	(	)	term	\$	E	L
1	Shift S4	error	Shift S3	error	Goto S2	
2	error	error	error	Accept		
3	Reduce 2	Reduce 2	Reduce 2	Reduce 2		
4	Shift S4 Reduce 4	Reduce 4	Shift S3 Reduce 4	Reduce 4	Goto S5	Goto S6
5						
6	error	Shift S7	error	error		
7						
8	Reduce 5	Reduce 5	Reduce 5	Reduce 5		