CSC488S Language Processors **Spring 1996/97**

Mid Term Test 100 marks total. 5 Questions 50 minutes. **13 Feb 1997**

OPEN BOOK and NOTES. Write LEGIBLY; unreadable answers do not count.
Conventions for all questions:

In grammars, uppercase letters are nonterminal symbols and lower case letters are terminal symbols. λ is the empty string.
Line/rule reference numbers on the left side of programs and grammars are provided for ease of reference only and are not part of the program or grammar.

1. [20 marks] Given the LL(1) grammar below with goal symbol S

1	S	$\rightarrow$	a	S	A
2		$\rightarrow$	B	b	C
3	A	$\rightarrow$	a	c	
4		$\rightarrow$	B	S	a
5	B	$\rightarrow$	b	B	b
6		$\rightarrow$	c	b	C
7	C	$\rightarrow$	d	C	
8		$\rightarrow$	λ		

Show the sequence of parser stack snapshots (similar to Slide 80) that would occur when an LL(1) parser for this grammar parses the input

```
a b c b b b d d a c |-
```

2. [25 marks] Consider the expression below in the context of the Turing programming language.

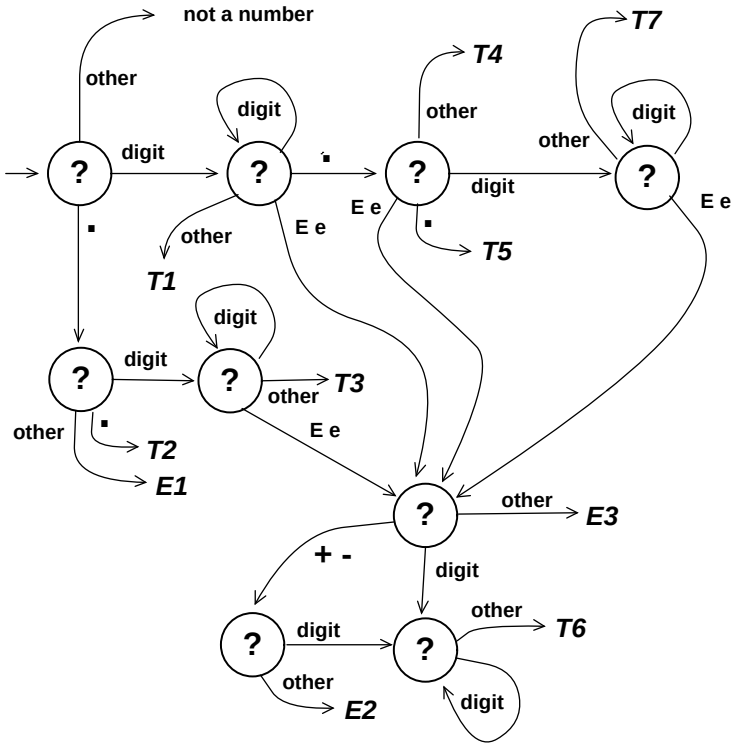
```
A( I ) + B( 7 )
```

a) [18 marks] describe all of the static semantic analysis checks that might be applied to this expression.
b) [7 marks] describe any dynamic semantic analysis checks that might be required for this expression.

3. [10 marks] Program generators (i.e. programs that generate programs) are becoming more and more common. Mechanically generated programs can be very different from programs written by programmers. Typically generated programs are much larger; there are more declarations often with massive initialization. Identifiers are often generated by template, e.g. K00001, K00002, ... Procedures and functions are used infrequently. Statement lists may contain thousands of statements. Errors are almost non-existent but must be checked for because they might indicate an error in the program generator.

Assuming you are designing a compiler from scratch to process only generated programs. How would you design this compiler for maximum performance (i.e. compilation speed)?

4. [20 marks] Consider the scanner for Turing real numbers (from Slide 50)



a) [14 marks] for each of the successful exists (labelled *T1 .. T7*) describe in words **exactly** what the lexical analyzer has recognized.

b) [6 marks] for each of the error exits, (labelled *E1 .. E3*) write a suitable error message that **precisely describes** the error.

5. [25 marks] Consider the following grammar with goal symbol S.

```
1        S  →  a  A  B  b  C  D
2           →  λ
3        A  →  A  S  d
4           →  λ
5        B  →  S  A  c
6           →  e  C
7           →  λ
8        C  →  S  f
9           →  C  g
10          →  λ
11       D  →  a  B  D
12          →  λ
```

a) [10 marks] find the follow set for each of the non-terminal symbols S, A, B, C, D.

b) [12 marks] find the director sets for each production.

c) [3 marks] determine if this is an LL(1) grammar. Justify your answer.