CSC488S Language Processors **Spring 1995/96**

Mid Term Test   100 marks total. 5 Questions 50 minutes. **5 March 1996**

OPEN BOOK and NOTES. Write legibly; unreadable answers are not answers.
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. [25 marks]   Describe the symbol and type table entries that a typical compiler would make for the following declarations:

```
 1      #define  ABOUND1  10
 2      #define  ABOUND2  20
 3      float * getMember( float X [] , const int i );
 4      const float waterlooPi = 3.0 ;
 5      int  iaa[ABOUND1][ABOUND2], **ipp, *(if()) ;
 6      typedef struct person {
 7          char * name ;
 8          int  iaa ;
 9          double  if ;
10          union cupe {
11              int memberNo ;
12              char * membRec ;
13          } unionRec ;
14      } PERSON ;
15      PERSON Class[100], * persPtr ;
```

2. [20 marks]   List all of the semantic analysis checks that a typical compiler would perform when processing the declarations in Question 1.

3. [20 marks]   The programming language Modula-3 allows the programmer to specify an optional base for integer constants by prefixing the constant with an base specifier of the form: *N*_ (i.e. base specification digit(s)(*N*) followed by the underscore (_) character). Integer constants without this optional specifier are assumed to be decimal numbers.
   Legal values for the base specifier *N* are 2 .. 16. The number following the base specification is written in base *N* notation. For any given base *N*, only the digits 0 .. (*N-1*). can legally occur in the constant. The letters A, B, C, D, E, F are used to represent the "digits" 10, 11, 12, 13, 14, 15 respectively.

   Examples: 2_10101 16_DEADBEEF 13_CBC941 8_4775 123456789

   Sketch the design of the part of a lexical analyzer that will correctly processes integer constants in Modula-3.

4. [15 marks] The grammar shown below is LL(k) for some value of k.
Determine the value of k for the grammar. Explain your answer (i.e. why is your value of k the smallest k for which this grammar is LL(k)).

1	S	→	a A a B
2		→	b A b B
3	A	→	a
4		→	a b
5	B	→	a B
6		→	a

5. [20 marks] Construct the director sets for the following LL(1) grammar:

1	S	→	B C c
2		→	g D B
3	B	→	b C D E
4		→	λ
5	C	→	D a B
6		→	c a
7	D	→	d D
8		→	λ
9	E	→	g S f
10		→	c