

being compiled.

Devise a mechanism such that each time you look up a name, if it finds an entry, it must be within the scope of the current procedure. (Hint: the name of the identifier ultimately hashed can have the scoping information embedded within it.) (Several strategies are possible. Pick one that works.)

IX [5]. Fill in the blanks with the best word or short phrase:

- (a) Postscript has an execution model most like the language _____.
- (b) The syntax of Postscript is most like (infix, postfix, prefix) _____.
- (c) The Latex word processor converts a description of a document into the set of pixels (bits) that describe each page of the document (true or false) _____.
- (d) Latex is a _____ pass word processor.
- (e) Latex builds a symbol table similar to the process in a two pass compiler (true or false) _____.

(b) Give the expressions that give the address of the elements A[I,J].B and A[I,J].C.

VI [10]. Read the following grammar:

$E \rightarrow E + T$	$E_1.val = E_2.val + T.val$
$E \rightarrow T$	$E.val = T.val$
$T \rightarrow T * P$	$T_1.val = T_2.val * P.val * P.num$
$T \rightarrow P$	$T.val = P.val * P.num$
$P \rightarrow (E)$	$P.val = E.val$
$P \rightarrow 0$	$P.num = 1$
	$P.val = 2$
$P \rightarrow 1$	$P.num = 2$
	$P.val = 1$

(a) Which attributes are inherited and which are synthesized?

(b) What is E.val for the string?: 10

(c) What is E.val for the string?: 111

VII [10]. (a) In the NIP fragment below, indicate the basic blocks.

```

1 A := 10;
2 B := A*10;
3 C := 20;
4 E := 10;
5 while A*E do
6 while C-A*E do
7 A := A*B;
8 if C then
9 A := A*B;
10 B := B*C;
11 end;
12 D := A*B;
13 if D-A*E then
14 D:= D+1;
15 while D-A*B do
16 D := A*B
17 end
18 else
19 B := A*B
20 end
21 end;
22 A := A*B
23 end
    
```

(b) Give an indication (by giving expression and line number) of an instance of:

- (1) Two common subexpressions
- (2) A loop invariant calculation
- (3) Constant propagation

VIII [10]. Assume a symbol table has a single set of entries and each name is hashed to get to the location of a symbol table entry. One problem with identifier lookup in such a symbol table is that after you have hashed a name to get to a symbol table entry, you have to check if that entry is within the current scope of the statement

I [10]. Is the language $(a b)^{2^n} (a b)^{2^n}$ regular? Prove your answer.

II [15]. Let M be a deterministic finite state automaton. Let G be the grammar generated from M by the standard algorithm.

(a) Show that G is not an LL(1) grammar.

(b) Is G SLR(1)? Explain your answer.

III [10]. Consider the grammar:

$S \rightarrow (X S S) \mid (X S) \mid a$
 $X \rightarrow b$

(a) Is the grammar SLR(1)? If so, give tables; if not, why not?

(b) Is the grammar LL(1)? If so, give tables; if not, why not?

IV [15]. Assume NIP activation records contain (in order):

End of stack pointer
 Dynamic Link
 Return address
 Display
 Local data storage

Consider the NIP program fragment:

```
A procedure
integer X;

    B procedure
    integer Y;
    call C

    C procedure
    integer Z;
    X := 1;
    Y := 2;
    Z := X+Y;
    write(X,Y,Z)
call B
```

(a) Assume that the activation record for procedure A begins at location 1000. Give the stack contents from 1000 on at the point of the write statement in procedure C .

(b) Assume you only have 3 registers - M , N , and P . Assume register P always points to the current activation record. Give the typical machine code that would be generated for the above statement: $Z:=X+Y$.

V [15]. Assume each object of Pascal type "thing" takes two words of storage, and each integer takes one word of storage. Consider the declaration:

var A: array[8..10, 4..20] of record B: thing; C: integer end;

If the array is allocated so that the first element begins at location 2000:

(a) What element of A is at location 2000?

(b) What is the virtual origin of A ?

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December 18, 1995
10:30 am

Answer all questions in the exam book. Before you are told to start, do the following:

1. Put your name on the exam book. Only answers in this book will be graded.
2. If you want your grade posted, then you must do all of the following: Inside the front cover of the exam book write: "Post my grade" write the code number: _____ (and remember this code number), and then sign your name under this statement. If you do not do all of this, no grade will be posted. Grades should be available outside of room 4121 AVW by Friday, December 22. Grades will be available on-line under `~mvz/final.grades` I hope by Tuesday evening, December 19.

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