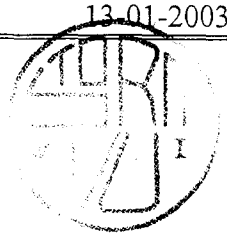
Faculteit der Exacte Wetenschappen	Tentamen Compilerbouw
Vrije Universiteit	13-01-2003

Questions can be answered in Dutch or English.



1. General knowledge: Explain the following terms:

   a. lexical analysis

   b. register allocation

   c. relocation bits

   d. heap

2. Lexical analysis: Give two reasons why it can be profitable to have a lexical identification module between the lexical analyser and the parser.

3. Attribute grammars: Consider the attribute grammar

$S \rightarrow A(i, s)$	$[\, i := s \,]$
$A(i_1, s_1) \rightarrow A(i_2, s_2)\ a$	$[\, i_2 := i_1 ;\ s_1 := s_2 \,]$
$A(i_1, s_1) \rightarrow B(i_2, s_2)$	$[\, i_2 := i_1 ;\ s_1 := s_2 \,]$
$B(i, s) \rightarrow b$	$[\, s := i \,]$

   in which the $\underline{i}$s are inherited attributes and the $\underline{s}$s are synthesized attributes. The attribute evaluation rules are given between square brackets.

   Show by constructing the IS/SI graph of A that the attribute grammar is circular (contains a cycle).

4. Code generation: Describe briefly how "peephole optimization" works.

5. Memory allocation: In a malloc/free system, a call `malloc(int size)` specifies the size of the requested block. Suppose the corresponding call `free(void *p, int size)` would specify the size of the released block as well, would that allow us to avoid storing the size of the chunk in the chunk?

6. Routines: Given the nested routines (in C-like notation)

```
void level_0(void) {
    void level_1(void) {
        void level_2(void) {
            ...
            goto L_1;
            ...
        }
        ...
    L_1:...
        ...
    }
    ...

}
```

and given that the calling sequence "`level_0` calls `level_1` calls `level_2` calls `level_2`" has occurred and that the last `level_2` has executed a jump to `L_1`.

a. Draw and explain the chain of activation records before and after the jump.

b. Is the static link (lexical pointer) involved in the jump?

7. Graph reduction:

a. Sketch the graph corresponding to the expression

```
twice square 3
```

b. Sketch the graph corresponding to the definition

```
twice f x = f (f x)
```

c. Show the actions of the graph reducer when reducing the graph under **a.** using those obtained from the definition under **b.**, and show the resulting graph.

8. Logic programs: In the Prolog rule

grandparent (X, Z) :– parent (X, Y), parent (Y, Z).

the goal *parent (X, Y)* may match for more than one *Y*. How are these multiple values transferred to the second goal *parent (Y, Z)* ?

Assessment:

	1:	2:	3:	4:	5:	6:	7:	8:
a:	4	7	15	6	6	12	4	8
b:	4					3	6	
c:	4						7	
d:	4							
	16	7	15	6	6	15	17	8

Total : 90