Vrije Universiteit, Department of Computer Science

Examination paper for **Principles of programming languages**

11 February 2008, 4A00, 18:30-21:15

This is a closed book written exam.

No printed material or electronic devices are admitted for use during the exam.

The answers can be given in Dutch or English.

The final grade is calculated as 0.3*assignment+0.7*exam

The exam grade is calculated as (Q1+Q2+Q3+….Q7+10)/10

A pass is given if both grades are >= 5.5.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	ΣQi
a)	3	4	5	3	5	7	5	
b)	3	4	5	3	3	3	5	
c)	3	4	5	3	3			
d)	3	4						
e)	3	4						
Total	15	20	15	9	11	10	10	90

Maximum credits= (ΣQi+10)/10=10

Good luck!

Q1. [15p] Define the following terms:

a) Closed world assumption in Prolog [3p]
b) Scanner [3p]
c) Labeled namespace [3p]
d) Referentially transparent language [3p]
e) Strong type checking [3p]

Q2. [20p] Define the following terms and give one example:

a) Short-circuiting operator [4p]
b) Type annotation [4p]
c) Rule in Prolog [4p]
d) Dynamic method binding [4p]
e) List slicing in Python [4p]

Q3. [15p] Give one example, one advantage and one disadvantage for:

a) Compiler optimization [5p]
b) Multiple inheritance [5p]
c) Pointers in C++ [5p]

Q4. [9p] Multiple choice questions

a) **[3p]** What is the binding time for the offset within an activation record of a local variable of a function?

A) language definition time
B) language implementation time
C) compile time
D) link time
E) load time
F) run time

b) **[3p]** What does the following Java code print?

```
public class Test_finally {

    public static void main(String[] args) throws Throwable {

      System.out.print("1");
            try {
                  System.out.print("2");
            if (true) throw new Exception();
                  System.out.print("3");
            }
            catch (Exception e) {
                  System.out.print("4") ;
            }
          catch (Throwable e) {
            System.out.print("5");
          }

            finally {
                  System.out.print("6");
            }
            System.out.println("7");
            }
    }
```

A) 1234567
B) 124567
C) 12567
D) 12467

c) **[3p]** Given this BNF grammar, with <exp> as start symbol:

```
<exp> ::= <term> * <exp>|<term> / <exp>|<term>
<term> ::= <term> + <factor>|<term> - <factor>|<factor>
<factor>::=(<exp>)|a|b|c|1|2|3|4
```

what is the value of 1+2*3 in the language defined by the grammar if expressions are evaluated in the order implied by the parse tree?

A) 7
B) 6
C) 5
D) 9

Q5. [11p] Functional programming

a) **[5p]** Explain what currying is and how it works in this ML code snippet:

```
fun f a = fn b => fn c => a + b + c ;

f (3,4,5)
```

b) **[3p]** What is the value of this ML expression (ML uses static block scoping)?

```
let val x = 0 in
  let val x = 1 in
     let fun f y = x + y in
         let val x = 2 in
         f 3
     end
  end
end
```

c) **[3p]** How would the answer change if ML used dynamic scoping instead of static scoping?

Q6. [10p] Logic programming

Consider the following Prolog facts:

```
parent(linda, simon).
parent(sam, simon).
parent(linda, sharon).
parent(sam, sharon).
female(sharon).
sister(S,X) :- parent(P,S), parent(P,X),female(S).
```

a).**[7p]** Show how the Prolog system uses backtracking to find solutions to this query:

```
?- sister (Who, simon).
```

Show all solutions found by the Prolog system.

b) **[3p]** Modify the code in order to reduce the number of solutions.

Q7. [10p] Languages evolution

a) **[5p]** What are factors that might influence the success of a certain programming language? Give one example from the history of programming languages.

b) **[5p]** Give one interesting feature and one shortcoming in case of the language you had to evaluate for the PPL assignment.