Principles of programming languages

Spring 2006

Examination paper (sample)

This is a closed book written exam.
The answers can be given in Dutch or English.
The final grade is calculated as (Q1+Q2+Q3+…..+10)/10
A pass for this exam is valid only in combination with a fulfilled assignment

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Credits:

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	SQi
a)	**3**	**4**	**5**	**10**	**10**	**5**	**5**	**5**	**5**	
b)	**2**	**4**	**5**			**5**	**3**	**6**	**5**	
c)	**2**						**3**			
d)	**3**									
Totaal	**10**	**8**	**10**	**10**	**10**	**10**	**11**	**11**	**10**	**90**

1. Syntax and semantics [10p]

Given the following BNF grammar:
<*exp*> ::= <*term*> + <*exp*> | <*term*> – <*exp*> | <*term*>
<*term*> ::= <*factor*> * <*term*> | <*factor*> / <*term*> | <*factor*>
<*factor*> ::= (<*exp*>) | a | b | c | d | 1 | 2 | 3 | 4

a) Build a parse tree for the expression a-b*(c+d). **[3p]**
b) Show on the tree what a production is, a non-terminal symbol, a token. **[2p]**
c) 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? **[2p]**
d) Which of the following expressions can NOT be parsed by the grammar? **[3]**

((a))
a+b+(c+d)
a+b*(-1)
a+b*c

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2. Language systems [8 p]

a) List the steps in the classical sequence of a language system**.[4 p]**
b) What is the binding time for the meaning of the keyword while in Java? **[4p]**

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3. Types [10p]

a) Which of the following is an example of coercion **[5p]?**

A. The way the expression a+b is evaluated in C, when a is an int and b is a float.
B. The way the length function in ML works on any type of the form 'a list .
C. The way the + operator in C applies to pairs of integers and also to pairs of real numbers

b) What is a type annotation? Give an example in ML. **[5p]**

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4. Functional programming [10 p]

Explain what pattern matching is in ML and show how this applies for the following code snippet]:

```
    fun f nil = 0
  | f (first::rest) = first + f rest


    f [1,3,5,7]
```

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5. Memory management [10p]

Comment on the trade-off between static and dynamic activation record allocation.

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6. Object oriented programming [10p]

Consider this C++ program :

```
#include <iostream>
using namespace std;

class A {
    public:
        void print() {cout << "A";}
};

class B : public A{
```

```
    public:
        void print() {cout << "B";}
};

int main()
{
    A* p ;
    p = new A() ;
    p->print() ;

    p = new B() ;
    p->print() ;
  return 0;
}
```

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7. Exceptions [11p]

a) Name and explain the components of a Java exception handling mechanism **[5p]**
b) What is the output of this Java code? **[3 p]**

```
1    System.out.print("1");
2    try {
3        System.out.print("2");
4        if (true) throw new Exception();
5        System.out.print("3");
6    }
7    catch (Exception e) {
8    System.out.print("4");
9    }
10    finally {
11    System.out.print("5");
12    }
13    System.out.println("6");
```

c) What happens if we change in line 7 **catch (Exception e)** with catch **(Throwable e)**? **[3 p]**

Q8. Logic programming (Prolog) [11 p]

Given the facts:

```
loves(john, jane).
loves(bill, jane).
loves(james,jane).
loves(mary, bill).
```

loves(jane, james).

And the rule:

goodmatch(X,Y) :- loves(X,Y), loves(Y,X).

a) What is unification? Show how unification works in answering the question **[5p]**

?- loves (mary, X)

b) Show the backtracking involved in answering the question: **[6p]**

?- goodmatch(A,B)

Q9. Scripting languages (Python) [10p]

a) Why is Python considered a very high level programming language? Support your answer with examples **[5p].**

b) Explain what this Python function does and give an example in which this function is used properly **[5p].**

```
def  func (*args):
    res = args[0]
    for arg in args[1:]:
        if arg < res:
          res = arg
    return res
```