Interpretação e Compilação de Linguagens– 2016-2017
Interpretation and Compilation of Programming Languages

Sample Test October, 14, 2016

Notes: The test contains two sample questions and is open book. Students can use any (individual) printed material that each one brings along. The test has a duraction of 1h30. The real test consists of 4 questions and is also open book.

Q-1 **[4 val.]** This question is about the definition of an abstract syntax for a programming language. Consider the following programming language, called `Blip`, with the concrete syntax given by the following grammar:

$$E \quad ::= \quad num \mid bool \mid string \mid E_1{+}E_2 \mid x \mid \mathsf{decl}\ x = E_1\ \mathsf{in}\ E_2 \mid E_1?E_2{:}E_3$$

The language comprises the base constructs for: **integer literals** (*num*), **boolean literals** (*bool*), **string literals** (*num*), and their usual operations, represented here by operation $E + E$; **string literals** (*string*); **identifier** use (x) and **declaration** $\mathsf{decl}\ x = E_1\ \mathsf{in}\ E_2$. The language also includes a conditional expression that yields the result of E_2 if E_1 denotes true, and of E_3 if E_1 denotes false. Consider the example written in the programming language `Blip`:

```
decl x = true in x ? decl y = 2 in y * 3 end + decl y = 3 in x?y:0 end : 4 end
```

a) **[2 val.]** **Define** the abstract syntax of language `Blip` by means of an abstract data type, defined by set of (abreviated) Java classes and interfaces.

b) **[2 val.]** **Define** the set of values of language `Blip` by means of an abstract data type, defined by a set of (abreviated) Java classes and interfaces.

Q-2 **[7 val.]** This question is about the definition of the operational semantics and type system of language `Blip`.

a) **[2 val.]** **Define** the operational semantics of language `Blip` by means of a method **eval** for the conditional expression in question **Q-1a**.

b) **[1 val.]** **State** the denotation of the example expression in question **Q-1**, according to the semantics defined in question **Q-2a**.

c) **[2 val.]** **Define** the type system of language `Blip` by means of a method **typecheck** for the conditional expression in question **Q-1a**.

d) **[1 val.]** **State** the (type) denotation of the example expression in question **Q-1**, according to the semantics defined in question **Q-2a**.

e) **[1 val.]** **Enumerate** the execution errors that may occur during the execution of a program written in language `Blip`, according to the semantics defined in question **Q-2a**. Indicate the ones that may be prevented by the type system, and those that can't.