

2006 Paper 6 Question 7

Comparative Programming Languages

(a) An author writes:

Most successful language design efforts share three important characteristics ...

1. Motivating Application: The language was designed so that a specific kind of program could be written more easily.
2. Abstract Machine: There is a simple and unambiguous program execution model.
3. Theoretical Foundations: Theoretical understanding was the basis for including certain capabilities and omitting others.

Briefly discuss the merits and/or shortcomings of *one* of the above three statements of your choice, giving examples and/or counterexamples from procedural, applicative, logical, and/or object-oriented programming languages. [6 marks]

(b) For *two* programming languages of your choice amongst FORTRAN, Algol, Pascal and C, briefly discuss and evaluate their typing disciplines. Further compare the advantages and disadvantages that their designs impose on the programmer. [5 marks]

(c) Consider the following two program fragments.

```
( defvar x 1 )
( defun g(z) (+ x z) )
( defun f(y)
  (+ (g 1)
    ( let
      ( ( x (+ y 3) ) )
      (
        g(+ y x)
      ) ) ) )
( f 2 )

val x = 1 ;
fun g(z) = x + z ;
fun f(y)
  = g(1) +
    let
      val x = y + 3
    in
      g(y+x)
    end ;
f(2) ;
```

What are their respective output values when run in their corresponding interpreters? Justify your answer, explaining it in a conceptual manner.

[4 marks]

(d) Outline the key features that a language must have to be called object-oriented. Further, briefly discuss to what extent *one* programming language of your choice amongst Simula, Smalltalk, C++, and Java has them. [5 marks]