## University of Swaziland

# **Department of Computer Science**

## **Final Examination**

## 2014/15

Title of Paper: Programming Languages

Course Number: CS343

Time Allowed: Three (3) hours

Instruction: ANSWER ALL QUESTIONS

You are not allowed to open this paper until you have been told to do so by the invigilator.

#### **Question 1**

- a) State and discuss the two main characteristics of functional programming. [6]
- b) Define lambda calculus and state its two uses. [3]
- c) Reduce the following  $\lambda$ -calculus expression to normal form:
  - i.  $(\lambda Y. Y Y) ((\lambda X.X) (\lambda Z.Z))$  [3] ii.  $((\lambda x.((\lambda y.(x y))x))(\lambda z.w))$  [4]
  - iii.  $((((\lambda f.(\lambda g.(\lambda x.((fx)(g x)))))(\lambda m.(\lambda n.(n m))))(\lambda n.z))p)$  [9]

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### **Question 2**

- a) What is your understanding of user-defined types? [2]
- b) Define abstraction. [2]
- c) State 3 reasons why low level languages are mostly avoided. [3]
- d) Discuss the following:
  - i. Overloading polymorphism. [3]
  - ii. Conversion polymorphism. [3]
- e) From the list of languages below state which of them are statically typed and which are dynamically typed:
  - Pascal [1]
  - Prolog [1]
  - Java [1]
  - Javascript [1]
  - C++ [1]
  - Haskell [1]
  - Logo [1]

- f) Why is overloading not possible in untyped languages. [2]
- g) In structured languages, for example, a program can be decomposed into smaller units called functions and procedures. What are these units called in concurrent languages? [1]
- h) Languages of the imperative paradigm are said to have statement-oriented syntax. What does that mean? [2]

#### **Question 3**

- a) Name the 3 defining properties of an object. [3]
- b) How is dynamic dispatch achieved? [5] .
- c) What is the difference between unification and backtracking? [2]
- d) State and discuss the 2 main components of a logic programming system.
   [4]



Formulate prolog queries for the following statements:

i. Was George I the parent of Charles I? [2]
ii. Who was Charles I's parent? [2]
iii. Who were the children of Charles I? [2]

f) The diagram below shows three pegs X, Y and Z. Peg X has N number of discs while pegs Y and Z have none.



The function Move (N, X, Y, Z) - moves N discs from peg X to peg Y, with peg Z being the auxiliary peg.

Write a query for the Base Case: One disc - To transfer a stack consisting of 1 disc from peg X to peg Y. [5]

move(1, X, Y, \_) :-

#### **Question 4**

- a) Write Haskell functions that can perform the following:
  - i. Compute the square of any integer. [3]
  - ii. Compute the average of any two integers. [4]
  - iii. Compute the square root of any number of integers. [3]
  - iv. Greets you e.g. "Morning Mcolisi". [5]
- b) Write an expression that takes a string and generates a copy of the string where all upper case letters are replaced by the letter 'X' and numerical characters are replaced by the letter 'Y'. [10]

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