

University of Swaziland
Department Of Computer Science
Main Examination May 2017

Title of paper : Programming Languages

Course number : CS343

Time Allowed : Three (3) hours

Instructions:

- **Answer ALL Questions in section A.**
- **Answer any three (3) questions in section B.**

This paper may not be opened until permission has been granted by the invigilator.

Section A

QUESTION 1 [25 marks]

- i. Explain the following terms: [10]
- a) Semantic Gap
 - b) Arity and Fixity
 - c) Inclusion Polymorphism
 - d) Procedural Paradigm
 - e) Lazy Evaluation
- ii. Discuss the differences between the following: [15]
- a. Axiomatic Semantics and Denotational Semantics
 - b. Untyped and Typed Languages
 - c. Imperative and Declarative Paradigms
 - d. Compiler and Interpreter
 - e. Inclusion Polymorphism and Parametric Polymorphism

Section B

QUESTION 2 [25 marks]

- i. State any 3 reasons why we study concepts of programming languages [3]
- ii. Discuss (in detail) low level (LL) programming, stating the main reasons why it mostly avoided. [7]
- iii. Most languages have about seven (7) ways of defining new types, name and describe any five of these ways giving a fragment of code as an example. [15]

QUESTION 3 [25 marks]

- i. Name the areas in which Prolog programming language is used? [3]
- ii. Briefly describe the following terms, as they are understood by a PROLOG programmer: [10]
- a) Fact
 - b) Rule
 - c) Query
 - d) Unification
 - e) Backtracking
- iii. What answers do you get for below queries for given prolog program? [12]

Program :

vegetarian(jose).

vegetarian(james).

vegetable(carrot).

vegetable(egg_plant).

likes(jose, X) :- vegetable(X).

loves(Who, egg_plant) :- vegetarian(Who).

Queries :

1 ?- vegetable(X).

2 ?- vegetable(potato).

3 ?- vegetarian(_).

4 ?- likes(jose, What).

5 ?- likes(Who, egg_plant).

6 ?- loves(Who, egg_plant).

QUESTION 4 [25 marks]

- i. State and discuss the two (2) main characteristics of functional programming. [5]
- ii. Describe in detail the structure of lambda calculus expressions, as well as the method by which the expressions are evaluated (reduced to normal form). [12]
- iii. Following proper grammatical rules, show the following lambda expressions are reduced to its normal form: [8]
 - a) $(\lambda x. ((\lambda y. x*y+3) ((\lambda z. z+7) 2))) 4$
 - b) $((((\lambda x. (\lambda y. (z.x*y*z))) 5) 8) 1)$

QUESTION 5 [25 marks]

- i. State any 2 advantages of formal descriptions of semantics [2]
- ii. Write a Haskell script that can be used to evaluate the expression: [5]

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- iii. Write simple Haskell expressions to perform following tasks: [8]
 - a) Return the list [20,45,26,79,24,33] without the first element.
 - b) Show the integer value from 1 to 500 which is even.
 - c) Show the ascending sorted list [23,89,1,7,36,46,97,100]
 - d) Return the largest value in the list [55,66,2,34,78,99,46]
- iii. What is the output of the following Haskell code : [10]
 - a) `fst ((1, "fool"), "food")`
 - b) `snd ((1, "fool"), "food")`
 - c) `[[x*y | y ← [1..10] | x ← [1..4]]`
 - d) `zipWith (+) [2,4,3,1] [5,2,4,9]`
 - e) `foldr (*) 1 [2,4,5,3]`

End of Question Paper