University of Swaziland

Department of Computer Science

Final Examination

2009/10

Title of Paper: Programming Languages

Course Number: CS343

Time Allowed: Three (3) hours

Instructions: 1) This paper has five (5) questions and each carries 25 marks.

2) Section A is ***COMPULSORY.***

3) Answer any two (2) questions in Section B.

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

SECTION A (COMPULSORY)

Question 1

a) What is a semantic gap? [2 marks]

b) Discuss the two (2) main reasons why natural language is unsuitable for writing computer instructions/programs? [4 marks]

c) Low level (LL) programming is often avoided, discuss the four (4) main reasons why this is so. [8 marks]

d) Distinguish between a compiler and an interpreter, stating the advantages of using each. [5 marks]

e) What is the difference between semantics and syntax? [2 marks]

f) Define the following concepts:

I. Axiomatic semantics [2 marks]

II. Denotational semantics [2 marks]

Question 2

a) Write a Haskell expression of the form:
let a=*any number* ; b=*any number* ; c=*any number*

in ...

that returns the difference between the highest and lowest of the 3 given numbers (a, b and c). [5 marks]

b) Write a Haskell expression of the form:
let chars=*any string* ;

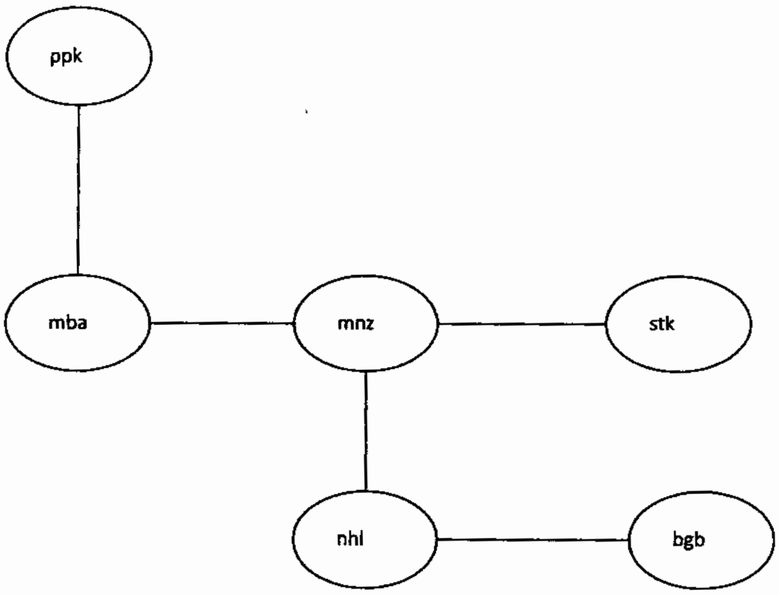
counts=*any list of positive integers*

in ...

that returns a list of strings. Specifically, the *i*-th item of the returned list must consist of the *i*-th character of chars repeated a number of times equal to the *i*-th item of counts. E.g. if chars is "Hoho!" and counts is [2,1,2,1,3], the expression must evaluate to ["HH", "o", "hh", "o", "!!!"]. You are permitted to assume that chars and counts will always be of equal length, and that counts will never contain zero or negative numbers.

[8 marks]

c)



The adjoining map shows 5 roads connecting 6 towns in Swaziland. Represent information about the roads by writing 5 Prolog facts, each of the form:
`road(Town1, Town2)`

where `Town1` and `Town2` are the two towns connected by the road. [5 marks]

d) Define a Prolog rule of the form:
`nearby(Town, Num) :- ...`

that succeeds when `Num` is the number of towns directly linked to the given `Town`. E.g. based on the above map, the query `nearby(mnz, 3)` must succeed. [7 marks]

SECTION B

Question 3

a) Give a clear distinction between the following, giving examples of code where appropriate:

I. Untyped and typed languages. [5 marks]

II. Primitive and user-defined types. [6 marks]

III. Static and dynamic typing. [6 marks]

b) Discuss the following kinds of polymorphism:

I. Overloading Polymorphism [3 marks]

II. Conversion Polymorphism [3 marks]

III. Parametric Polymorphism [2 marks]

Question 4

a) State and discuss the three properties of an object. [6 marks]

b) Discuss the imperative paradigm. [3 marks]

c) Structured programming has three (3) main "good practices", name them and then give a clear discussion of each. [9 marks]

d) In C++ inclusion polymorphism (IP) is the most important form of polymorphism. Discuss inclusion polymorphism, giving an appropriate example. [4 marks]

e) In C++ multiple inheritance introduces a problem, state and discuss this problem.

[3 marks]

Question 5

a) State and discuss the two (2) the main characteristics of functional programming.

[6 marks]

b) What are the 2 main components of a logic programming system? [2 marks]

c) What is the difference between unification and backtracking? [2 marks]

d) Describe in detail the structure of Lambda calculus expressions, as well as the method by which the expressions are evaluated (reduced to normal form). [10 marks]

e) Show how the following λ–calculus expression is reduced to normal form:

$$(((\lambda x.x)\ (\lambda y.y*y))\ ((\lambda z.z+1)\ 2))$$

[5 marks]

End!!!