

Semester II Examinations, 3007/3008

Exam Code(s) 2BA1

Exam(s) BA1 B.A. Degree

Module Code(s) CT243

Module(s) Programming – Data Structures

Paper No. 1

Repeat Paper _____ Special Paper _____

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Internal Examiner(s) Professor G. Lyons

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Instructions

Answer 4 questions.
All questions will be marked equally.

Duration 2hrs

No. of Answer Books 1

Requirements

Handout _____

MCQ _____

Statistical Tables _____

Graph Paper _____

Log Graph Paper _____

Other Material _____

No. of Pages _____

Department(s) _____

1. (a) Consider the functions

```
Function f_one(i As Integer, j as Integer)
If i>j Then Return i+j
Else Return f_two(j,i)
End If
End Function
```

```
Function f_two(i As Integer, j as Integer)
If i+j>5 Then Return i-j
Else Return f_one(i,i+1)
End If
End Function
```

State what is the result of these recursive functions, if we call them using

- (i) `f_one(2,1)`
- (ii) `f_one(1,1)`
- (iii) `f_one(0,-1)`
- (iv) `f_one(-1,0)`

In each case, state separately the **total** number of times (including the first call) each function is called. (16 marks)

- (b) Write a function in VB .NET that uses recursion and the concept of Binary Powering to calculate x^y where x is any real number and y is a positive integer. (9 marks)

2. Given a two-dimensional array `km(i,j)` of distances (in kilometers) between n cities (so i and j run from 1 to n , `km(i,j) = km(j,i)` and `km(i,i) = 0`) write a VB.NET function

```
Function ShowFurthest(km(,) As Integer)
```

which calculates the city (indexed by i) whose average distance from all the other cities is greatest (i.e. in some sense it is furthest from the other cities). (25 marks)

3. (a) In VB .NET graphics, explain the distinction between

- (i) a pen and a brush.
- (ii) `Draw` and `Fill` methods.
- (iii) the `DrawArc` and the `DrawPie` methods.

(12 marks)

- (b) Explain (giving an example in each case) how you would use

- (i) the `DrawRectangle` method to draw a square.
- (ii) the `FillEllipse` method to draw a solid circle.
- (iii) the `DrawPie` method to draw a semi-circle.

(12 marks)

4. In the “all pairs shortest path” problem, Floyd’s algorithm uses Dynamic Programming to find the shortest route between any two nodes on a network (e.g. cities in a road network). Suppose the input data for this problem is given as

$$\begin{pmatrix} \infty & 2 & 7 & 9 \\ 2 & \infty & 6 & \infty \\ 7 & 6 & \infty & 3 \\ 9 & \infty & 3 & \infty \end{pmatrix}$$

- (a) Draw the network. (5 marks)
- (b) Calculate (by hand) the result by calculating the intermediate matrices. (8 marks)
- (c) Write a function in VB .NET to implement the Floyd Algorithm. (12 marks)
5. (a) Write a Console Application which reads command line parameters, and writes them back to the screen in reverse order. So if my input command line parameters are “bionn gach tosu lag”, the program should output (use Console.WriteLine()) “lag tosu gach bionn”. (15 marks)
- (b) Adapt your program from part (a) so that it prints out the input command line arguments in reverse order, *letter by letter*: So if my input is “bionn gach tosu lag”, the program should output “gal usot hcag nnoib”. (10 marks)

6. Answer four of the following:

- (a) Explain The Rule of Entity Integrity and the Rule of Referential Integrity, and comment on how they may influence interaction of VB .NET with a Database. (6 marks)
- (b) Explain (using an example) how to create a random integer between two fixed values in VB .NET. (6 marks)
- (c) Explain (using an example) the concept of (method) overloading in VB .NET (6 marks)
- (d) Define the *signature* of a function. Give an example of a function that takes optional parameters, and state all of its signatures. (6 marks)
- (e) In *hashing* explain what is meant by the load factor, and state
- (i) the advantage/disadvantage of having a high load factor
- (ii) the advantage/disadvantage of having a low load factor

(6 marks)