

W249/102

DUBLIN INSTITUTE OF TECHNOLOGY
KEVIN STREET, DUBLIN 8.

BSc Information Systems / Information Technology

Stage 1

WINTER EXAMINATIONS 2007

PROGRAMMING AND ALGORITHMS

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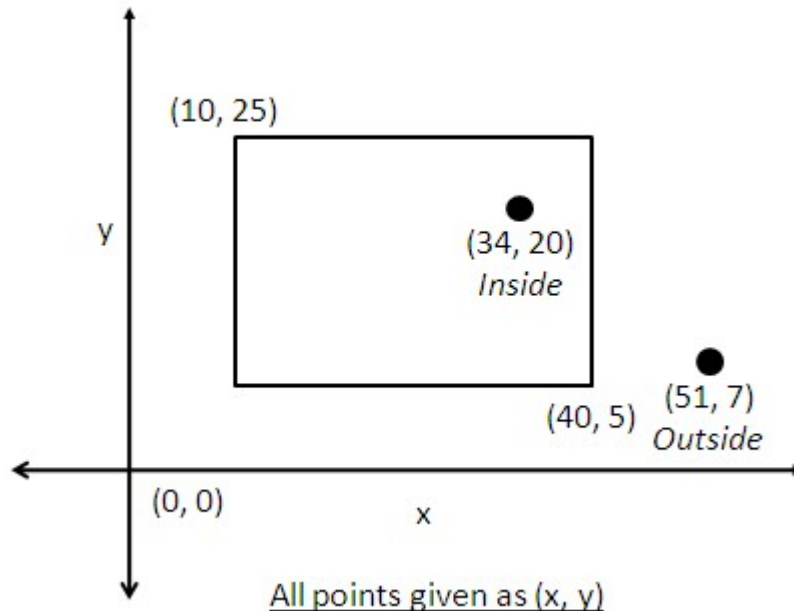
2 HOURS

ATTEMPT **3** QUESTIONS

ALL QUESTIONS CARRY EQUAL MARKS

1. (a) Design using pseudocode and implement in the C programming language a program which takes the x and y coordinates of the upper left and bottom right corners of a rectangle, as well as the x and y coordinates of some other point. The program should tell the user whether the point is inside or outside the rectangle.

For example, consider the rectangle and points shown in figure 1 below:



The rectangle shown has a top left corner at (10, 25) and a bottom right corner at (40, 5). The point (34, 20) is inside the rectangle and the point (51, 7) is outside the rectangle.

Your program must produce output in the form shown below (user input is shown in bold):

```
C:\problems>p1
Enter x, y for top left      : 10 25
Enter x, y for bottom right: 40 5
Enter x, y for point        : 34 20
(34, 20) is inside the rectangle
```

```
C:\problems>p1
Enter x, y for top left      : 10 25
Enter x, y for bottom right: 40 5
Enter x, y for point        : 51 7
(51, 7) is outside the rectangle
```

(15 marks)

- (b) Using sample code where necessary, briefly answer each of the following short questions.
- i. What is a function argument?
 - ii. What is the signature of a function?
 - iii. What does it mean to return a value from a function?
 - iv. Distinguish between passing arguments by reference and by value.
 - v. What is a recursive function call?
 - vi. Distinguish between a static variable and an auto variable in a function.
- (6 marks)**
- (c) Demonstrate, using diagrams and either C or pseudocode how to *insert into*, *search in* and *delete from* a linked list which stores phone company customer details (phone number, name, address) with entries ordered by phone number.
- (12 marks)**

2. (a) Design using pseudocode and implement in the C programming language a program which takes an amount of money as a real number and produces output identifying how much of each €denomination (notes and coins) are required to produce that amount of money in €cash.

Assume that the following are the only Euro denominations:

- 1c
- 2c
- 5c
- 10c
- 20c
- 50c
- €1
- €2
- €5

Your program must produce output in the form shown below (user input is shown in bold):

```
C:\problems>p2
Enter Euro amount : 5.67
1 5 Euro notes
1 50 cent coins
1 10 cent coins
1 5 cent coins
1 2 cent coins
```

```
C:\problems>p2
Enter Euro amount : 51.99
10 5 Euro notes
1 1 Euro coins
1 50 cent coins
2 20 cent coins
1 5 cent coins
2 2 cent coins
```

```
C:\problems>p2
Enter Euro amount : 0.61
1 50 cent coins
1 10 cent coins
1 1 cent coins
```

(15 marks)

(b) Using sample code where necessary, briefly answer each of the following short questions.

- i. What is purpose of the ASCII character set?
- ii. Give two reasons why a program would use a file.
- iii. What is the difference between a text file and a binary file?
- iv. What is meant by random access of a file?
- v. What three file abstractions are automatically associated with a process?
- vi. What two functions are required to find the size of a file?

(6 marks)

(c) Demonstrate, using diagrams and either C or pseudocode how to serialise a linked list to a binary file, while maintaining the facility to *search*, *insert* and *delete*.

(12 marks)

3. (a) Design using pseudocode and implement in the C programming language a program which reads an integer of up to 6 digits, converts it to a string (char array) without using any library functions such as `sprintf`, and then prints the string in reverse order.

Note that the ASCII value for the character '0' is 48.

Your program must produce output in the form shown below (user input is shown in bold):

```
C:\problems>p3
Enter number : 156432
234651
C:\problems>p3
Enter number : 98765
56789
```

(15 marks)

(b) Using sample code where necessary, briefly answer each of the following short questions.

- i. For what problems are *switch* statements typically used?
- ii. For what problems are *while* loops typically used?
- iii. For what problems are *do..while* loops typically used?
- iv. For what problems are *for* loops typically used?
- v. For what purpose are sentinel values used in loops?
- vi. What operator is used to combine two conditions such that both must be true for a loop to keep iterating?

(6 marks)

- (c) Demonstrate, using diagrams and either C or pseudocode, the operation of the quicksort algorithm for the following set of numbers:

19 18 32 71 37 48 50 56

(12 marks)

4. (a) Design using pseudocode and implement in the C programming language a program which reads a simple HTML (Hypertext Markup Language) document and strips out all the tags.

For example, the following is a part of a HTML document:

```
<p>It was the best of times.</p>
<p>It was the <b>worst</b> of times.</p>
```

The tags (<p> and) as well as the closing tags (</p> and) are formatting instructions for a web browser.

Your program must convert the above HTML to the text shown below:

```
It was the best of times.
It was the worst of times.
```

Assume that the HTML is stored in an ASCII file named `my_file.html`. All output must be written to the terminal (standard output).

```
C:\problems>p4
It was the best of times.
It was the worst of times.
```

(15 marks)

- (b) Using sample code where necessary, briefly answer each of the following short questions.

- i. How are arrays declared?
- ii. How are multi-dimensional arrays declared?
- iii. Why is the preprocessor often used for declaring array sizes?
- iv. How can the memory for an array be allocated at run-time?
- v. What is the relationship between strings and arrays?
- vi. What special character is used to terminate a character string?

(6 marks)

- (c) Demonstrate, using diagrams and either C or pseudocode, the implementation of stacks and queues using arrays.

(12 marks)