

Tuesday 11 June 2019 – Morning

A Level Computer Science

H446/02 Algorithms and programming

Time allowed: 2 hours 30 minutes



You may use:

- a ruler (cm/mm)
- an HB pencil

Do not use:

- a calculator



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

INSTRUCTIONS

- Use black ink.
- Answer **all** the questions.
- Write your answer to each question in the space provided. Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).

INFORMATION

- The total mark for this paper is **140**.
- The marks for each question are shown in brackets [].
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.



Section A

- 1 The temperatures of an ocean are input into a computer system. They are recorded, and will be accessed, in the order in which they arrive. The data for one week is shown:

5, 5.5, 5, 6, 7, 6.5, 6

- (a) The data is to be stored in a data structure. The programmer stores the data in a queue.

Explain why a queue is used instead of a stack.

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.....

.....

..... [2]

- (b) The data is processed. After processing, the value for the first day is stored as 0. The value for each following day is stored as an increase, or decrease, from the first day.

For example: if the first day was 7, the second was 6 and the third was 9, after processing it would be stored as 0, -1, 2.

- (i) The queue uses `dequeue ()` to return the first element of the queue.

`dequeue ()` is a function.

Explain why `dequeue ()` is a function, not a procedure.

.....

..... [1]

- (ii) Complete the algorithm to process the data in the queue and store the results in an array called `processedData`.

```
processedData[0] = 0
firstDay = .....
for count = 1 to 6
    processedData[.....] = dequeue () - .....
next count
```

[3]

(iv) A bubble sort has the following complexities:

Best time	$O(n)$
Average and worst time	$O(n^2)$
Worst space	$O(1)$

Describe what each of these complexities mean.

Best time $O(n)$

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Average and worst time $O(n^2)$

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Worst Space $O(1)$

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[6]

- 2 A program needs to store the names of plants that are in a garden, so they can be easily found and accessed in alphabetical order.

The data is stored in a tree structure. Part of the tree is shown.

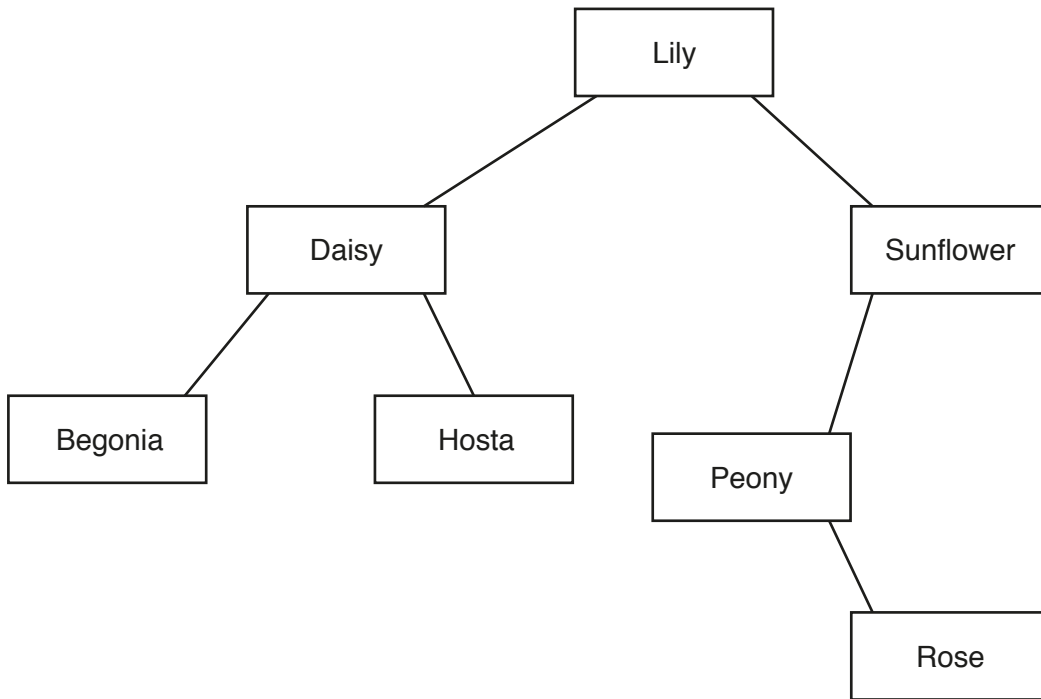


Fig. 2.1

- (a) (i) State the type of tree shown in Fig. 2.1.

..... [1]

- (ii) Show the output of a breadth-first traversal of the tree shown in Fig. 2.1.

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..... [3]

3 A recursive function, GCD, is given in pseudocode.

```
function GCD(num1, num2)
    if num2 == 0 then
        return num1
    else
        return GCD(num2, num1 MOD num2)
    endif
endfunction
```

(a) The function uses branching.

(i) Identify the type of branching statement used in the function.

..... [1]

(ii) Explain the difference between branching and iteration.

.....
.....
.....
..... [2]

(iii) Identify the **two** parameters in the function.

1
2 [1]

(iv) State whether the parameters should be passed by value, or by reference. Justify your answer.

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.....
.....
..... [2]

(ii) Complete the missing statements in this iterative version of the function.

```

function newGCD(num1, num2)
    temp = 0
    while (num2 != ..... )
        ..... = num2
        num2 = num1 MOD .....
        num1 = temp
    endwhile
    return .....
endfunction

```

[4]

4 Mabel is a software engineer. She is writing a computer game for a client. In the game the main character has to avoid their enemies. This becomes more difficult as the levels of the game increase.

(a) Mabel uses decomposition to design the program.

Explain how decomposition can aid the design of this program.

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..... [2]

(b) The computer game allows a user to select a character (e.g. name, gender). They can then choose a level for the game (easy, normal, challenging). The user controls their character by moving it left or right. The character can jump using space bar as an input. If the character touches one of the enemies then it loses a life. The character has to make it to the end of the level without losing all their lives.

The game is designed in a modular way.

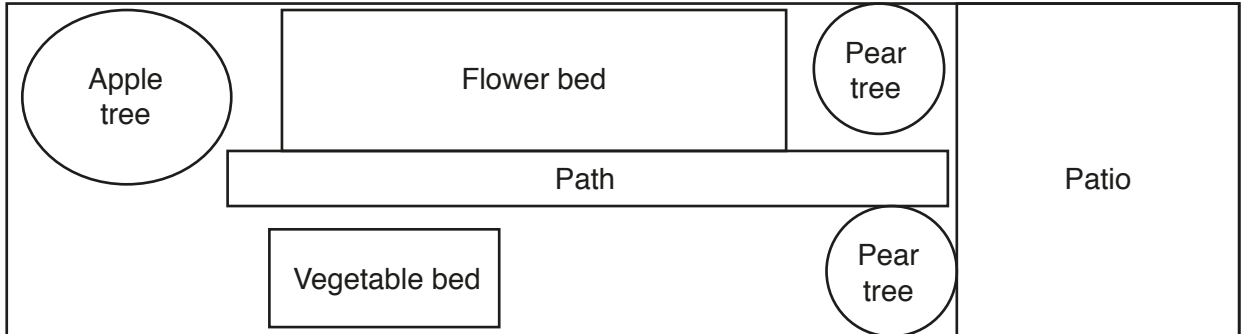
17
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Section B

7 A program is needed to plan the layout of a garden.

The program will allow the user to create an image of the garden, for example:



(a) The programmer will use abstraction to produce the program interface to represent the garden.

(i) Give **two** different examples of how abstraction has been used to produce the layout of the garden.

- 1
-
- 2
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[2]

(ii) Explain the need for abstraction in the production of this program.

-
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-
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[3]

(iii) The user needs to input data into the program to set up their garden layout.

Identify **three** pieces of data that the user may input into this program.

1

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2

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3

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[3]

(b) The program is to be built using object oriented programming.

All items that can be added to the garden are declared as instances of the class `GardenItem`.

The class has the following attributes:

Attribute	Description	Example
<code>itemName</code>	The name of the item	Flowerbed
<code>length</code>	The length of the item in metres	2
<code>width</code>	The width of the item in metres	1

(i) The constructor method sets the attributes to values that are passed as parameters.

Write pseudocode or program code to declare the class `GardenItem` and its constructor. All attributes should be private and initialised through the constructor (e.g. `daisies = new GardenItem("Flowerbed", 2, 1)`).

[4]

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- (iii) The Common Oak is a type of tree. It has a maximum height, length and width of 40 m. It can grow in sun and shade.

Write a statement, using pseudocode or program code, to declare an instance of tree for the Common Oak. Give the object the identifier `firstTree`.

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..... [4]

- (iv) The classes `GardenItem` and `Tree` use get and set methods to access and alter their private attributes.

Write the get method `getItemName` and set method `setItemName` for class `GardenItem`. The set method takes the new value as a parameter.

Do not write any other methods, or re-declare the class.

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