AQA Computer Science A-Level

4.3.2 Tree-traversal

Past Paper Questions

June 2017 Paper 1

0 4

Figure 4 shows the data Norbert, Phil, Judith, Mary, Caspar and Tahir entered into a binary search tree.

Figure 5 contains pseudo-code for a recursive binary tree search algorithm.

Figure 4

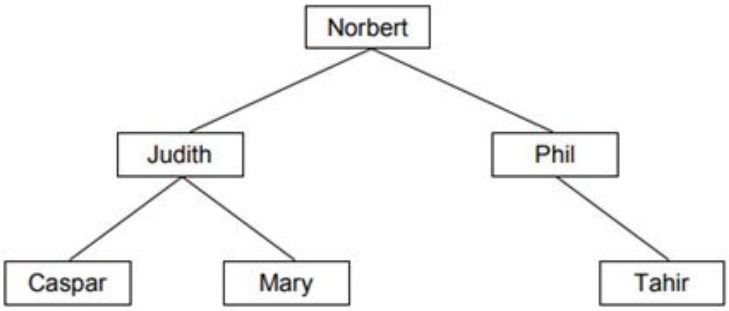

Figure 5

```
FUNCTION TreeSearch(target, node)
  OUTPUT 'Visited ', node
  IF target = node THEN
    RETURN True
  ELSE IF target > node AND Exists(node, right) THEN
    RETURN TreeSearch(target, node.right)
  ELSE IF target < node AND Exists(node, left) THEN
    RETURN TreeSearch(target, node.left)
  ENDIF
  RETURN False
ENDFUNCTION
```

The subroutine `Exists` takes two parameters – a node in the binary tree and a direction (`left` or `right`). It returns a Boolean value indicating if the node given as a parameter has a child node in the direction specified by the second parameter. For instance, `Exists(Mary, left)` will return a value of `False` as there is no node to the left of `Mary` in the binary tree.

`node.right` evaluates to the child node to the right of `node`,
eg `Judith.right` is `Mary`.

`node.left` evaluates to the child node to the left of `node`,
eg `Judith.left` is `Caspar`.

0 4 . 1 What is meant by a recursive subroutine?

[1 mark]

0 4 . 2 There are two base cases for the subroutine `TreeSearch`. State **one** of the base cases.

[1 mark]

0 4 . 3 Complete the unshaded cells of **Table 3** to show the result of tracing the `TreeSearch` algorithm shown in **Figure 5** with the function call `TreeSearch(Olivia, Norbert)`. You may not need to use all of the rows.

[3 marks]

Table 3

Function call	Output
`TreeSearch(Olivia, Norbert)`	

Copy the contents of the unshaded cells in **Table 3** into the table in your Electronic Answer Document.

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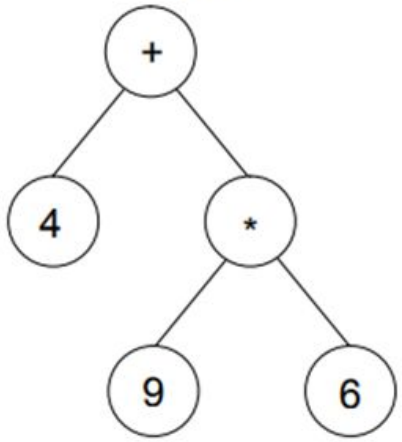
4 A tree can be used to represent a mathematical expression. This is known as an expression tree. **Figure 5** is an expression tree for the infix expression 4 + 9 * 6.

Figure 5



4 (b) The expression tree in **Figure 5** could be represented using three one-dimensional arrays named **A**, **B** and **C**. **Figure 6** shows a representation of **Figure 5** together with the array indices.

Figure 6

Arrays

Index	A	B	C
[1]	+	2	3
[2]	4	0	0
[3]	*	4	5
[4]	9	0	0
[5]	6	0	0

4 (d) The procedure in **Figure 7** describes a type of tree traversal that can be carried out on the representation of the tree shown in **Figure 6**.

Figure 7

```
Procedure Traverse(Pos:Integer)
  If B[Pos] > 0 Then Traverse(B[Pos])
  If C[Pos] > 0 Then Traverse(C[Pos])
  Output A[Pos]
End Procedure
```

Using the table below, trace the execution of the procedure when it is called using `Traverse(1)`. You may not need to use all of the lines provided in the table.

Pos	Output

(4 marks)

4 (e) Which type of tree traversal does the procedure `Traverse` carry out?

.....

(1 mark)

4 (f) What does the output of the procedure represent?

.....

(1 mark)