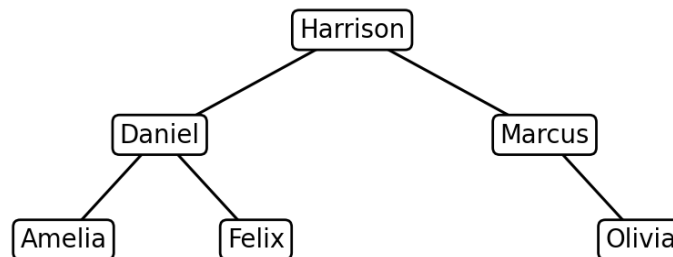




4.1.1 Recursion

- 1) The binary search tree in Figure 1 contains the following names. Figure 2 shows a recursive subroutine called SearchTree that searches the tree for a specified name.

Figure 1



HasChild returns True if a node has a child in the specified direction, and False otherwise. node.left and node.right refer to the corresponding child nodes.

Figure 2

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

- a) Explain what is meant by a recursive subroutine.

[1 mark]

- b) The SearchTree subroutine has two possible base cases. State one of the base cases.

[1 mark]





- c) The following function call is made: `SearchTree(Grace, Harrison)`. Complete the table to show the function calls and output produced as the algorithm searches for Grace. You may not need to use every row.

[3 marks]

Function call	Output
<code>SearchTree(Grace, Harrison)</code>	

- d) State the return value after the function call `SearchTree(Grace, Harrison)`.

[1 mark]

- 2) The function in Figure 3 is a recursive function.

Figure 3

```
FUNCTION Mystery(n)
  IF n <= 1 THEN
    RETURN 1
  ELSE
    RETURN n * Mystery(n - 2)
  ENDIF
ENDFUNCTION
```

- a) Write down the sequence of function calls made when `Mystery(7)` is called.

[2 marks]

- b) Trace the function and state the value returned by `Mystery(7)`. Show your working.

[3 marks]





- 3) The algorithm in Figure 4 is intended to calculate the factorial of a positive integer.

Figure 4

```
FUNCTION Factorial(n)
  IF _____ THEN
    RETURN 1
  ELSE
    RETURN _____
  ENDIF
ENDFUNCTION
```

- a) Complete the condition for the base case.

[1 mark]

- b) Complete the recursive return statement.

[1 mark]

-
- 4) A function called PowerOfTwo should calculate 2 raised to the power of n.

For example:

PowerOfTwo(0) returns 1

PowerOfTwo(4) returns 16

- a) Write a recursive algorithm for PowerOfTwo(n). Your algorithm must include a suitable base case and recursive case.

[4 marks]

