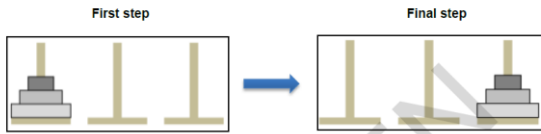


“3-a-day” A-Level Exam Practice Unit 1 (004)

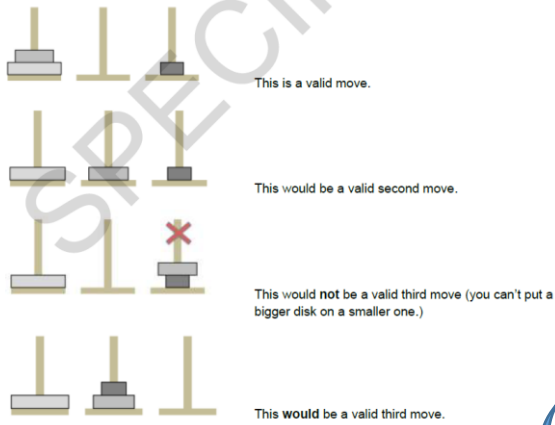
Questions 1, 2 and 3

10 The Towers of Hanoi is a classic puzzle. Disks are placed in order on a pole, the biggest disc at the bottom of the pole, the smallest disk at the top of the pole, on the first of three poles. The challenge is to get them to the third pole in the same order.



The disks can only be moved under the following rules:

- only one disk can be moved at a time
- a disk can only ever be placed on an empty pole or on top of a larger disk
- a larger disk can never be placed on a smaller disk.



(ii) The tower class has the method push. It takes in the value of the disk to be pushed. It adds it to the top of the stack if it is a valid move. If it is not a valid move, the value of the disc is not added and the message 'Invalid move' is printed to the screen.

The stack is implemented using an array called pole and an integer called pointer. Pointer represents the index of the array position at the top of the stack.

```
class Tower
private array pole[10]
private pointer

public procedure new()
    pointer=0
endprocedure

public procedure push(diskValue)
    //Code for push method
endprocedure
endclass
```

Write the pseudocode to go in the push method. Annotate your pseudocode with comments to show how it solves the problem. You are not expected to test for overflow.

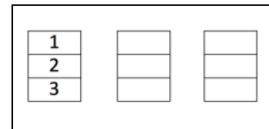
[6]

(a) Each disk can be represented by an integer denoting its size.

So



Can be represented by



(i) Explain why you would use a *stack* rather than a *queue* to store the configuration of disks at each pole.

.....

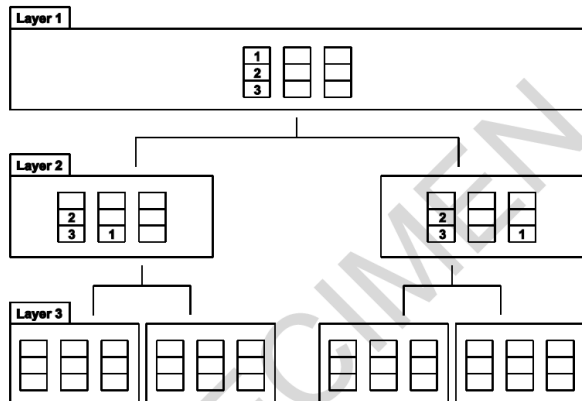
.....

..... [2]

(b) One way to try to find a solution would be to generate a tree of possible moves until a solution is found.

(i) A tree has been started below. Complete Layer 3 to show 4 possible moves.

[4]



Answer 1

10	(a)	(i)	<ul style="list-style-type: none"> A disk can only be put onto the top of the pole (1) and a stack is a last in first out structure (1) whereas a queue is first in first out (1). 	2 AO2.1 (2)	Up to 2 marks for a valid explanation.
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Answer 2

		(ii)	<p>Individual steps in pseudocode:</p> <ul style="list-style-type: none"> Checks if pointer is 0 (i.e. pointer is 0) Checks if the disk being added is smaller than the one at the top of the pole Puts diskValue at the top of stack Move the pointer up one If it's not a valid move, no disk is added ...and prints Invalid move <p>Programming marks to be awarded as follows:</p> <ul style="list-style-type: none"> Checks if pointer is 0 and checks if the disk being added is smaller than the one at the top of the pole (1 – AO 3.2). Puts diskValue at the top of stack and moves the pointer up one (1 – AO 3.2). If it's not a valid move, no disk is added and prints Invalid move (1 – AO 3.2). <p>Possible annotated comments:</p> <ul style="list-style-type: none"> The IF statement checks the pointer value is 0 so we can assume the disk is available to be moved (1 – AO 2.2). If these conditions are met then pole value is set to the diskValue and incremented by 1 so the disk can move to the next pole (1 – AO 2.2). If these conditions are not met then the else prints Invalid move (1 – AO 2.2). 	6 AO2.2 (3) AO3.2 (3)	<p>Up to 3 marks for valid pseudocode (AO3.2).</p> <p>Up to 3 marks for annotated comments used (AO2.2).</p> <p>Example pseudocode:</p> <pre> If pointer==0 or pole[pointer]>diskValue then pole[pointer]=diskValue pointer=pointer+1 else print("Invalid move") endif </pre> <p>Example of pseudocode with comments in code for guidance:</p> <pre> If pointer==0 or pole[pointer]>diskValue then pole[pointer]=diskValue pointer=pointer+1 else print("Invalid move") endif </pre>
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Answer 3

	(b)	(i)	<p>Left hand boxes, any 2 of:</p> <table style="margin-left: 20px;"> <tr> <td style="border: 1px solid black; padding: 2px;">2</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">2</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> </table> <p style="text-align: center;">or</p> <table style="margin-left: 20px;"> <tr> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">2</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> </table> <p>or</p> <p>(1 Mark each, Max 2)</p> <p>Right hand boxes, any 2 of:</p> <table style="margin-left: 20px;"> <tr> <td style="border: 1px solid black; padding: 2px;">2</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> </table> <p style="text-align: center;">or</p> <table style="margin-left: 20px;"> <tr> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;">1</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;">2</td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> </table> <p style="text-align: center;">or</p> <table style="margin-left: 20px;"> <tr> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">2</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> </table> <p>(1 Mark each, Max 2)</p>	2		1	3	1	2	3						1			2			3			2	1		3					1	3	2		1			2			3			4 AO2.2 (4)	For 4 marks as indicated.
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