Stack

William Fiset

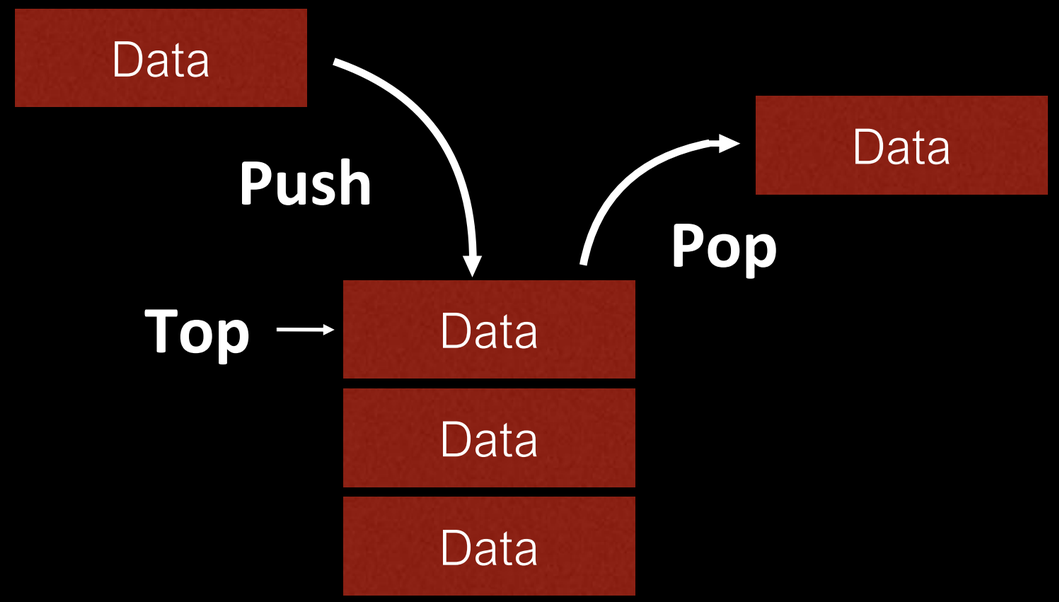
Outline

- Discussion about Stacks
  - What is a Stack?
  - When and where is a Stack used?
  - Complexity Analysis
  - Stack usage examples
- Implementation details
  - Pushing elements on stack
  - Popping elements from stack
- Code Implementation

Discussion

What is a Stack?

A stack is a one-ended linear data structure which models a real world stack by having two primary operations, namely **push** and **pop**.



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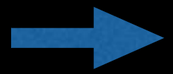

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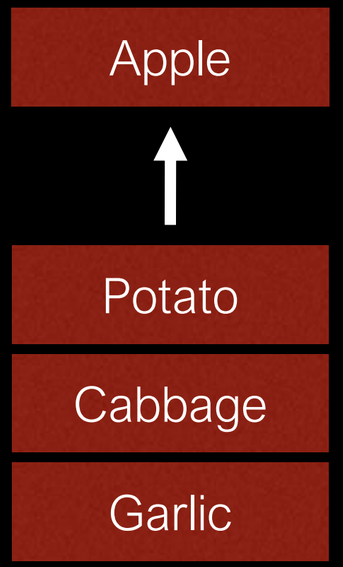

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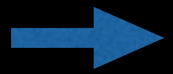

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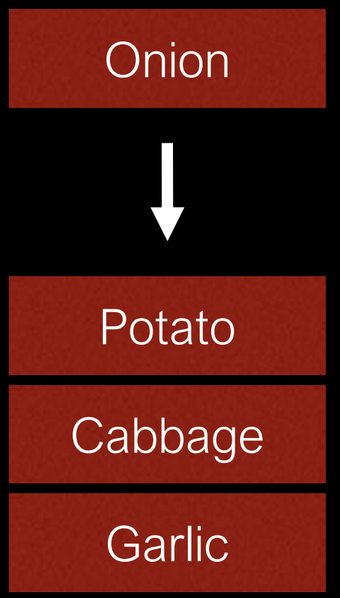

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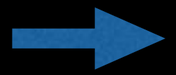

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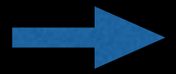

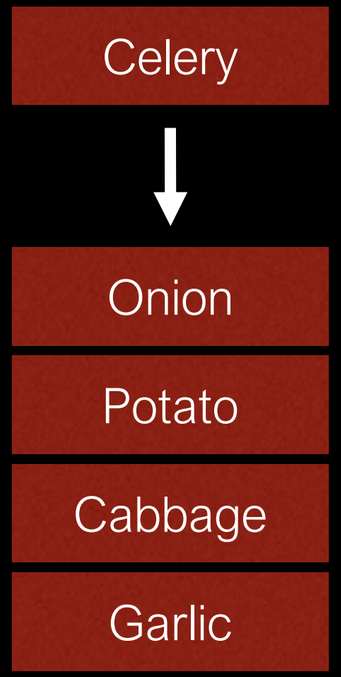

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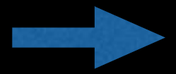

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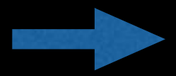

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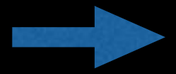

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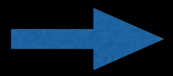

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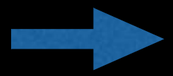

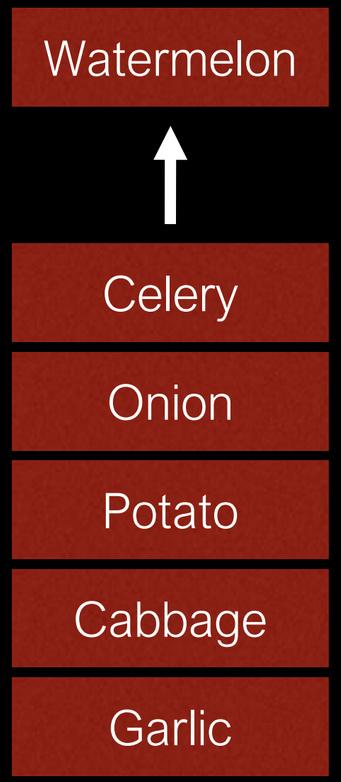

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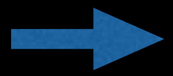

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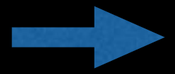

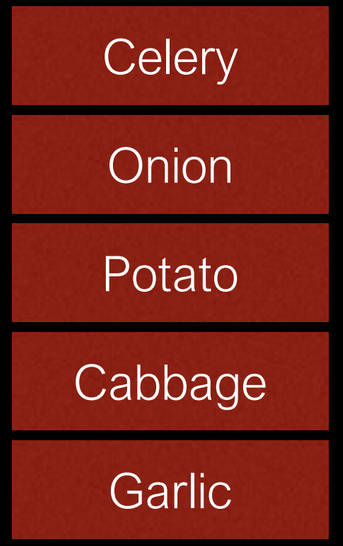

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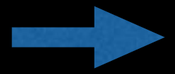

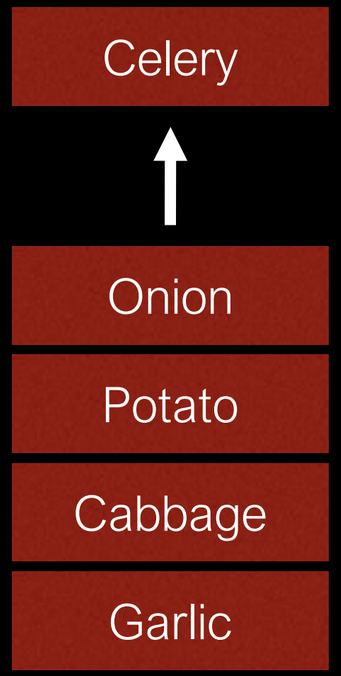

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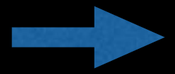

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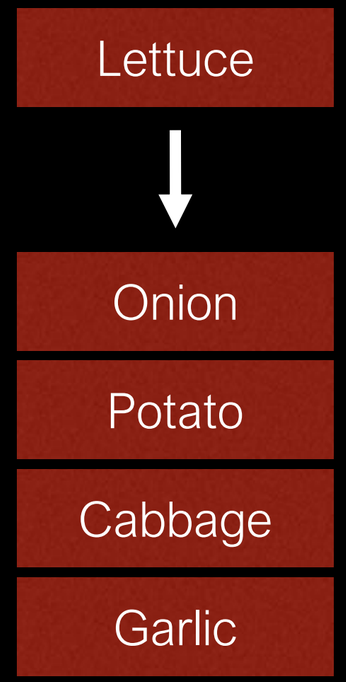

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When and where is a Stack used?

- Used by undo mechanisms in text editors.
- Used in compiler syntax checking for matching brackets and braces.
- Can be used to model a pile of books or plates.
- Used behind the scenes to support recursion by keeping track of previous function calls.
- Can be used to do a Depth First Search (DFS) on a graph.

Complexity Analysis

Complexity

Pushing	O(1)
Popping	O(1)
Peeking	O(1)
Searching	O(n)
Size	O(1)

Example - Brackets

Problem: Given a string made up of the following brackets: ()[]{}, determine whether the brackets properly match.

[{}]		**Valid**
(()())		**Valid**
{]		**Invalid**
[()]))()		**Invalid**
[]{}({})		**Valid**

Example - Brackets

Bracket Sequence:

[[{}]()]

Current Bracket: Ø

Reversed Bracket: Ø

Example - Brackets

Bracket Sequence:

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Current Bracket: [

Reversed Bracket:]

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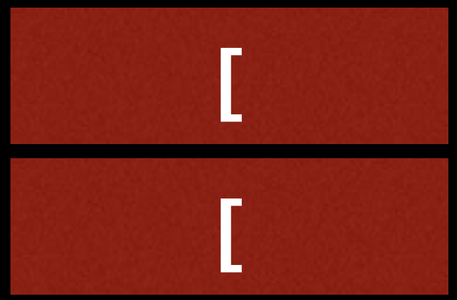


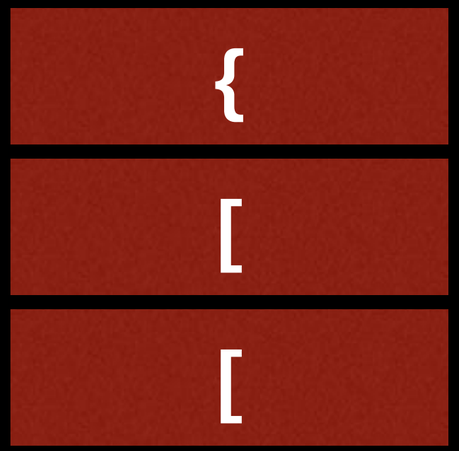
Example - Brackets

Bracket Sequence:

[[{}]()]

Current Bracket: {

Reversed Bracket: }



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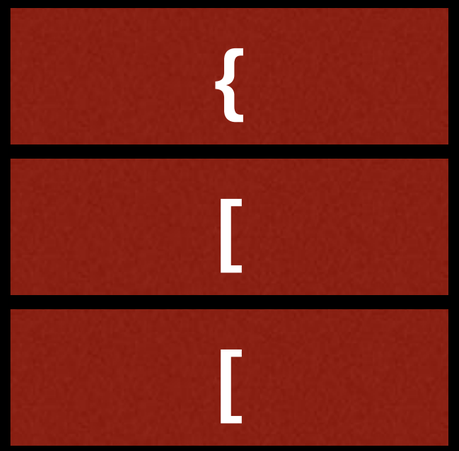

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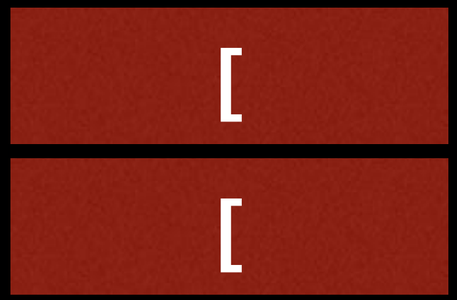

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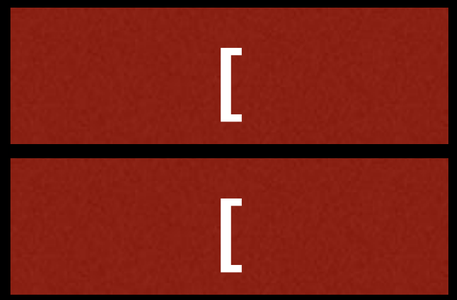


Example - Brackets

Bracket Sequence:

[[{}]()]

Current Bracket:]

Reversed Bracket: [

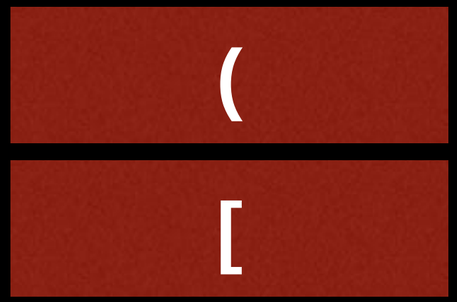
Example - Brackets

Bracket Sequence:

[[{}](())]

Current Bracket: (

Reversed Bracket:)



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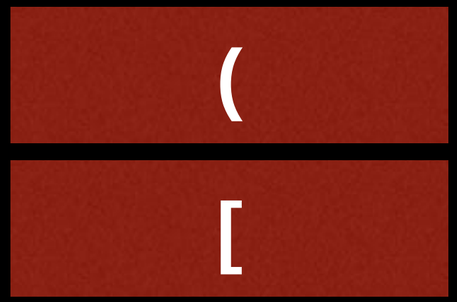

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[[{}]()]

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Example - Brackets

Bracket Sequence:

[[{}]()]  Valid

Current Bracket:]

Reversed Bracket: [

Example - Brackets

Bracket Sequence:

[{})[]

Current Bracket: Ø

Reversed Bracket: Ø

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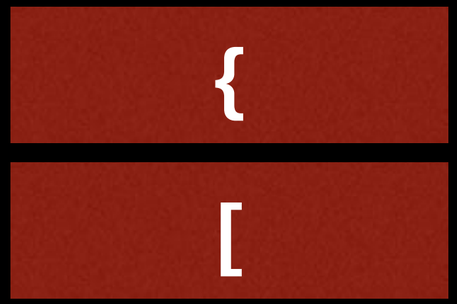

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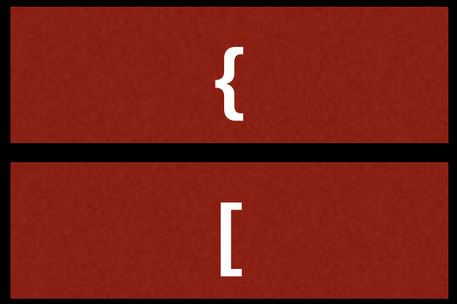

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Reversed Bracket: {

Example - Brackets

Bracket Sequence:

[{})[]

Current Bracket:)

Reversed Bracket: (

Example - Brackets

Bracket Sequence:

[{})[] → Invalid

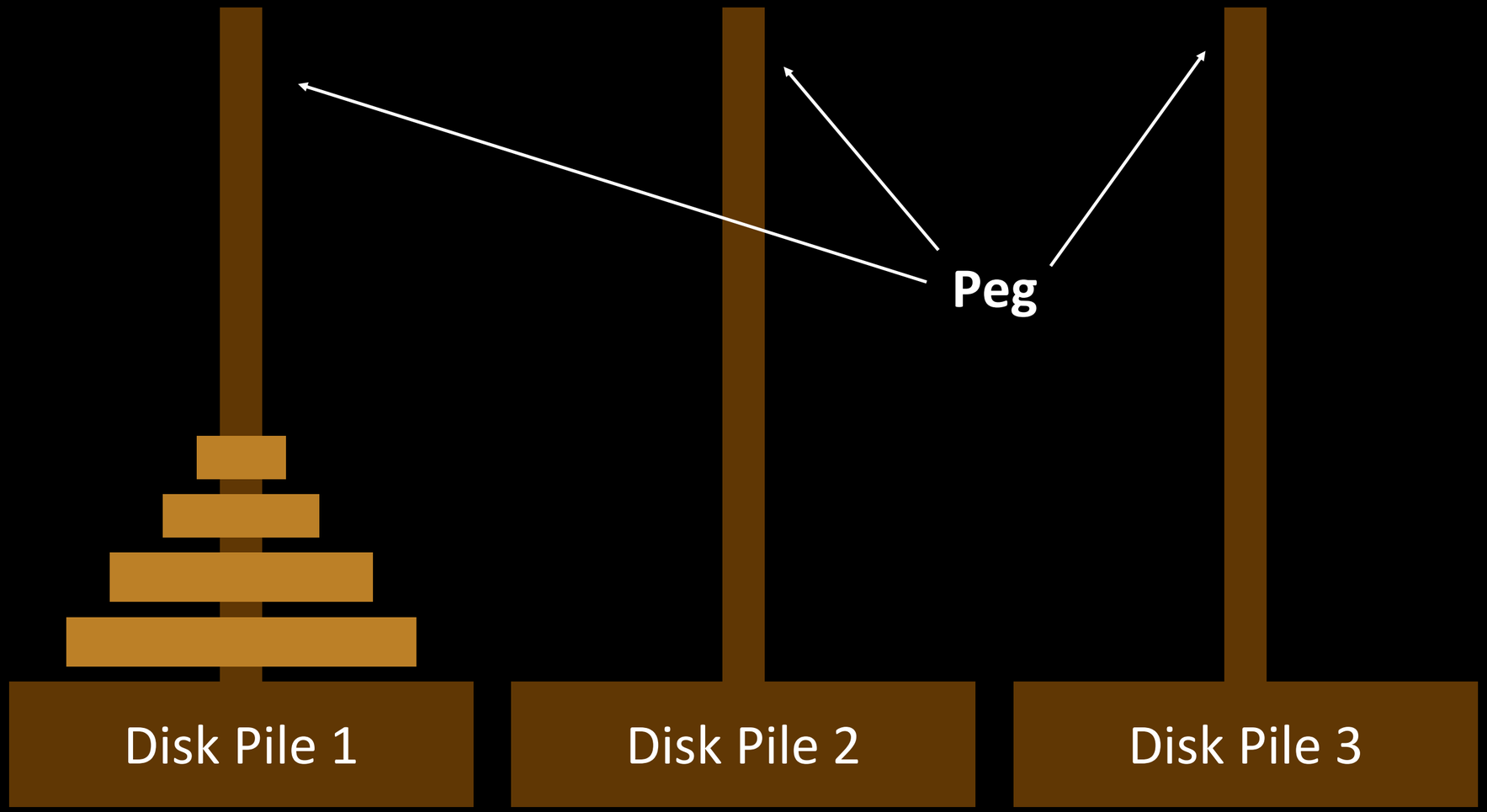
Current Bracket:)

Reversed Bracket: (

Example - Brackets

```
Let S be a stack
For bracket in bracket_string:

    rev = getReversedBracket(bracket)

    If isLeftBracket(bracket):
        S.push(bracket)

    Else If S.isEmpty() or S.pop() != rev:
        return false // Invalid

return S.isEmpty() // Valid if S is empty
```

Tower of Hanoi



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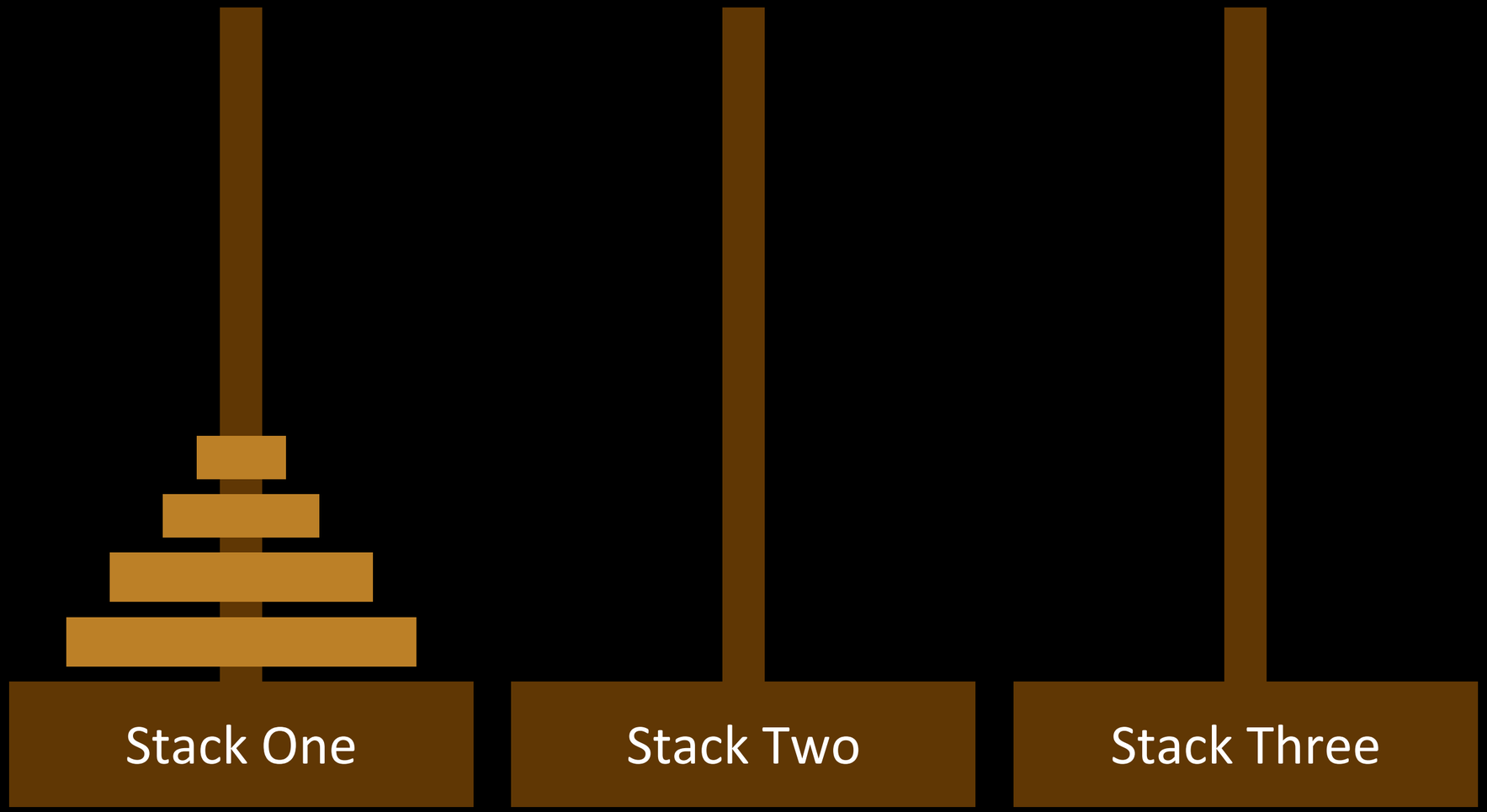

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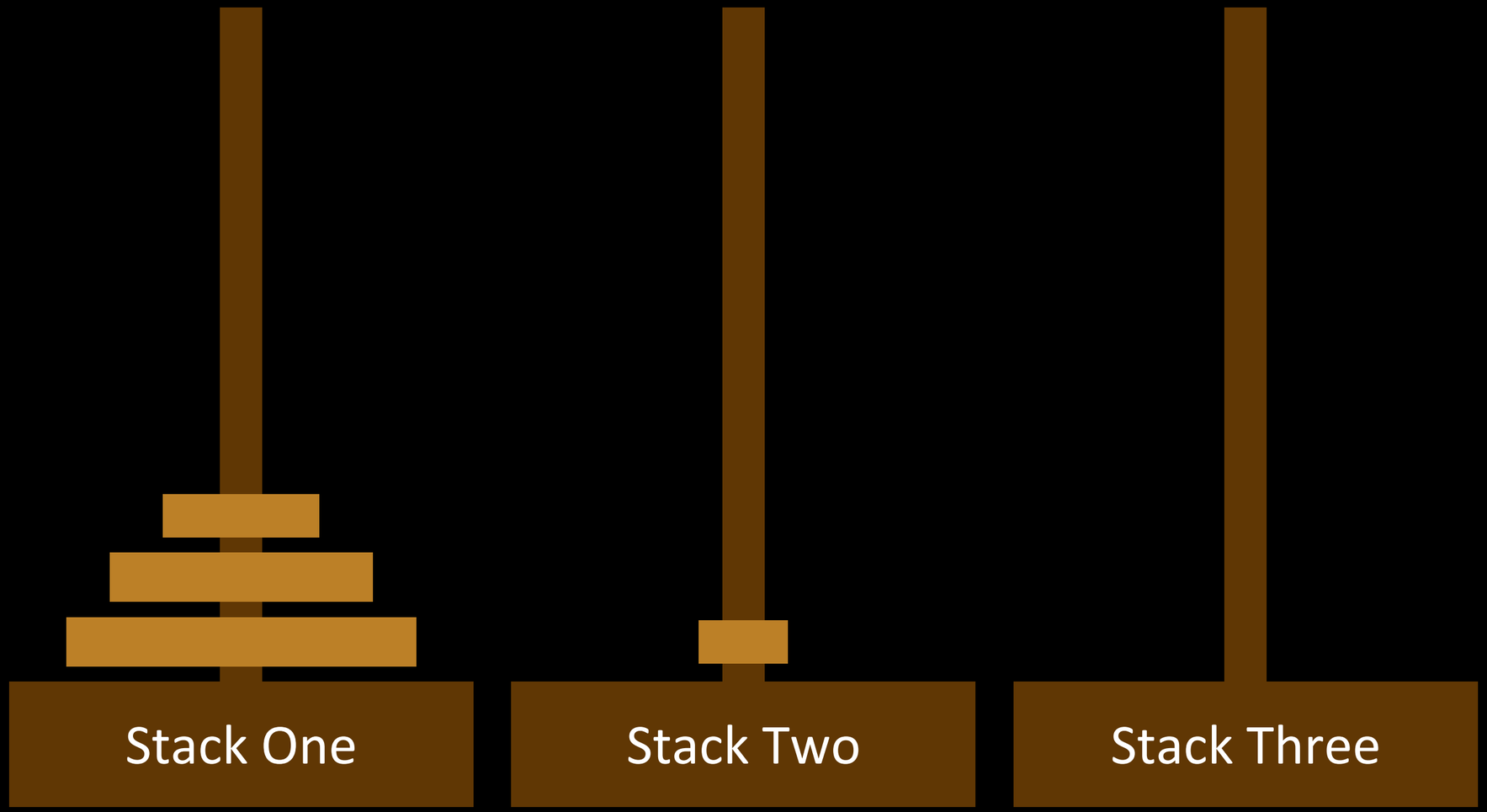

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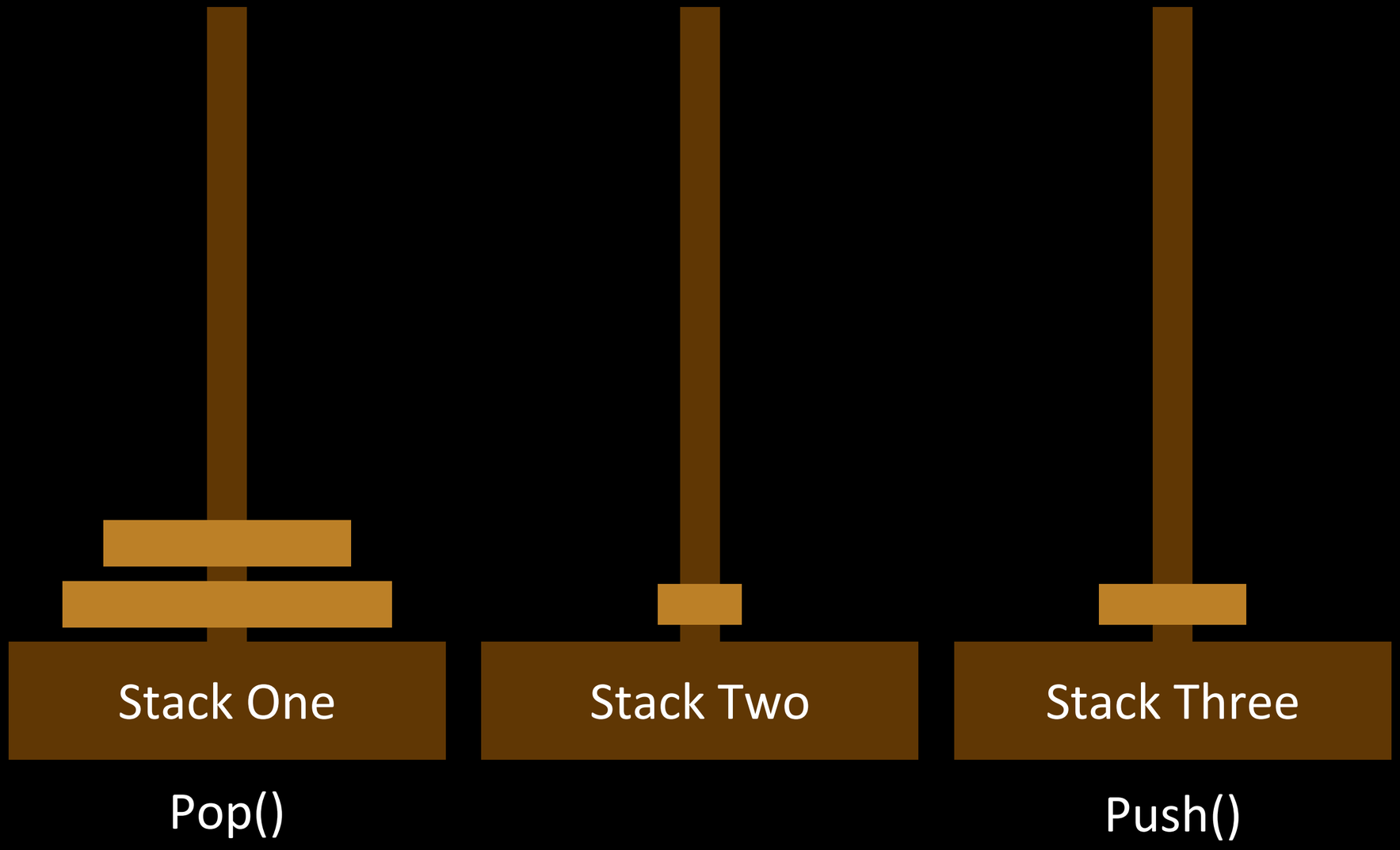

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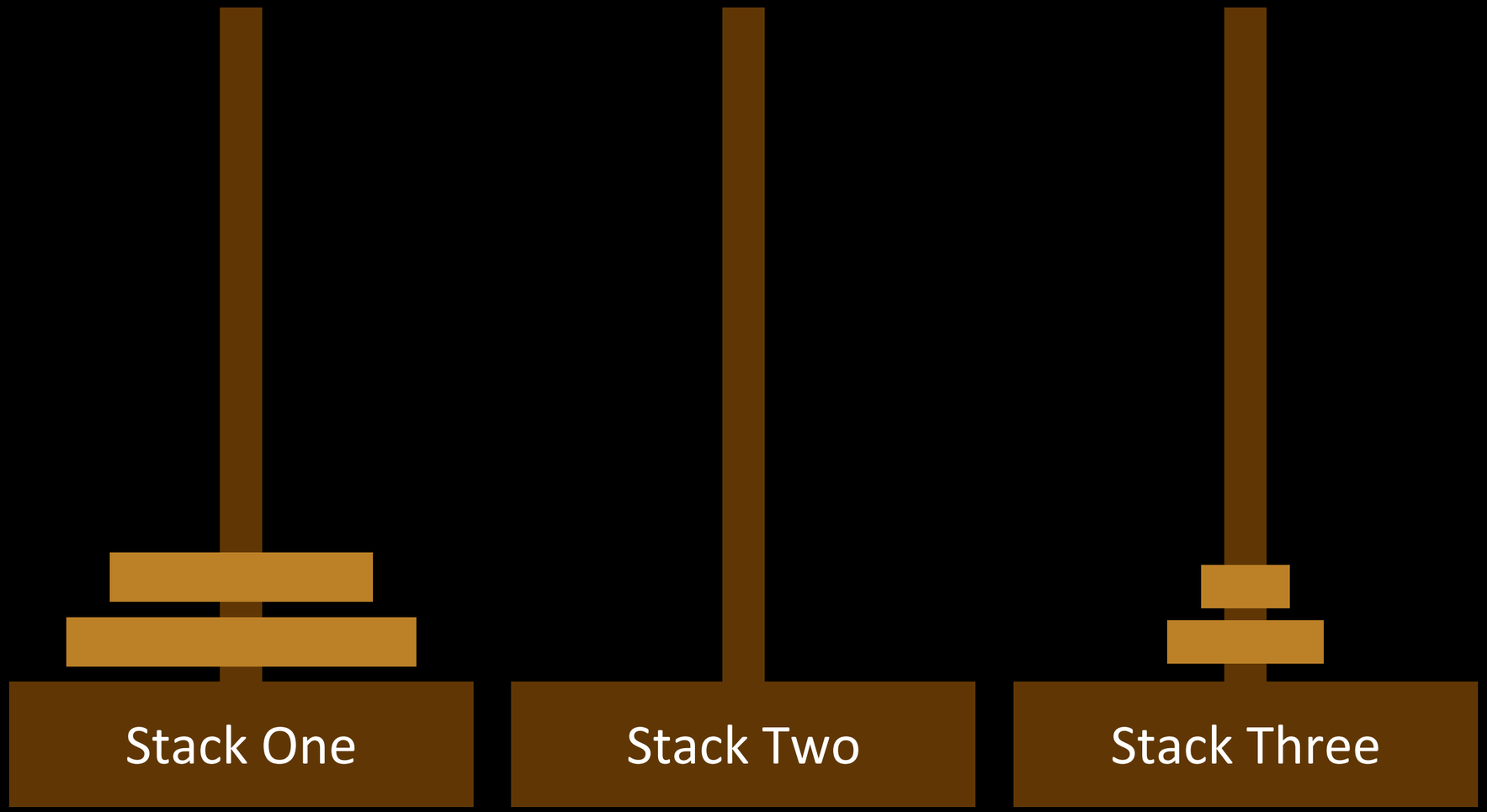

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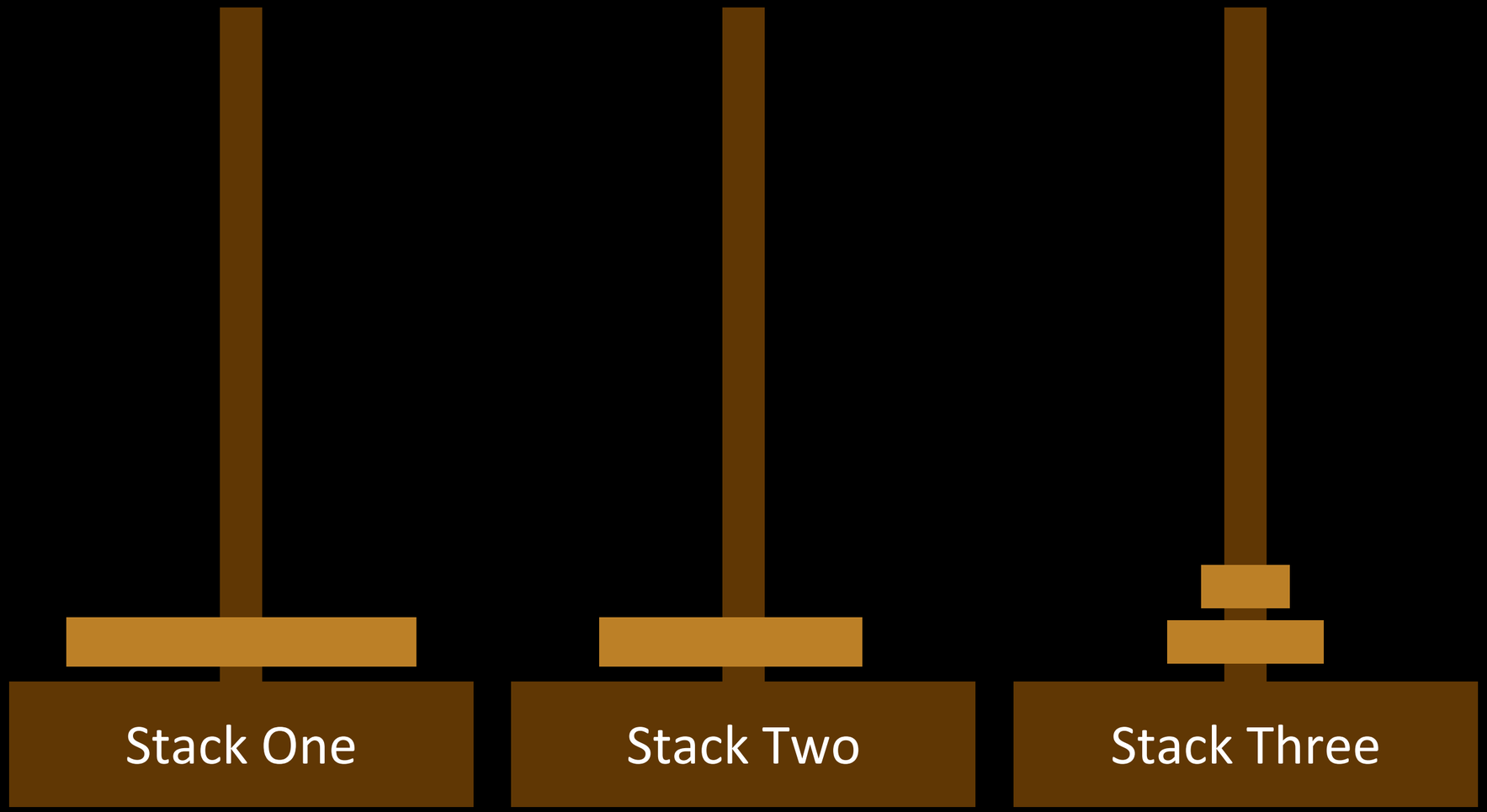

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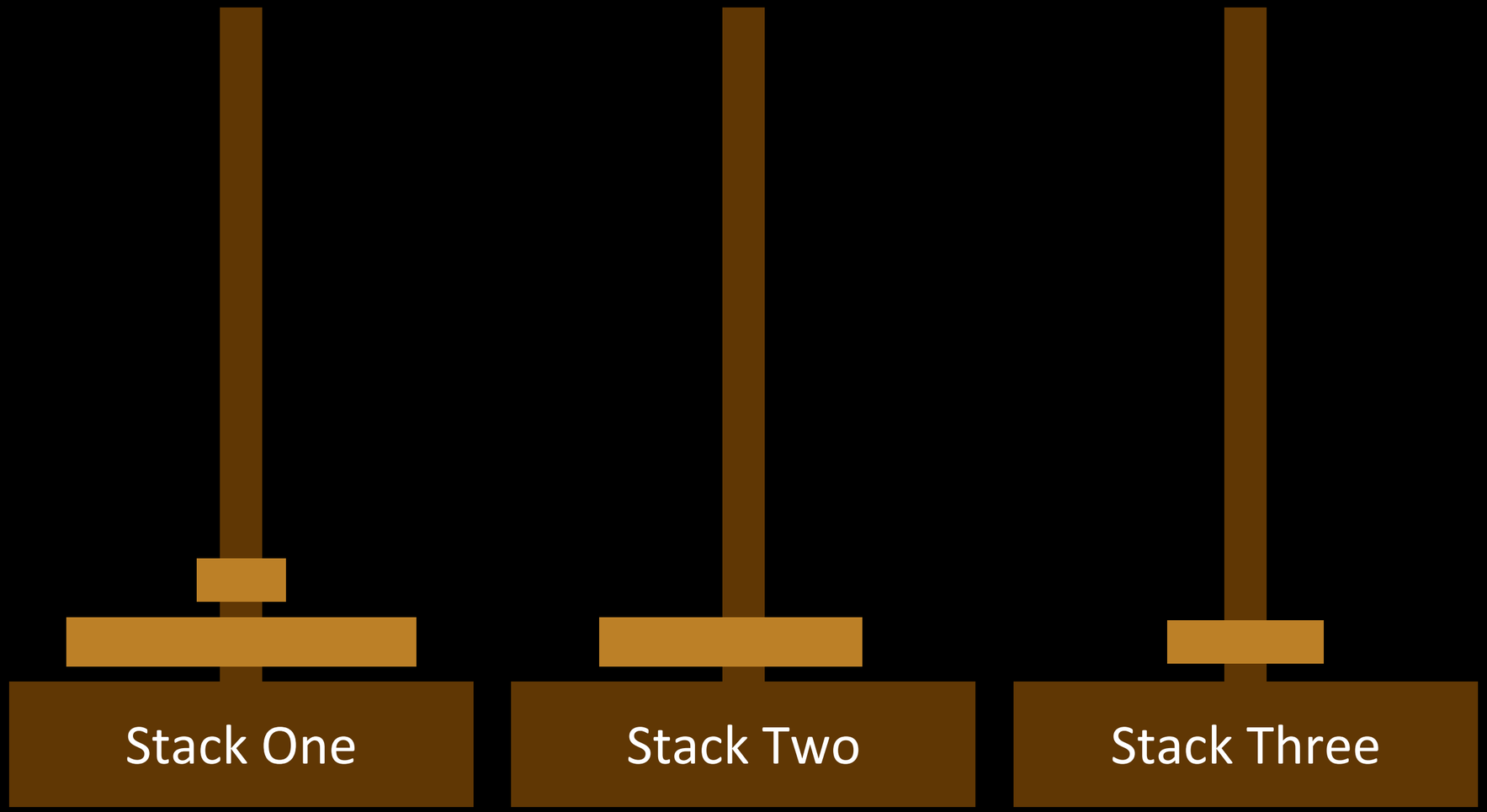

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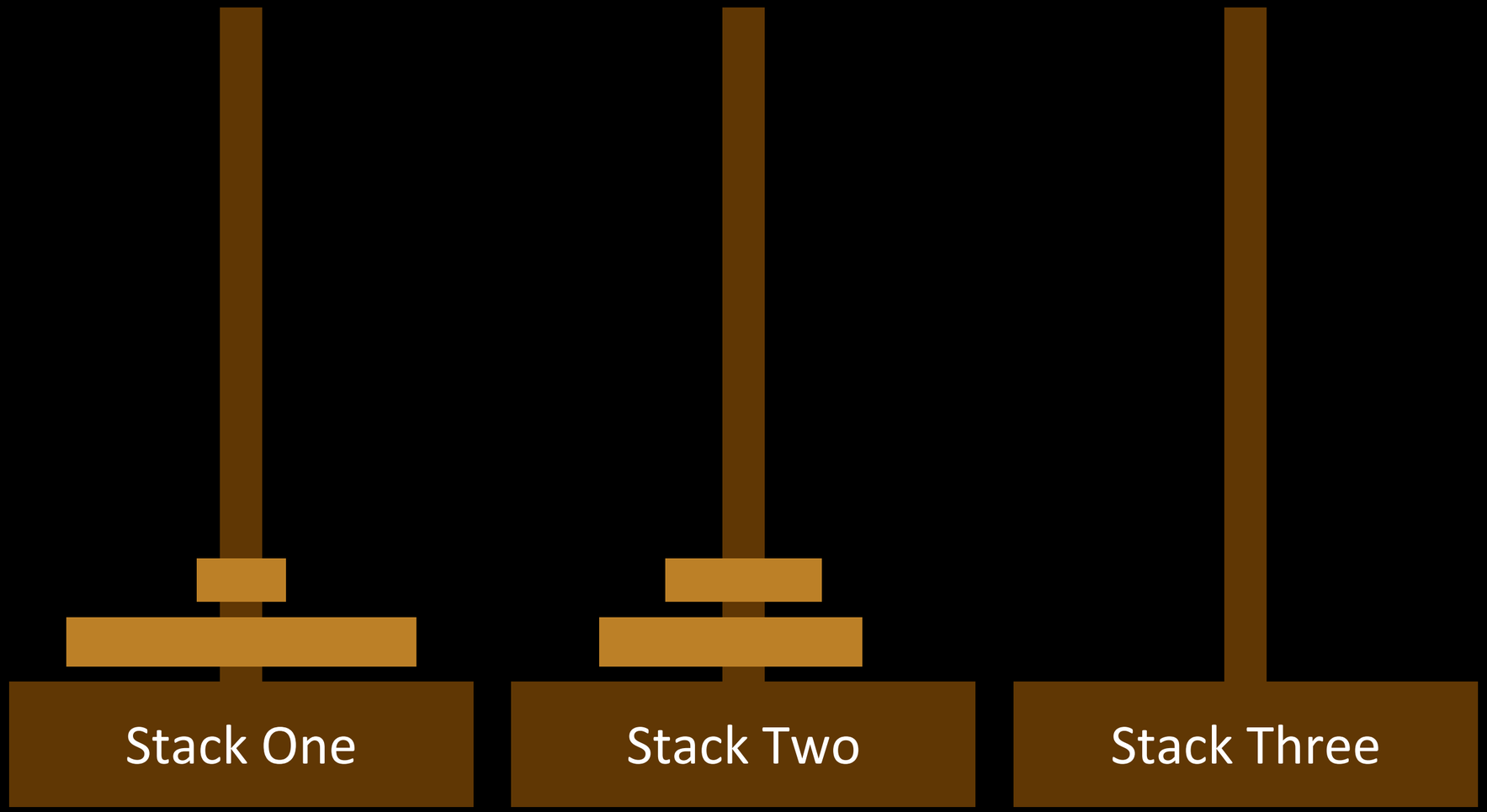

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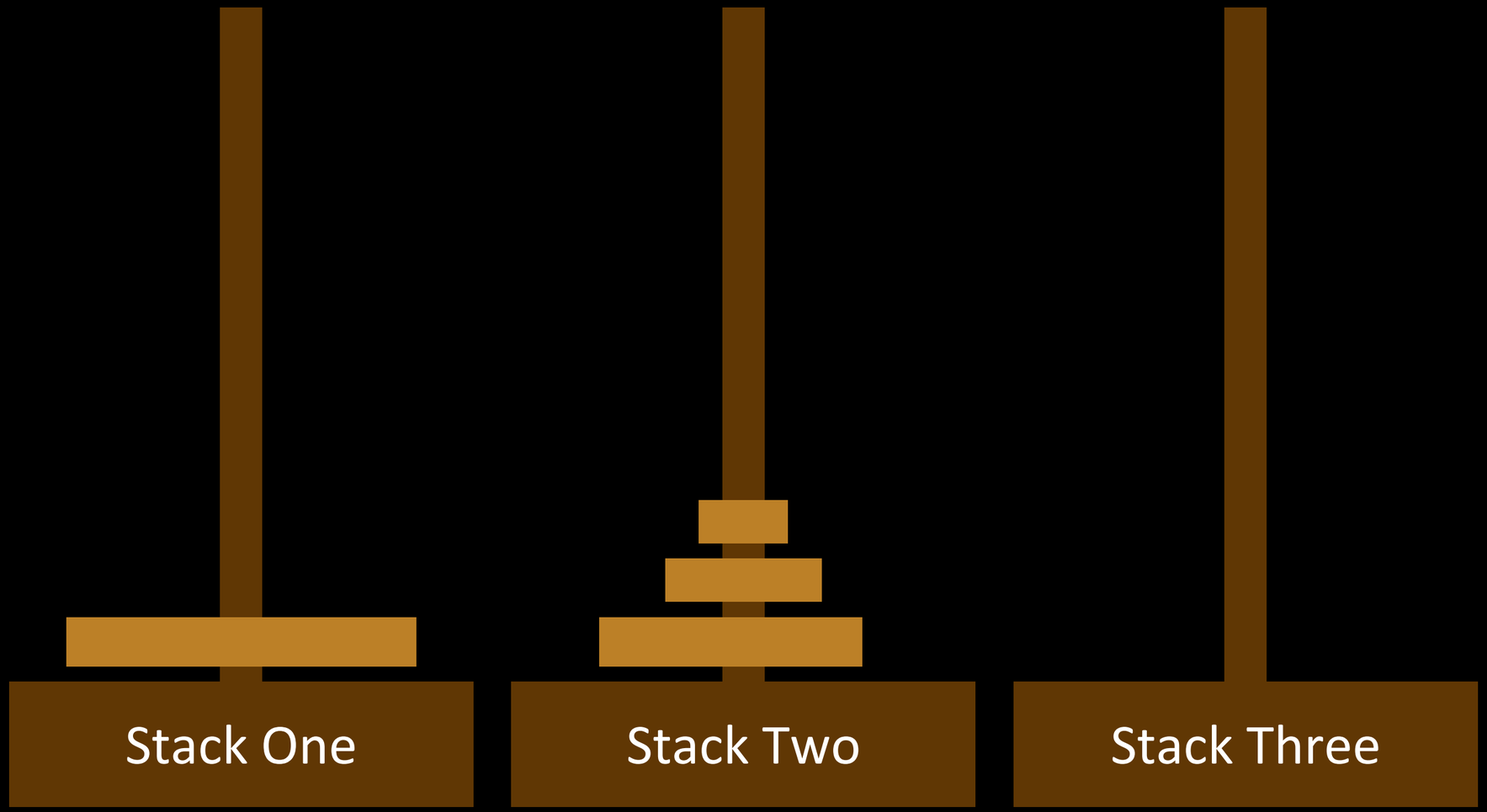

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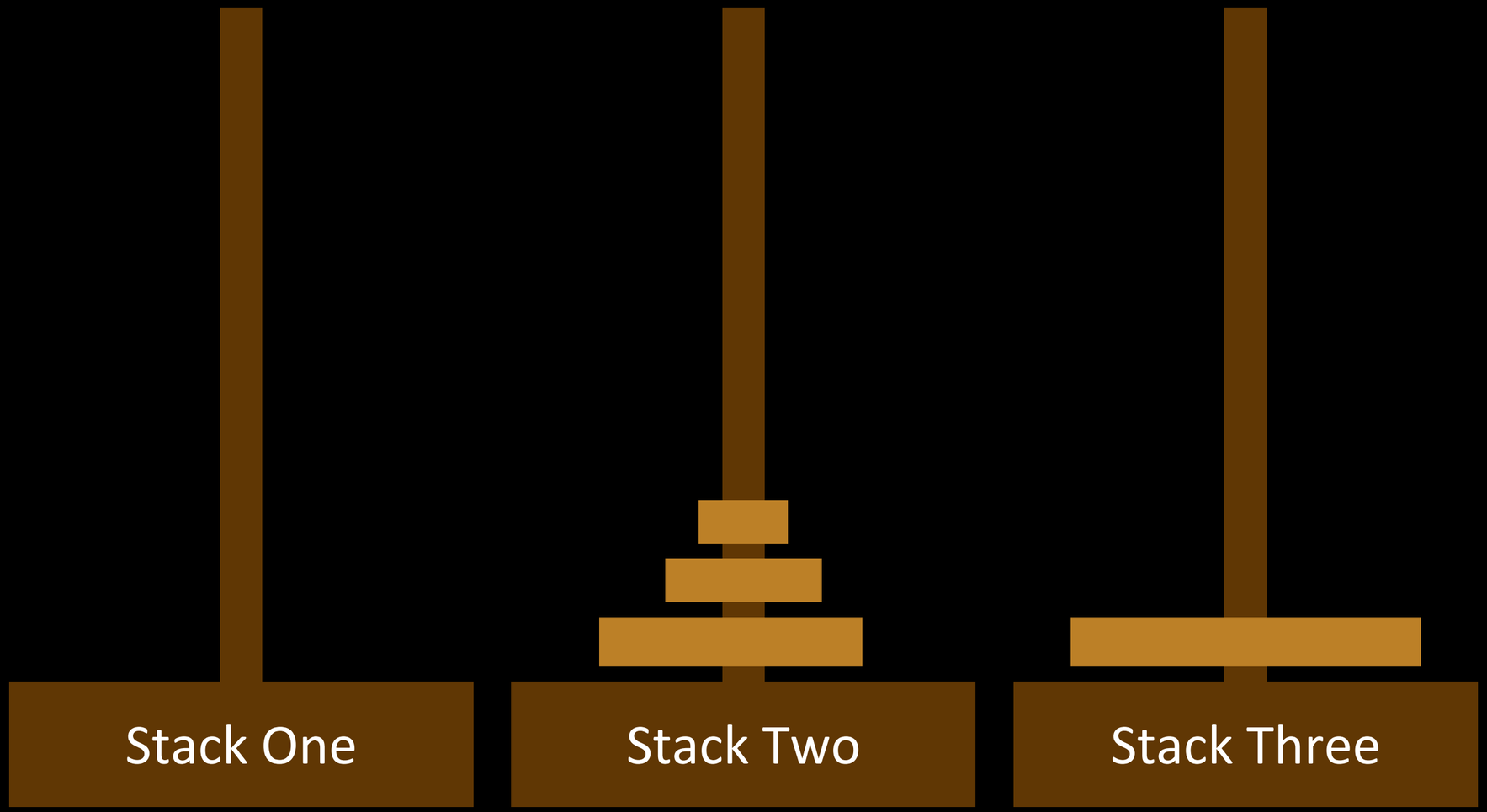

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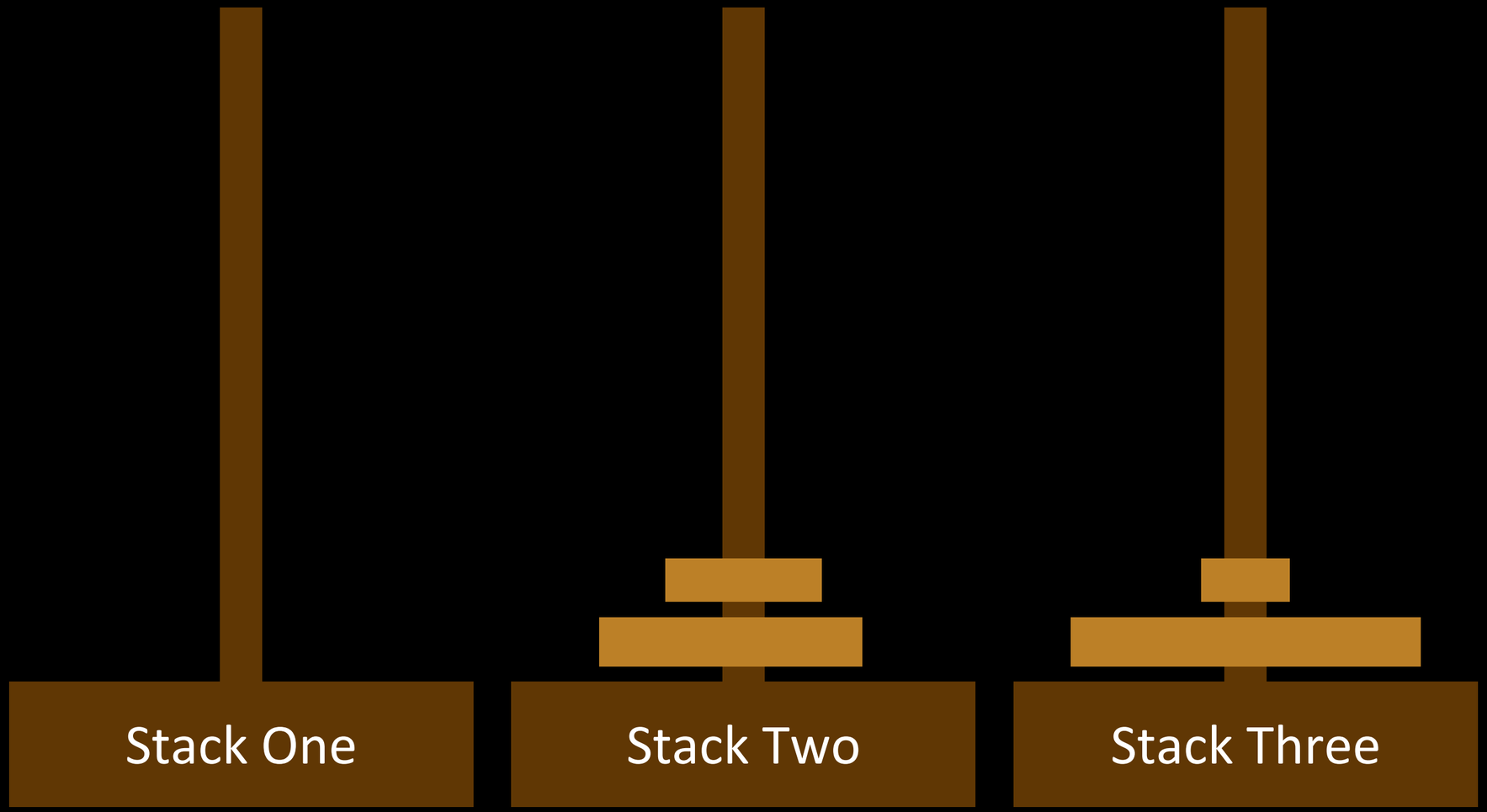

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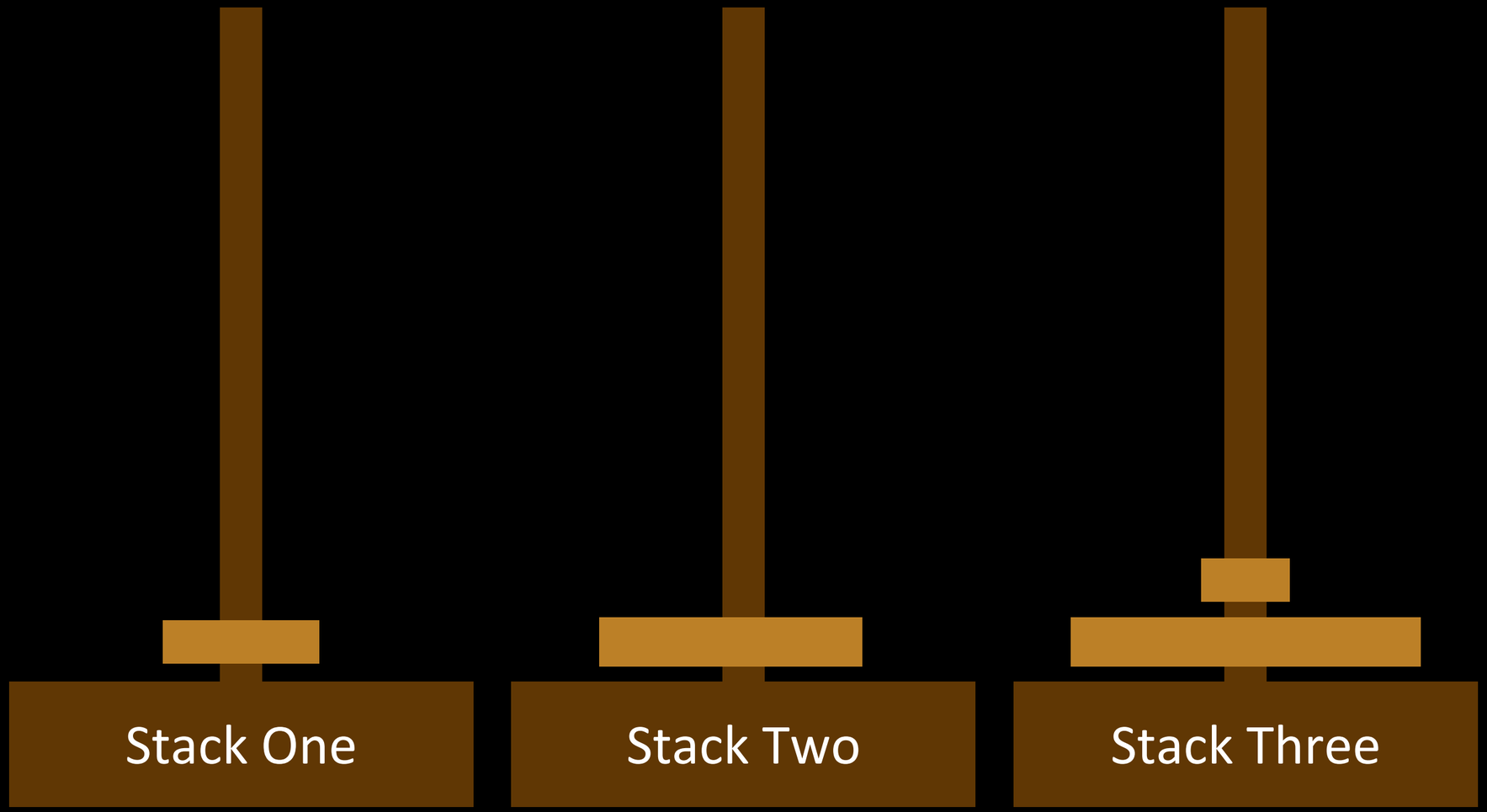

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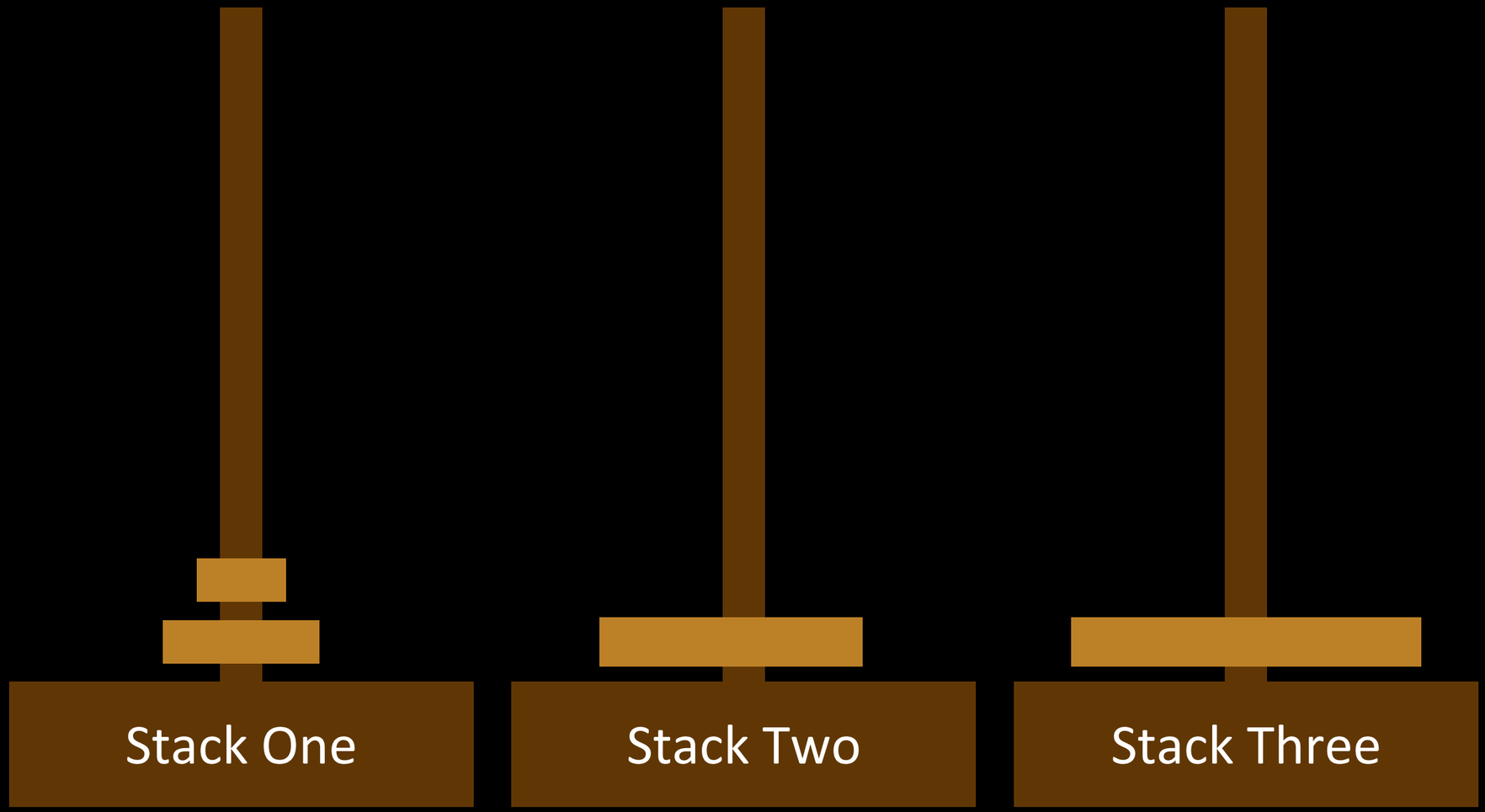

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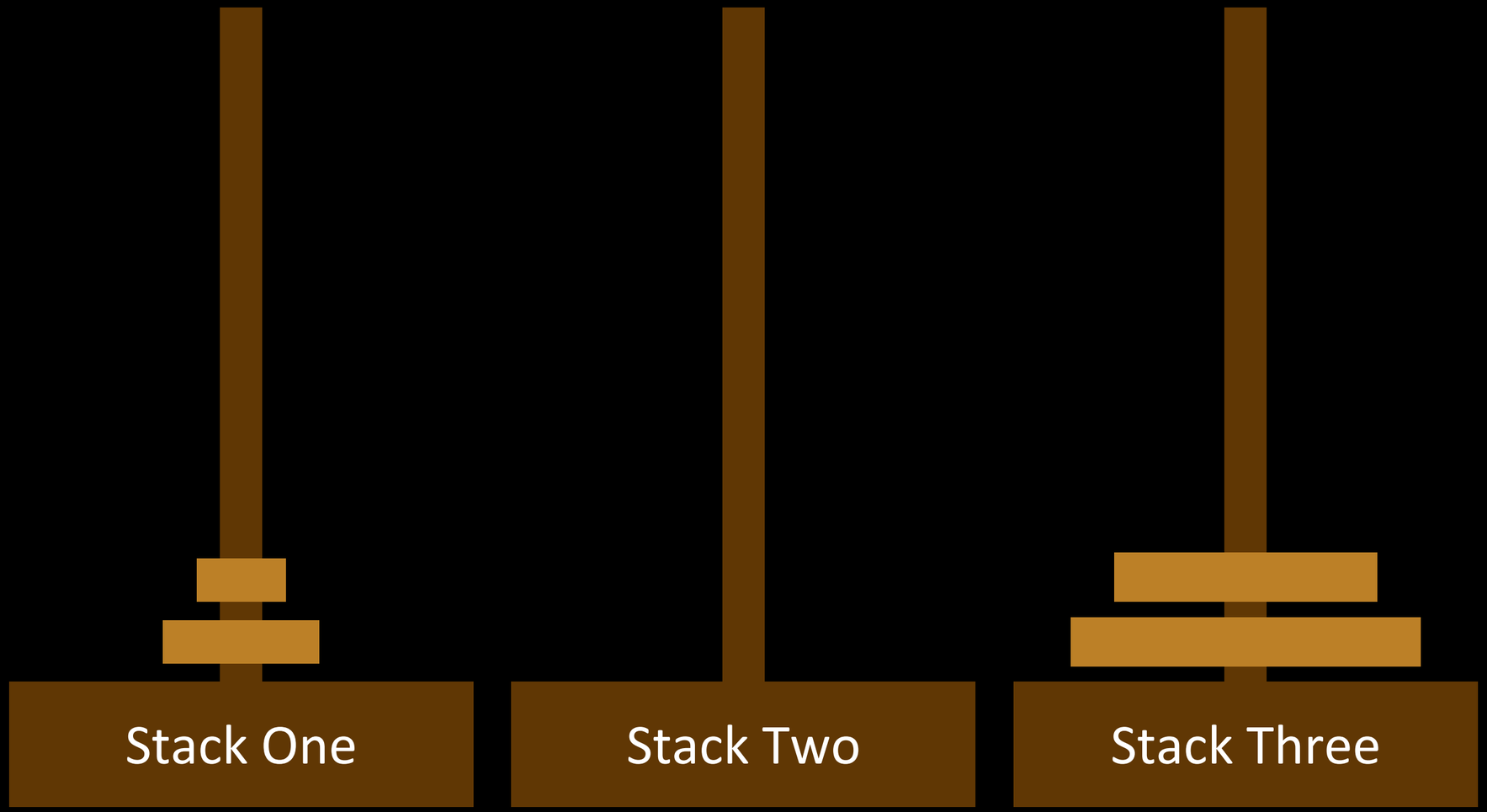

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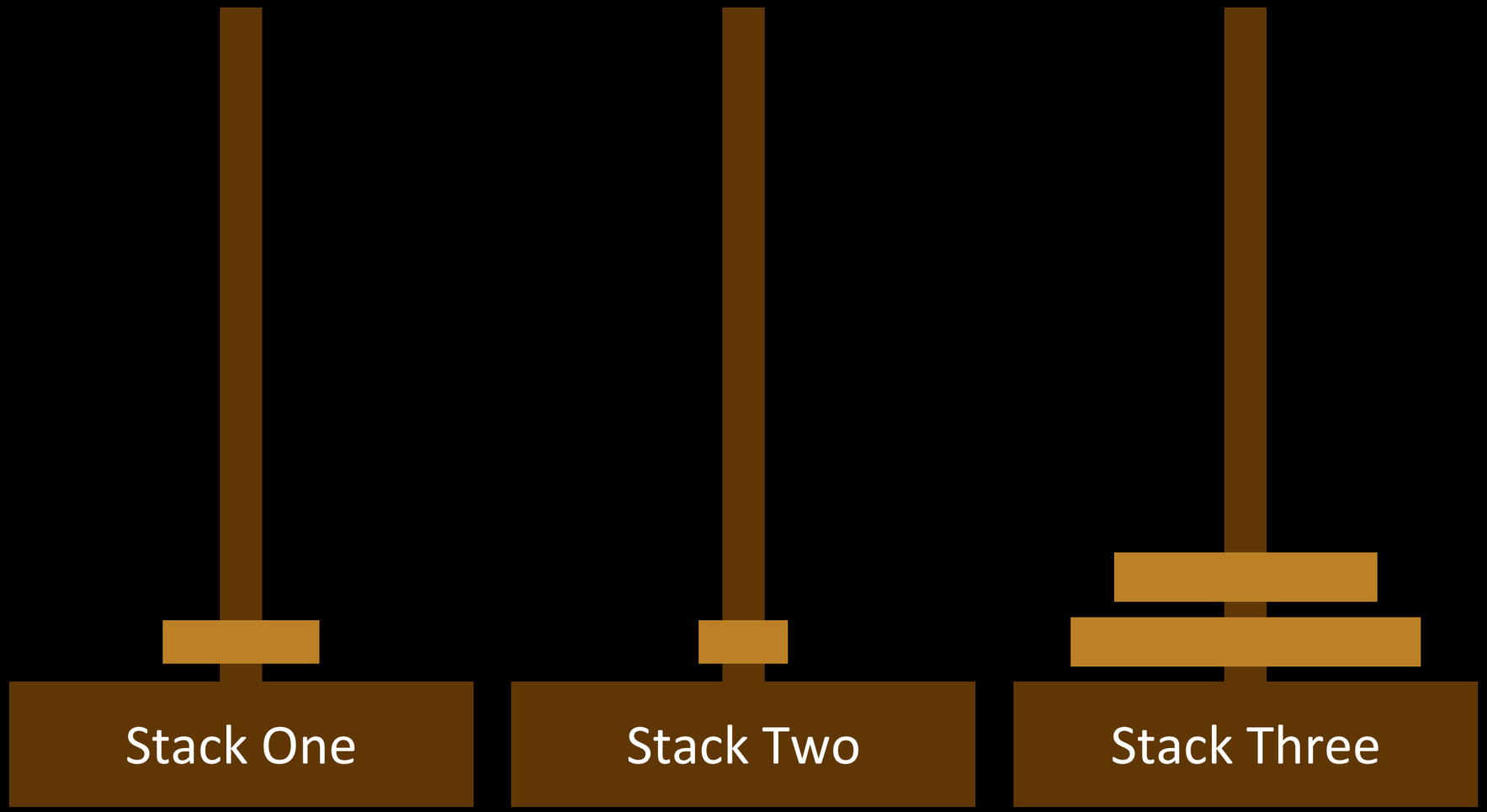

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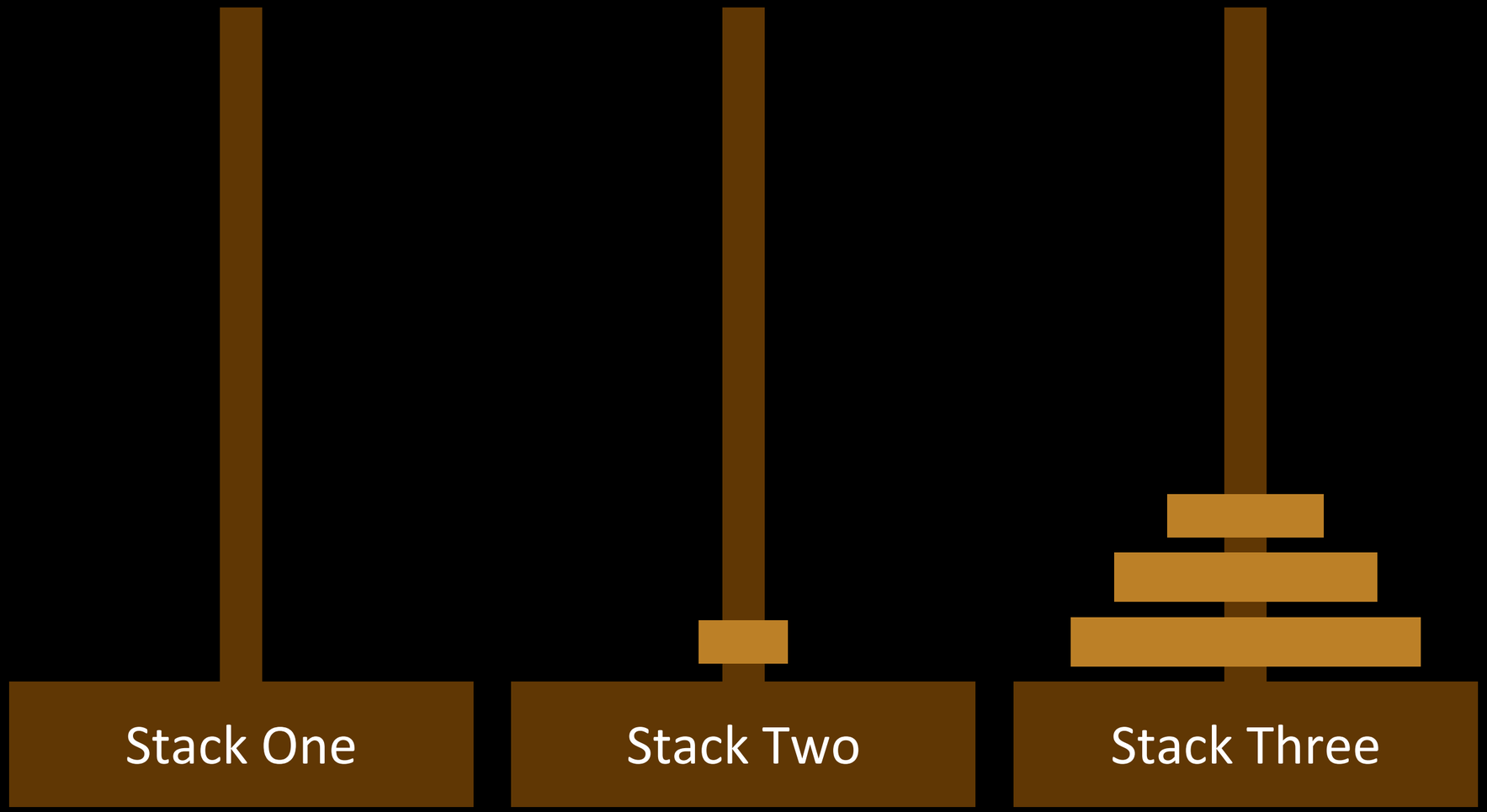
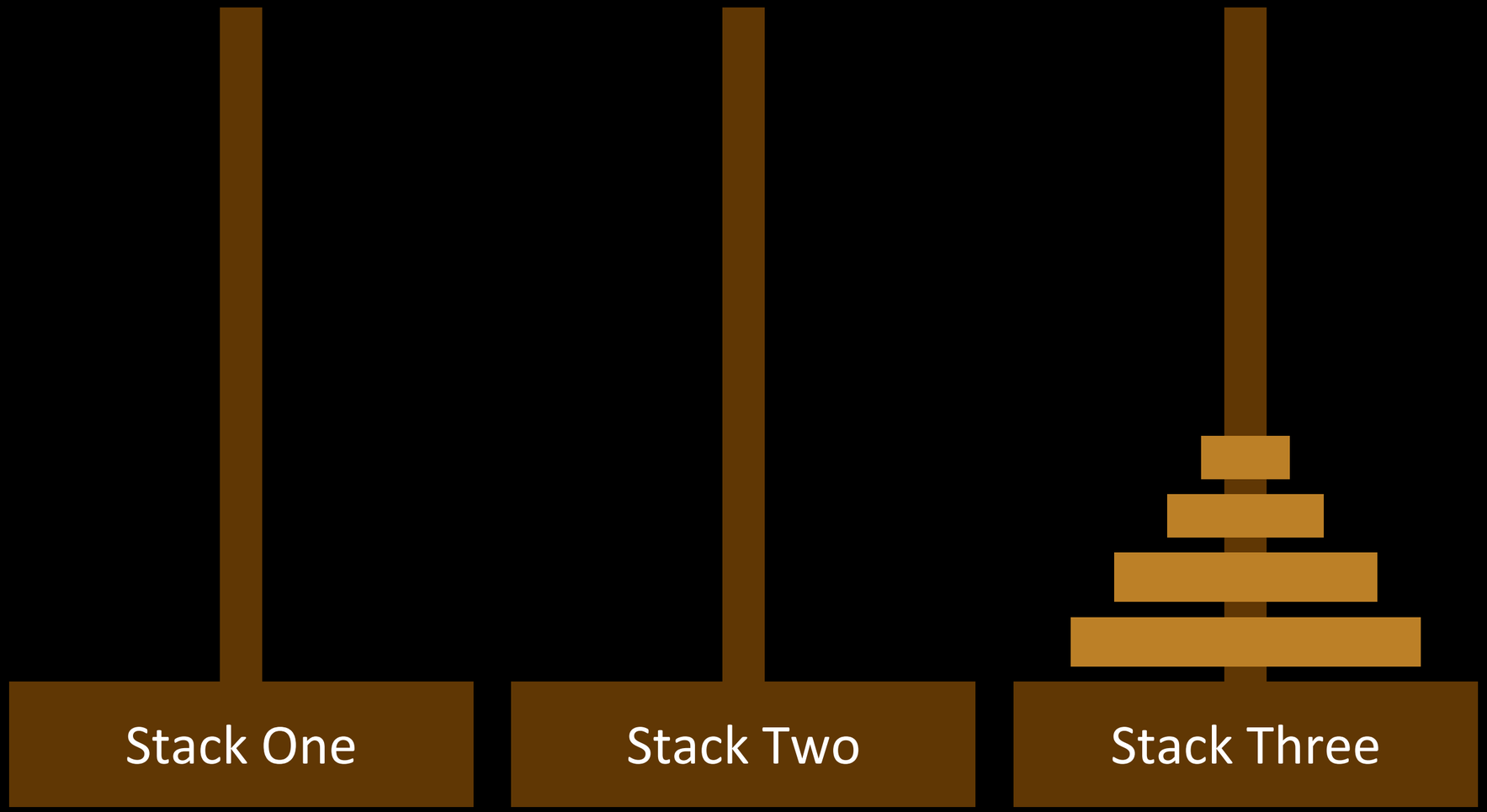
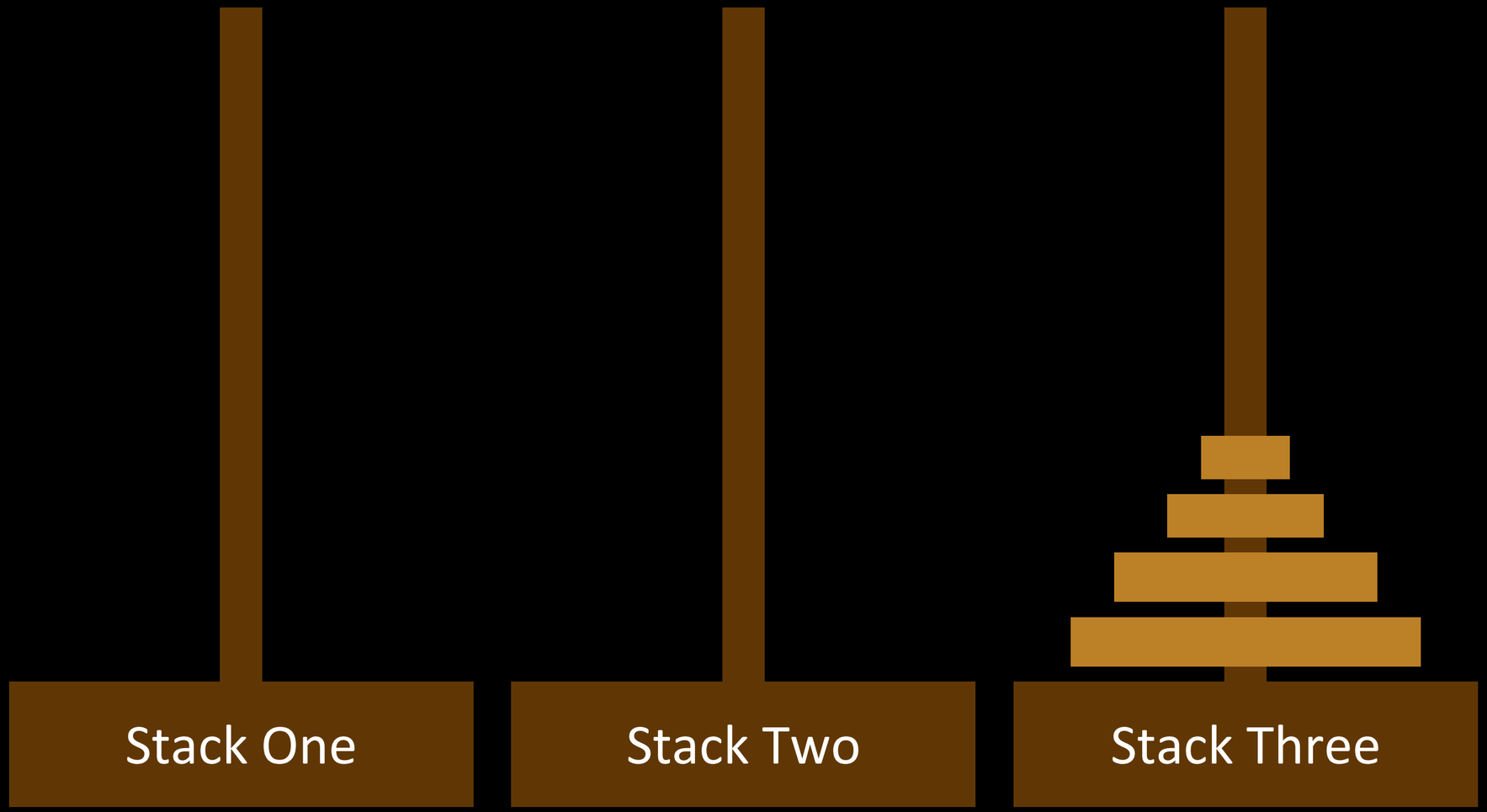


Tower of Hanoi



Tower of Hanoi



Stack Operations

William Fiset

Pushing

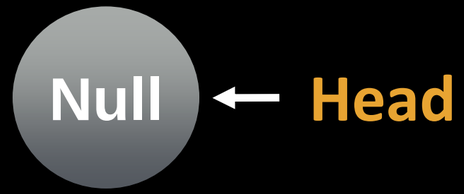
Instructions

Push(4)
Push(2)
Push(5)
Push(13)

Pushing

Instructions

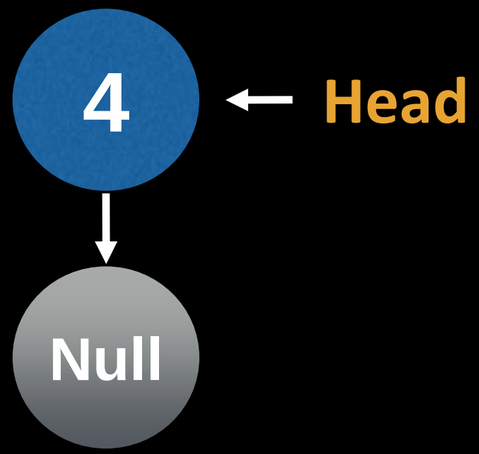
Push(4)
Push(2)
Push(5)
Push(13)



Pushing

Instructions

Push(4)
Push(2)
Push(5)
Push(13)



Pushing

Instructions

Push(4)
Push(2)
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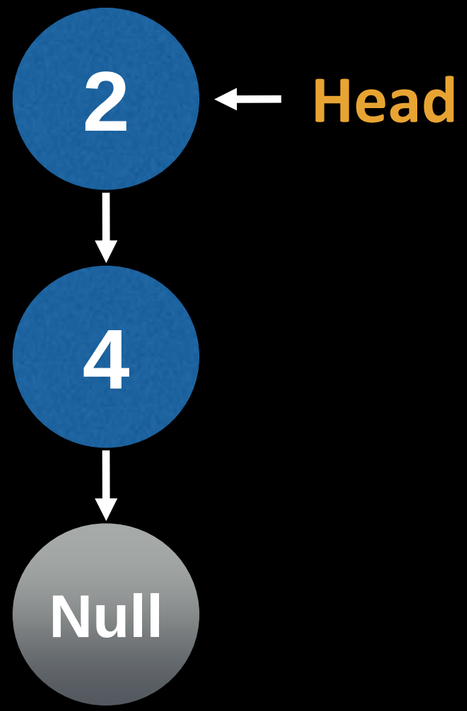
Push(13)



Pushing

Instructions

Push(4)
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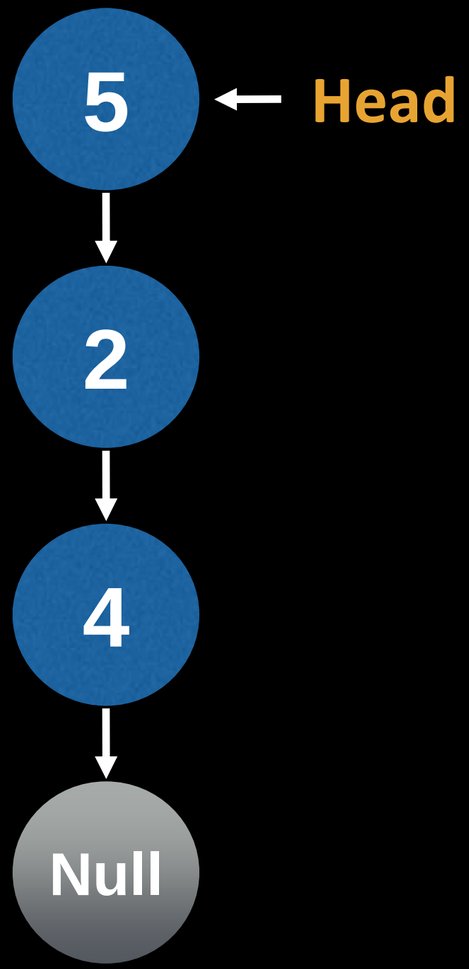
Push(13)



Pushing

Instructions

Push(4)
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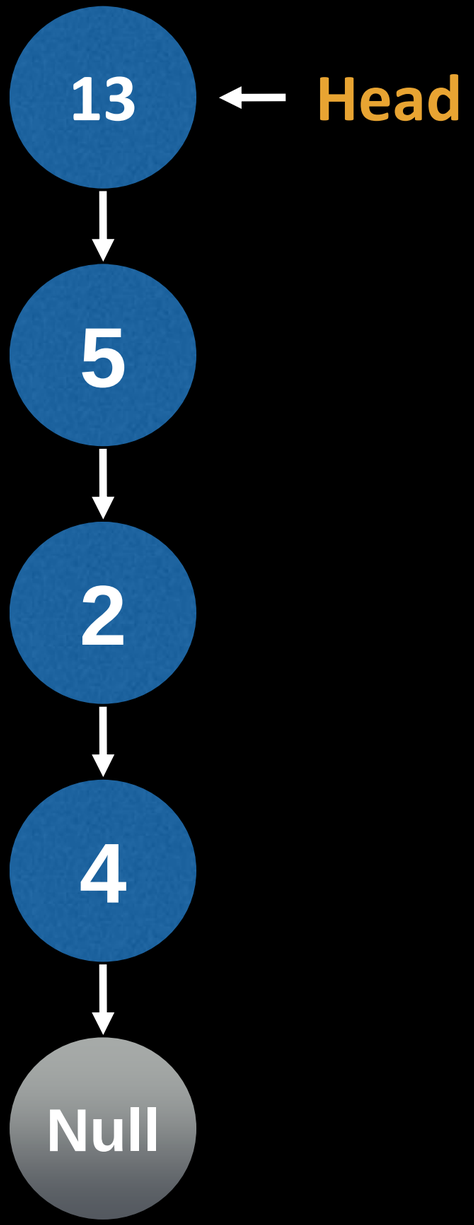
Push(13)



Popping

Instructions

Pop()
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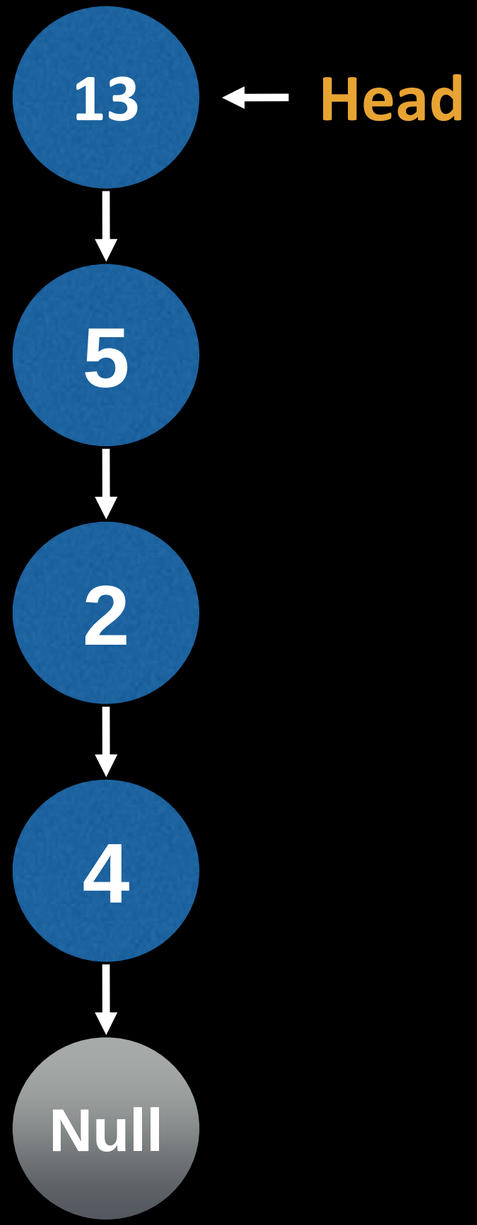
Pop()
Pop()



Popping

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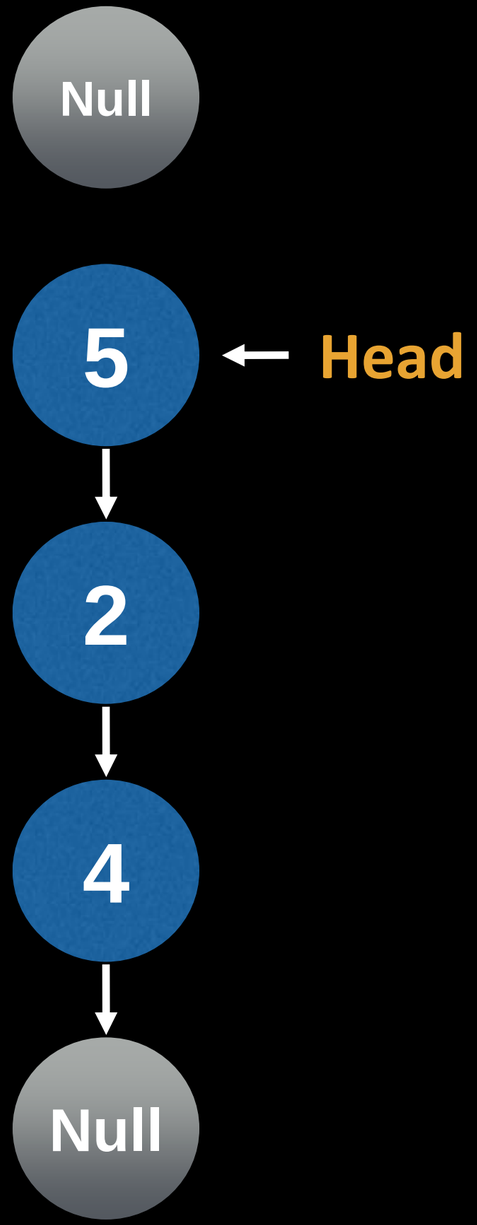

Popping

Instructions

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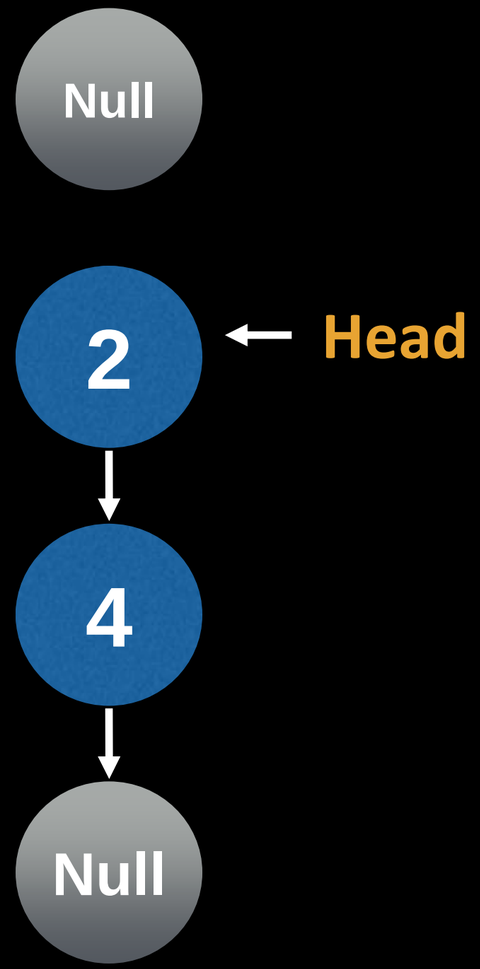

Popping

Instructions

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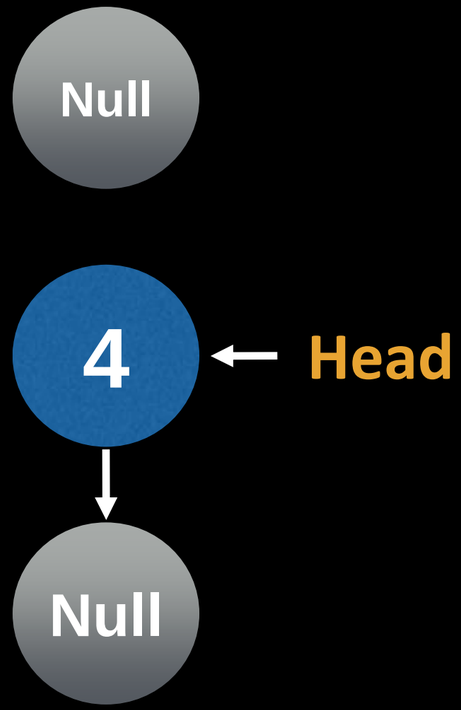

Popping

Instructions

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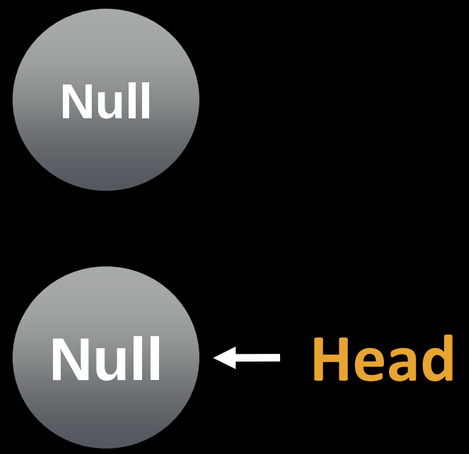

Popping

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