An Abstract Data Type (ADT) is a conceptual model that defines a set of operations and behaviors for a data type, without specifying how these operations are implemented or how data is organized in memory.

In Stack ADT, the order of insertion and deletion should be according to the FILO or LIFO Principle. Elements are inserted and removed from the same end, called the top of the stack. It should also support the following operations:

- **push():** Insert an element at one end of the stack called the top.
- **pop():** Remove and return the element at the top of the stack, if it is not empty.
- **peek():** Return the element at the top of the stack without removing it, if the stack is not empty.
- **size():** Return the number of elements in the stack.
- **isEmpty():** Return true if the stack is empty; otherwise, return false.
- **isFull():** Return true if the stack is full; otherwise, return false.

Applications of Stack

The simplest application of a stack is to reverse a word. You push a given word to stack - letter by letter - and then pop letters from the stack.

There are other uses also like:

1. Parsing
2. Expression Conversion(Infix to Postfix, Postfix to Prefix etc)

Algorithm for PUSH operation

1. Check if the stack is **full** or not.
2. If the stack is full, then print error of overflow and exit the program.
3. If the stack is not full, then increment the top and add the element.

Algorithm for POP operation

1. Check if the stack is empty or not.
2. If the stack is empty, then print error of underflow and exit the program.
3. If the stack is not empty, then print the element at the top and decrement the top.

Analysis of Stack Operations

Below mentioned are the time complexities for various operations that can be performed on the Stack data structure.

- **Push Operation** : O(1)
- **Pop Operation** : O(1)
- **Top Operation** : O(1)
- **Search Operation** : O(n)

The time complexities for push() and pop() functions are O(1) because we always have to insert or remove the data from the **top** of the stack, which is a one step process.

Assume the infix expression is a string of tokens delimited by spaces. The operator tokens are *, /, +, and -, along with the left and right parentheses, (and). The operand tokens are the single-character identifiers A, B, C, and so on. The following steps will produce a string of tokens in postfix order.

1. Create an empty stack called opstack for keeping operators. Create an empty list for output.
2. Convert the input infix string to a list by using the string method split.
3. Scan the token list from left to right.
    - If the token is an operand, append it to the end of the output list.
    - If the token is a left parenthesis, push it on the opstack.
    - If the token is a right parenthesis, pop the opstack until the corresponding left parenthesis is removed. Append each operator to the end of the output list.

- If the token is an operator, *, /, +, or -, push it on the opstack. However, first remove any operators already on the opstack that have higher or equal precedence and append them to the output list.

4. When the input expression has been completely processed, check the opstack. Any operators still on the stack can be removed and appended to the end of the output list.

Infix Expression	**Prefix Expression**	**Postfix Expression**
A + B	+ A B	A B +
A + B * C	+ A * B C	A B C * +

Infix Expression	**Prefix Expression**	**Postfix Expression**
(A + B) * C	* + A B C	A B + C *

Infix Expression	**Prefix Expression**	**Postfix Expression**
A + B * C + D	+ + A * B C D	A B C * + D +
(A + B) * (C + D)	* + A B + C D	A B + C D + *
A * B + C * D	+ * A B * C D	A B * C D * +
A + B + C + D	+ + + A B C D	A B + C + D +