

Estructura de datos y algoritmos

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Recordatorio: TDA

- **Tipo de dato abstracto (TDA):** Una especificación de un conjunto de datos y las operaciones que pueden ser realizadas sobre esos datos.
 - Describe qué hace, no cómo lo hace.
- No sabemos exactamente cómo se implementa, solo qué hace y qué operaciones podemos hacer.
 - Solo necesitamos entender la idea de la colección de datos y las operaciones que puede realizar.

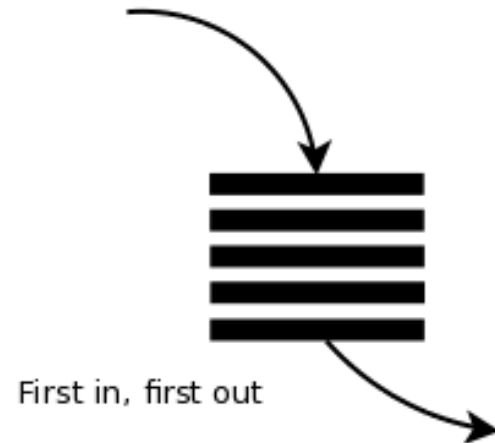
Pilas y colas

- **pila:** El único elemento accesible es el ultimo añadido.
- **cola:** El único elemento accesible es el que se añadió más temprano.
- Menos posibilidades de operaciones que una lista pero más eficientes.

Stack:



Queue:



Pila (stack)

- **LIFO**: Last In First Out
 - Los elementos son guardados en el orden de inserción
 - No solemos pensar en la posición de los elementos, solo en el último añadido.
 - El "cliente" solo puede acceder al último elemento añadido.
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- Operaciones básicas:
 - push: añadir un elemento
 - pop: quitar el último elemento añadido
 - peek (o top): ver el último elemento añadido

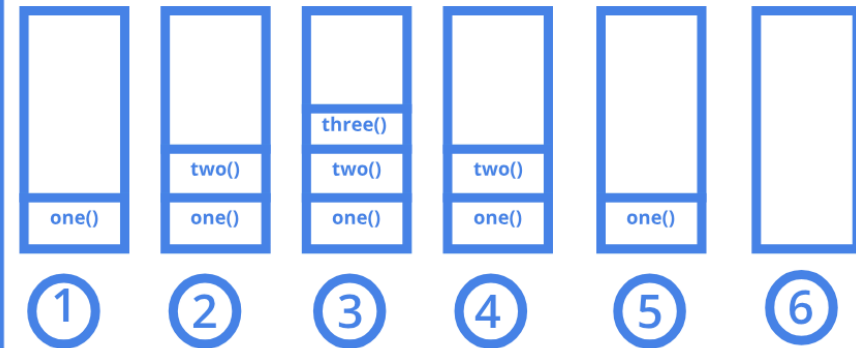


Pila (stack)



```
function one(){  
  two();  
}  
  
function two() {  
  three();  
}  
  
function three() {  
  console.trace("Call  
Stack");  
}
```

Call Stack



Class Stack

java.util.Stack

Constructor Summary

Constructors

Constructor and Description
Stack() Creates an empty Stack.

Method Summary

All Methods	Instance Methods	Concrete Methods
Modifier and Type	Method and Description	
boolean	empty() Tests if this stack is empty.	
E	peek() Looks at the object at the top of this stack without removing it from the stack.	
E	pop() Removes the object at the top of this stack and returns that object as the value of this function.	
E	push(E item) Pushes an item onto the top of this stack.	
int	search(Object o) Returns the 1-based position where an object is on this stack.	

Class stack

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JAVA ▼

RUN ▶

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STDIN

Input for the program (Optional)

Output:

[]

- Para iterar sobre una pila se usa un bucle `while` para vaciarla.

```
while (!stack.isEmpty()) {  
    System.out.println(stack.pop());  
}
```


<https://visualgo.net/en/stack>

The screenshot shows the Visualgo website interface for the Stack data structure. The top navigation bar includes the Visualgo logo, a language dropdown set to 'en', and links for 'list', 'LL', 'STACK', 'QUEUE', 'DLL', and 'DEQUE'. On the right, it says 'Exploration Mode' with a dropdown arrow and a 'LOGIN' button. The main area is a large black rectangle representing the stack. On the left side of this area, there is a vertical menu with a back arrow and four options: 'Create(A)', 'Peek', 'Push', and 'Pop'. At the bottom left of the main area, there is a '1x' zoom indicator. At the bottom right, there are links for 'About', 'Team', 'Terms of use', and 'Privacy Policy'.

```

class Stack {
    class Node {
        int data;
        Node next;
        public Node(int data) {
            this.data = data;
            this.next = null;
        }
    }
    Node head;
    public Stack() { this.head = null; }
    public void push(int e) {
        Node newNode = new Node(e);
        if (head != null) {
            newNode.next = head;
        }
        head = newNode;
    }
    public int pop() {
        int e = head.data;
        head = head.next;
        return e;
    }
    public int peek() { return head.data; }
}

```

Complejidad de las operaciones de una pila:

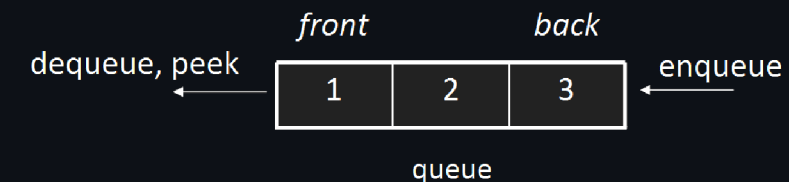
- `push` : $O(1)$
- `pop` : $O(1)$
- `peek` : $O(1)$

Cola (queue)

- **FIFO**: First In First Out
- Los elementos son guardados en el orden de inserción y no suelen tener índices.
- El "cliente" puede añadir elementos al final y examinar/quitar elementos del principio.



- Operaciones básicas:
 - enqueue: añadir un elemento al final
 - dequeue: quitar el elemento del principio
 - peek: ver el elemento del principio



Cola (queue)



www.datainfinities.com

Interface Queue

```
java.util.Queue
```

Method Summary

All Methods	Instance Methods	Abstract Methods
Modifier and Type	Method and Description	
boolean	add(E e)	Inserts the specified element into this queue if it is possible to do so immediately without violating capacity restrictions, returning true upon success and throwing an <code>IllegalStateException</code> if no space is currently available.
E	element()	Retrieves, but does not remove, the head of this queue.
boolean	offer(E e)	Inserts the specified element into this queue if it is possible to do so immediately without violating capacity restrictions.
E	peek()	Retrieves, but does not remove, the head of this queue, or returns null if this queue is empty.
E	poll()	Retrieves and removes the head of this queue, or returns null if this queue is empty.
E	remove()	Retrieves and removes the head of this queue.

Class stack

<https://visualgo.net/en/queue>

The screenshot shows the Visualgo website's Queue visualization page. The interface has a dark theme. At the top, the Visualgo logo is on the left, followed by a language dropdown set to 'en' and a breadcrumb path '/list'. Navigation links for 'LL', 'STACK', 'QUEUE' (which is highlighted), 'DLL', and 'DEQUE' are in the center. On the right, it says 'Exploration Mode' with a dropdown arrow and a 'LOGIN' button. The main area is a large dark rectangle. On the left side of this area, there is a vertical toolbar with a left-pointing arrow and four buttons: 'Create(A)', 'Peek', 'Enqueue', and 'Dequeue'. At the bottom left of the main area, there is a '1x' zoom control. At the bottom right, there are links for 'About', 'Team', 'Terms of use', and 'Privacy Policy'.


```

class Queue {
    class Node {
        int data;
        Node next;
        public Node(int data) {
            this.data = data;
            this.next = null;
        }
    }
    Node head, tail;
    public Queue() {
        this.head = this.tail = null;
    }
    public void enqueue(int e) {
        Node newNode = new Node(e);
        if (head == null) {
            head = tail = newNode;
        } else {
            tail.next = newNode;
            tail = newNode;
        }
    }
    public int dequeue() {
        int e = head.data;
        head = head.next;
        return e;
    }
    public int peek() {
        return head.data;
    }
}

```

Complejidad de las operaciones de una cola:

- enqueue : $O(1)$
- dequeue : $O(1)$
- peek : $O(1)$

Ejercicios

- List
 - Reverse a doubly linked list (easy)
 - Cycle Detection (medium)
 - Add two numbers
- Stack
 - Stack using two queues (medium)
 - Balanced brackets (medium)
- Queue
 - Queue using two stacks (medium)