Estructura de datos y algoritmos

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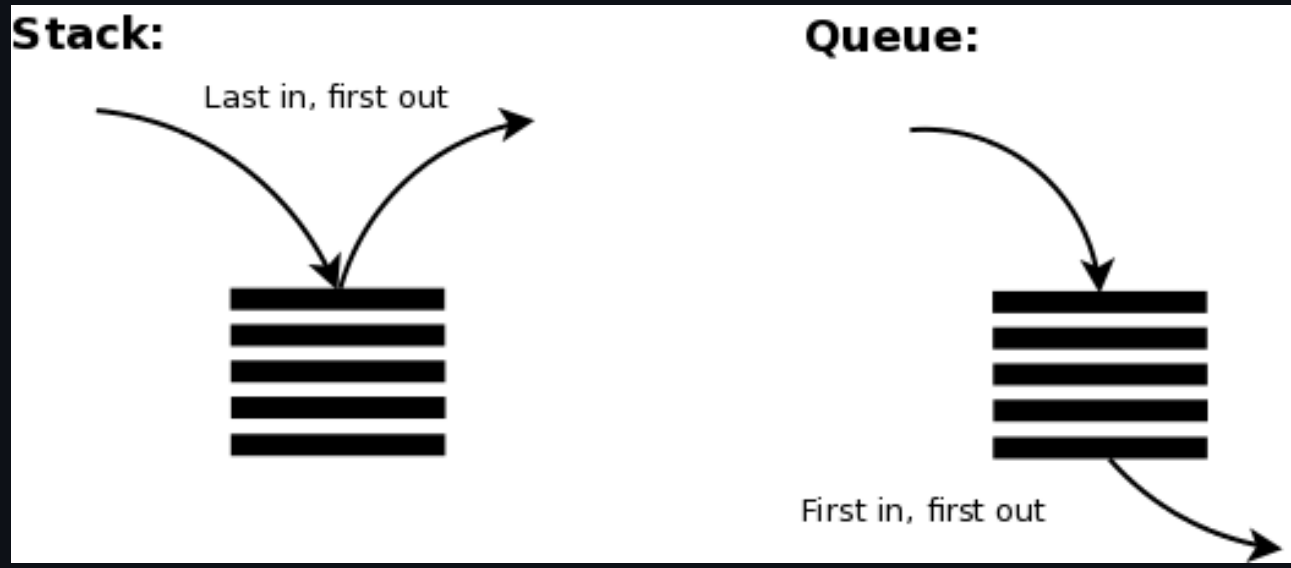
Recordatorio: TDA

- **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

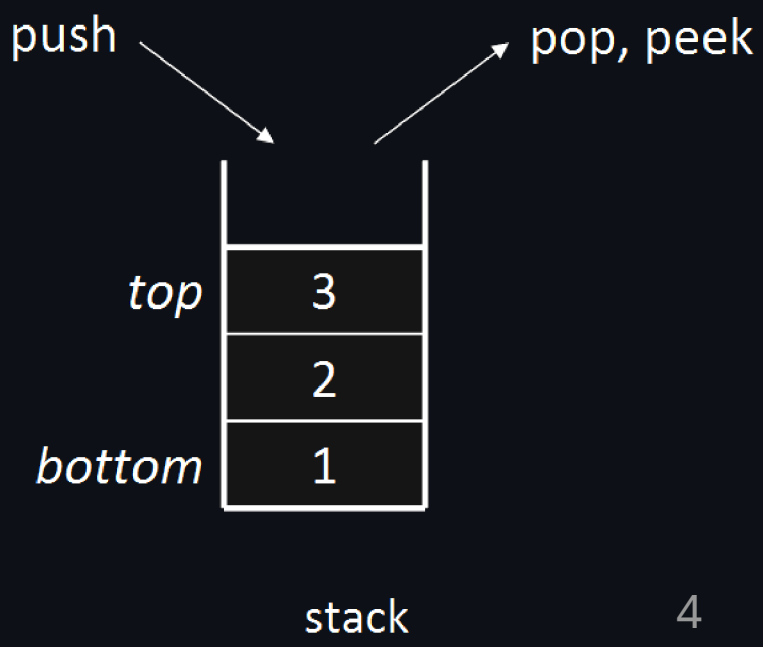
- **pila**: El único elemento accesible es el ultimo añadido.
- **cola**: El único elemento accesible es el que se añadió más temprano.
- Menos posibilidades de operaciones que una lista pero más eficientes.



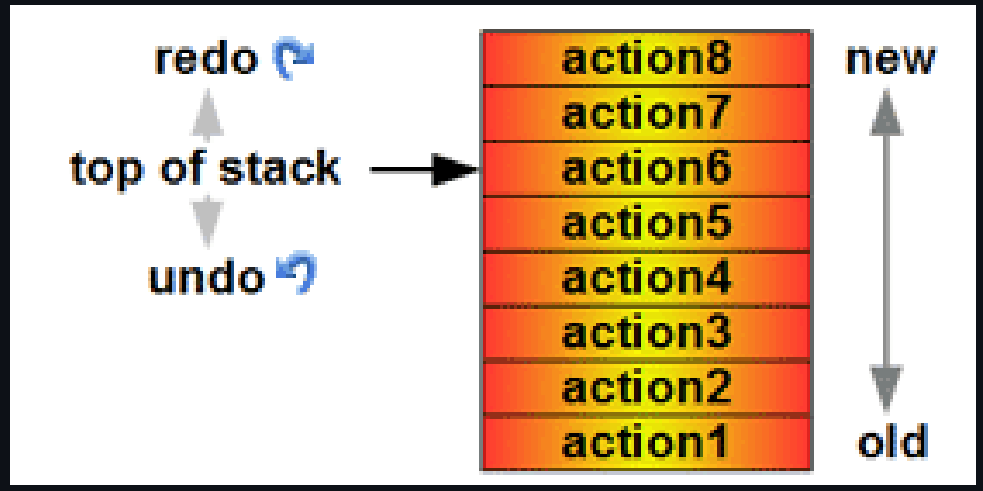
Pila (stack)

- **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.

- Operaciones básicas:
  - push: añadir un elemento
  - pop: quitar el último elemento añadido
  - peek (o top): ver el último elemento añadido



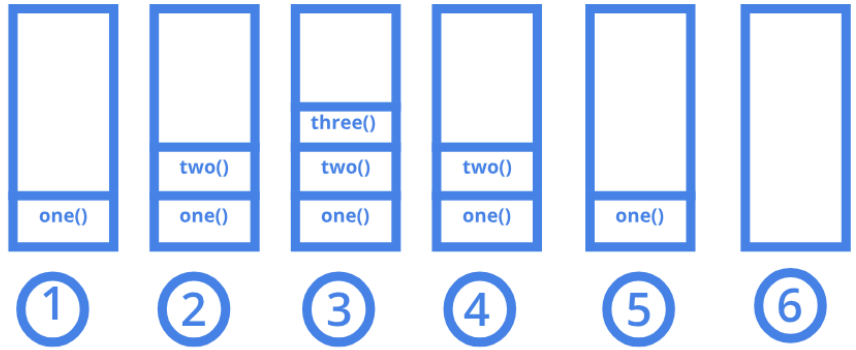
Pila (stack)




```
function one(){
  two();
}

function two() {
  three();
}

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



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

```
1
```

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());
}
```

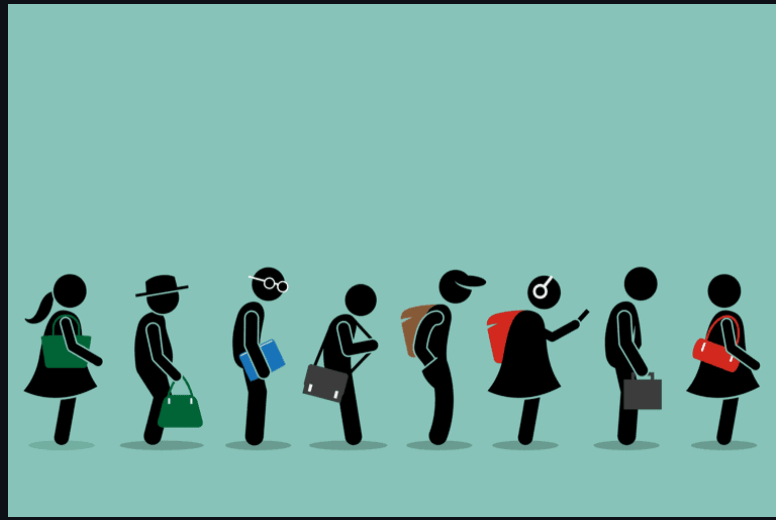
https://visualgo.net/en/stack

```
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:

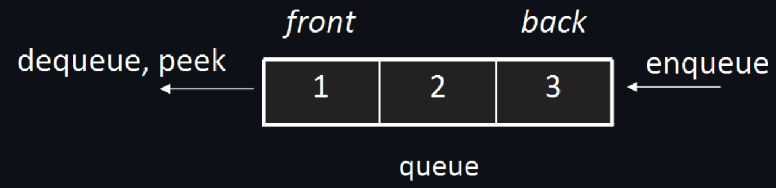
- `push`: O(1)
- `pop`: O(1)
- `peek`: O(1)

Cola (queue)

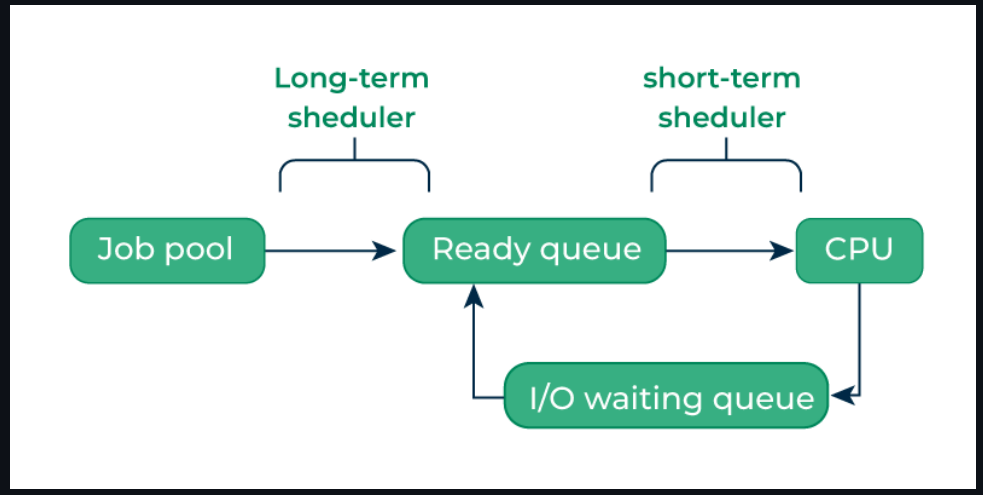


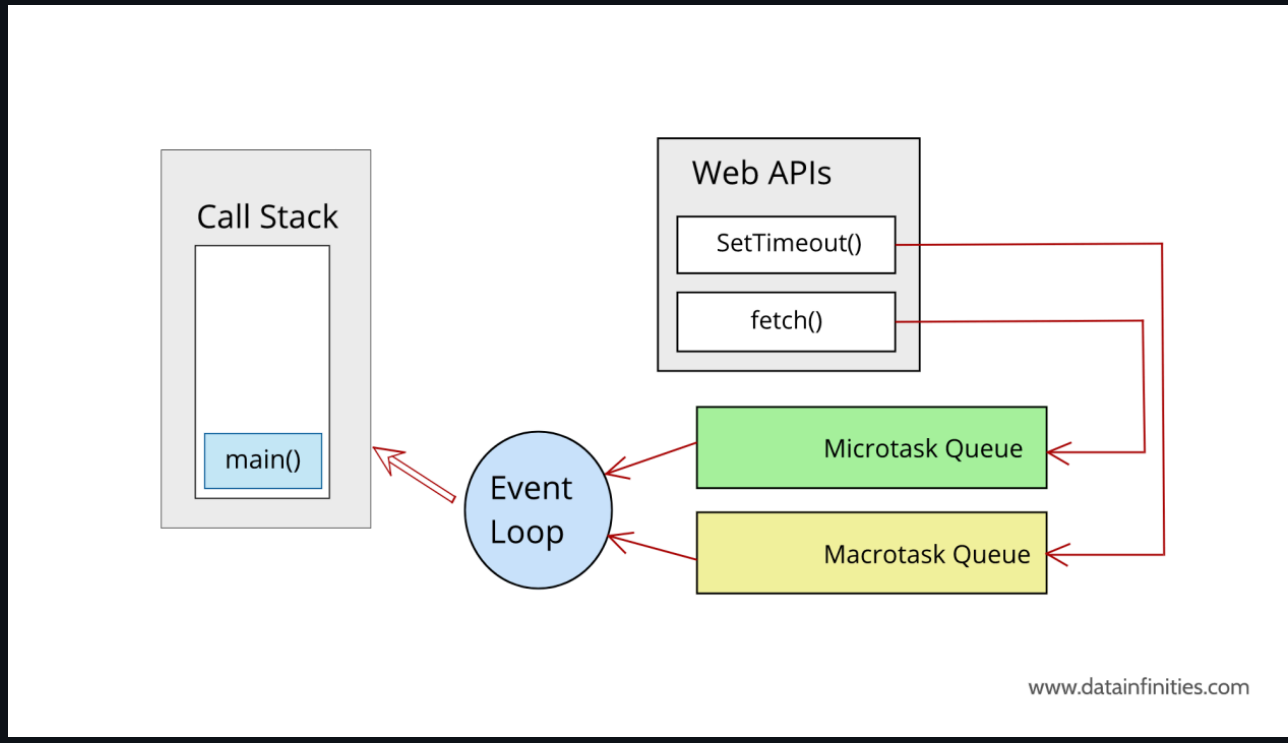
- **FIFO**: First In First Out
- Los elementos son guardados en el orden de inserción y no suelen tener indices.
- El "cliente" puede añadir elementos al final y examinar/quitar elementos del principio.

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



Cola (queue)


Long-term
sheduler
short-term
sheduler
Job pool
Ready queue
CPU
I/O waiting queue


Call Stack
main()
Web APIs
SetTimeout()
fetch()
Event
Loop
Microtask Queue
Macrotask Queue
www.datainfinities.com

Interface Queue

`java.util.Queue`

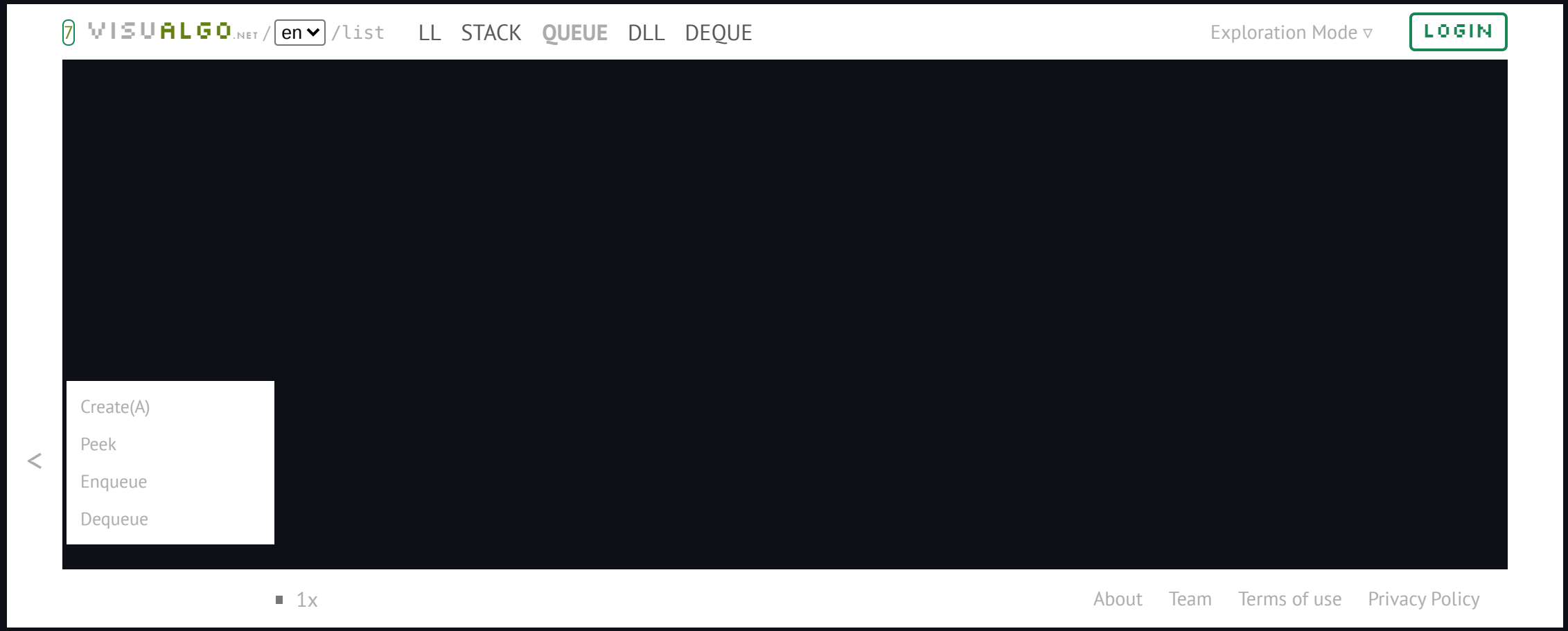
Method Summary

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 `IllegalStateException` 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



```
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)