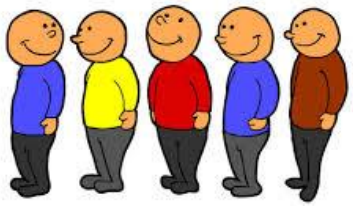
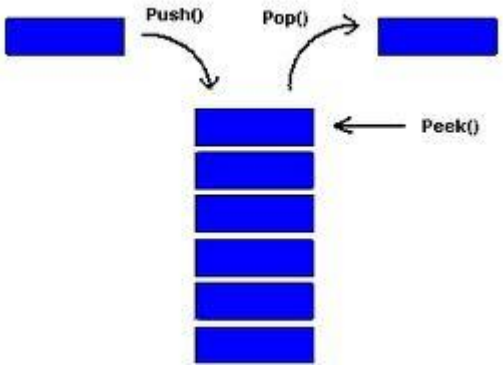
Unidade 10 – Análise de Algoritmos com Estruturas de Dados Lineares – Parte 4

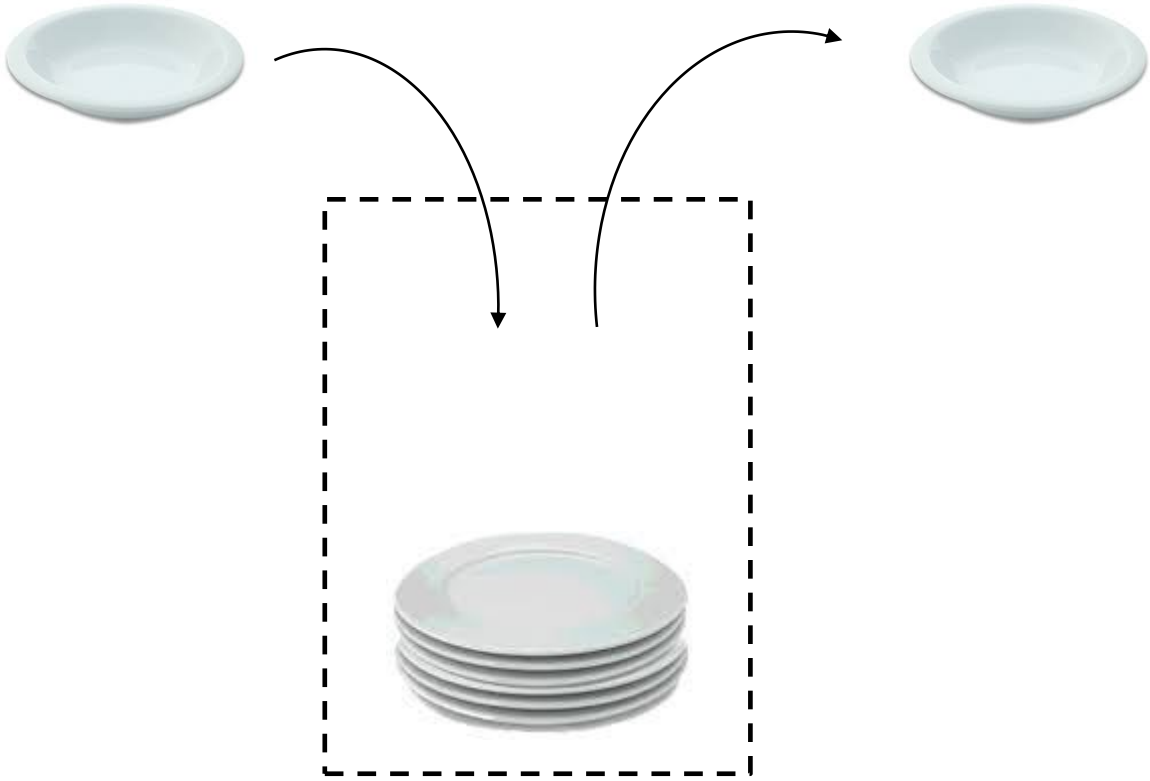


Pilhas e Filas

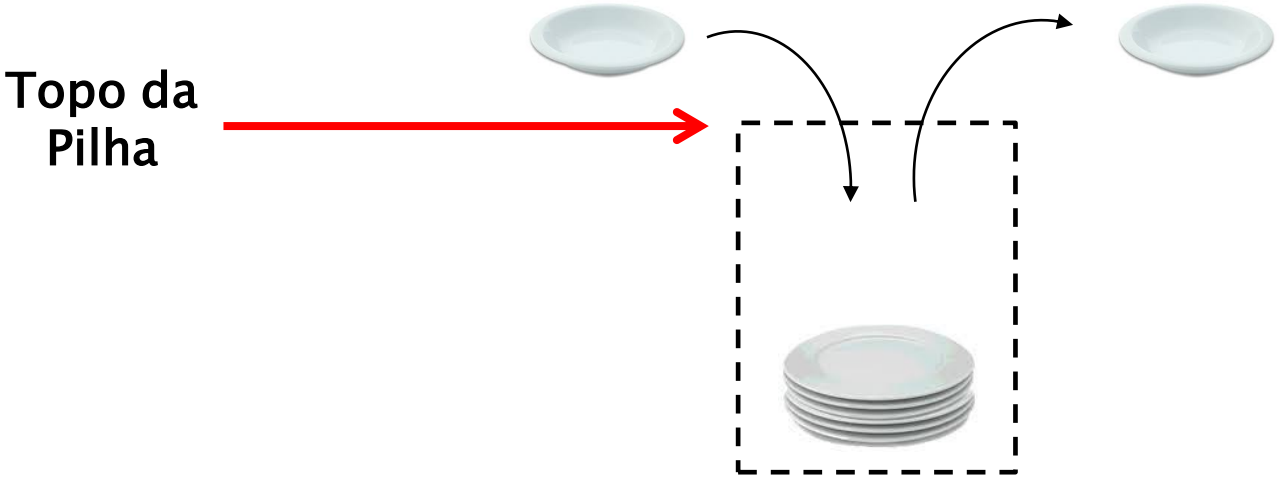


Pilha

- Estrutura de Dados que implementa uma lista **LIFO** (Last Input First Output).

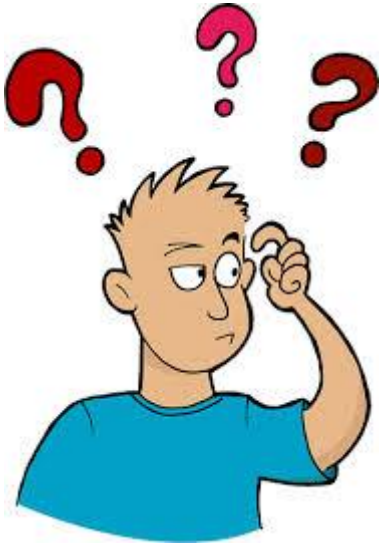


Pilha

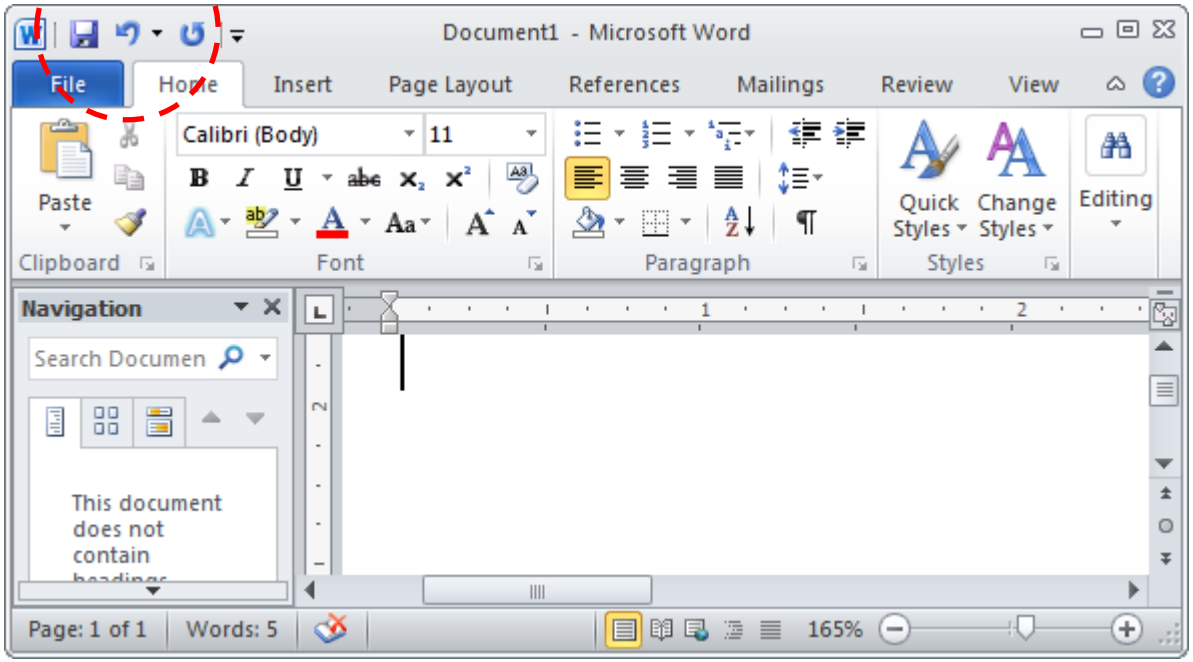


- Estrutura de Dados do tipo **LIFO**
- Inserção de dados: Sempre no Topo da Pilha
- Remoção de dados: Sempre no Topo da Pilha

O conceito de Pilha é utilizado em Computação ?



Pilha – Exemplo de Aplicação



- Recurso "**Undo**" (desfazer) do MS-Word utiliza uma estrutura de dados do tipo Pilha.

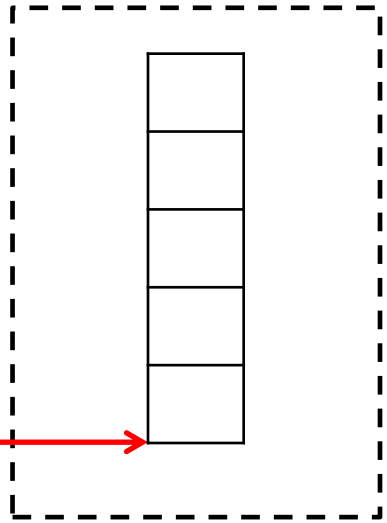
Pilhas - Aninhamento

```
public static void main (String[] args {
      int i = 0;

      while ( i < 10 )   {
                  System.println(i);
                  i = i + 1;
            }
}
```

- Podemos empregar uma pilha para checar o aninhamento de blocos no programa acima.

Pilhas – Aninhamento

```
public static void main (String[] args {
        int i = 0;

        while ( i < 10 ) {
                System.println(i);
                i = i + 1;
              }
}
```



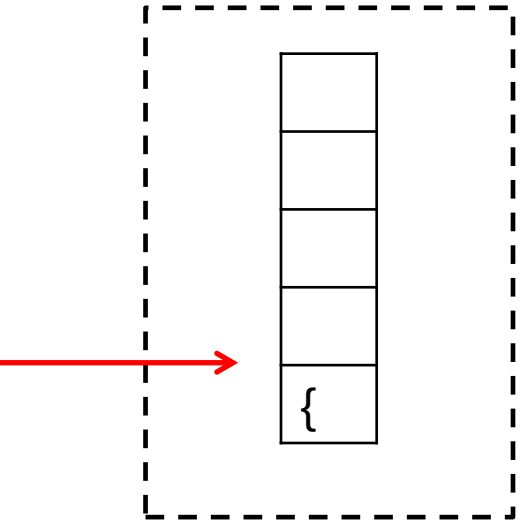
Topo da Pilha

Pilha Vazia

O compilador irá proceder à operação de scanner no texto do programa.

Pilhas – Aninhamento

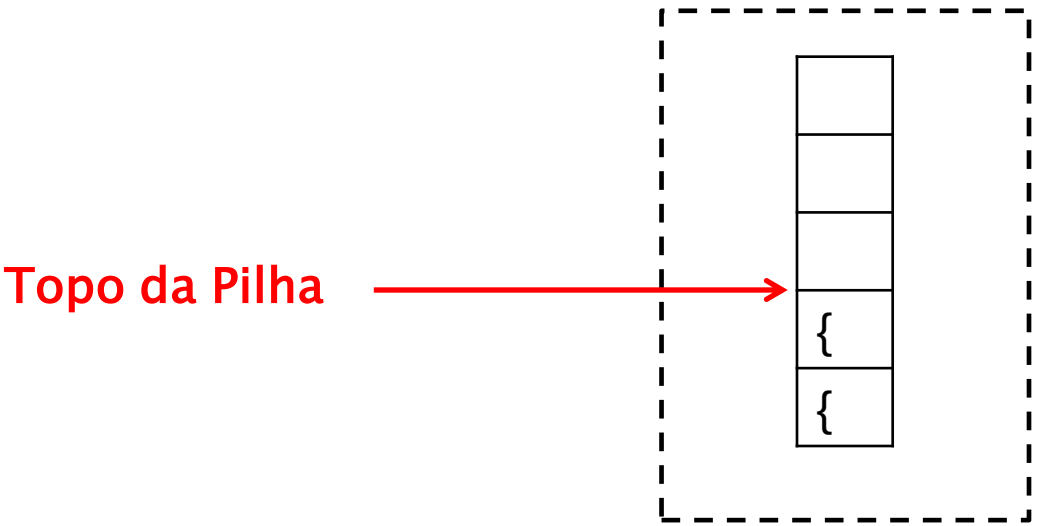
```
public static void main (String[] args) {
        int i = 0;

        while ( i < 10 ) {
                System.println(i);
                i = i + 1;
              }
}
```



Topo da Pilha

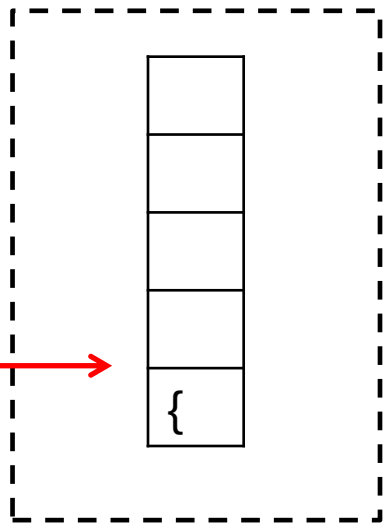
Pilhas – Aninhamento

```
public static void main (String[] args {
        int i = 0;

        while ( i < 10 ) {
                System.println(i);
                i = i + 1;
              }
}
```



Pilhas – Aninhamento

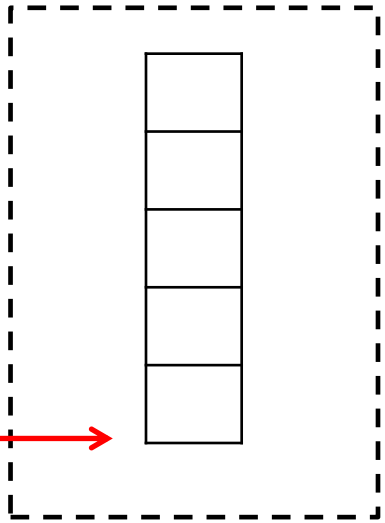
```
public static void main (String[] args {
        int i = 0;

        while ( i < 10 ) {
                System.println(i);
                i = i + 1;
        }
}
```



Topo da Pilha

Pilhas – Aninhamento

```
public static void main (String[] args {
        int i = 0;

        while ( i < 10 ) {
                System.println(i);
                i = i + 1;
              }
}
```



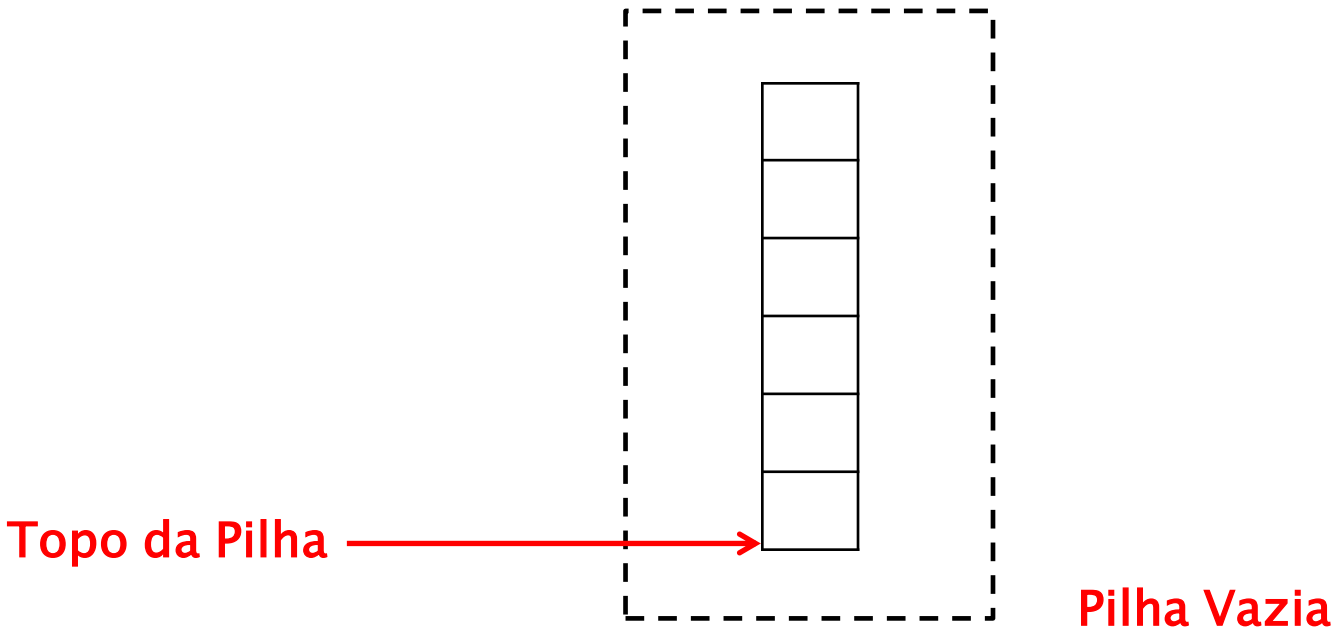
Topo da Pilha

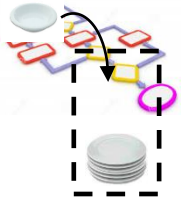
Pilha Vazia

Ao final da operação, se a pilha estiver vazia, a quantidade de { é igual à quantidade de }

Pilha – Exemplo de Aplicação

- Considere uma lista de números em ordem **crescente**: 1,2,3,4,5,6

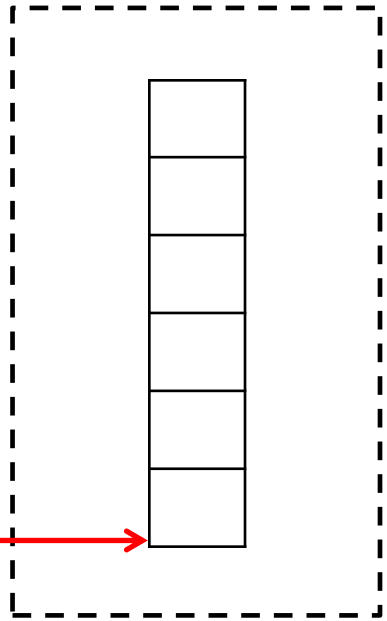




Empilhamento

1

- Operação de Empilhamento da lista: 1,2,3,4,5,6



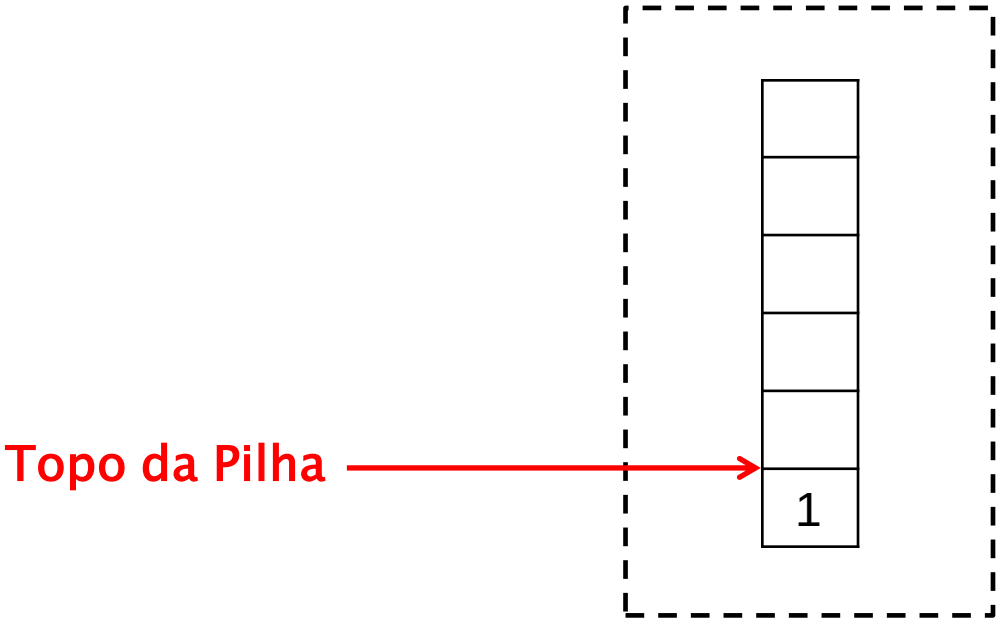
Topo da Pilha

Pilha Vazia

Empilhamento

2

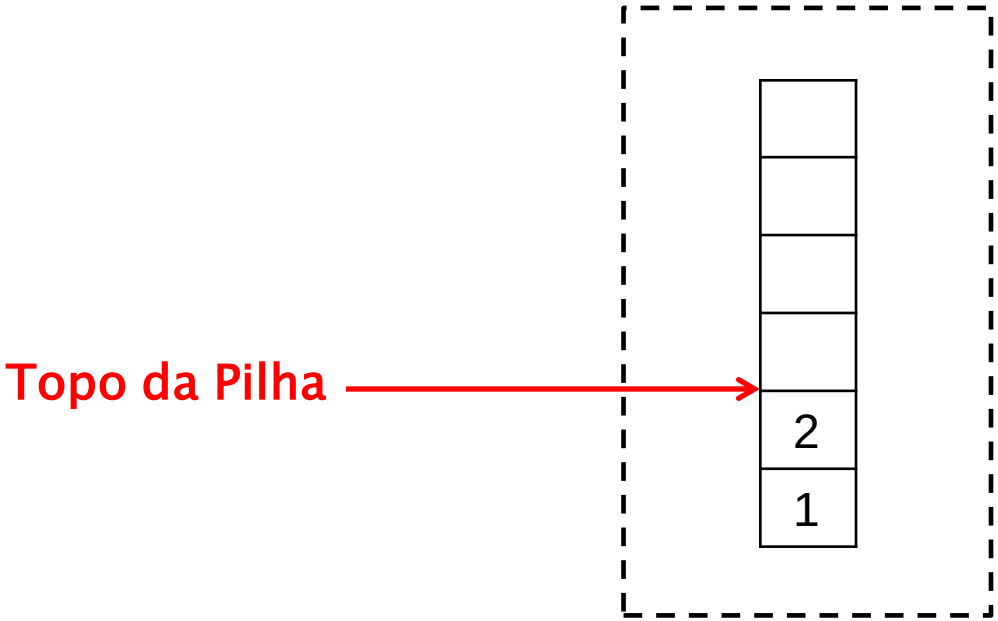
- Operação de Empilhamento da lista: ,2,3,4,5,6

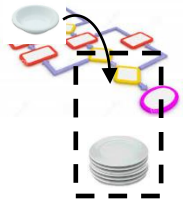


Empilhamento

3

- Operação de Empilhamento da lista: ,3,4,5,6



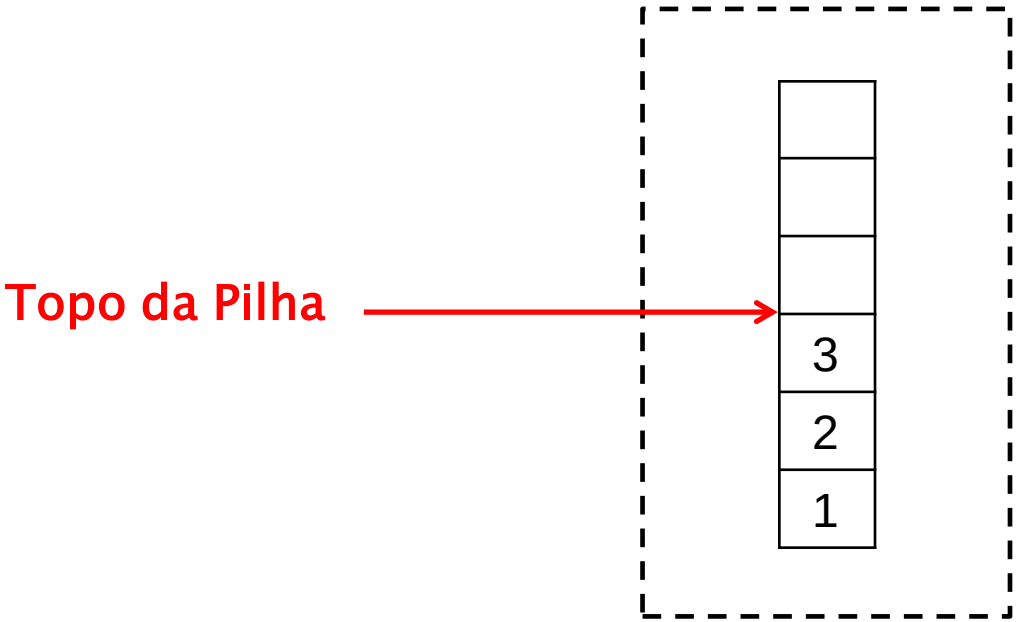


Empilhamento

4

- Operação de Empilhamento da lista:

,4,5,6

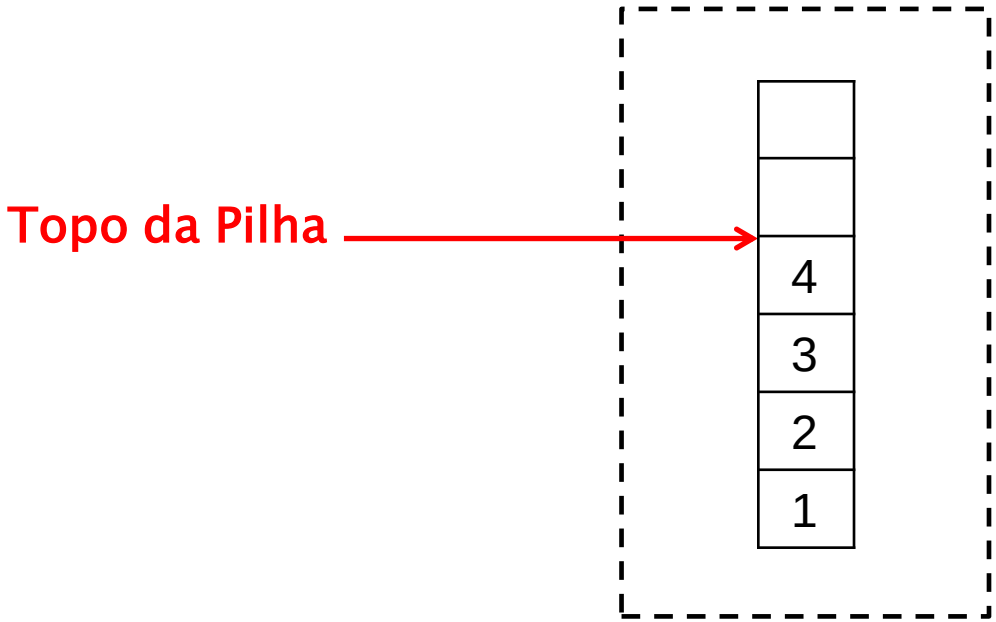


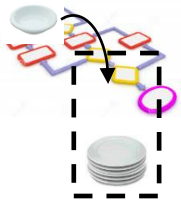
Empilhamento

5

- Operação de Empilhamento da lista:

,5,6



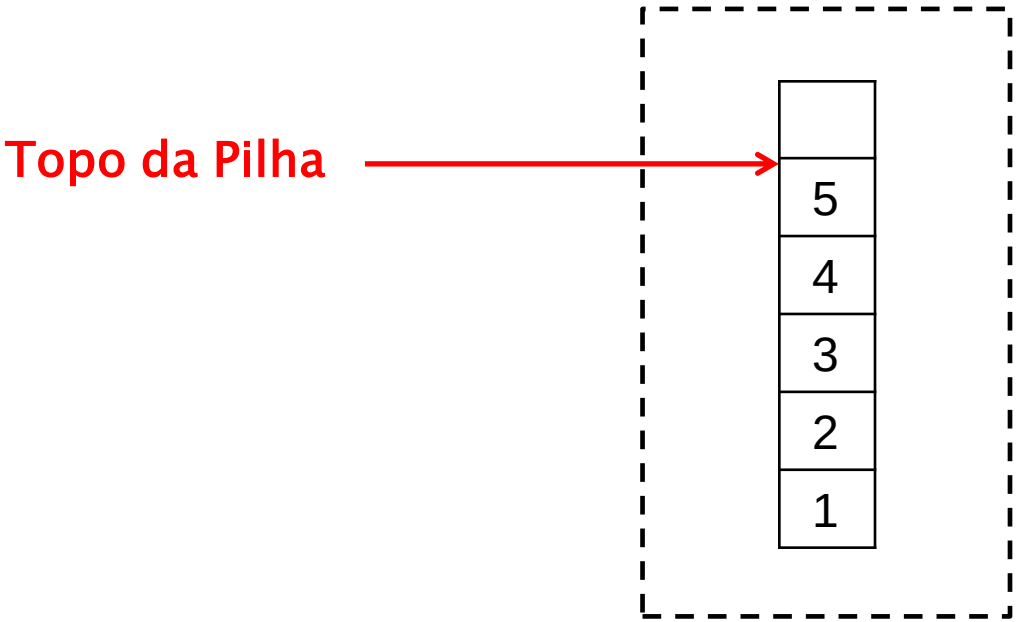


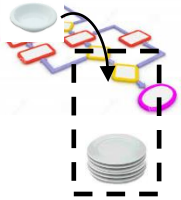
Empilhamento

6

- Operação de Empilhamento da lista:

,6



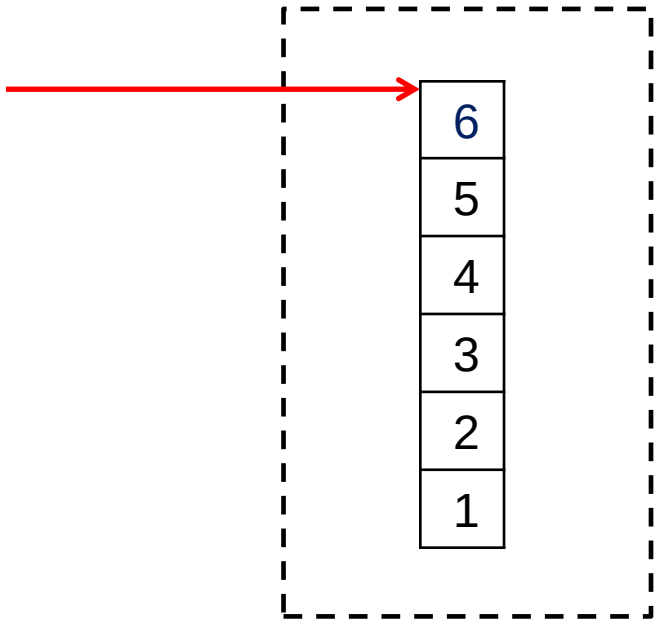


Empilhamento

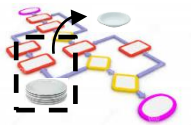
7

- Operação de Empilhamento concluída:

Topo da Pilha



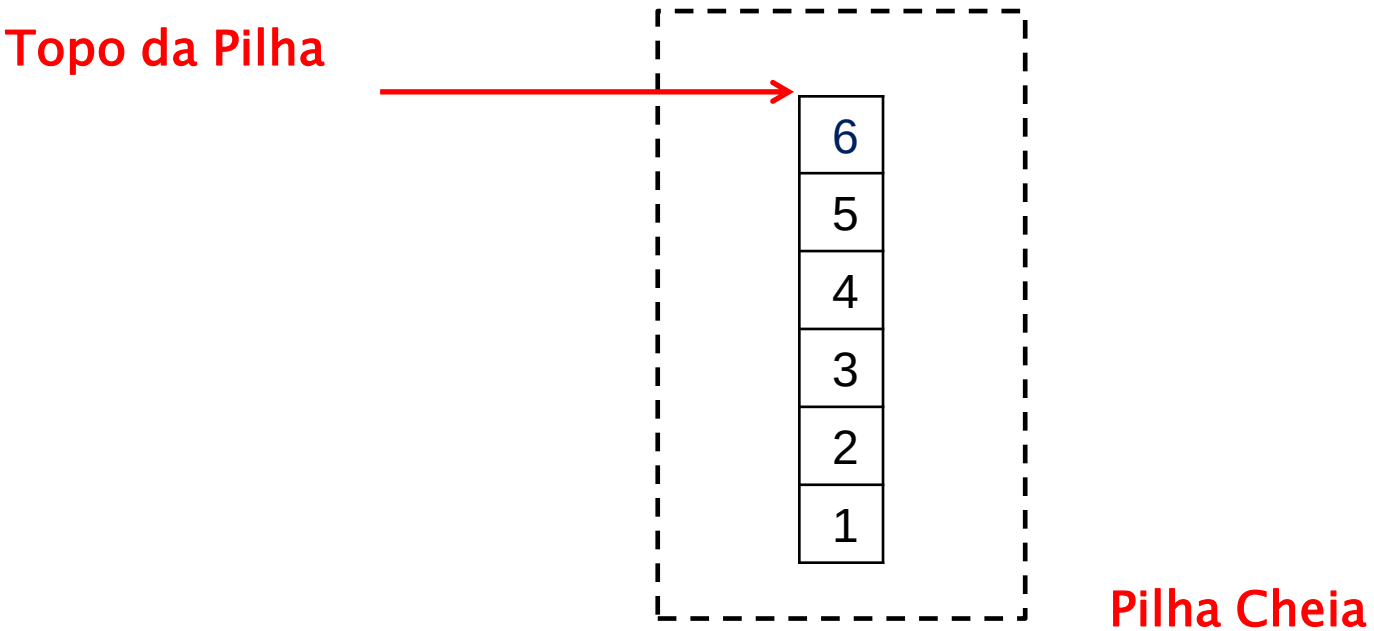
Pilha Cheia



Desempilhamento

1

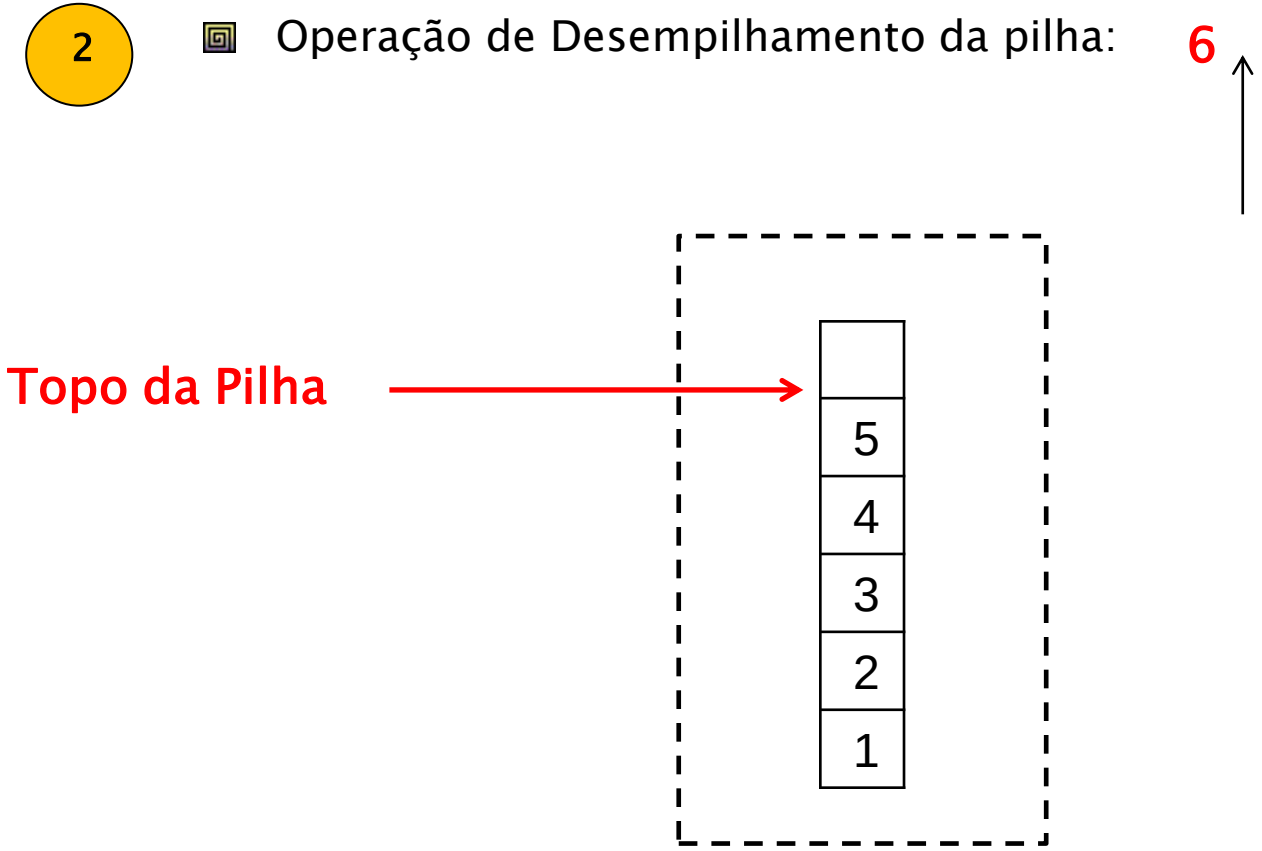
- Operação de Desempilhamento da pilha:

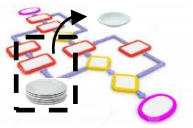


Desempilhamento

2

- Operação de Desempilhamento da pilha:

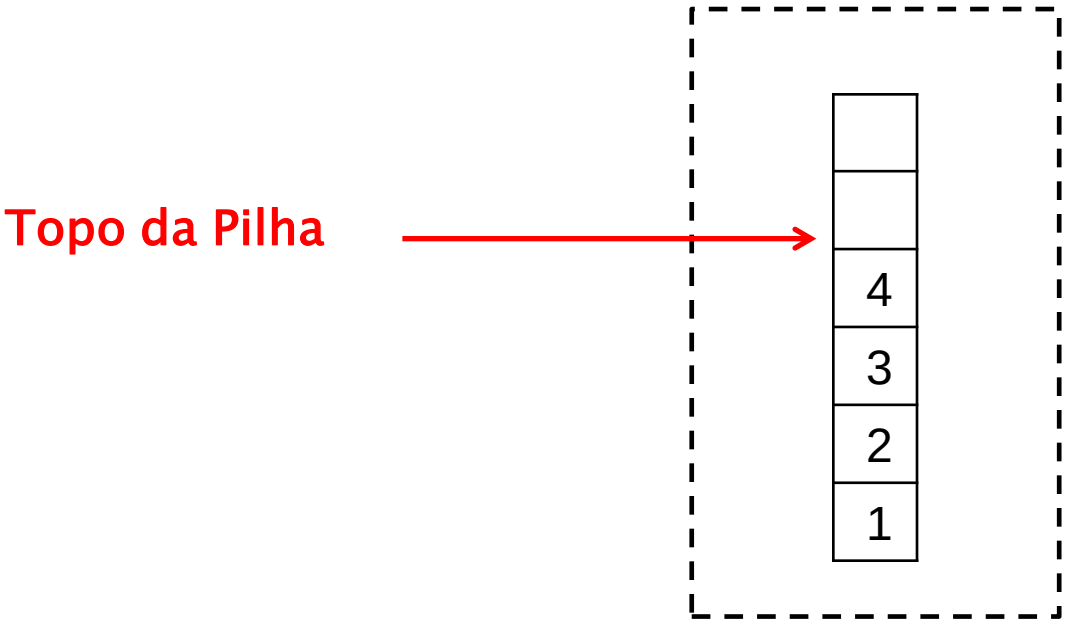


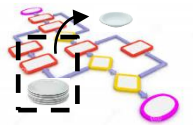


Desempilhamento

3

- Operação de Desempilhamento da pilha: **6,5**

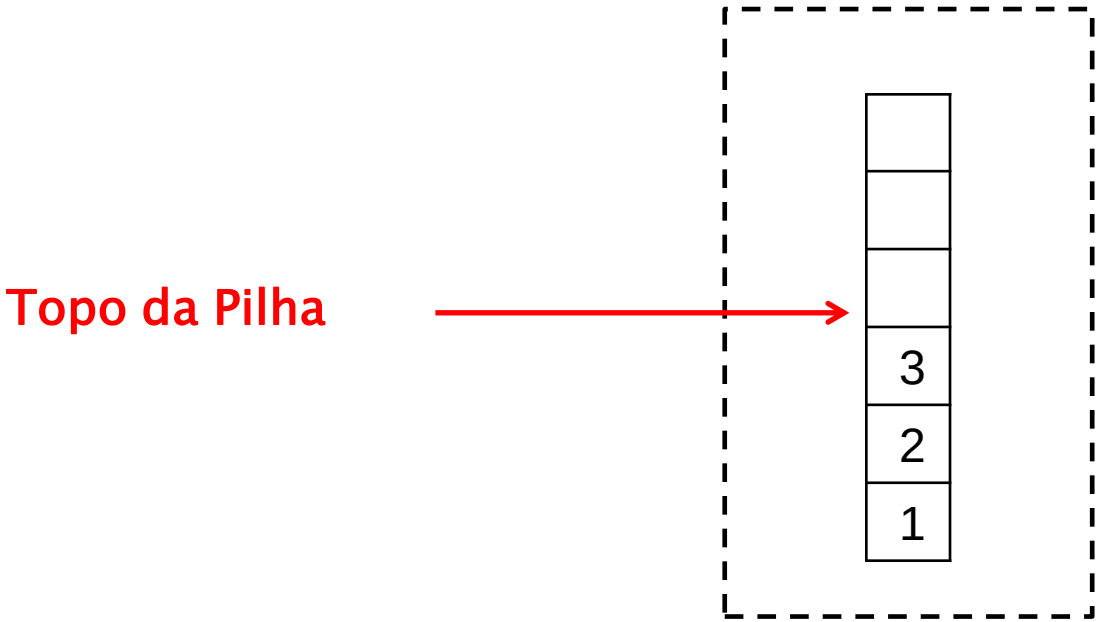


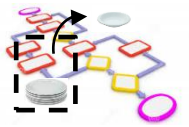


Desempilhamento

4

- Operação de Desempilhamento da pilha: 6,5,4

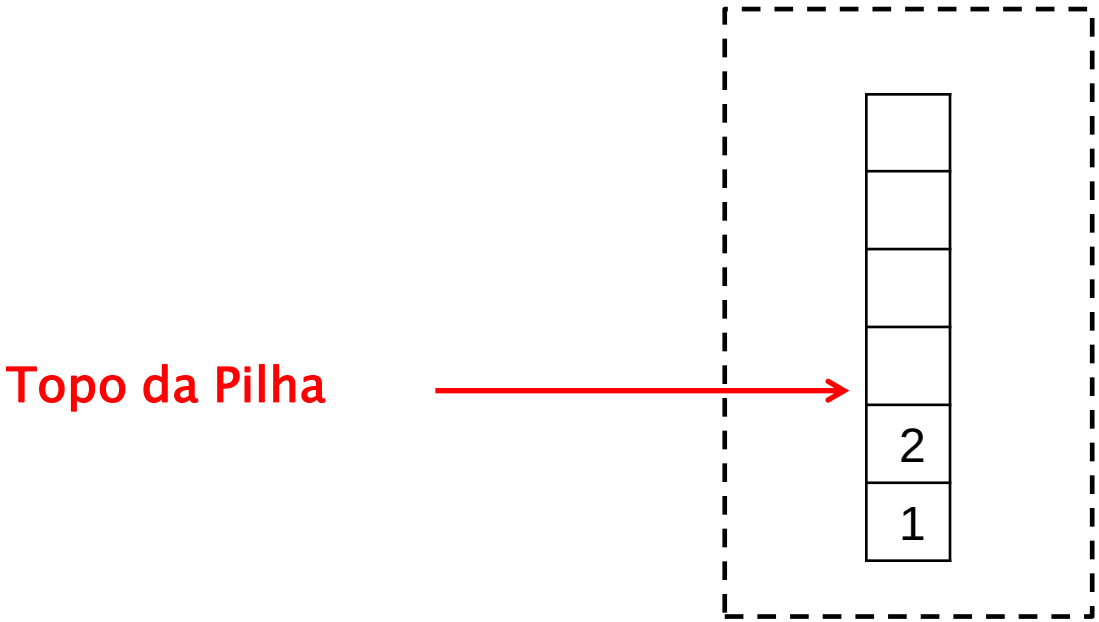


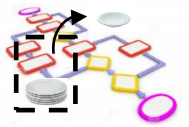


Desempilhamento

5

- Operação de Desempilhamento da pilha: 6,5,4, 3

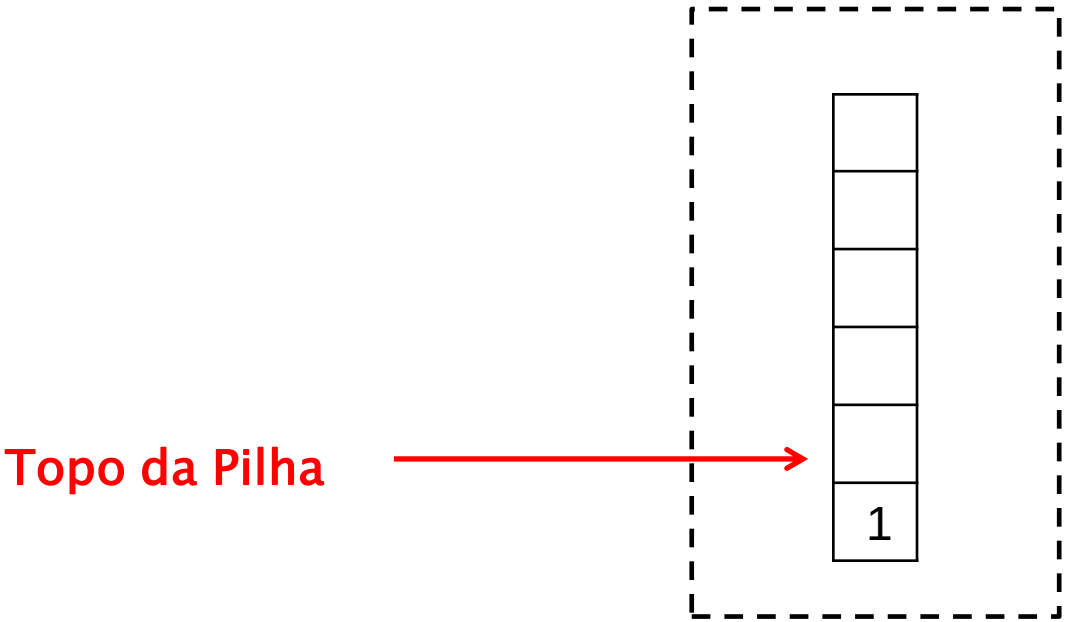




Desempilhamento

6

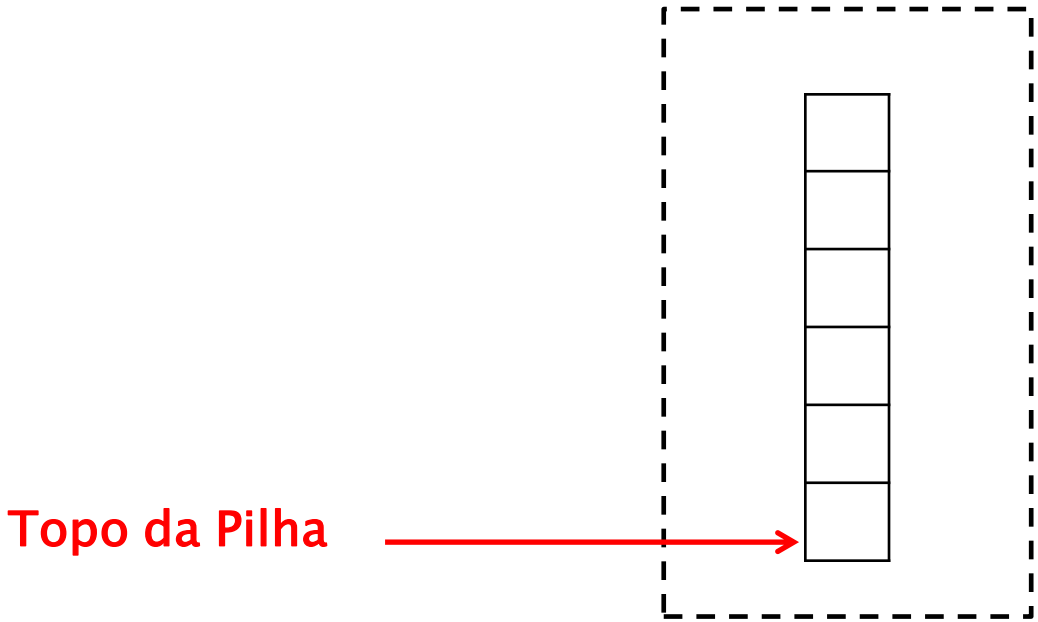
- Operação de Desempilhamento da pilha: 6,5,4, 3,2



Desempilhamento

7

- Operação de Desempilhamento da pilha: 6,5,4, 3,2,1



Aplicação - Pilha

- Lista original antes do empilhamento: 1,2,3,4,5,6
- Lista após o desempilhamento: 6,5,4,3,2,1

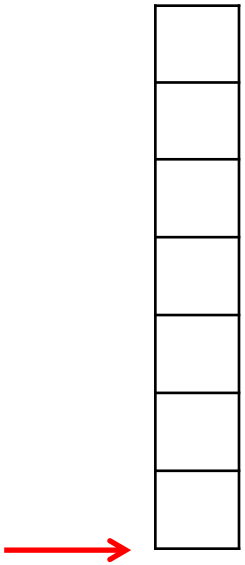
Portanto, os elementos da lista foram invertidos !

Como podemos fazer esta operação aritmética ?

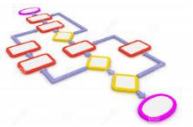
(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas

Pilha

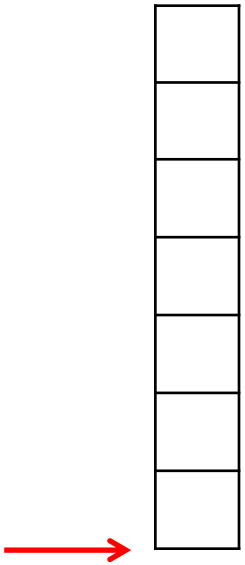


(((1 + 2) * 3) + (2 * (1 + 3)))

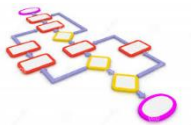


Pilhas – Operações Aritméticas

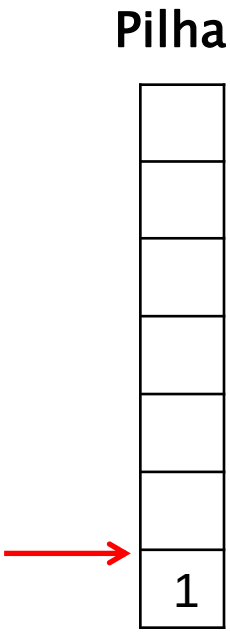
Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

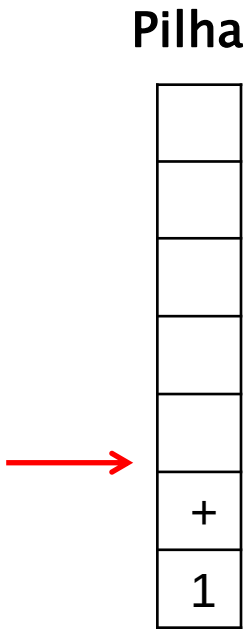


Pilhas – Operações Aritméticas

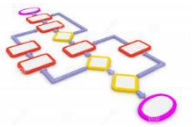


(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas

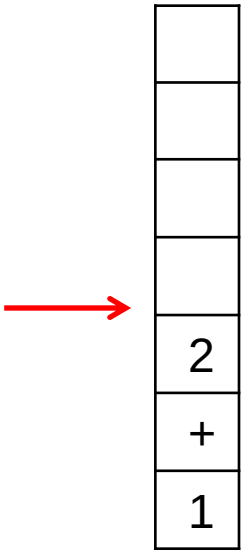


(((1 + 2) * 3) + (2 * (1 + 3)))



Pilhas – Operações Aritméticas

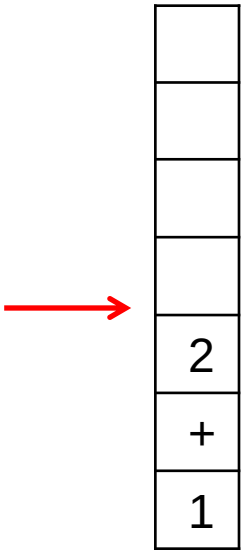
Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

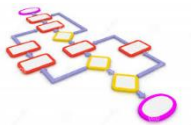
Pilhas – Operações Aritméticas

Pilha

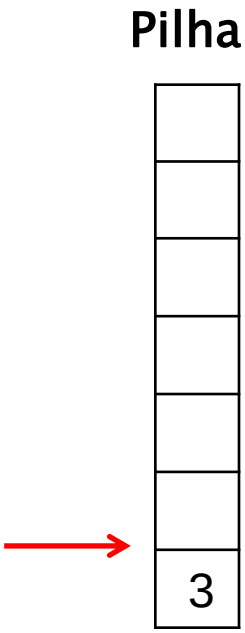


(((1 + 2) * 3) + (2 * (1 + 3)))

2 + 1 = 3



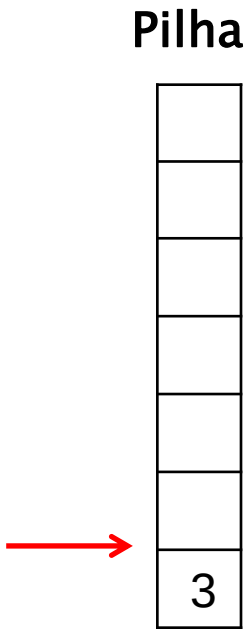
Pilhas – Operações Aritméticas



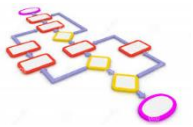
(((1 + 2) * 3) + (2 * (1 + 3)))

2 + 1 = 3

Pilhas – Operações Aritméticas

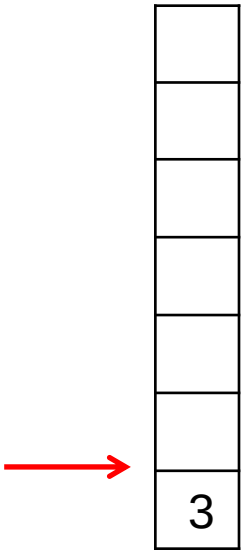


(((1 + 2) * 3) + (2 * (1 + 3)))

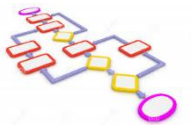


Pilhas – Operações Aritméticas

Pilha

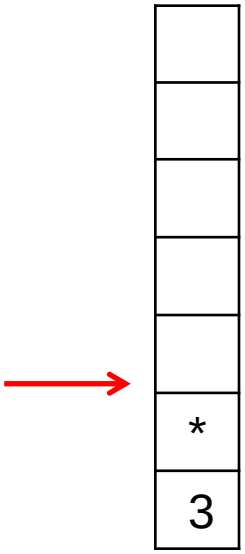


(((1 + 2) * 3) + (2 * (1 + 3)))



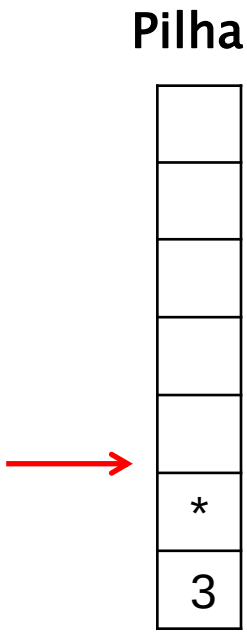
Pilhas – Operações Aritméticas

Pilha



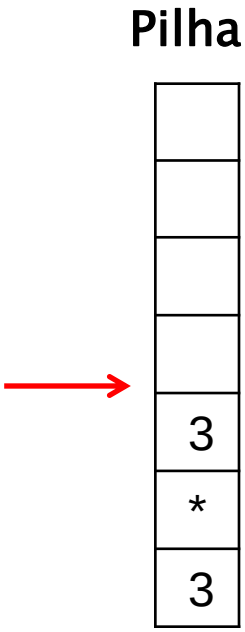
(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas



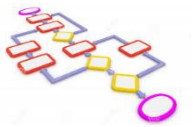
(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas



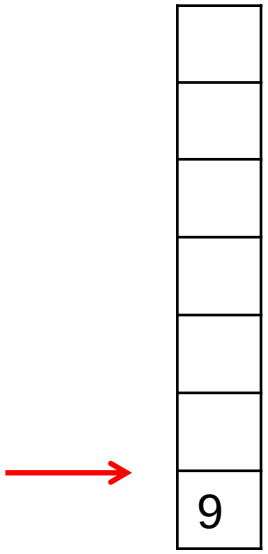
(((1 + 2) * 3) + (2 * (1 + 3)))

3 * 3 = 9



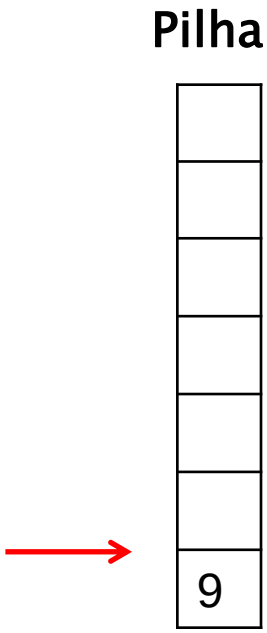
Pilhas – Operações Aritméticas

Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

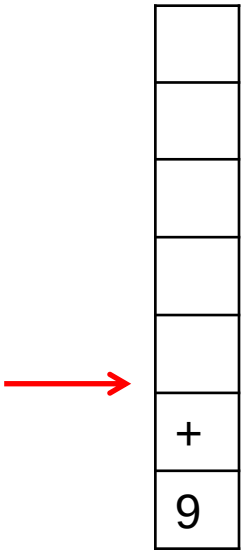
Pilhas – Operações Aritméticas



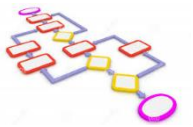
(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas

Pilha

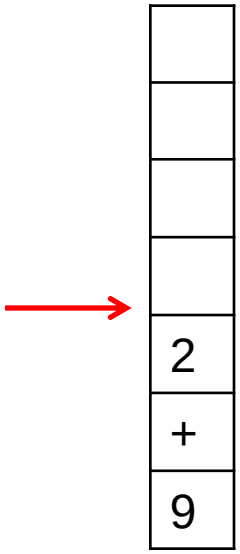


(((1 + 2) * 3) + (2 * (1 + 3)))



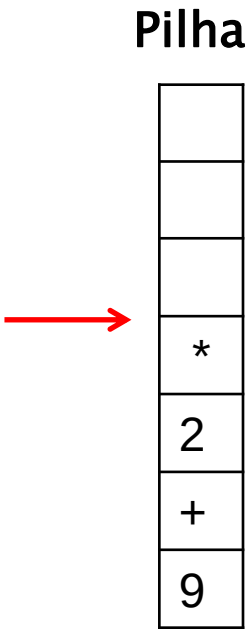
Pilhas – Operações Aritméticas

Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

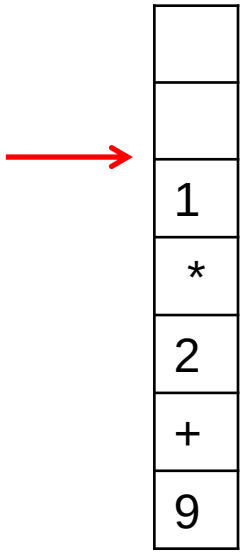
Pilhas – Operações Aritméticas



(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas

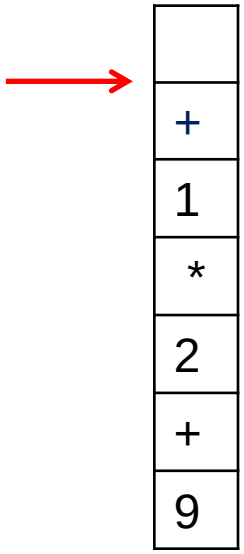
Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas

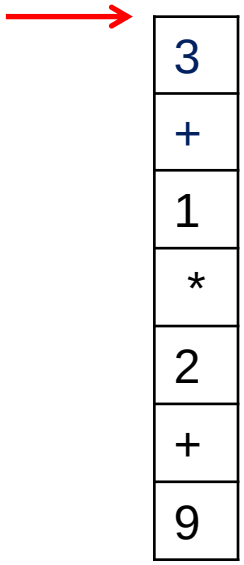
Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas

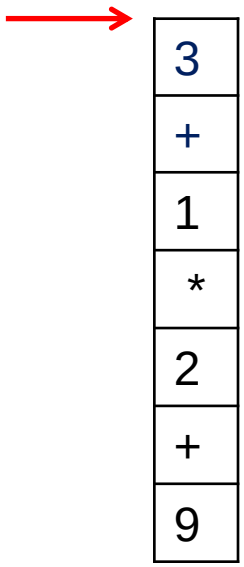
Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

Pilhas – Operações Aritméticas

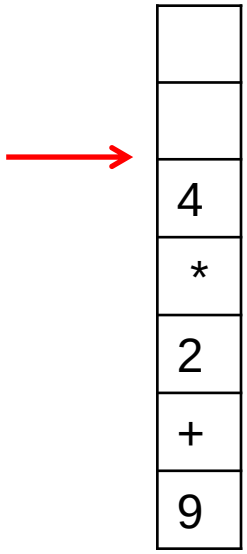
Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

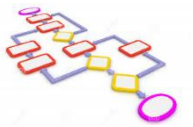
Pilhas – Operações Aritméticas

Pilha



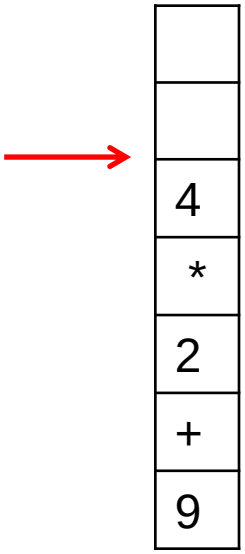
(((1 + 2) * 3) + (2 * (1 + 3)))

1 + 3 = 4



Pilhas – Operações Aritméticas

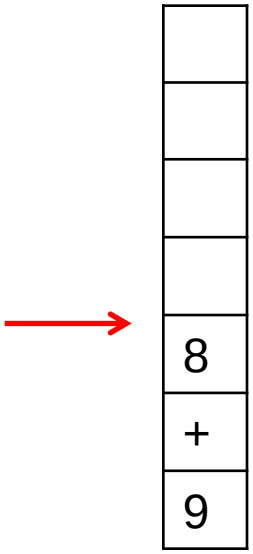
Pilha



(((1 + 2) * 3) + (2 * (1 + 3)))

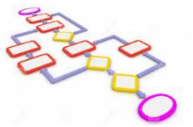
Pilhas – Operações Aritméticas

Pilha

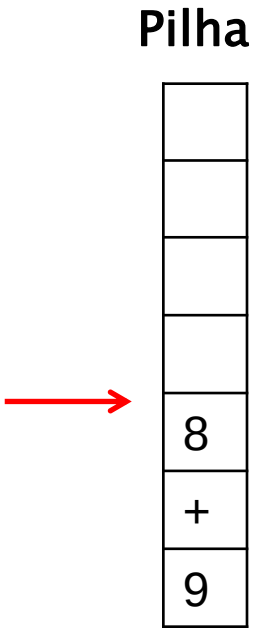


(((1 + 2) * 3) + (2 * (1 + 3)))

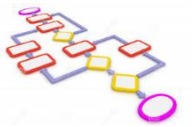
2 * 4 = 8



Pilhas – Operações Aritméticas

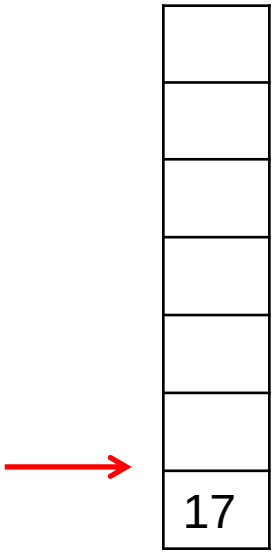


(((1 + 2)*3) + (2 * (1 + 3)))



Pilhas – Operações Aritméticas

Pilha

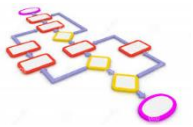


(((1 + 2)*3) + (2 * (1 + 3)))

8 + 9 = 17

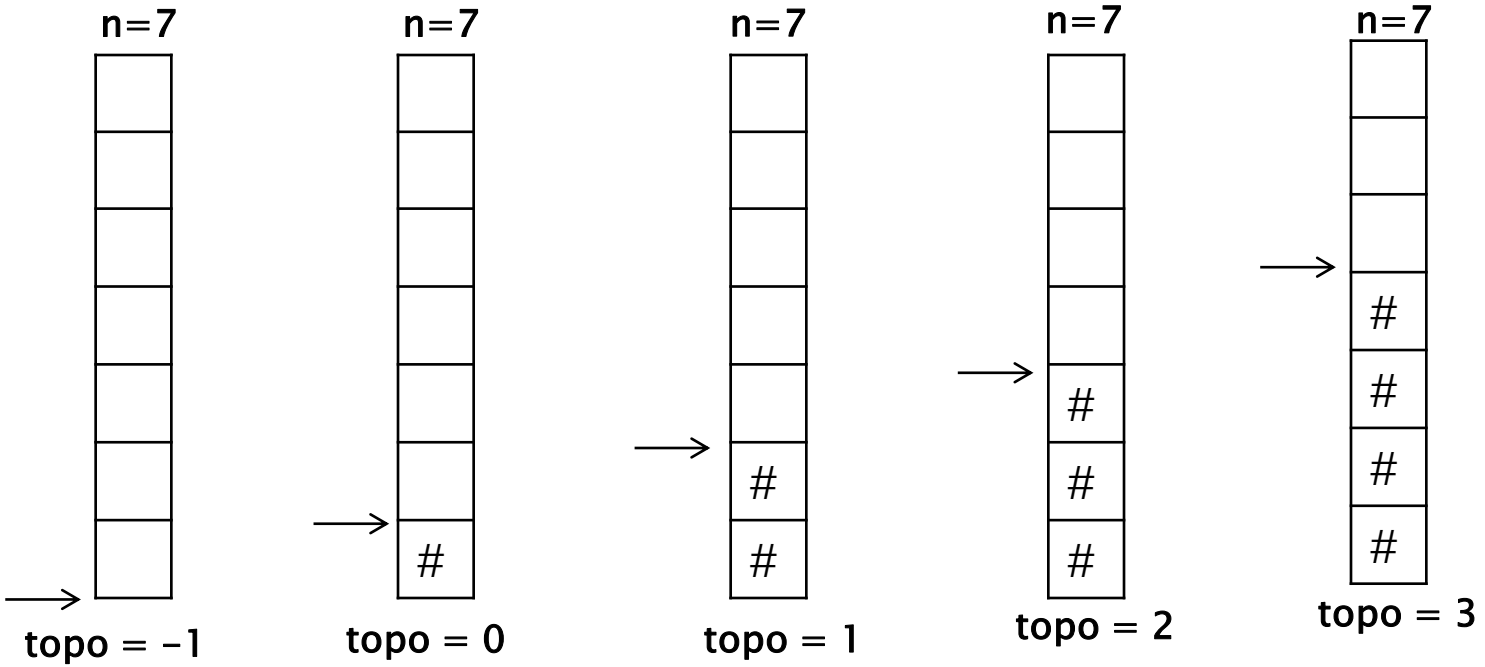
Implementação de Pilhas

- Em uma pilha, todo o acesso à seus elementos se dão no topo.
- Inserções e remoções sempre são feitas pelo topo.
- Existem duas operações básicas na pilha: a operação para empilhar um novo elemento (**push**) e a operação para desempilhar um elemento (**pop**).
- Quando se conhece a priori o tamanho da pilha, podemos implementá-la com o emprego de arrays.
- No entanto, quando o número máximo de elementos da pilha é desconhecido, devemos implementá-la com uma estrutura de dados dinâmica, lista ligada ou encadeada.

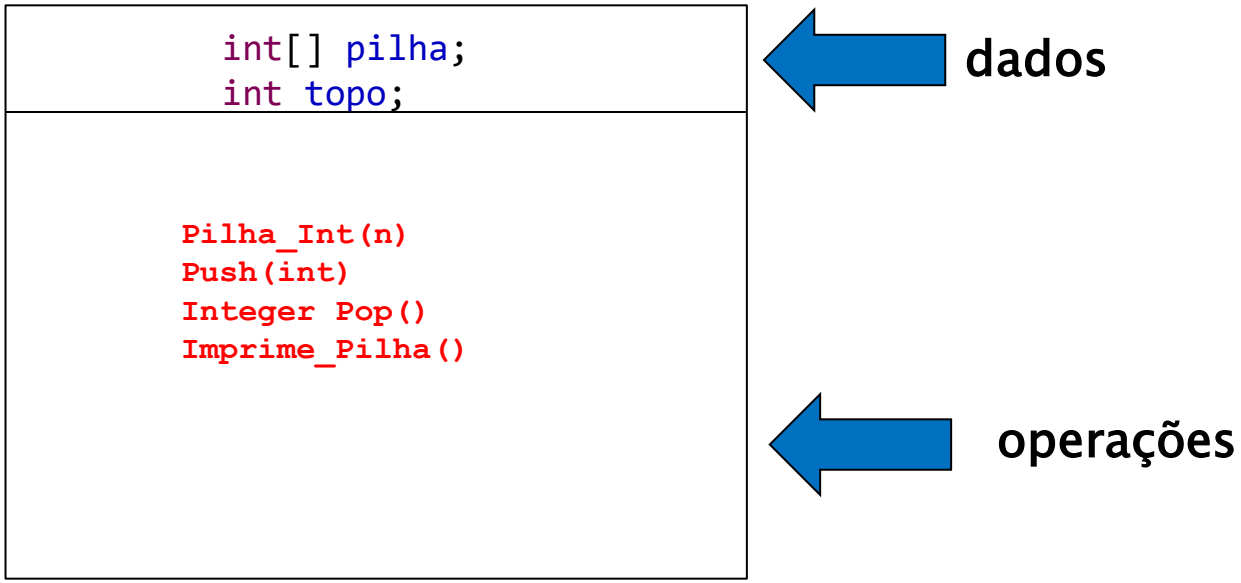


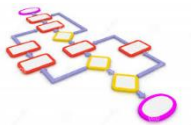
Implementação de Pilhas com arrays

- A estrutura que representa a pilha deve ser composta pelo array (com um tamanho previamente conhecido) e por um número (índice) que representa o topo da pilha.



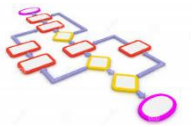
Tipo Abstrato de Dados: Pilha_Int





Implementação de Pilhas com arrays

```
package maua;

public class Pilha_Int {

        int[] pilha;
        int topo;

        public Pilha_Int(int n) {
                pilha = new int[n];
                topo = -1;
}
```



Implementação de Pilhas com arrays

```
public void Push(int item) {

        if (topo >= pilha.length - 1)

                System.out.println ("Stack Overflow! Erro no push...!");

        else  {
                        topo = topo + 1;
                        pilha[topo] = item;
        }

}
```

Implementação de Pilhas com arrays

```
public Integer Pop() {

  if (topo <= -1) {
              System.out.println("Stack empty! Erro no pop...!");
              return null;
  }
  else {
       topo = topo -1;
       return (pilha[topo+1]);
  }
}
```

Implementação de Pilhas com arrays

```
public void Imprime_Pilha() {
  System.out.print("Pilha: ");
  int trab = topo;
  if (trab <= -1 )
        System.out.print(" vazia!");
        else {
               while (trab >= 0) {
                      System.out.print(" " + pilha[trab]);
                      trab = trab - 1;
               }
        }
  System.out.println(" ");
}
```

Implementação de Pilhas com arrays

```
public static void main(String[] args) {
        Pilha_Int x = new Pilha_Int(3);
        x.Imprime_Pilha();

        x.Push(9);
        x.Push(4);
        x.Push(3);

        x.Imprime_Pilha();

        x.Pop();
        x.Imprime_Pilha();

        x.Pop();
        x.Imprime_Pilha();

        x.Pop();
        x.Imprime_Pilha();


        }
}
```

```
Pilha:  vazia!
Pilha:  3 4 9
Pilha:  4 9
Pilha:  9
Pilha:  vazia!
```

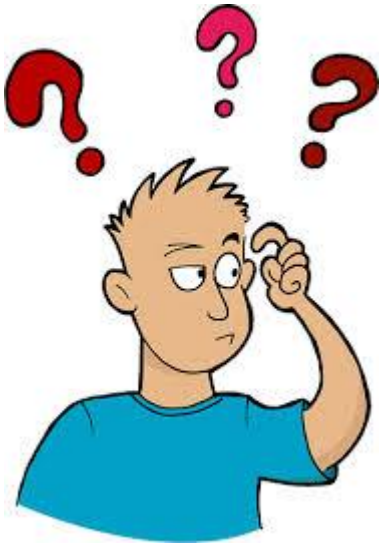
Fila

- Estrutura de Dados que implementa uma lista **FIFO** (First In, First Out).

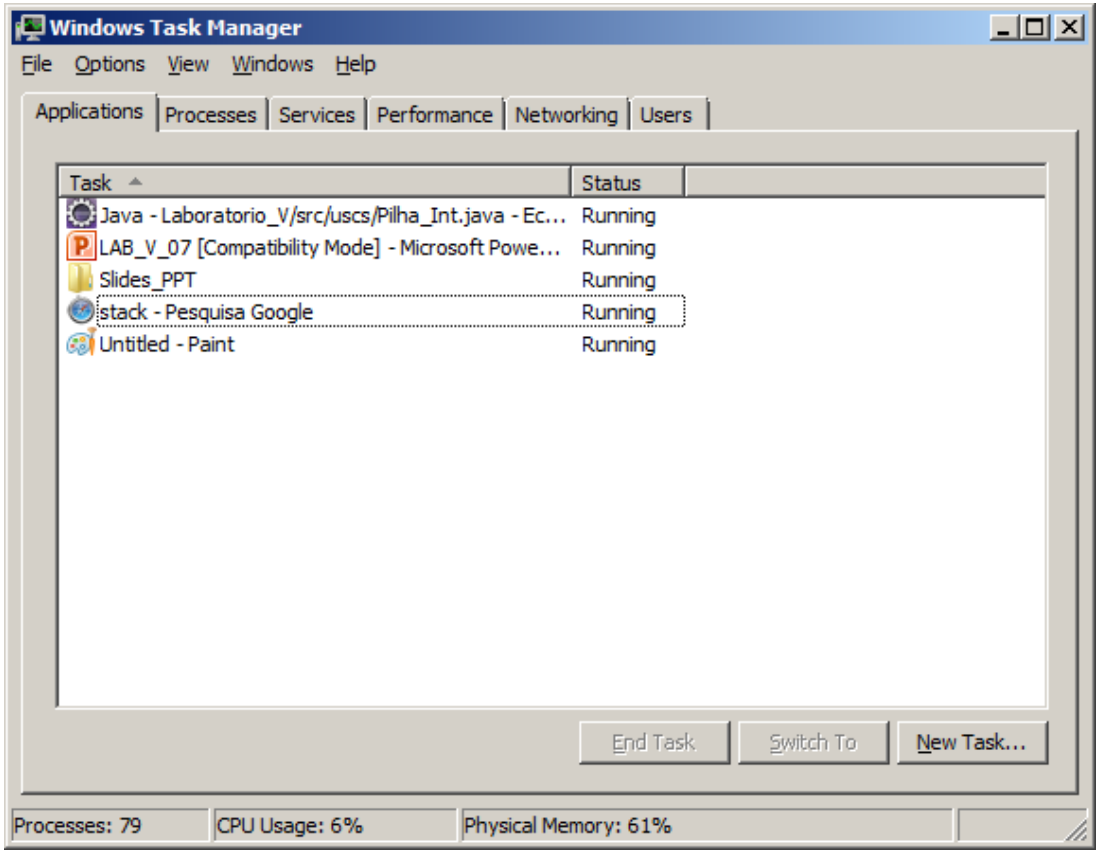
Fila

- Quem primeiro entra na fila, primeiro será atendido.
- Inserções sempre são feitas no final da fila.
- Remoções sempre são feitas no início da fila.

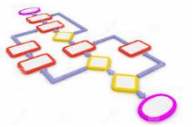
O conceito de Fila é utilizado em Software ?



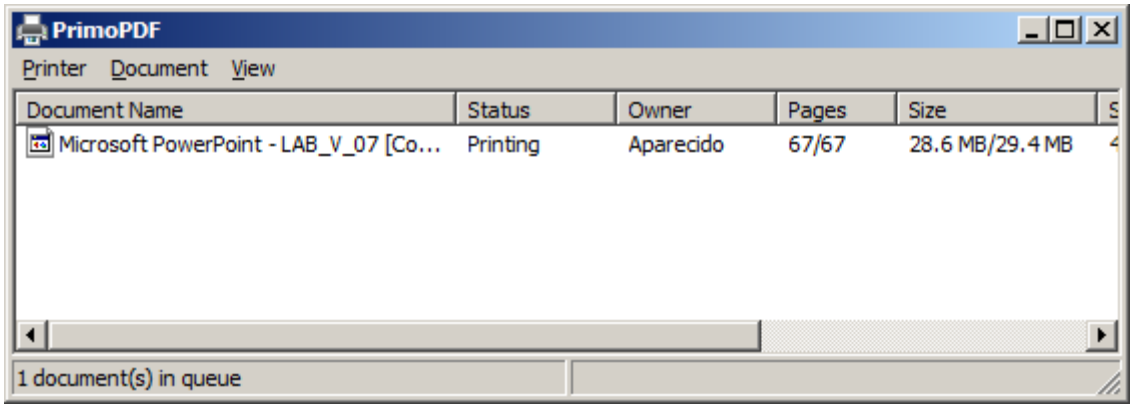
Fila – Exemplo de Aplicação



- Fila de Processos

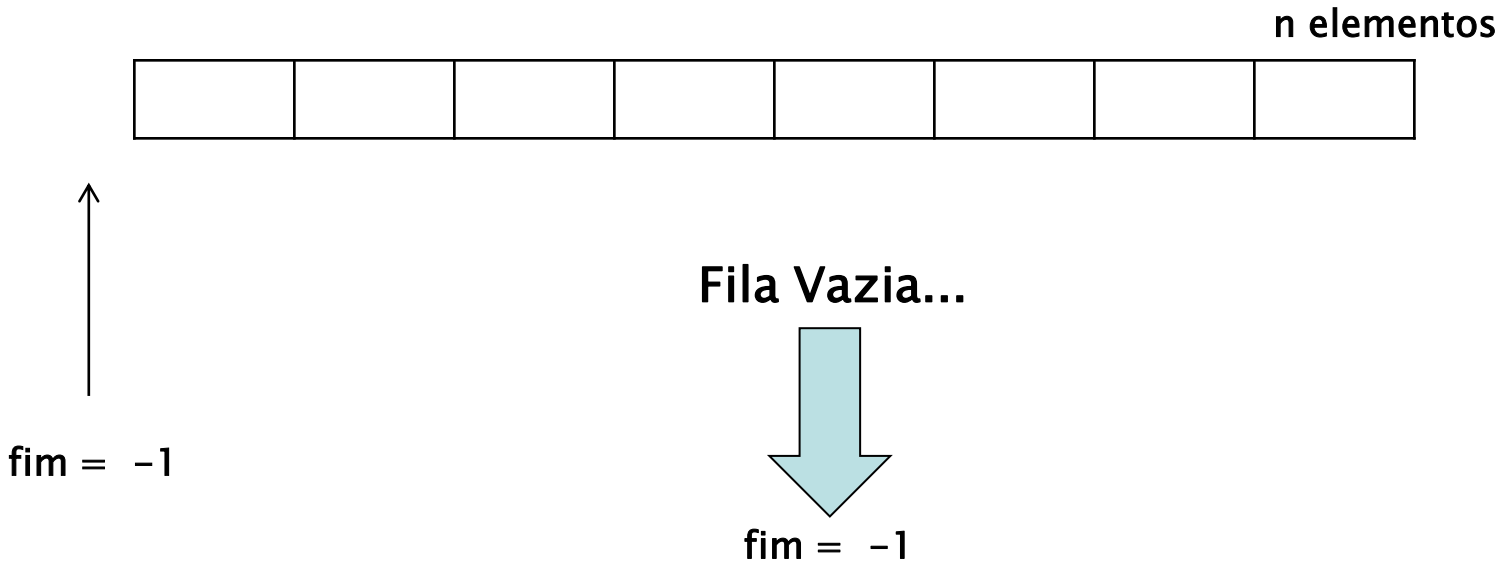


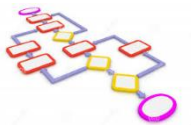
Fila – Exemplo de Aplicação



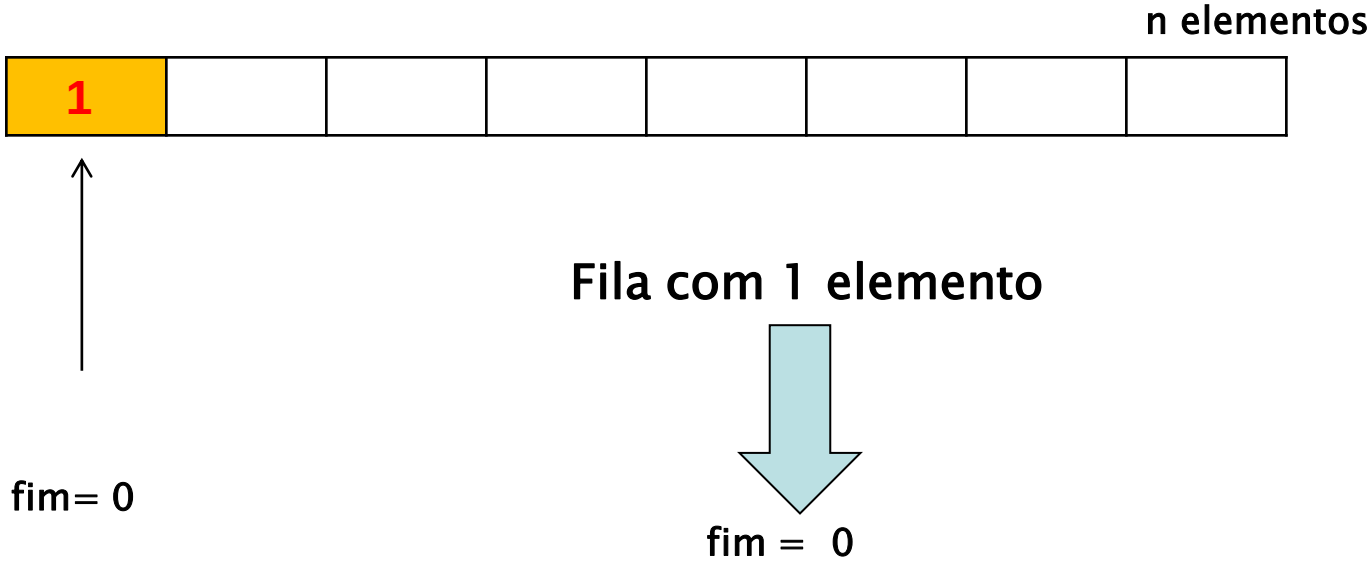
- Fila de Impressão

Implementação de Filas com Arrays

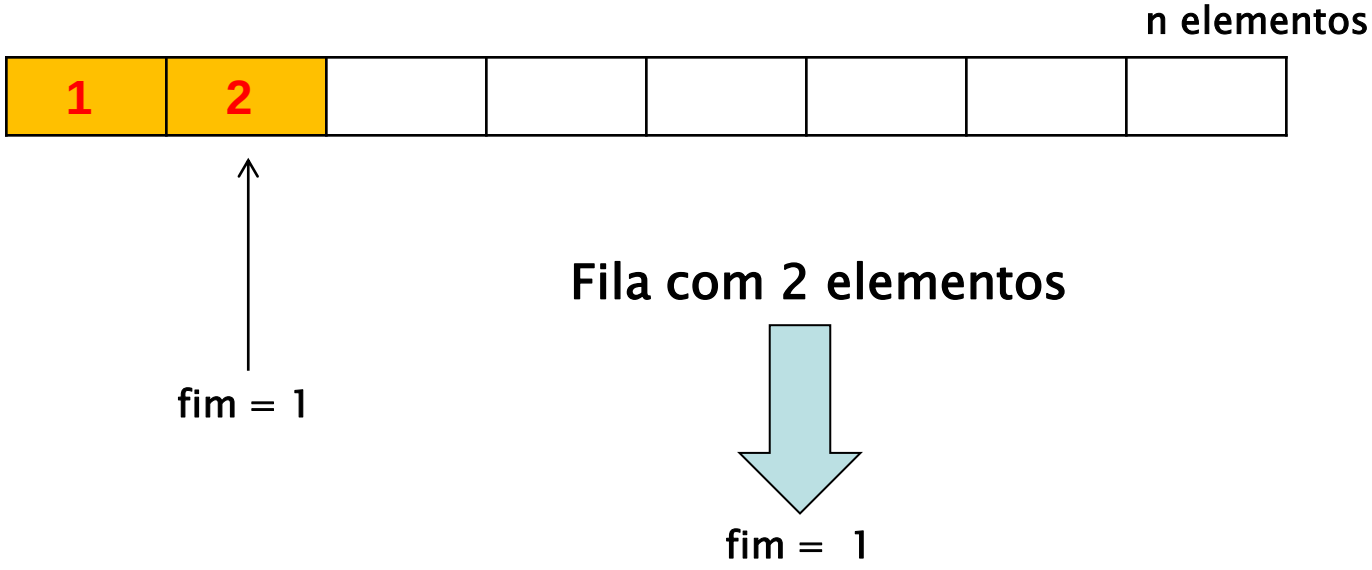




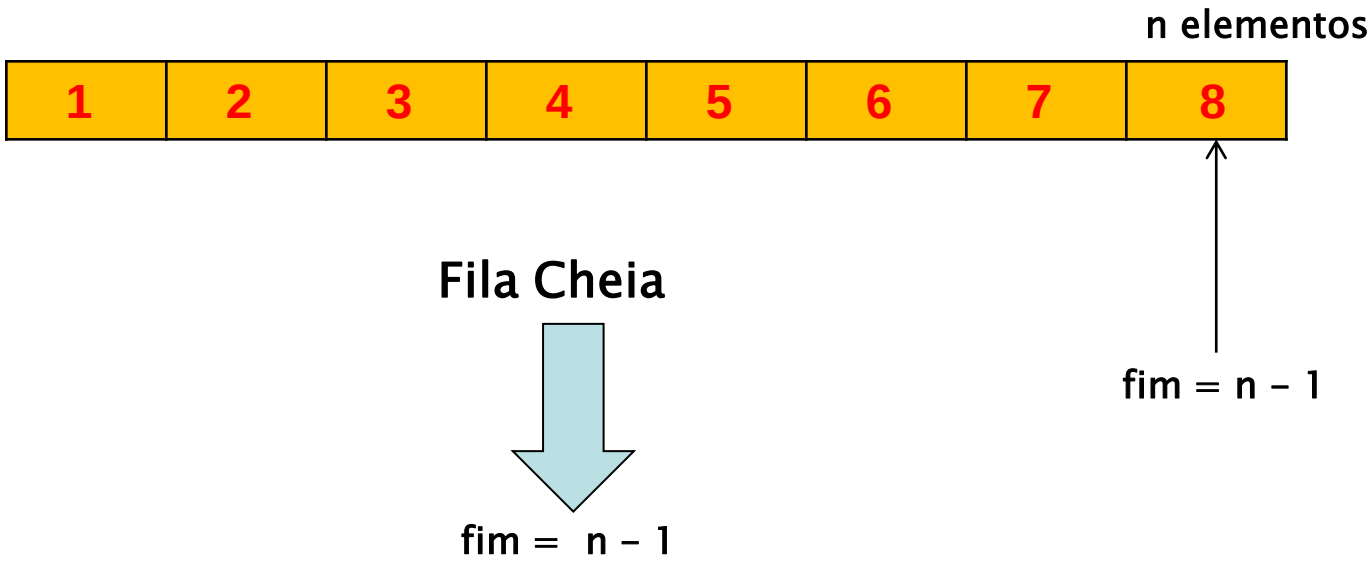
Inserção na Fila



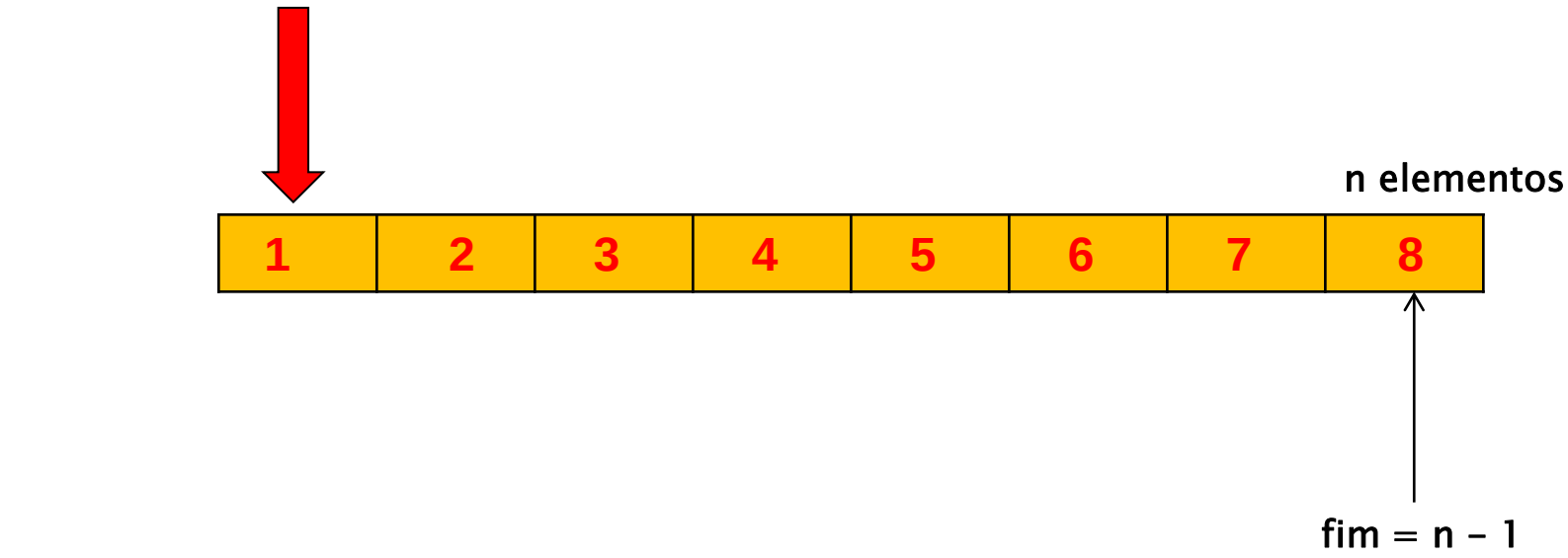
Inserção na Fila



Inserção na Fila

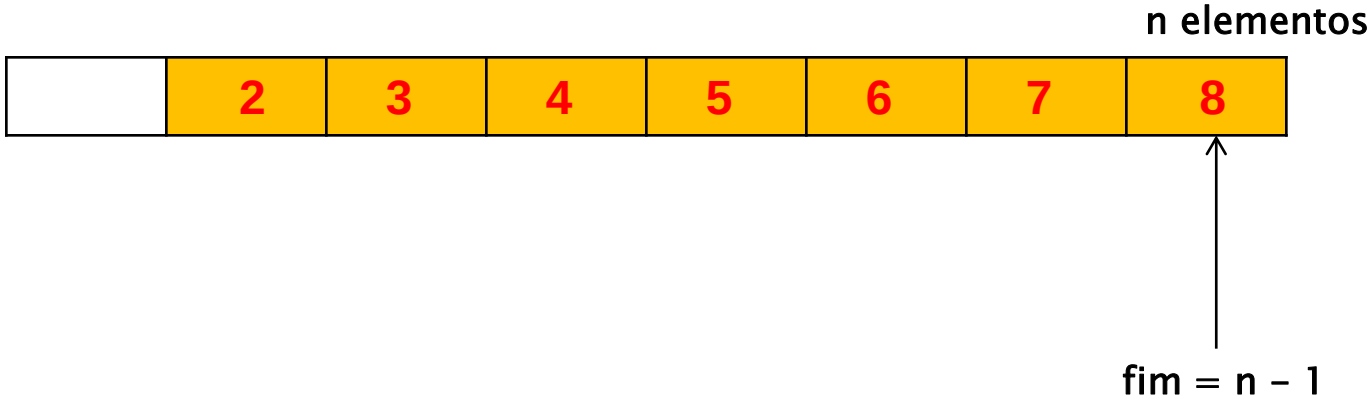


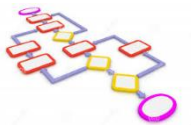
Remoção da Fila



Remoção da Fila

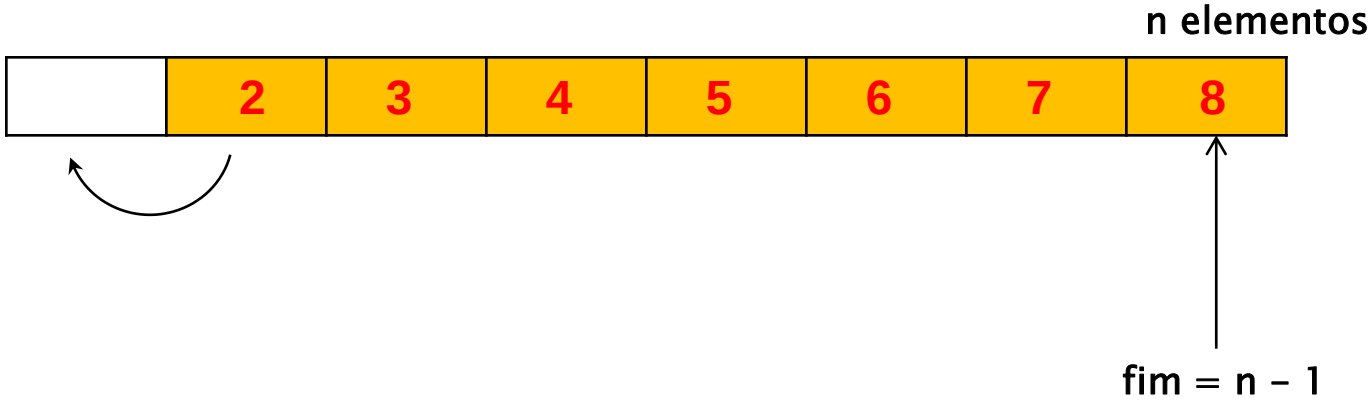
A fila anda !!!





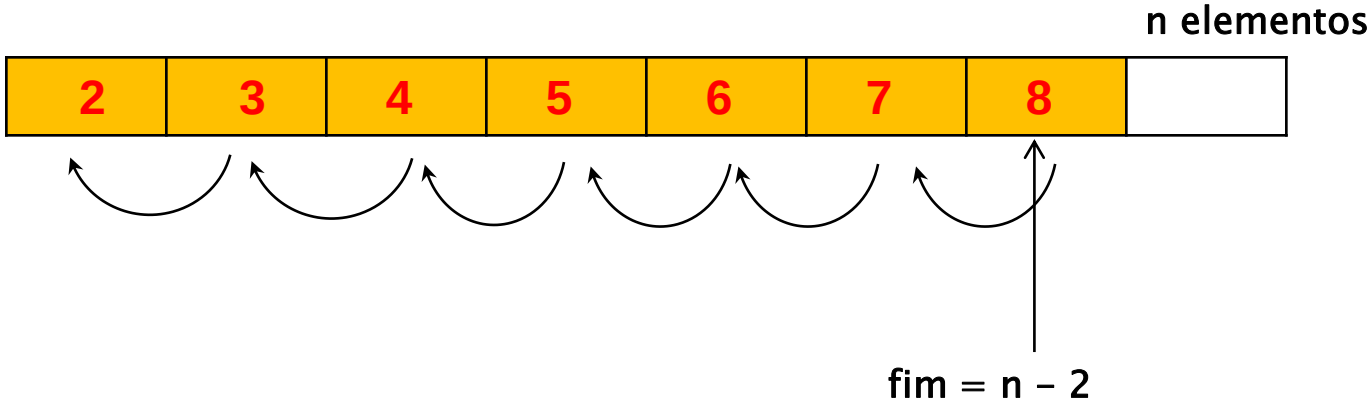
Remoção da Fila

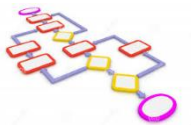
A fila anda !!!



Remoção da Fila

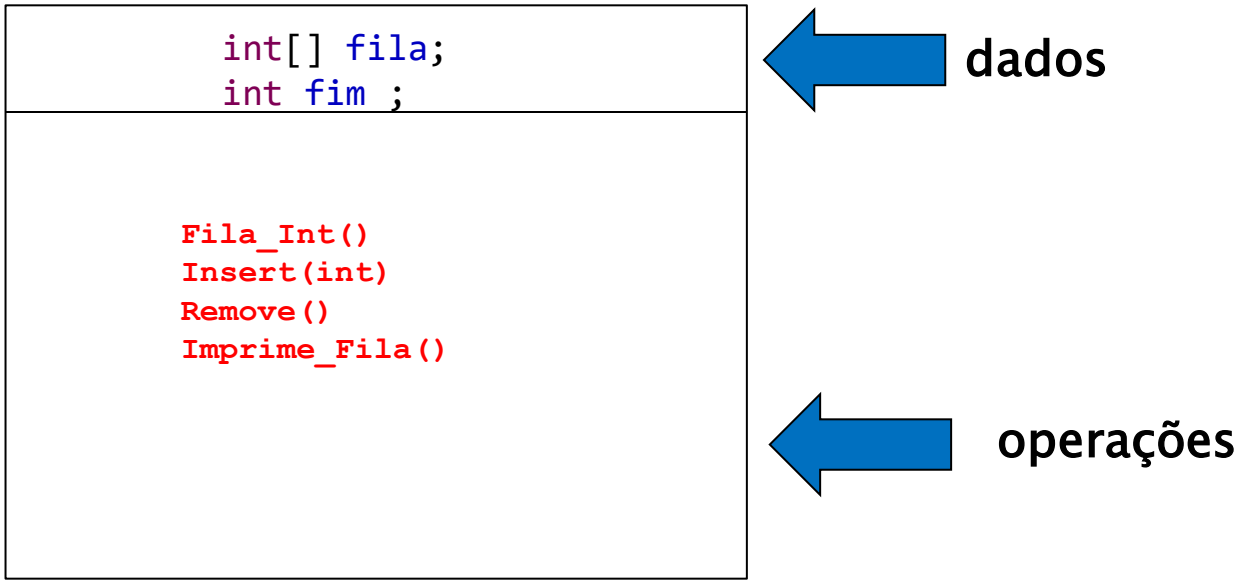
A fila anda !!!

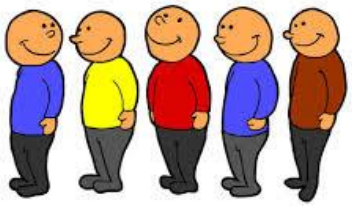




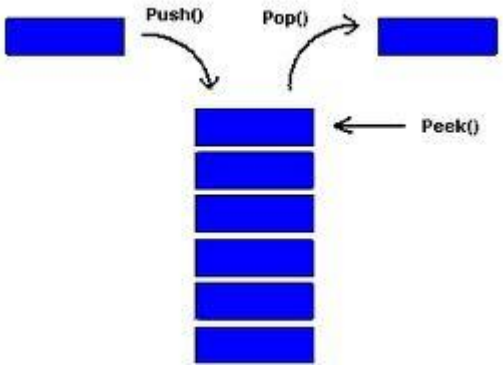
Implementação de Filas com arrays

Tipo Abstrato de Dados: Fila_Int



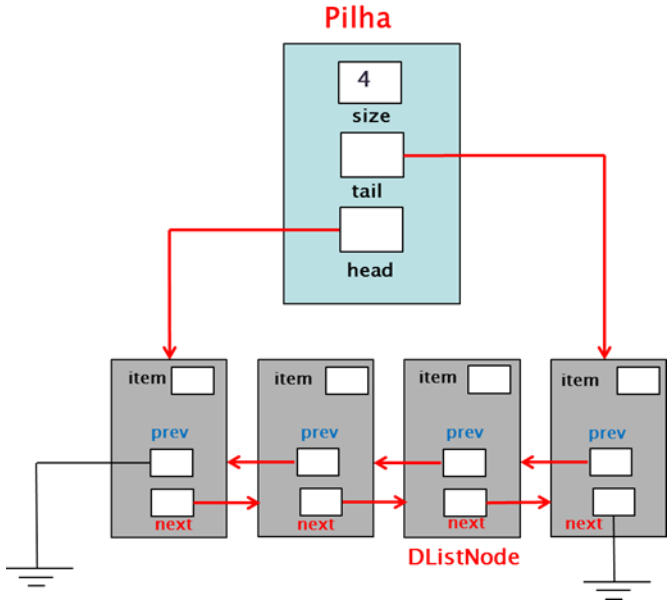


Implementação Dinâmica de Pilhas e Filas



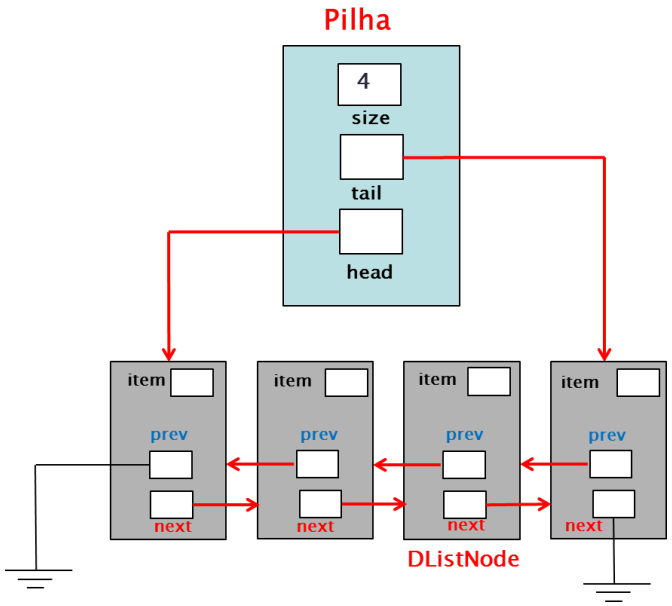
Tipo Abstrato de Dados Pilha

- `public Integer size;`
- `public DListNode head;`
- `public DListNode tail;`
- `public void push(Integer item);`
- `public Integer pop();`
- `public void imprimePilha();`



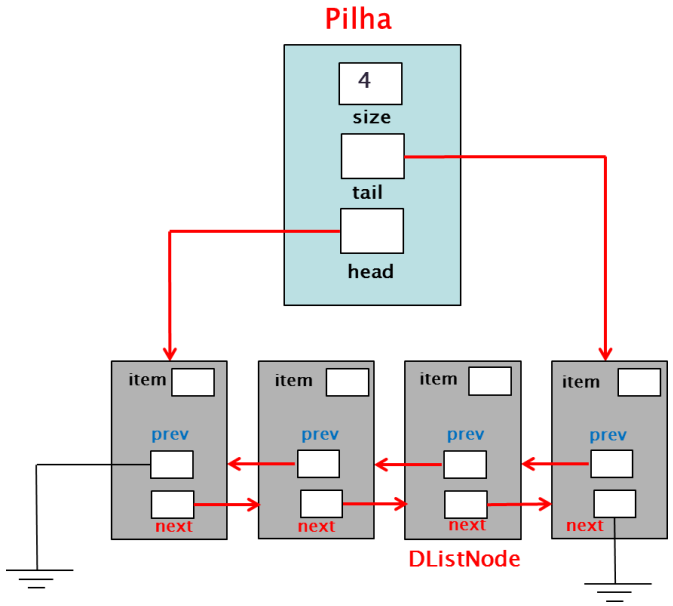
Classe DListNode

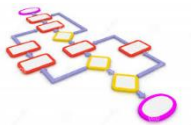
```
package maua;

public class DListNode {

        public Integer item;

        public DListNode next;

        public DListNode prev;

        public DListNode() {

                this.item = 0;
                this.next = null;
                this.prev = null;
        }

        public DListNode(Integer item) {

                this.item = item;
                this.next = null;
                this.prev = null;
        }

}
```



Classe Pilha

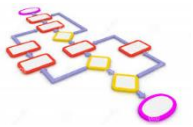
```
package maua;

public class Pilha {

        public int size;
        public DListNode head;
        public DListNode tail;

        public Pilha() {

                this.size = 0;
                this.head = null;
                this.tail = null;
        }
}
```





Método push(Integer)

```
public void push(Integer item) {

        DListNode novoNode = new DListNode(item);

        if (this.size == 0) {
                this.head = novoNode;
                this.tail = novoNode;
                this.size++;
        }
        else {
                this.head.prev = novoNode;
                novoNode.next = this.head;
                this.head = novoNode;
                this.size++;
        }

}
```



Método pop()

```
public Integer pop() {
        Integer trab;
        if (this.size == 0) {
                System.out.println("Stack empty ...");
                return null;
        }
        else {
                if (this.size == 1)  {
                        trab = this.head.item;
                        this.head = null;
                        this.tail = null;
                        this.size = 0;
                        return trab;

                }
                else {
                        trab = this.head.item;
                        this.head = this.head.next;
                        this.head.prev = null;
                        this.size--;
                        return trab;
                }
        }
}
```

Método imprimePilha()

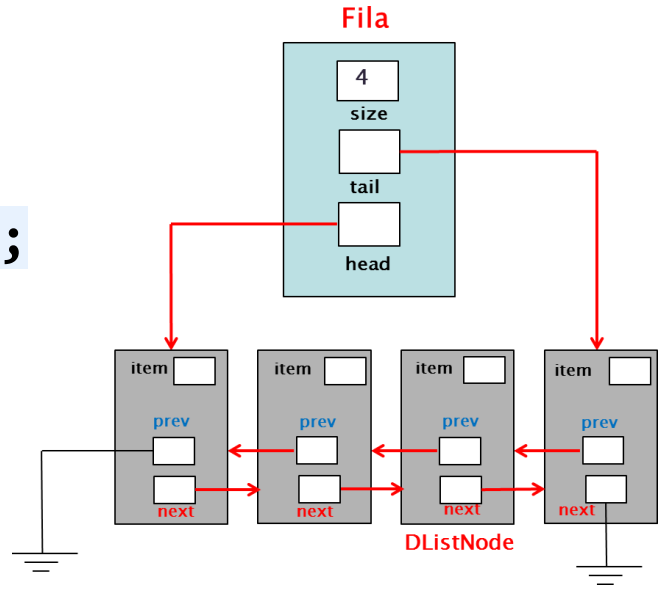
```
public void imprimePilha() {
        DListNode p;

        p = this.head;

        if (this.size ==  0 )
                System.out.println("Stack empty...");
        else {
                System.out.print( "( " );
                while ( p != null ) {
                        System.out.print ( p.item + " ");
                        p = p.next;
                }
                System.out.print(")" + "\n");
        }

}
```

Execução

```
package maua;

public class TestPilha {

	public static void main(String[] args) {

		Pilha x = new Pilha();
		x.imprimePilha();

		for(int i = 0; i < 20 ; i++ ) {
			x.push(i);
			x.imprimePilha();
		}
		int tamanho = x.size;

		x.imprimePilha();
		for (int i = 0; i < tamanho ; i++ ) {
			System.out.println("Valor retirado: " + x.pop());
			x.imprimePilha();
		}
		x.imprimePilha();
	}
}
```

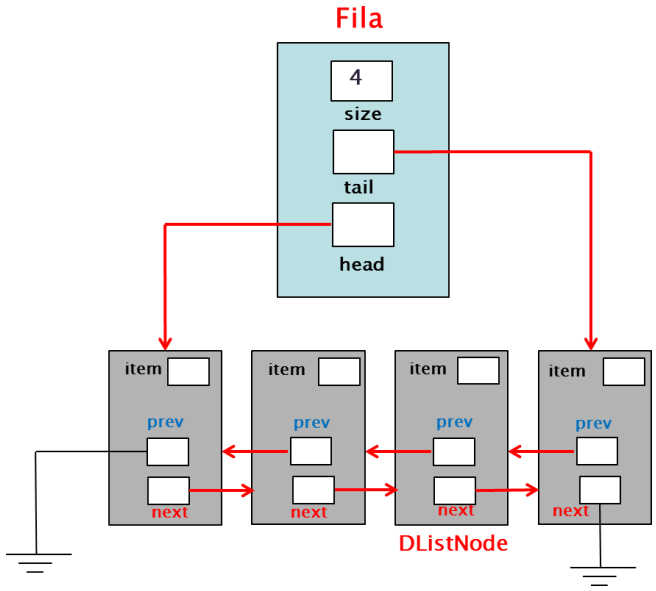
Tipo Abstrato de Dados Fila

- `public Integer size;`
- `public DListNode head;`
- `public DListNode tail;`
- `public void enqueue(Integer item);`
- `public Integer dequeue();`
- `public void imprimeFila();`



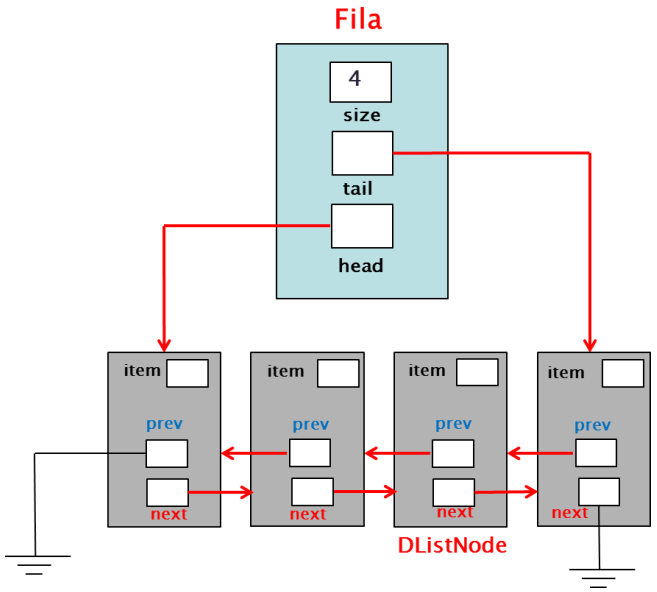
Classe DListNode

```
package maua;

public class DListNode {

        public Integer item;

        public DListNode next;

        public DListNode prev;

        public DListNode() {

                this.item = 0;
                this.next = null;
                this.prev = null;
        }

        public DListNode(Integer item) {

                this.item = item;
                this.next = null;
                this.prev = null;
        }

}
```



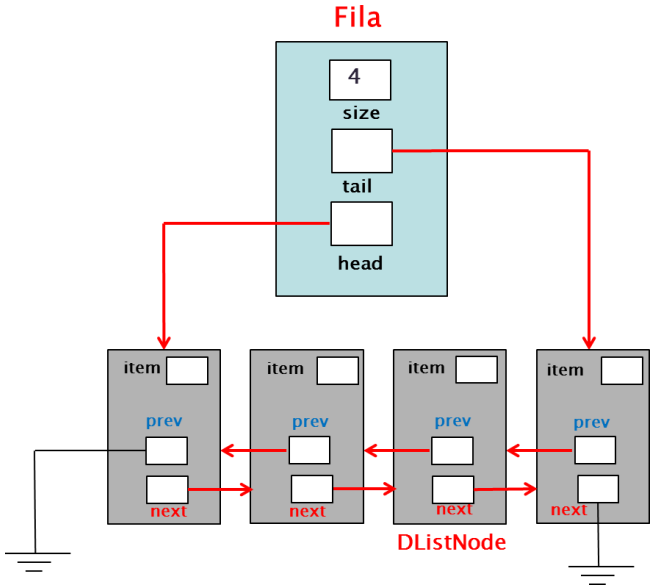
Classe Fila

```
package maua;

        public class Fila {

                public int size;
                public DListNode head;
                public DListNode tail;

        public Fila() {

                this.size = 0;
                this.head = null;
                this.tail = null;
        }
}
```



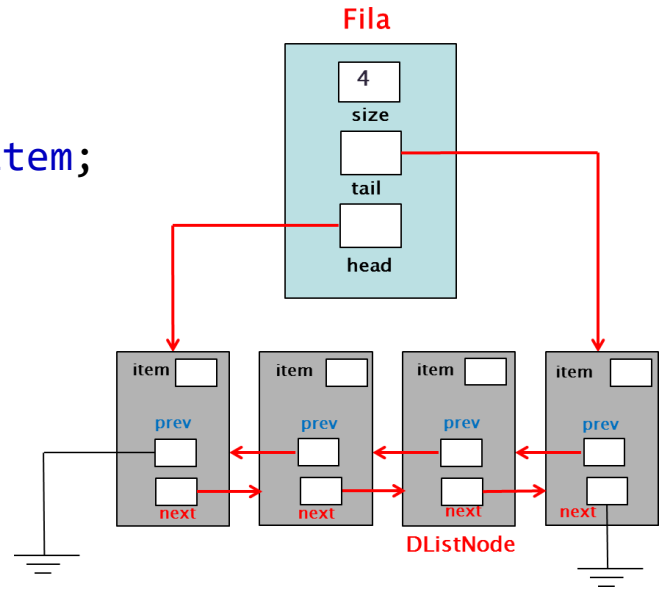
Método enqueue(Integer)

```
public void enqueue(Integer item) {

        DListNode novoNode = new
        DListNode(item);

        if (this.size == 0) {
                this.head = novoNode;
                this.tail = novoNode;
                this.size++;
        }
        else {
                this.tail.next = novoNode;
                this.tail = novoNode;
                this.size++;
        }
}
```



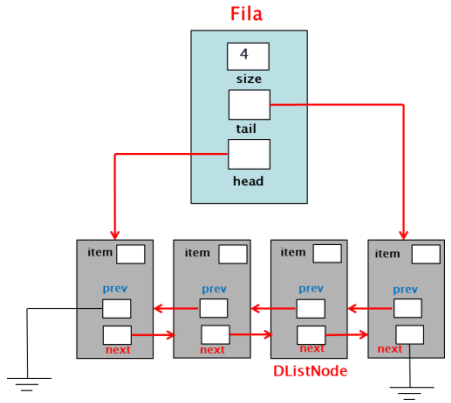
Método enqueue(Integer)

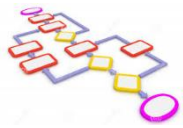
```
public Integer dequeue() {
      Integer trab;
      if (this.size == 0) {
            System.out.println("Stack empty ...");
            return null;
      }
      else {
            if (this.size == 1)  {
                  trab = this.head.item;
                  this.head = null;
                  this.tail = null;
                  this.size = 0;
                  return trab;

            }
      else {
            trab = this.head.item;
            this.head = this.head.next;
            this.head.prev = null;
            this.size--;
            return trab;
          }
      }
  }
```



Método imprimeFila(Integer)

```
public void imprimeFila() {
        DListNode p;

        p = this.head;

        if (this.size ==  0 )
                System.out.println("Stack empty...");
        else {
                System.out.print( "( " );
                while ( p != null ) {
                        System.out.print ( p.item + " ");
                        p = p.next;
                }
                System.out.print(")" + "\n");
        }

}
```





Execução

```
package maua;

public class TestFila {

        public static void main(String[] args) {

                Fila x = new Fila();
                x.imprimeFila();

                for(int i = 0; i < 20 ; i++ ) {
                        x.enqueue(i);
                        x.imprimeFila();
                }

                int tamanho = x.size;

                x.imprimeFila();
                for (int i = 0; i < tamanho ; i++ ) {
                   System.out.println("Valor retirado: " + x.dequeue());
                   x.imprimeFila();
                }
                x.imprimeFila();
        }
}
```