CSCI 132:
Basic Data Structures and Algorithms

Stacks (Array implementation)

Reese Pearsall

Spring 2023

Fall 2023/Summer 2023 Registration

- **CSCI 232-** Data Structures and Algorithms

Other Classes that may be of interest

- **CSCI 112** – Programming with C
- **CSCI 204** – Multimedia Development Methods (Game Design)
- **CSCI 215** – Social and Ethical Issues in Computer Science
- **CS145** – Web Design

If you ever have any questions about which classes to take, your CS degree, or registration info, I am always available to help

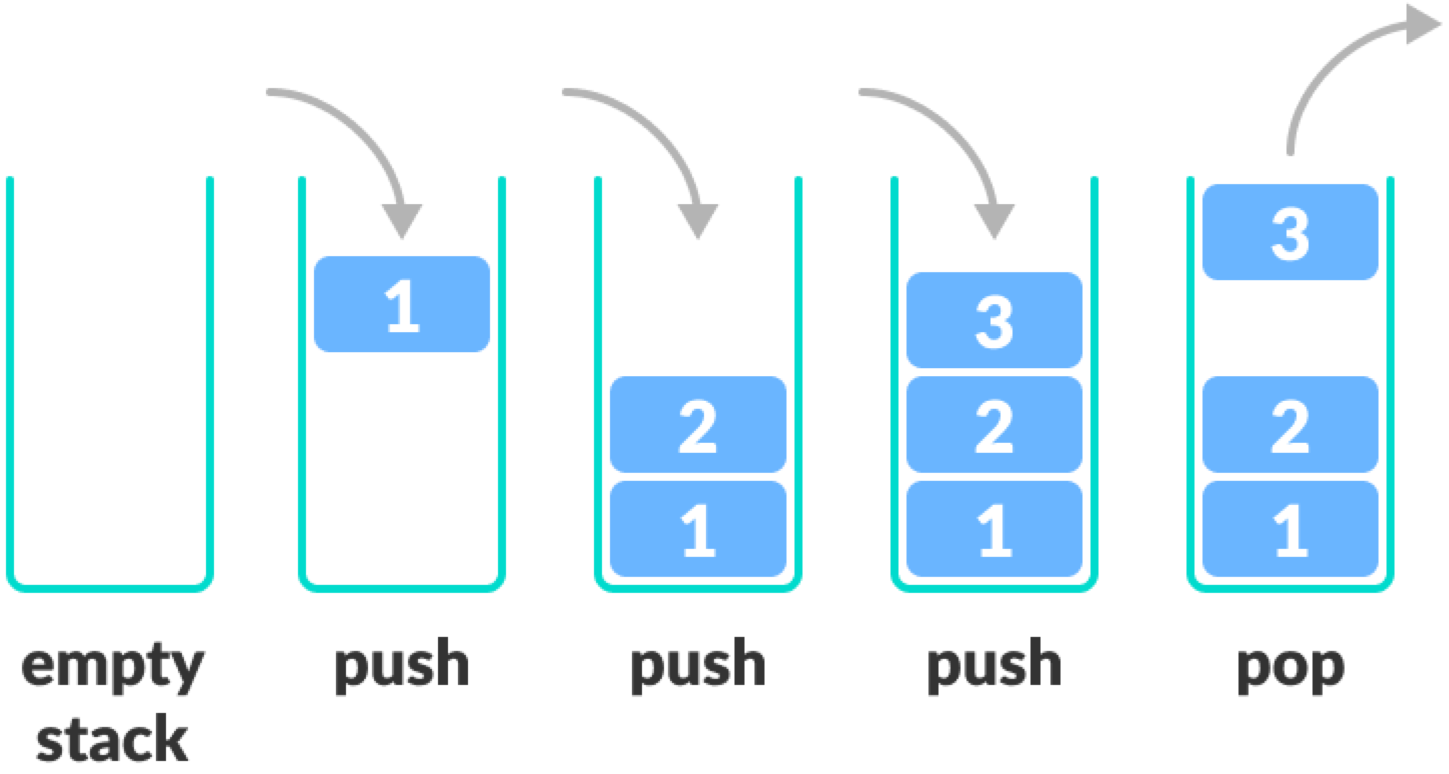
Other Announcements

Program 3 is Posted (Due April 2nd)

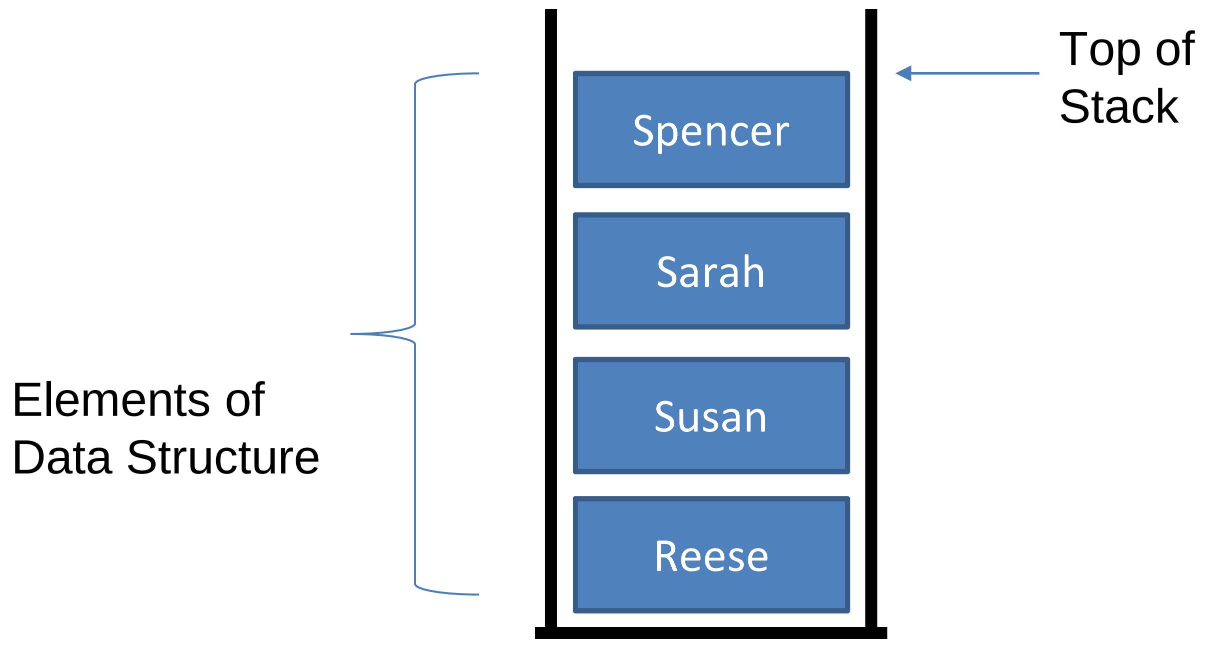
A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle

We can:

- Add an element to the top of the stack (**push**)
- Remove the top element (**pop**)

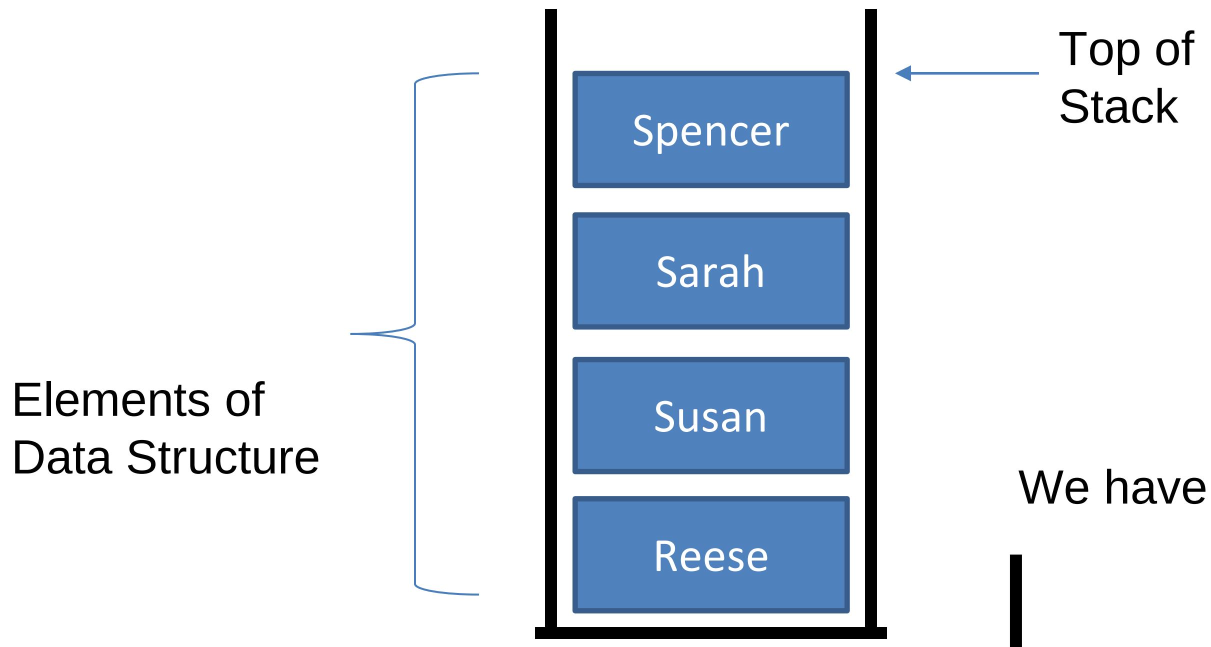


A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle



Our stack data structure needs to keep track of a few things
1. Something to hold our stack elements

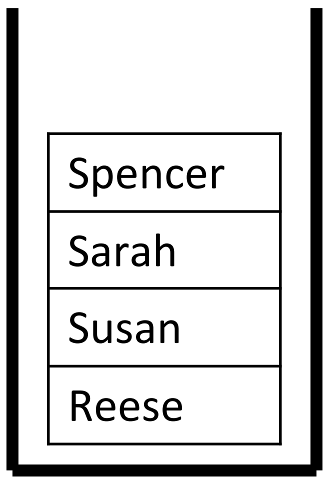
A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle



Our stack data structure needs to keep track of a few things

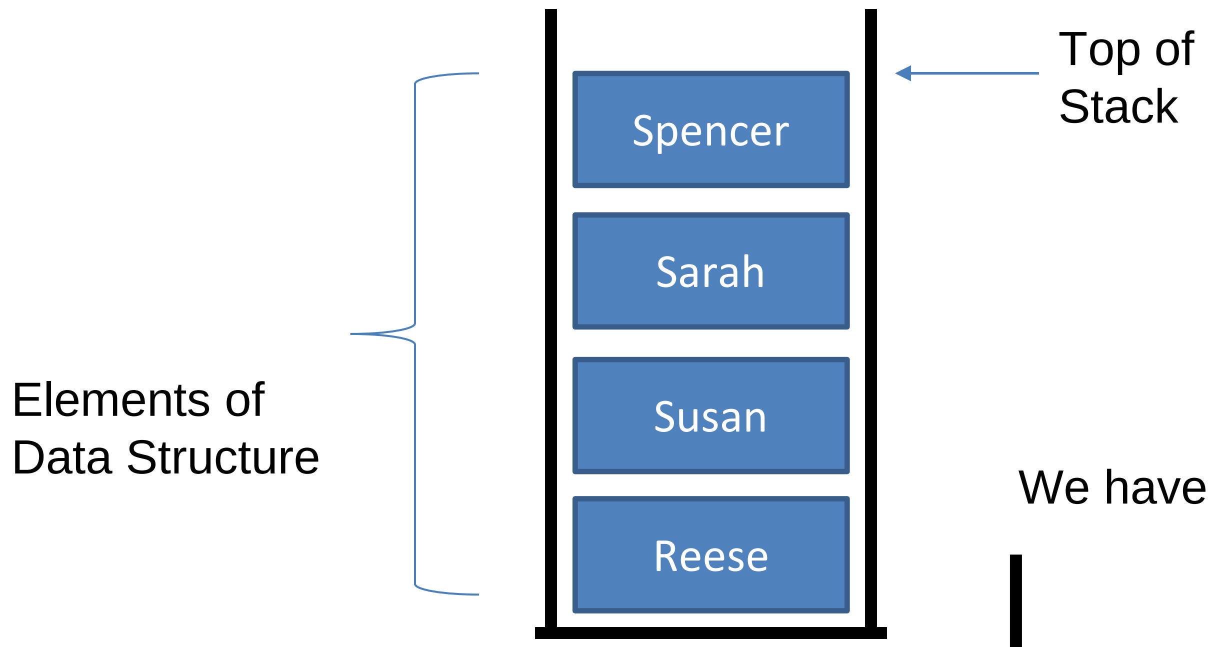
1. Something to hold our stack elements

We have a few options:



1. Array

A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle



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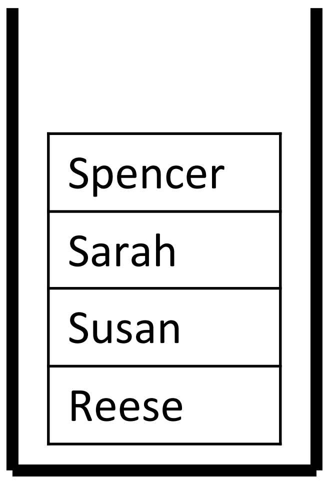
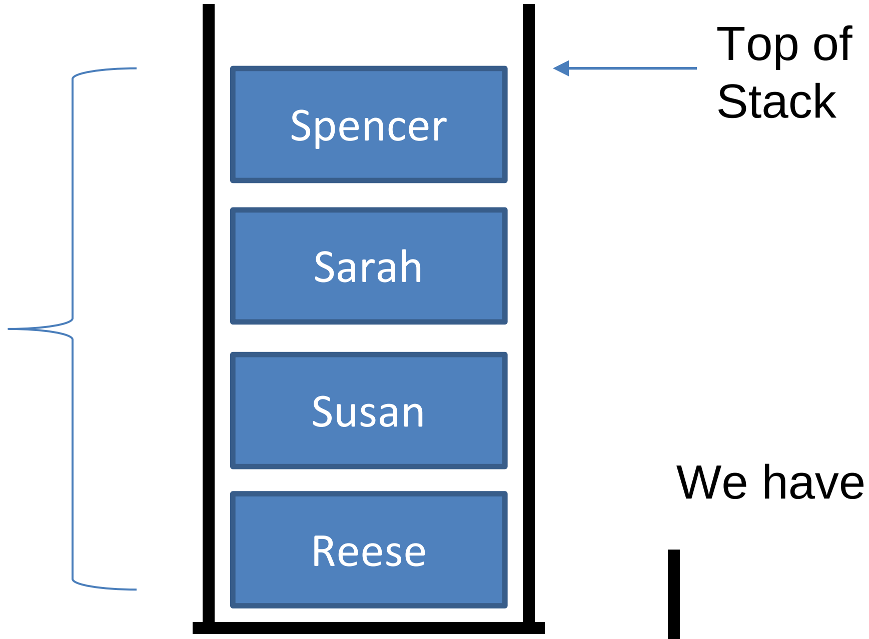


1. Array
2. ArrayList

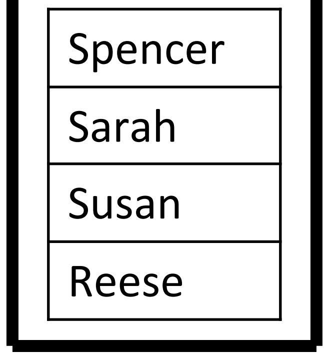
A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle



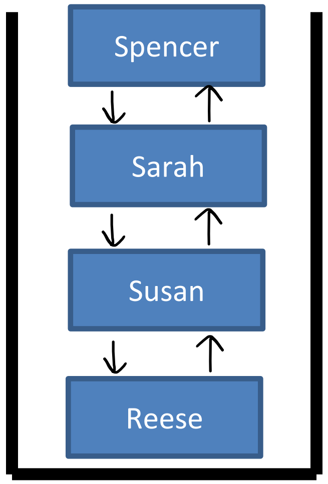
Our stack data structure needs to keep track of a few things

1. Something to hold our stack elements

We have a few options:

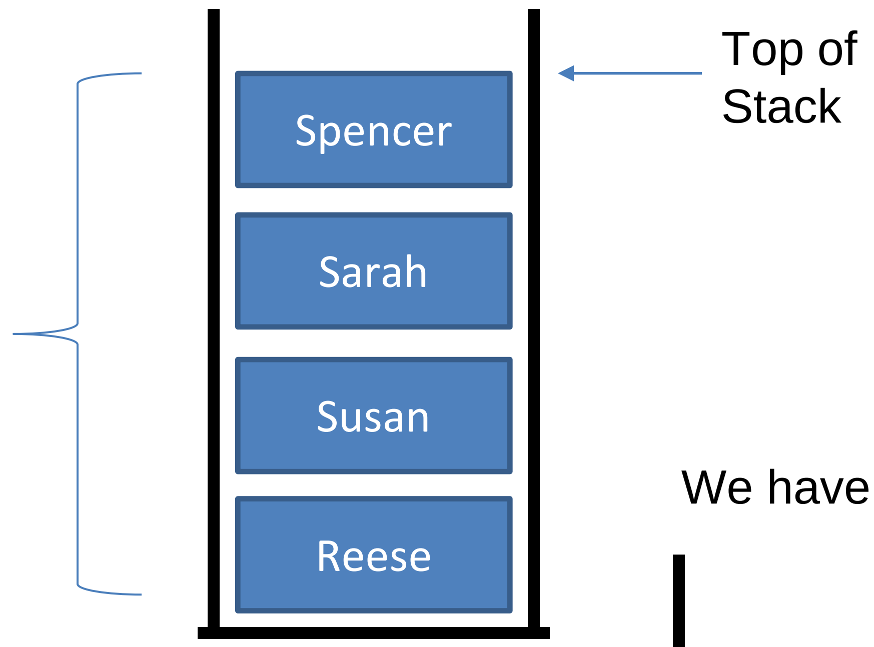


1. Array
2. ArrayList



3. Linked List

A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle

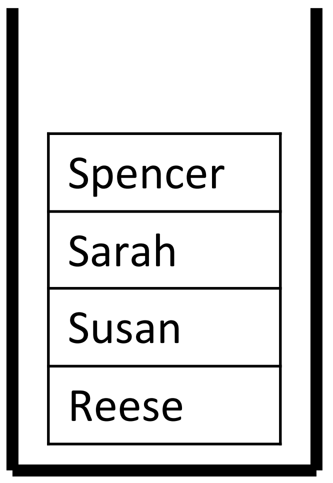


Our stack data structure needs to keep track of a few things

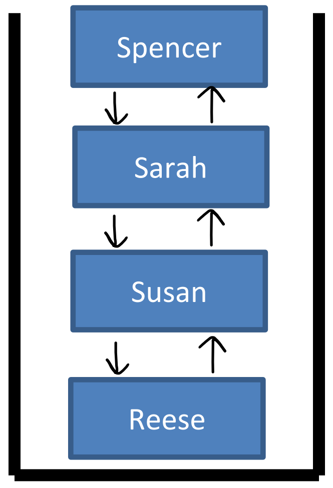
1. Something to hold our stack elements

Which should you pick?

We have a few options:

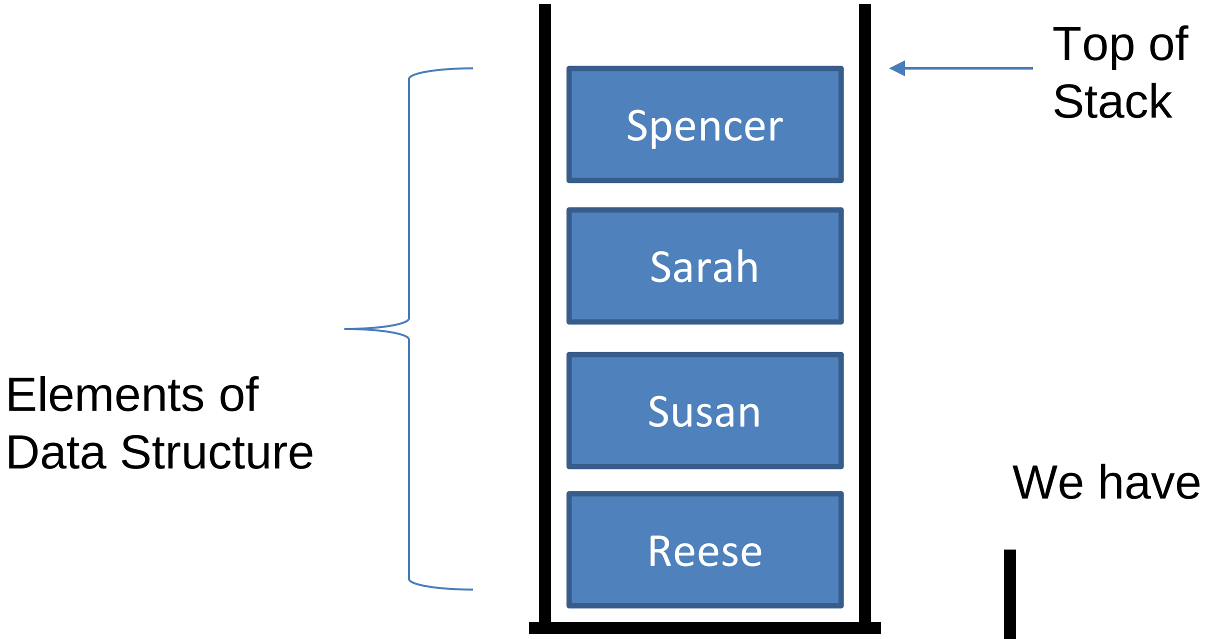


1. Array
2. ArrayList



3. Linked List

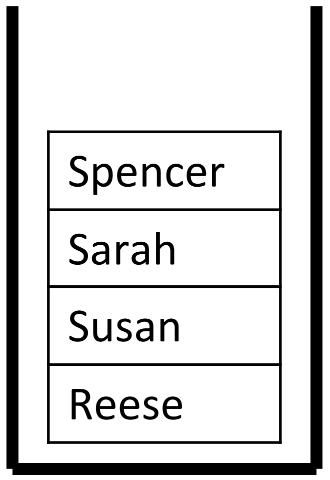
A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle



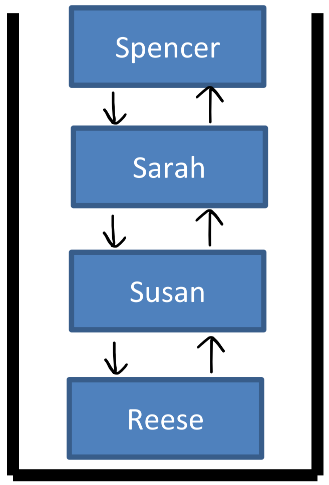
Our stack data structure needs to keep track of a few things

1. Something to hold our stack elements

We have a few options:



1. Array
2. ArrayList

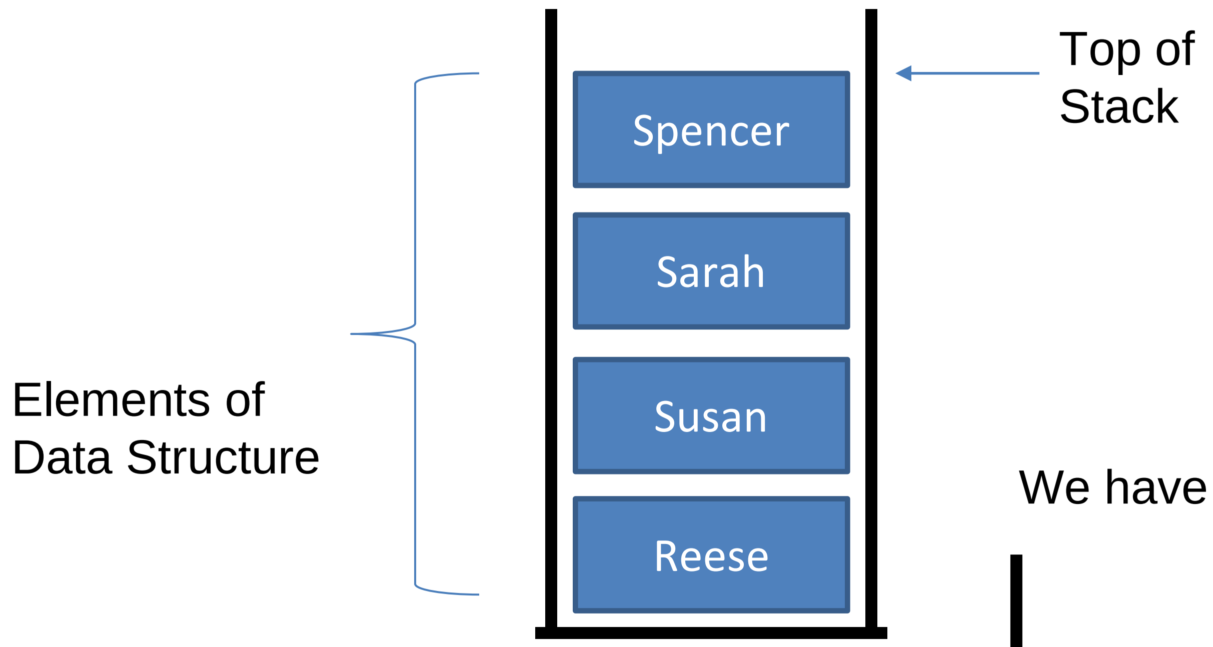


3. Linked List

Which should you pick?

- Depends on how you are using the stack

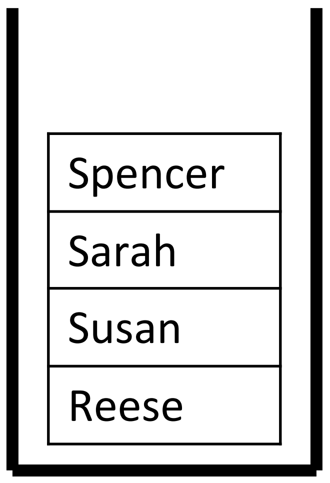
A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle



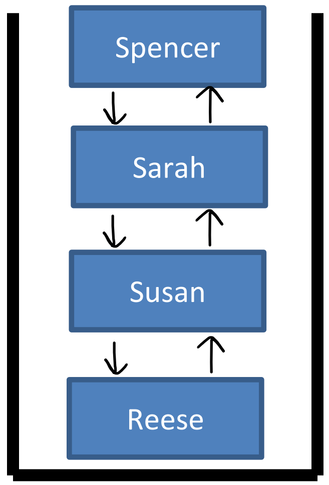
Our stack data structure needs to keep track of a few things

1. Something to hold our stack elements

We have a few options:



1. Array
2. ArrayList

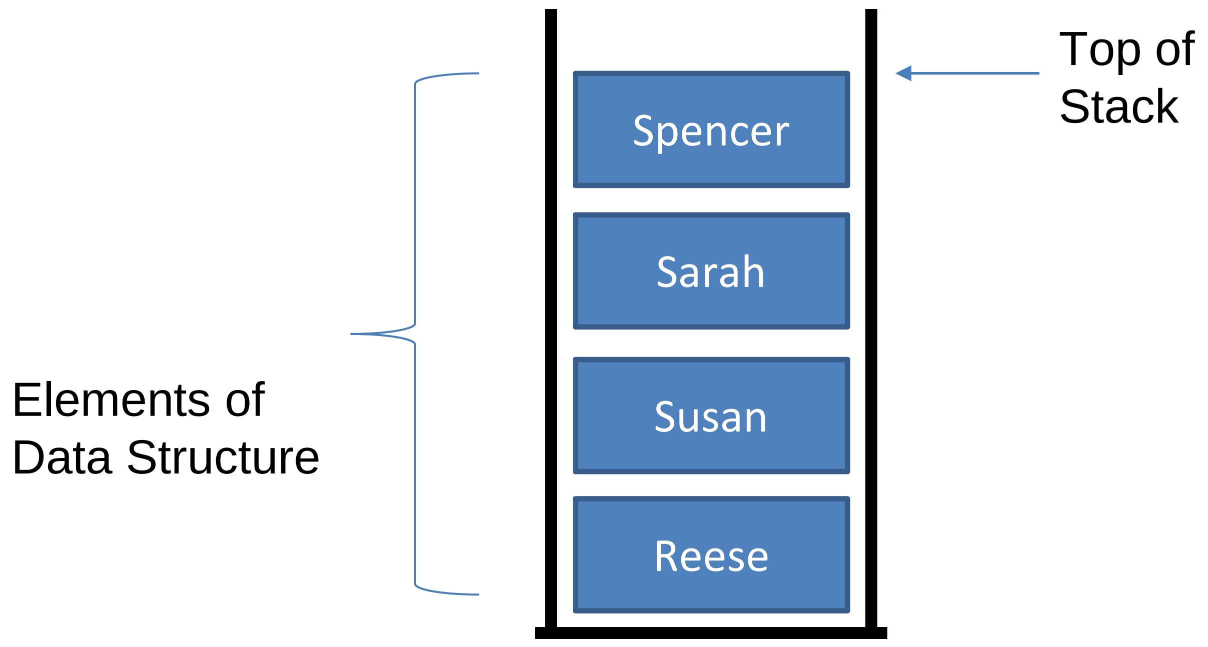


3. Linked List

Which should you pick?

- If you know how big the stack needs to be
  → Array
- If you don't know how big the stack needs to be
  → Linked List

A **stack** is a data structure that can hold data, and follows the **last in first out (LIFO)** principle

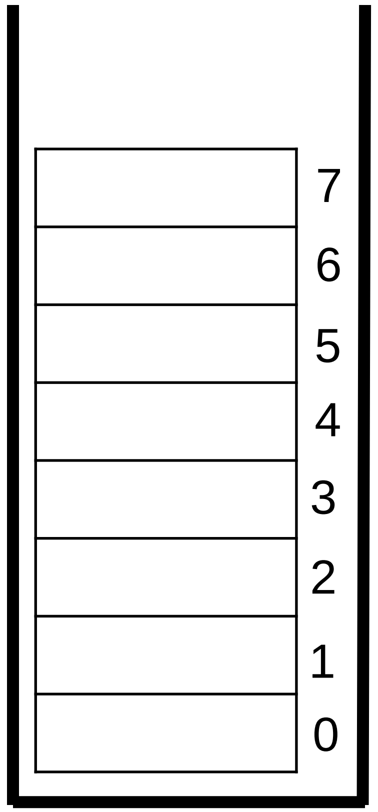


Our stack data structure needs to keep track of a few things

1. Something to hold our stack elements (Array/LinkedList)
2. Something that points the current top element of the stack
3. The size of the stack

Stack Implementation (Array)

Here, we've created an array of size 8 to hold our stack data



To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Stack Implementation (Array)

To Do List:
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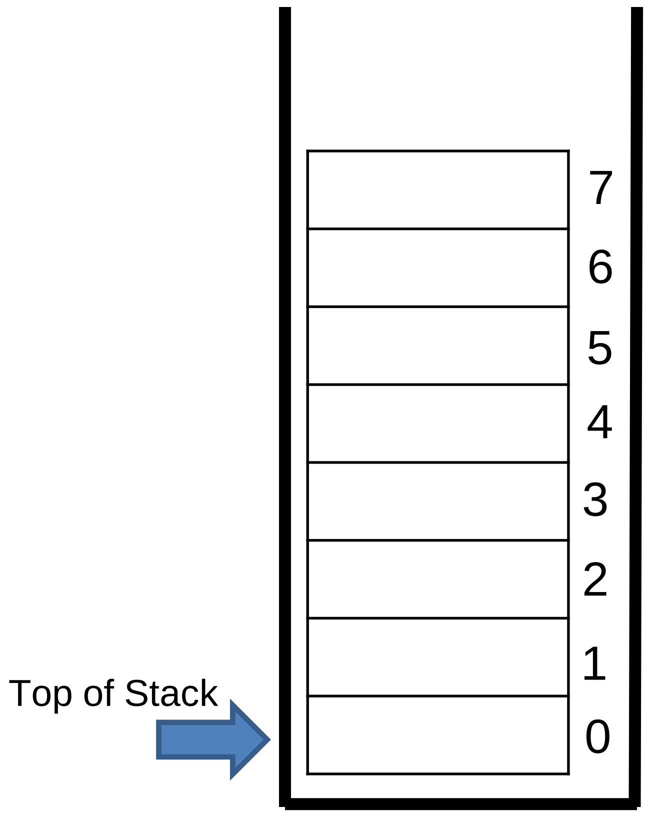

The bottom of the stack will always be at index 0, and grows towards the higher indices

```
String[] data = new String[8]
```

When the stack is empty, the index of the bottom of the stack, and the index of the top of the stack will be the same

```
top_of_stack = 0
```

The size of the stack will start at 0

```
size = 0
```

Stack Implementation (Array)

To Do List:
- Push()
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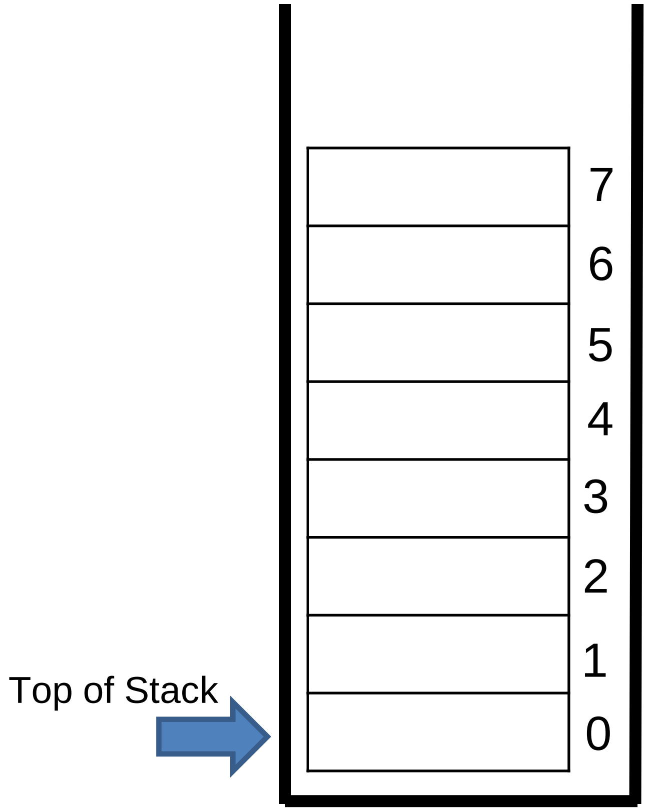
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



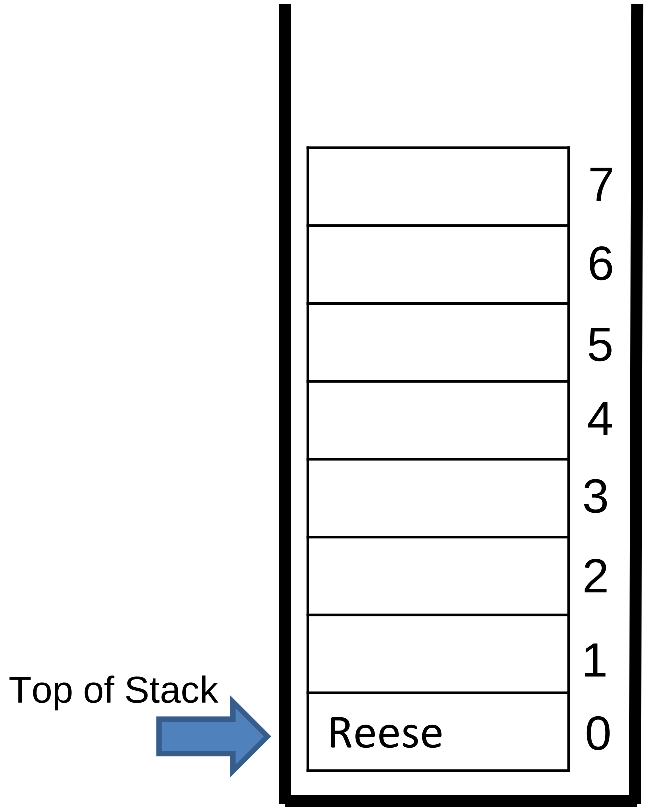
```
public void push(newElement){



}
```

Stack Instance Fields

```
String[] data = new String[8]
          top_of_stack = 0
                  size = 0
```

Stack Implementation (Array)

Here, we've created an array of size 8 to hold our stack data



```
public void push(newElement){

  if stack is empty:
      place newElement at current top_of_stack
      size++


  if stack if full:
      return



}
```

To Do List:

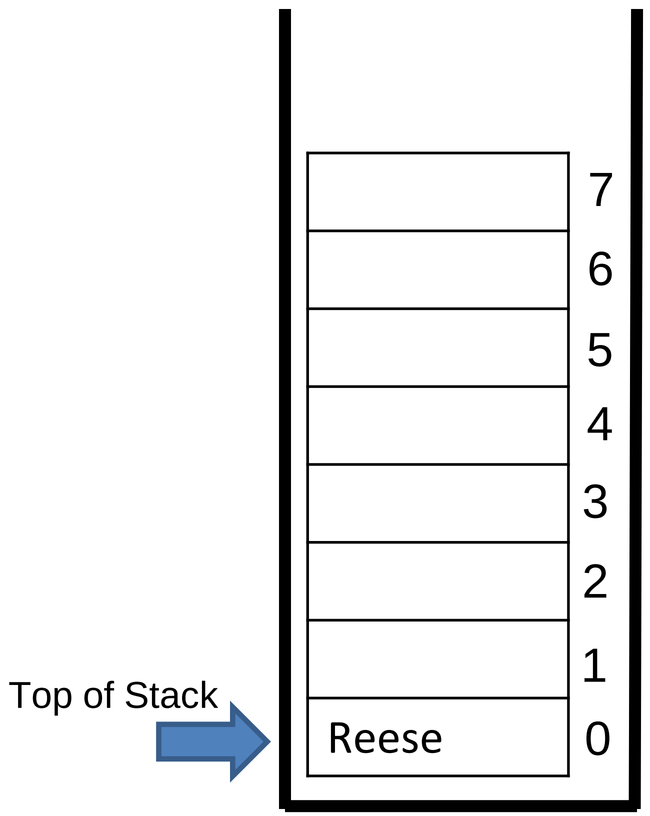
- Push()
- Pop()
- Peek()
- IsEmpty()

Stack Instance Fields

```
String[] data = new String[8]
              top_of_stack = 0
                      size = 1
```

Stack Implementation (Array)

Here, we've created an array of size 8 to hold our stack data



```
public void push(newElement){

  if stack is empty:
      place newElement at current top_of_stack
      size++


  if stack if full:
      return


  else:
      top_of_stack++;
      place newElement at index top_of_stack
      size++
}
```

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

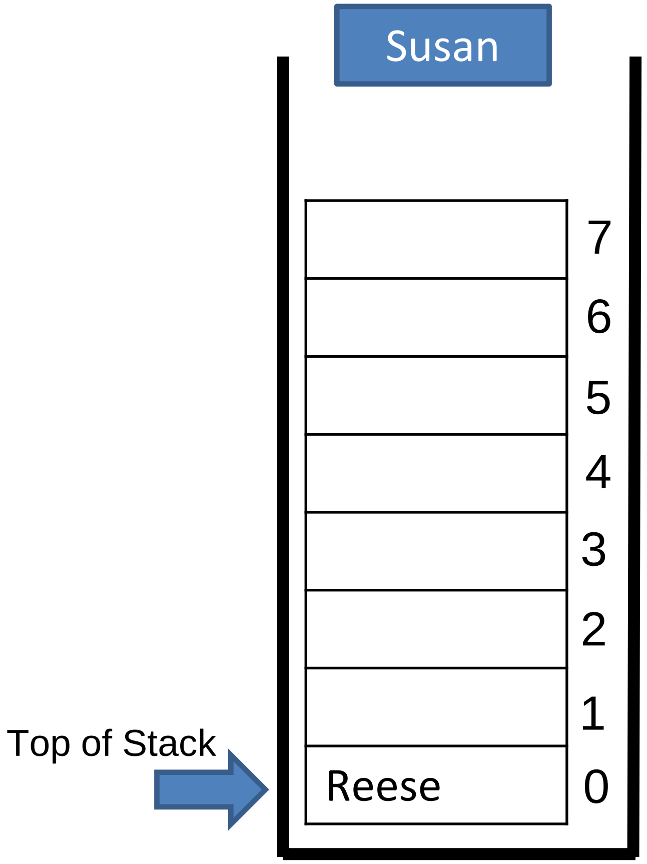
Stack Instance Fields

```
String[] data = new String[8]
             top_of_stack = 0
                     size = 1
```

Stack Implementation (Array)

Here, we've created an array of size 8 to hold our stack data

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()



```
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  if stack is empty:
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      size++

  if stack if full:
      return

  else:
       top_of_stack++;
       place newElement at index top_of_stack
       size++
}
```

Stack Instance Fields

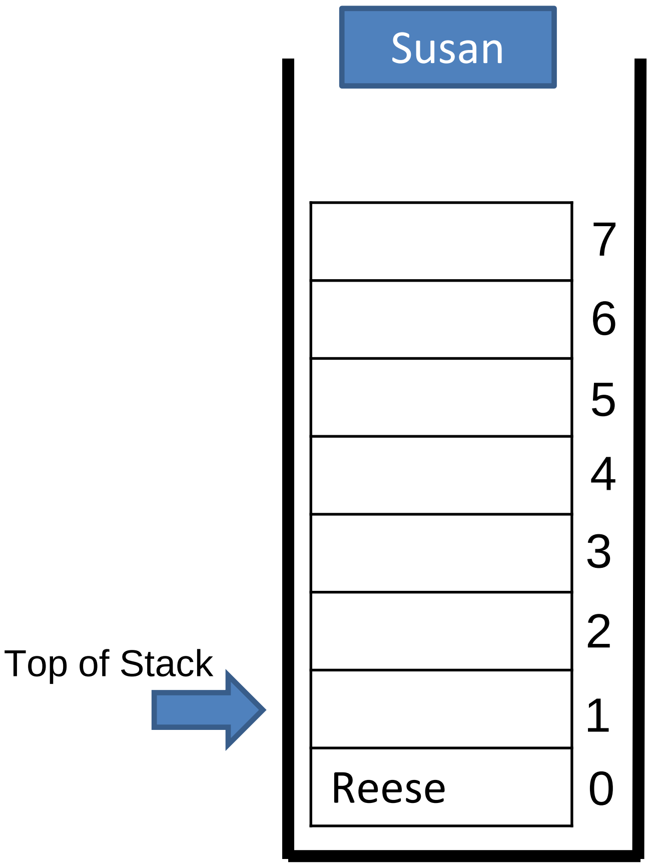
```
String[] data = new String[8]
            top_of_stack = 0
                    size = 1
```

```
stack.push("Susan")
```

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void push(newElement){

  if stack is empty:
      place newElement at current top_of_stack
      size++



  if stack if full:
      return


  else:
       top_of_stack++;
       place newElement at index top_of_stack
       size++
}
```

Stack Instance Fields

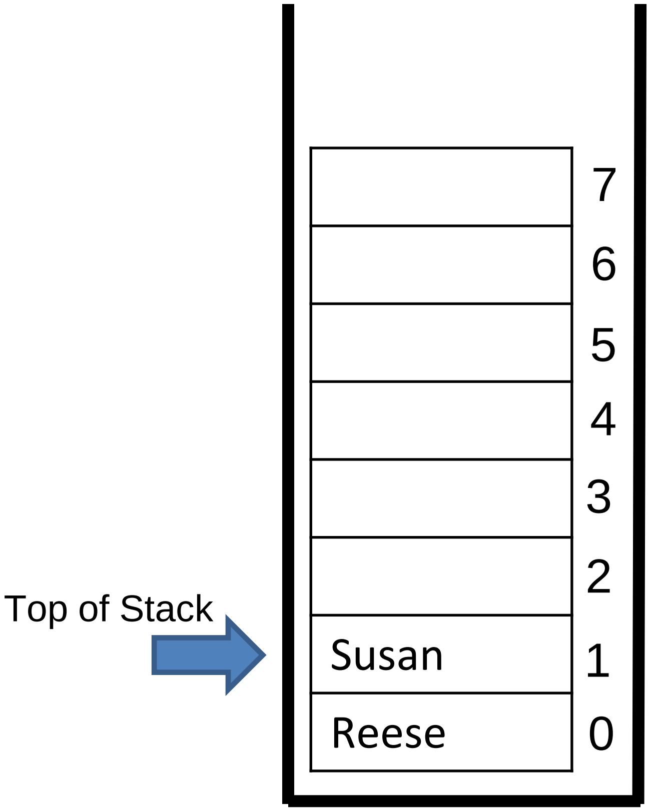
```
String[] data = new String[8]
         top_of_stack = 1
                 size = 1
```

`stack.push("Susan")`

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void push(newElement){

  if stack is empty:
      place newElement at current top_of_stack
      size++



  if stack if full:
      return


  else:
       top_of_stack++;
       place newElement at index top_of_stack
       size++
}
```

stack.push("Susan")

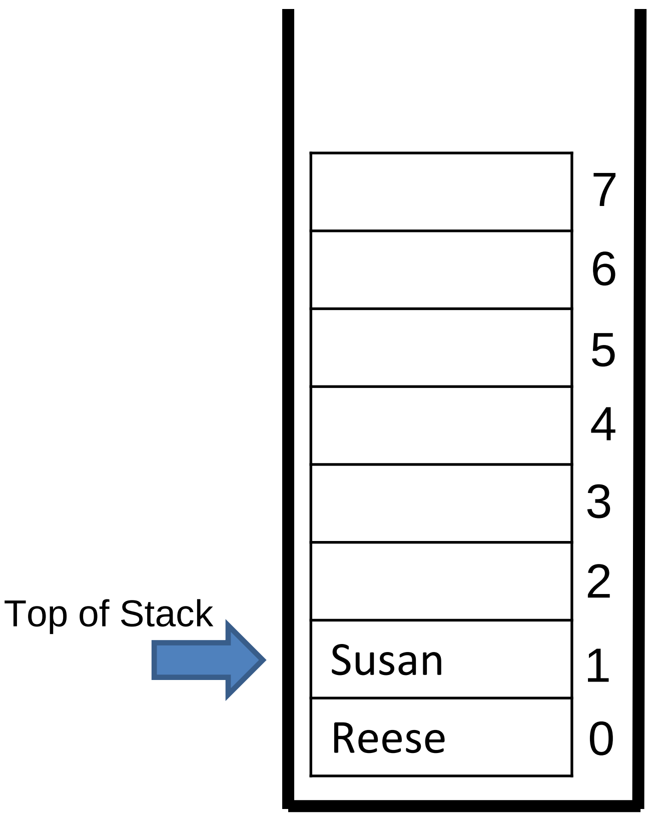
Stack Instance Fields

```
String[] data = new String[8]
              top_of_stack = 1
                      size = 1
```

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void push(newElement){

  if stack is empty:
      place newElement at current top_of_stack
      size++

  if stack if full:
      return

  else:
      top_of_stack++;
      place newElement at index top_of_stack
      size++
}
```

stack.push("Susan")

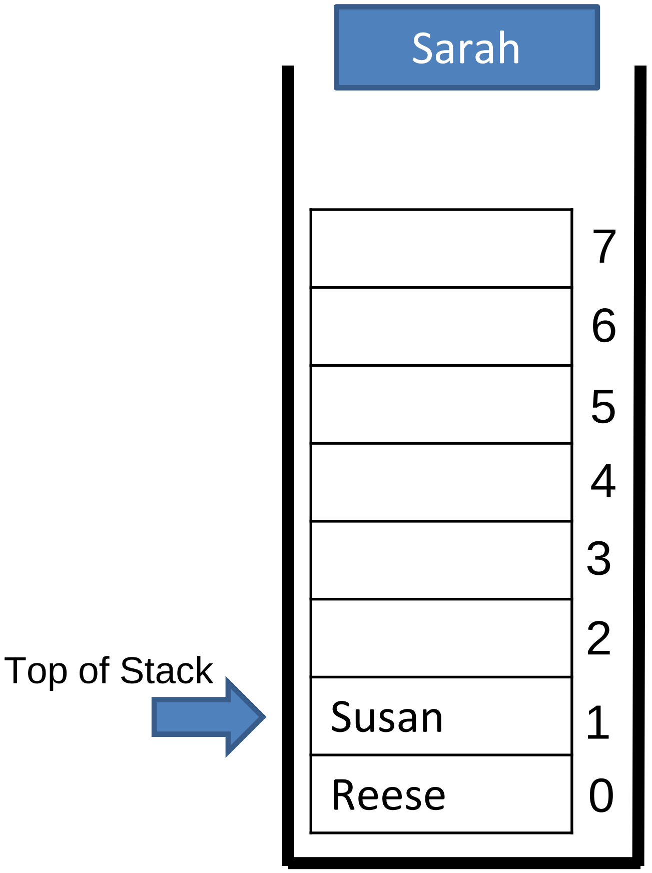
Stack Instance Fields

```
String[] data = new String[8]
            top_of_stack = 1
                    size = 2
```

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void push(newElement){

  if stack is empty:
      place newElement at current top_of_stack
      size++


  if stack if full:
      return


  else:
      top_of_stack++;
      place newElement at index top_of_stack
      size++
}
```

Stack Instance Fields

```
String[] data = new String[8]
             top_of_stack = 1
                     size = 2
```

```
stack.push("Sarah")
```

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

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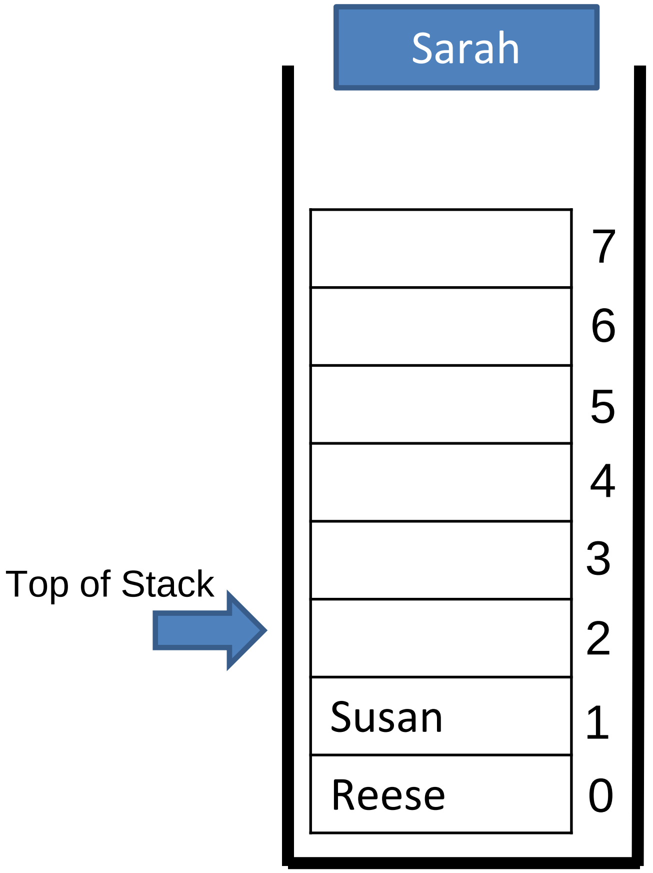


```
public void push(newElement){

  if stack is empty:
      place newElement at current top_of_stack
      size++



  if stack if full:
      return



  else:
      top_of_stack++;
      place newElement at index top_of_stack
      size++
}
```

Stack Instance Fields

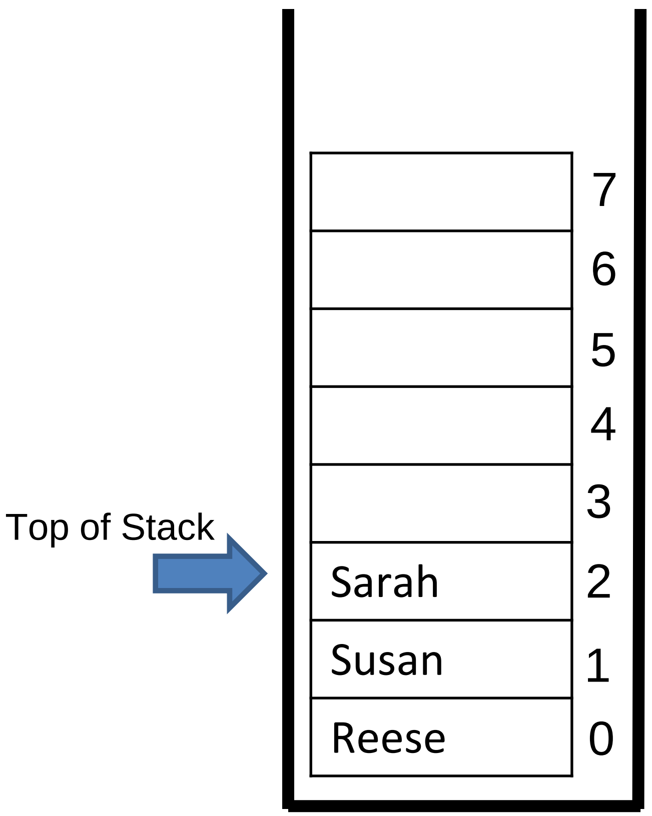
```
String[] data = new String[8]
             top_of_stack = 2
                     size = 2
```

`stack.push("Sarah")`

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void push(newElement){

  if stack is empty:
      place newElement at current top_of_stack
      size++

  if stack if full:
      return

  else:
      top_of_stack++;
      place newElement at index top_of_stack
      size++
}
```

Stack Instance Fields

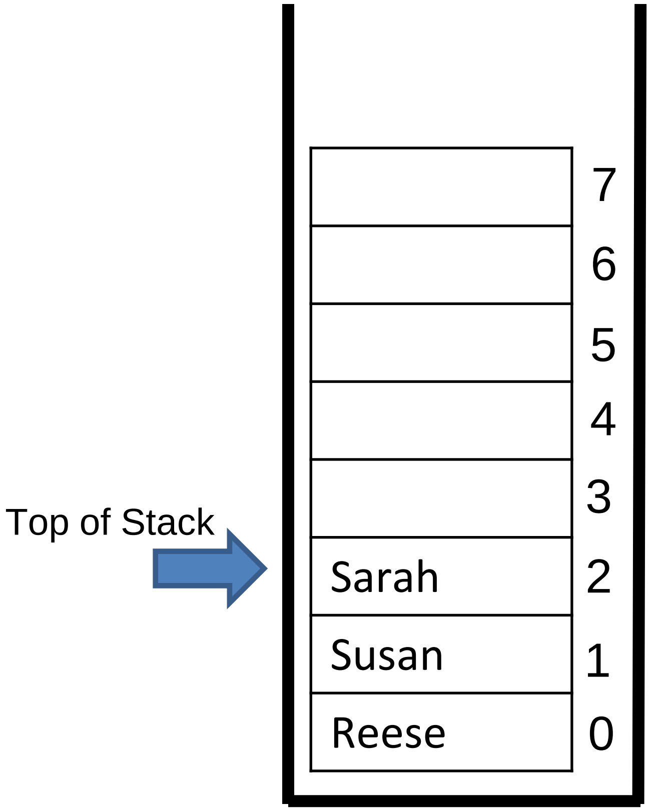
```
String[] data = new String[8]
            top_of_stack = 2
                    size = 3
```

`stack.push("Sarah")`

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void pop(){




}
```

The pop method will always remove the element on the top of the stack

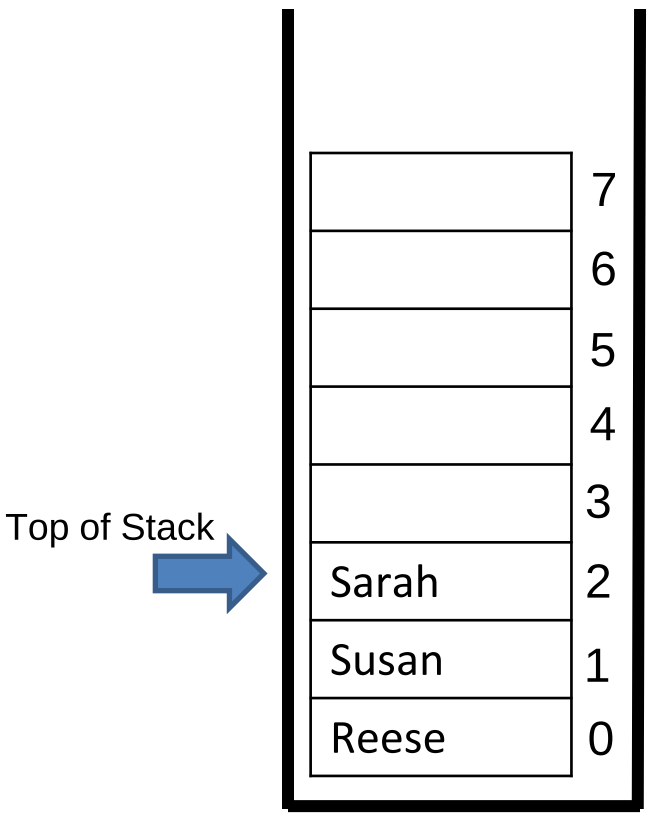
Stack Instance Fields

```
String[] data = new String[8]
         top_of_stack = 2
                 size = 3
```

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void pop(){

   if stack is empty:
       return

   Set index top_of_stack to be null
   top_of_stack--
   size--

}
```

Stack Instance Fields

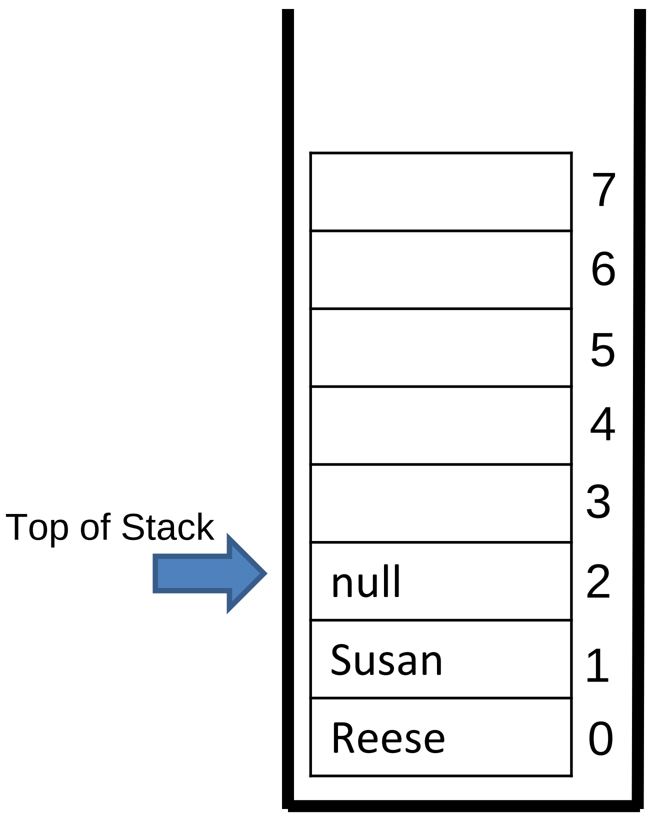
```
String[] data = new String[8]
            top_of_stack = 2
                    size = 3
```

```
stack.pop()
```

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void pop(){

   if stack is empty:
       return

   Set index top_of_stack to be null
   top_of_stack--
   size--

}
```

Stack Instance Fields

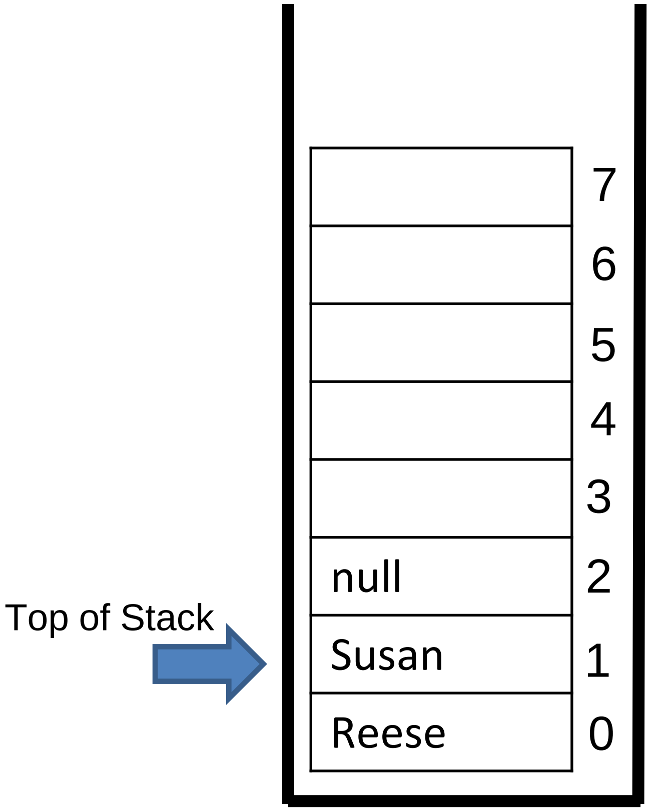
```
String[] data = new String[8]
            top_of_stack = 2
                    size = 3
```

`stack.pop()`

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void pop(){

   if stack is empty:
       return

   Set index top_of_stack to be null
   top_of_stack--
   size--

}
```

Stack Instance Fields

```
String[] data = new String[8]
          top_of_stack = 1
                  size = 3
```

```
stack.pop()
```

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

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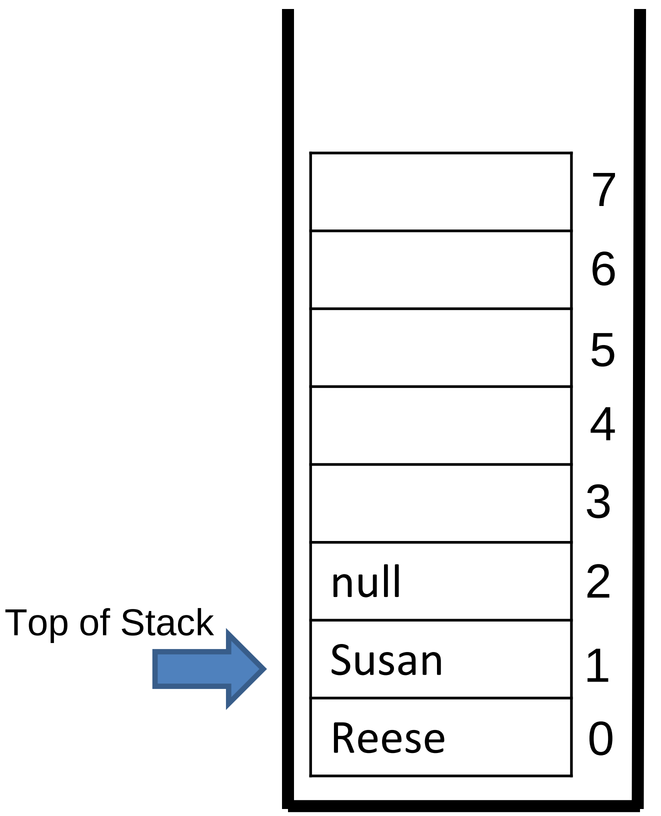


```
public void pop(){

   if stack is empty:
       return

   Set index top_of_stack to be null
   top_of_stack--
   size--

}
```

Stack Instance Fields

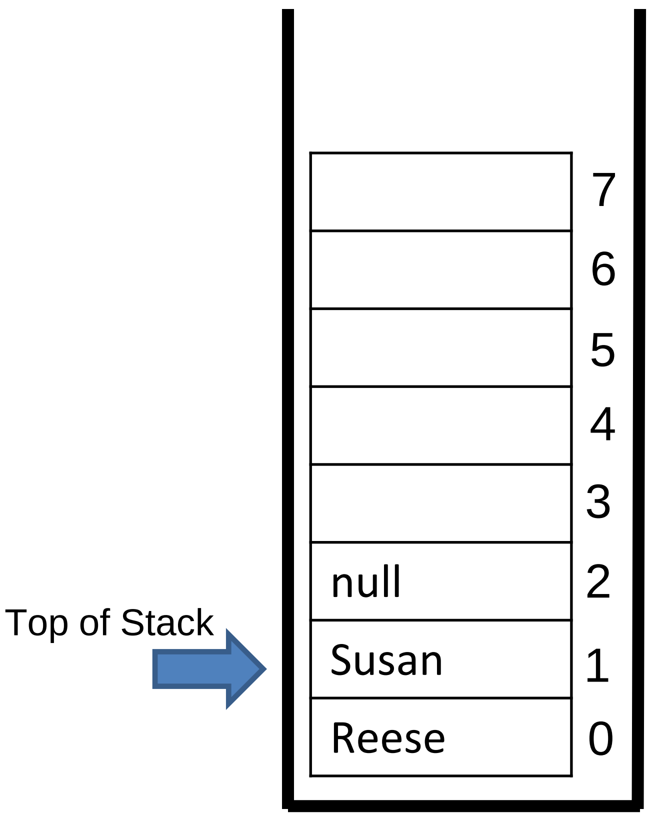
```
String[] data = new String[8]
            top_of_stack = 1
                    size = 2
```

`stack.pop()`

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public void pop(){

   if stack is empty:
       return

   Set index top_of_stack to be null
   top_of_stack--
   size--

}
```

Stack Instance Fields

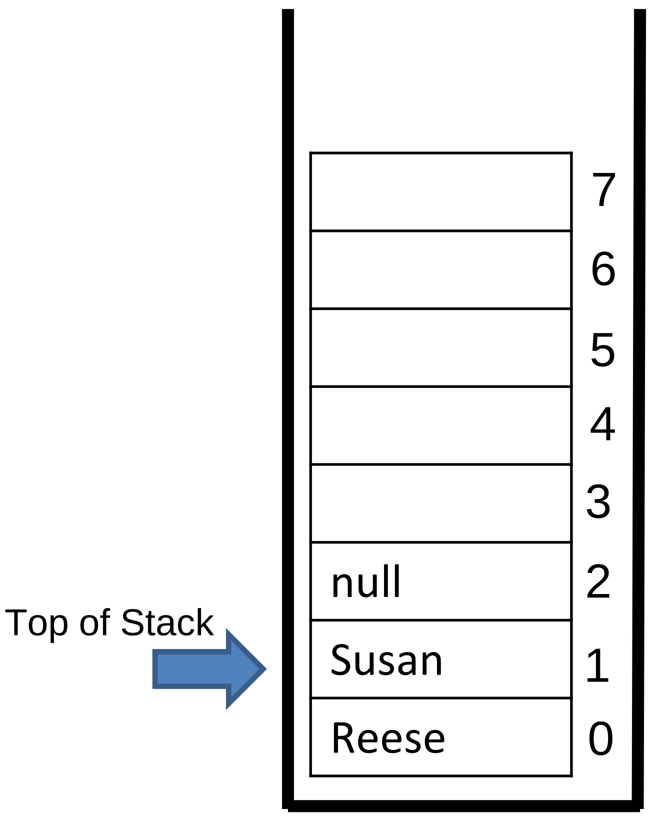
```
String[] data = new String[8]
            top_of_stack = 1
                    size = 2
```

Note: This method does not return the element that was removed, however there may be times where the pop() method returns the element that got removed

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public String peek(){



}
```

Stack Instance Fields

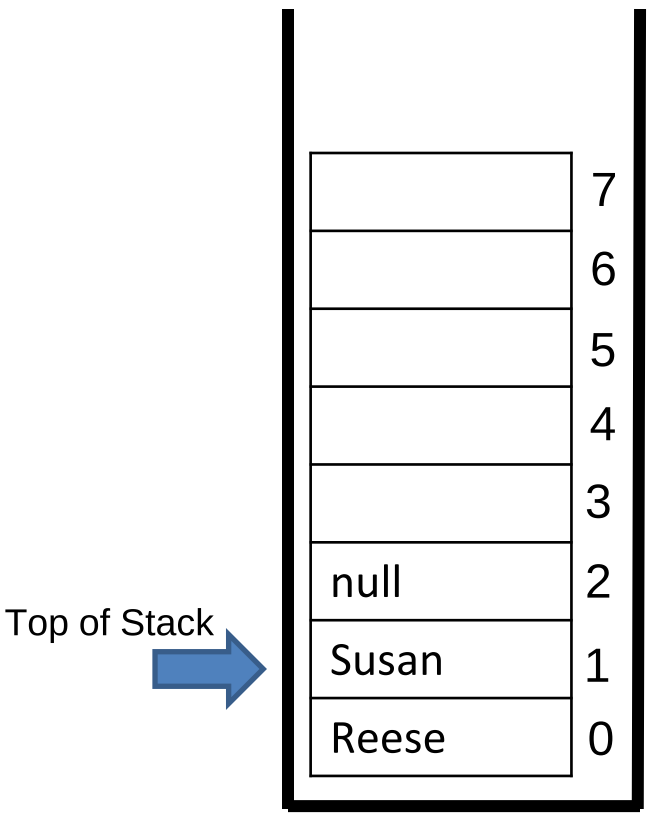
```
String[] data = new String[8]
          top_of_stack = 1
                  size = 2
```

The `peek()` method returns the element that is currently on the top of the stack

Stack Implementation (Array)

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Here, we've created an array of size 8 to hold our stack data



```
public String peek(){


  If stack is not empty:
     return data[top_of_stack]


}
```

Stack Instance Fields

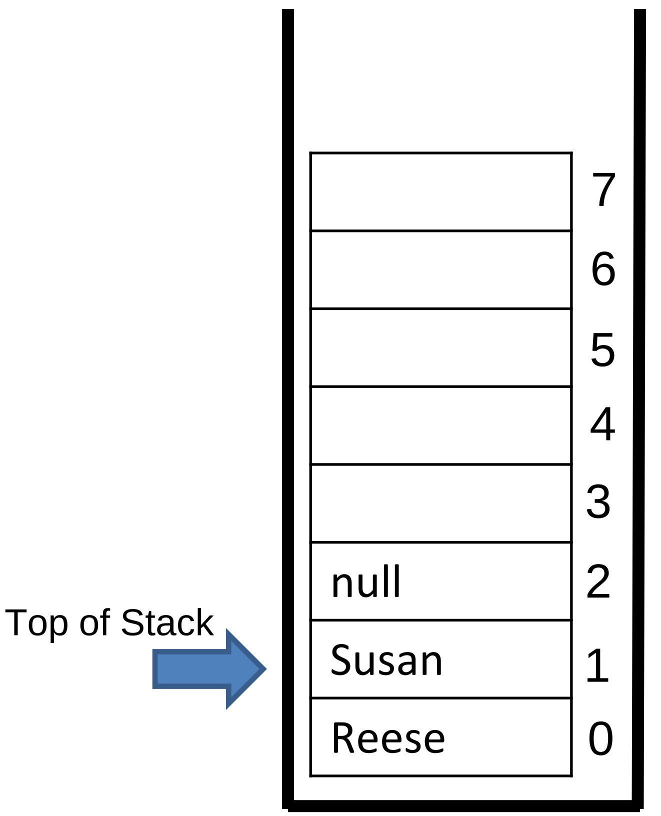
```
String[] data = new String[8]
           top_of_stack = 1
                   size = 2
```

The `peek()` method returns the element that is currently on the top of the stack

Stack Implementation (Array)

Here, we've created an array of size 8 to hold our stack data

To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()



```
public boolean isEmpty(){


    if size == 0:
        return true

    else:
        return false
}
```

Stack Instance Fields

```
String[] data = new String[8]
             top_of_stack = 1
                     size = 2
```

The `isEmpty()` method returns a boolean: true if the stack is empty, false if the stack is not empty