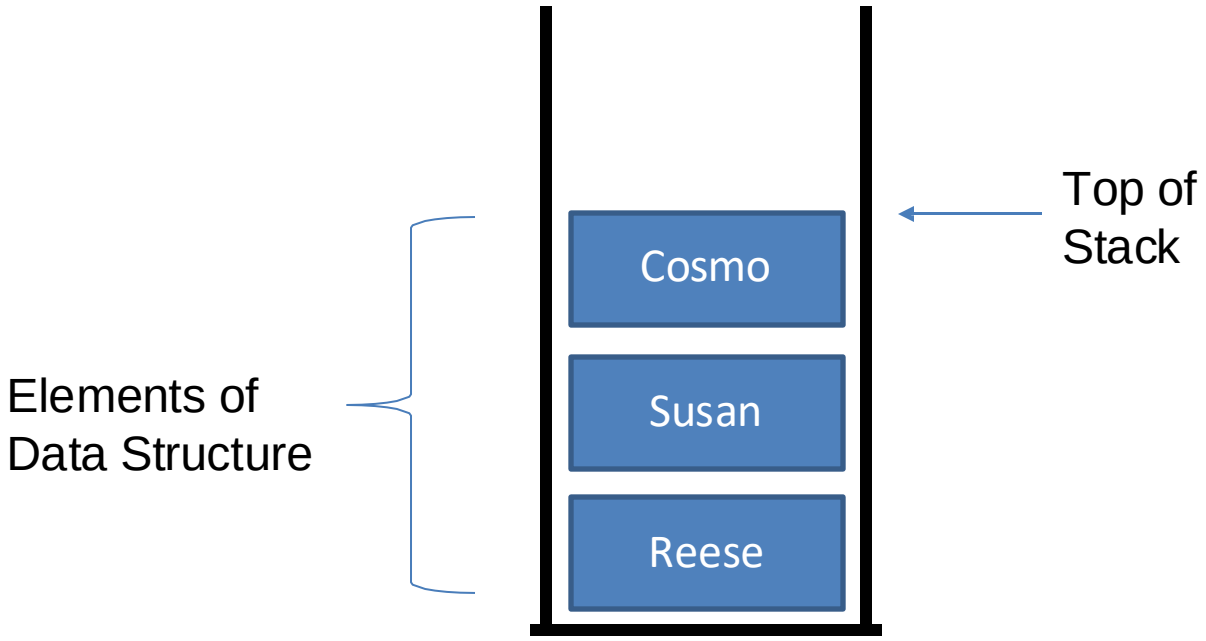
CSCI 132:
Basic Data Structures and Algorithms

Stacks (Array Representation)

Reese Pearsall & Iliana Castillon

Spring 2024

A **stack** is a data structure that can hold data, however the way we interact with a stack is a little bit different



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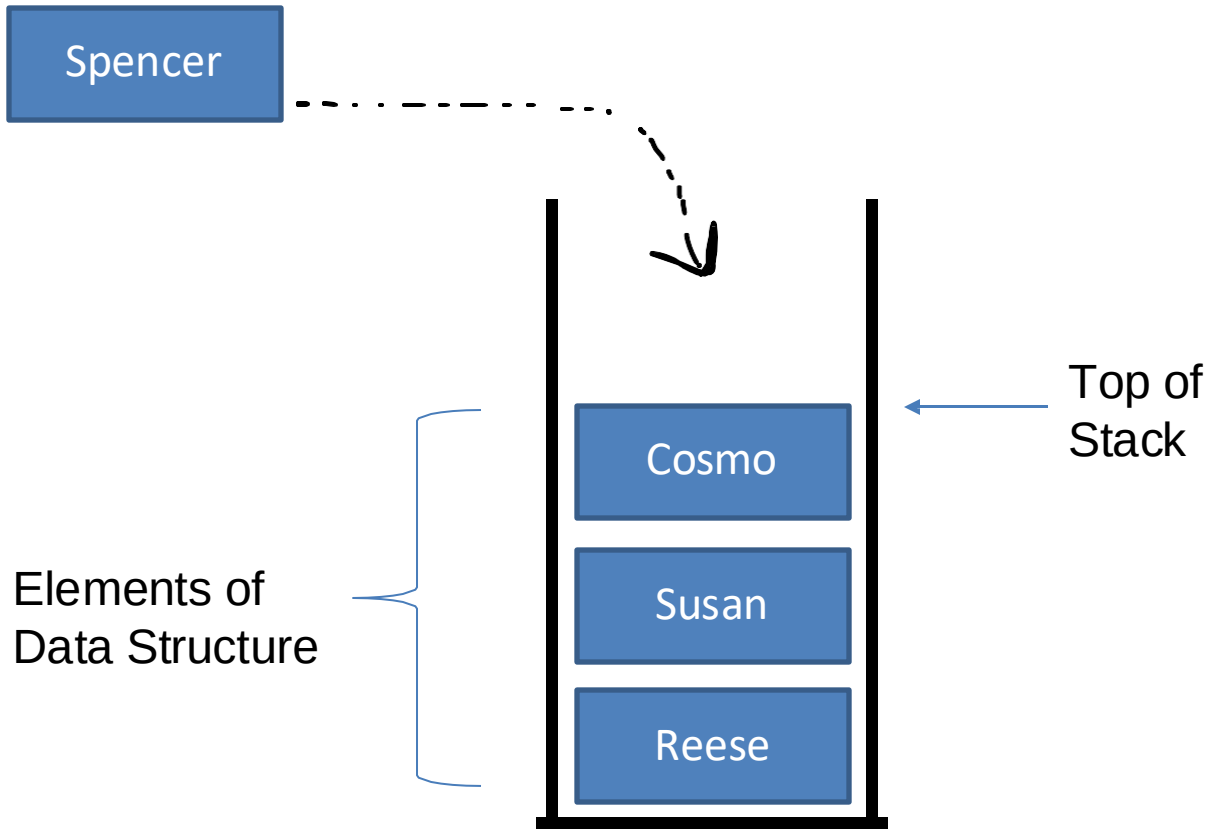
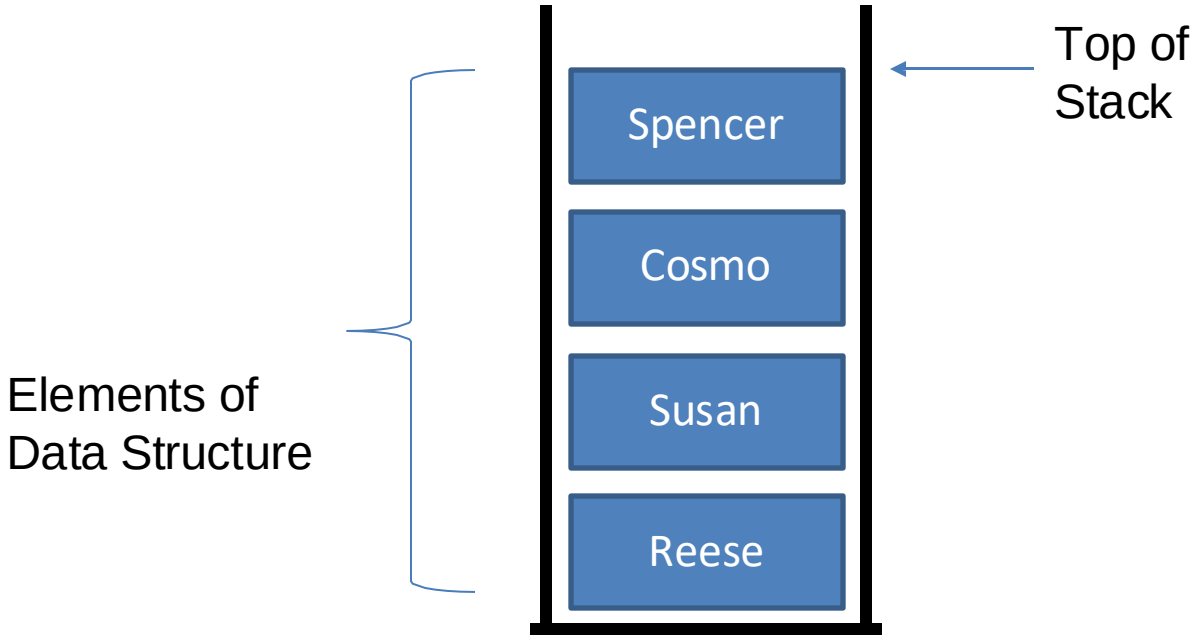


When only interact with the top of the stack.

If we want to add a new element, we must put it on the top of the stack

A **stack** is a data structure that can hold data, however the way we interact with a stack is a little bit different



Adding something to a stack is known as the **push** operation

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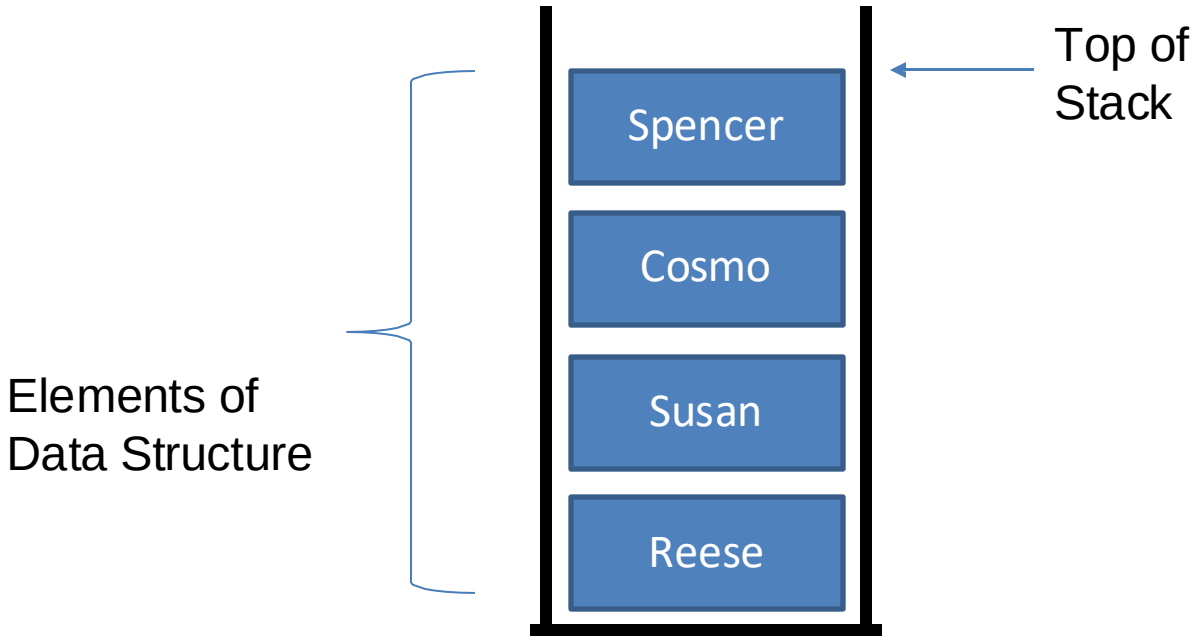
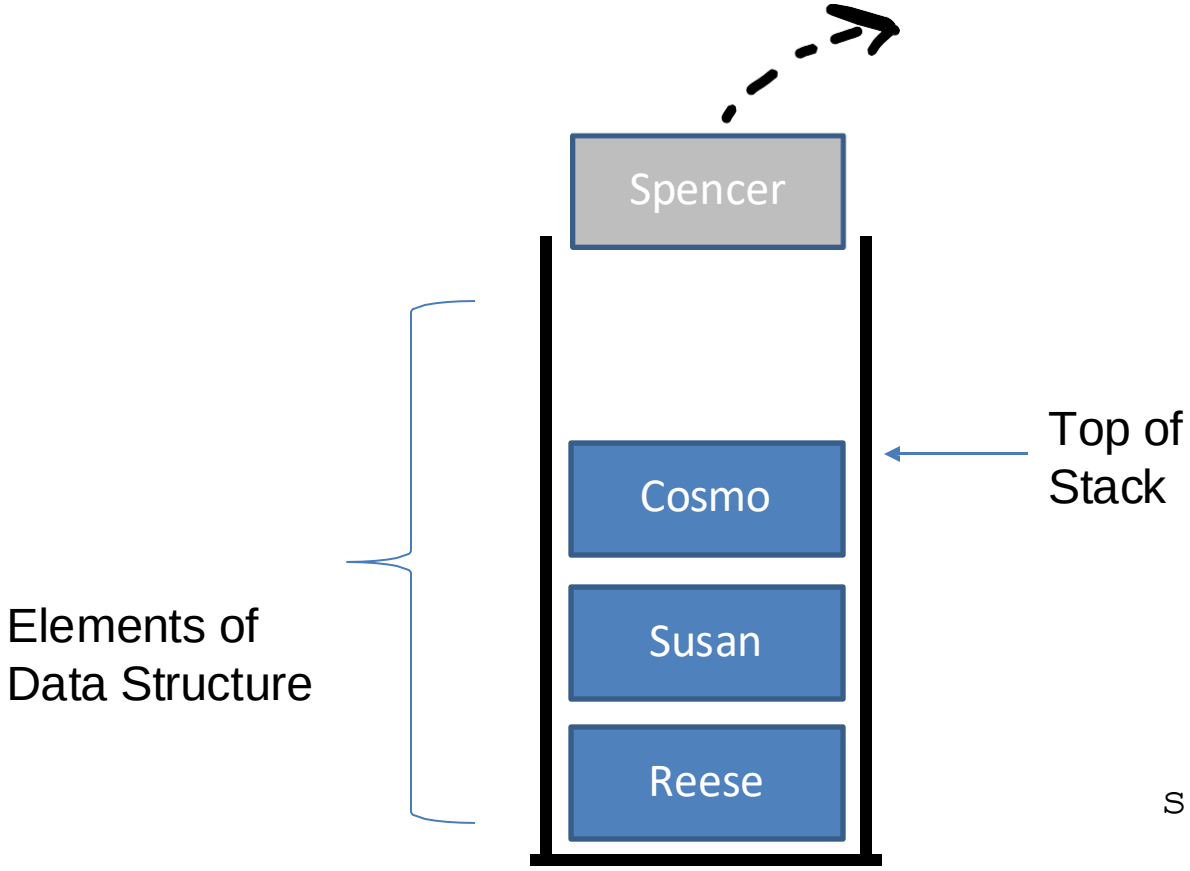


If we want to remove something, we must always remove the element on the top of the stack

A **stack** is a data structure that can hold data, however the way we interact with a stack is a little bit different



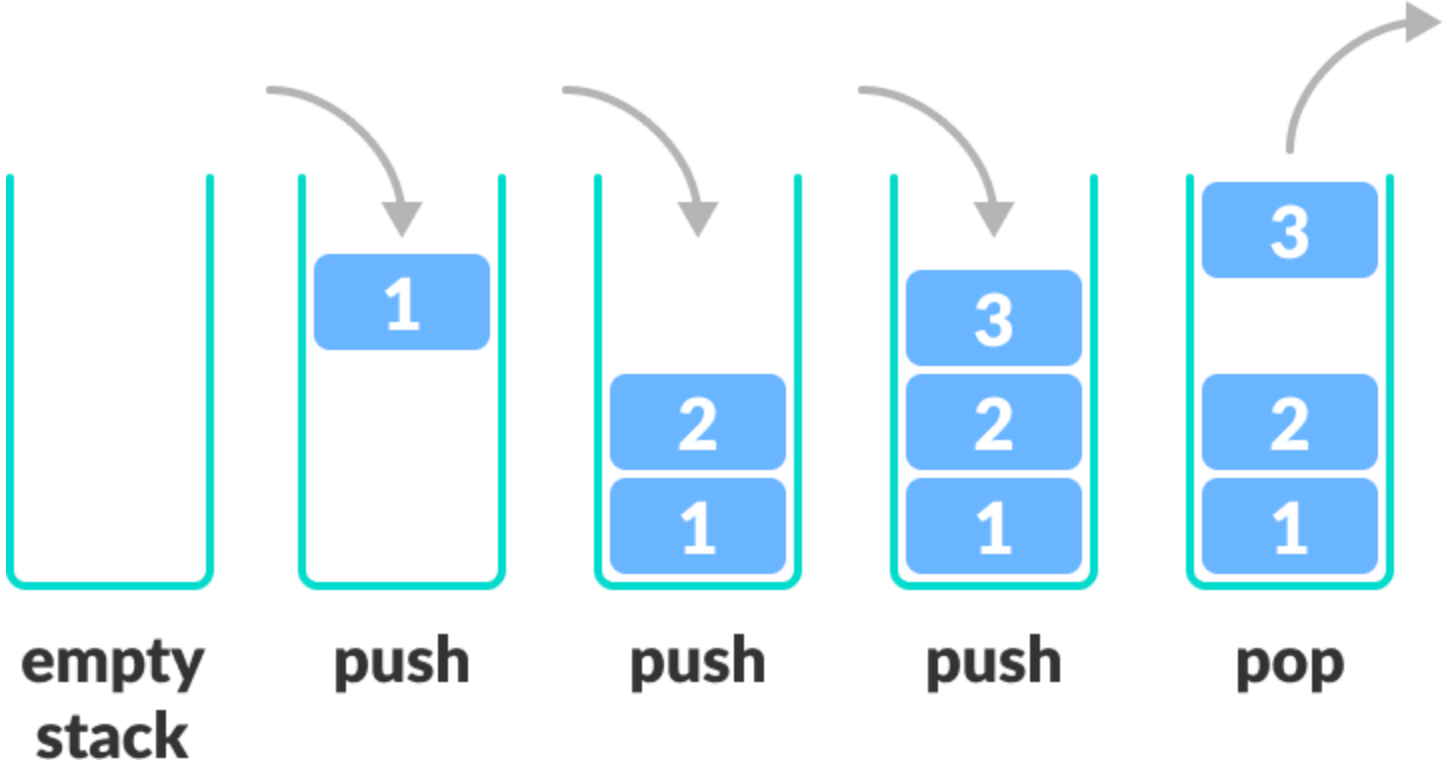
Removing an element is known as the **pop** operation

`stack.pop()` → Top node (spencer) is removed

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

We can:

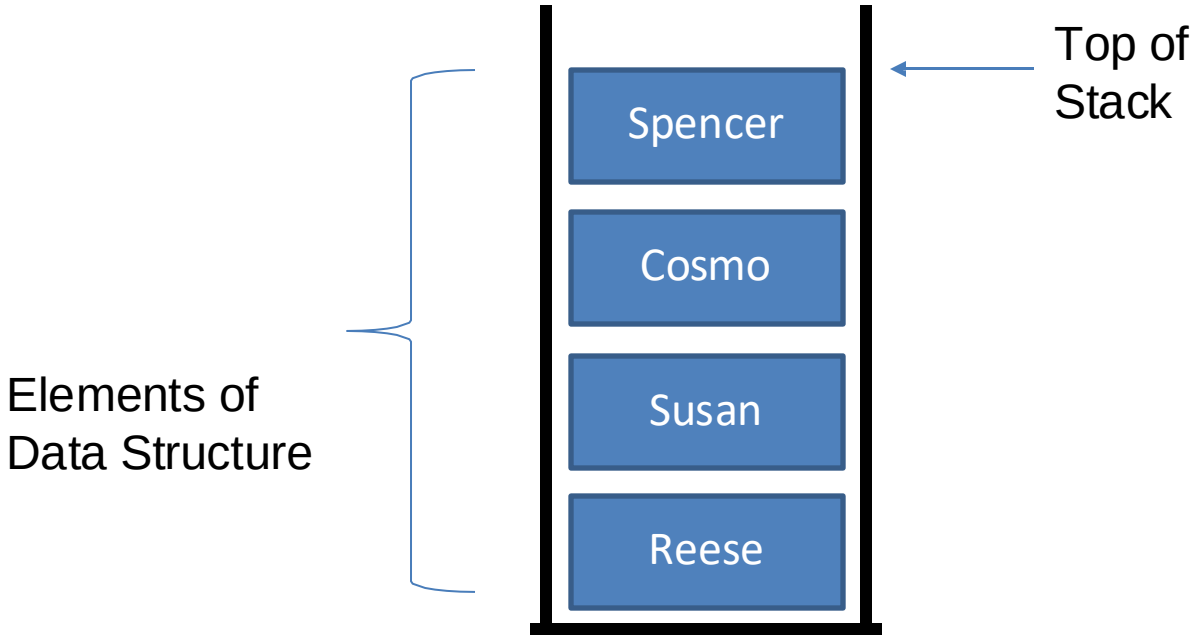
- Add an element to the top of the stack (push)
- Remove the top element (pop)



Stack Operations

push()
pop()
peek()
isEmpty()

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

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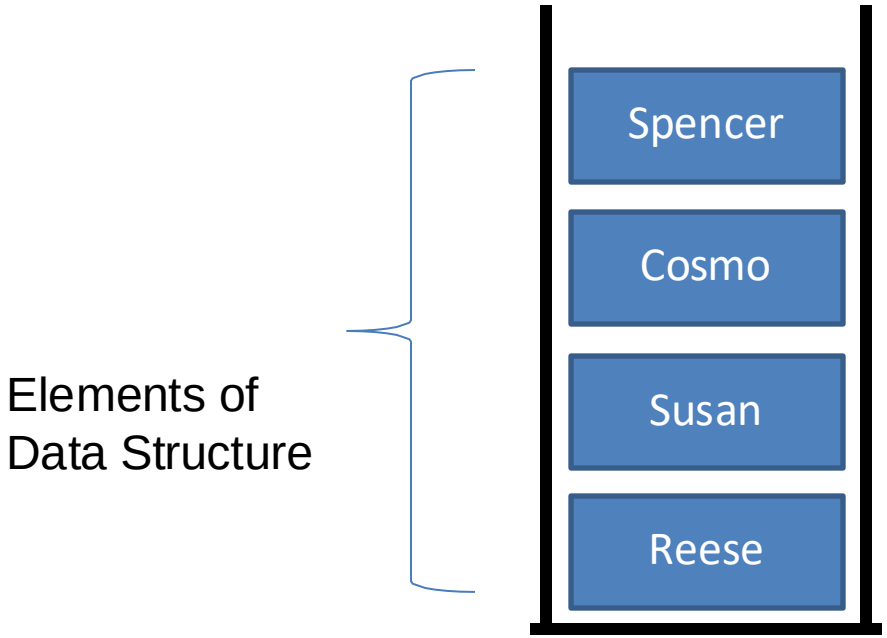

Our stack data structure needs to keep track of a few things

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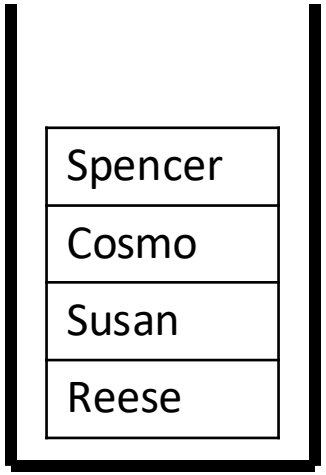

1. Array

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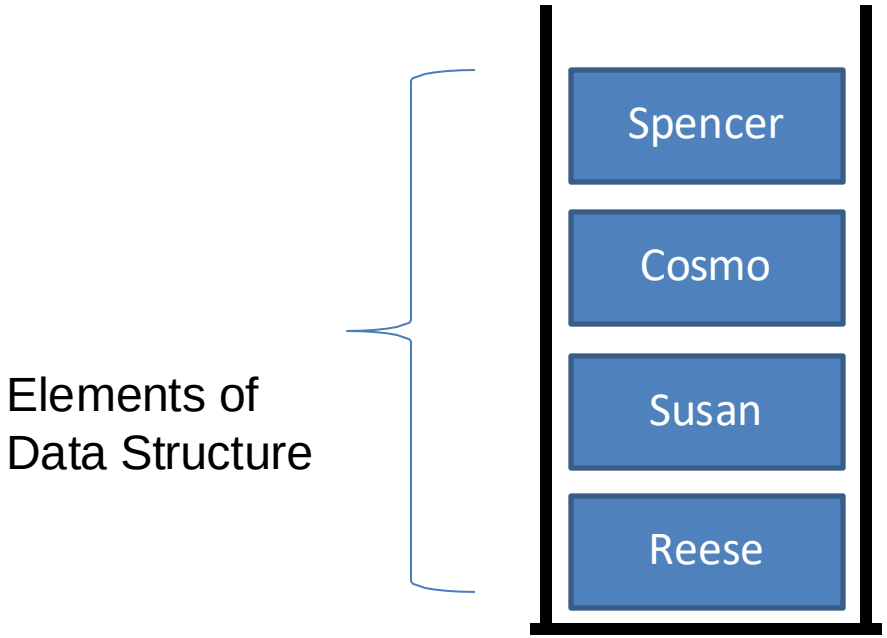

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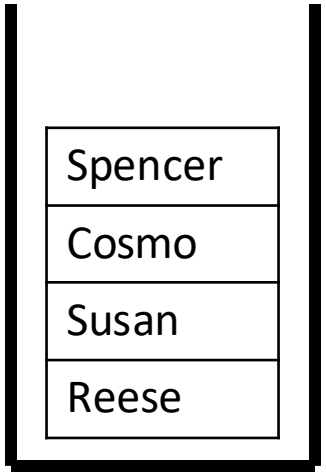

1. Array
2. ArrayList

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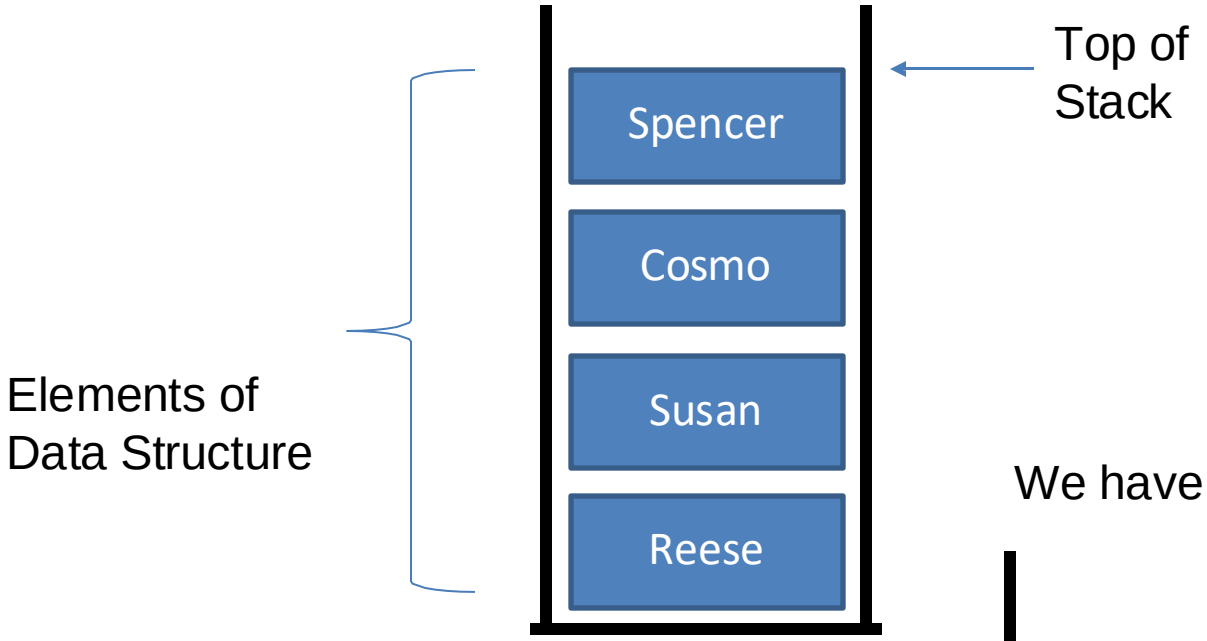

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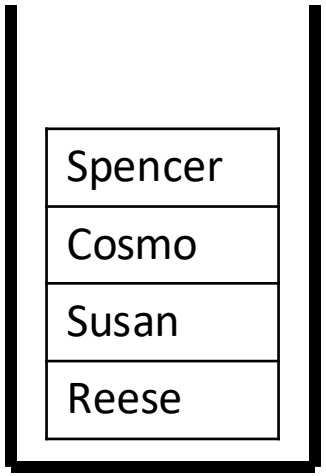
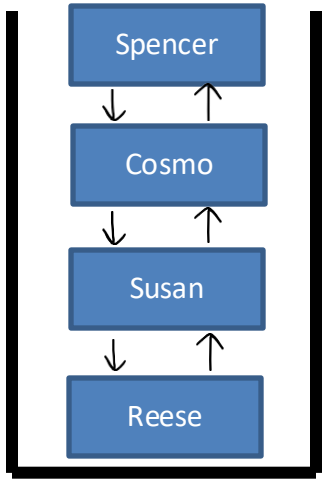
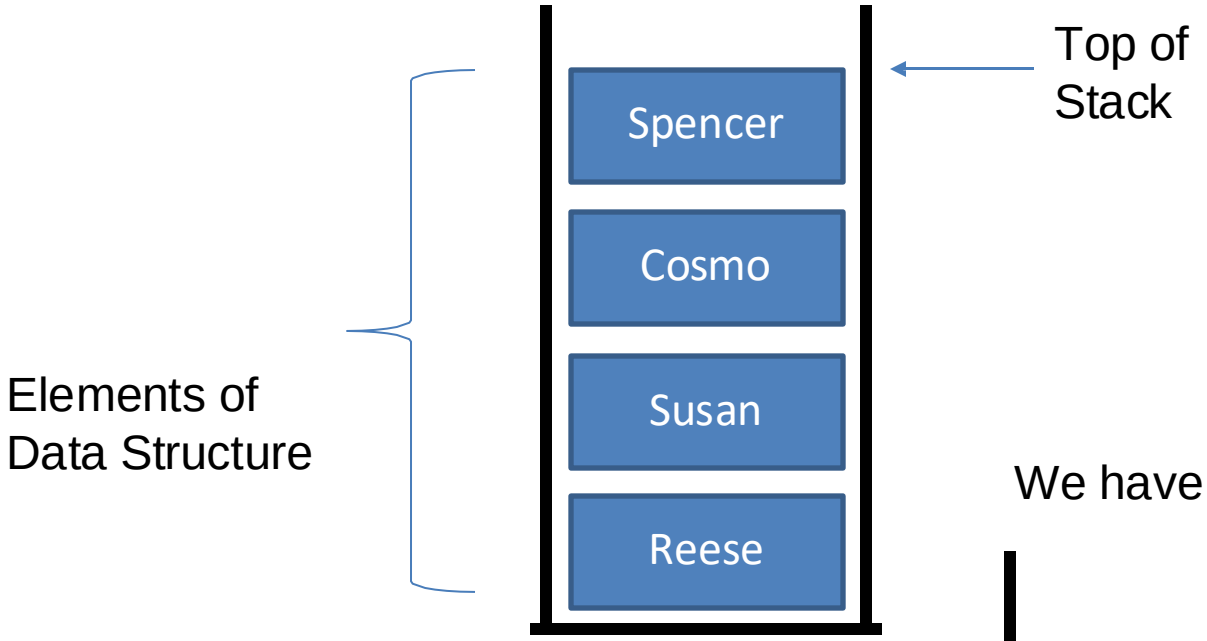


1. Array
2. ArrayList



3. Linked List

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

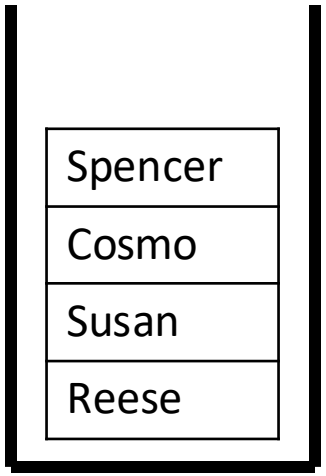


Our stack data structure needs to keep track of a few things

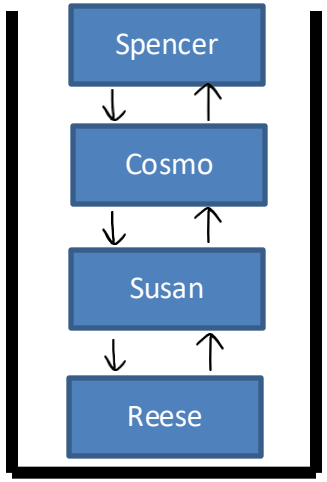
1. Something to hold our stack elements

Which should you pick?

We have a few options:



1. Array
2. ArrayList



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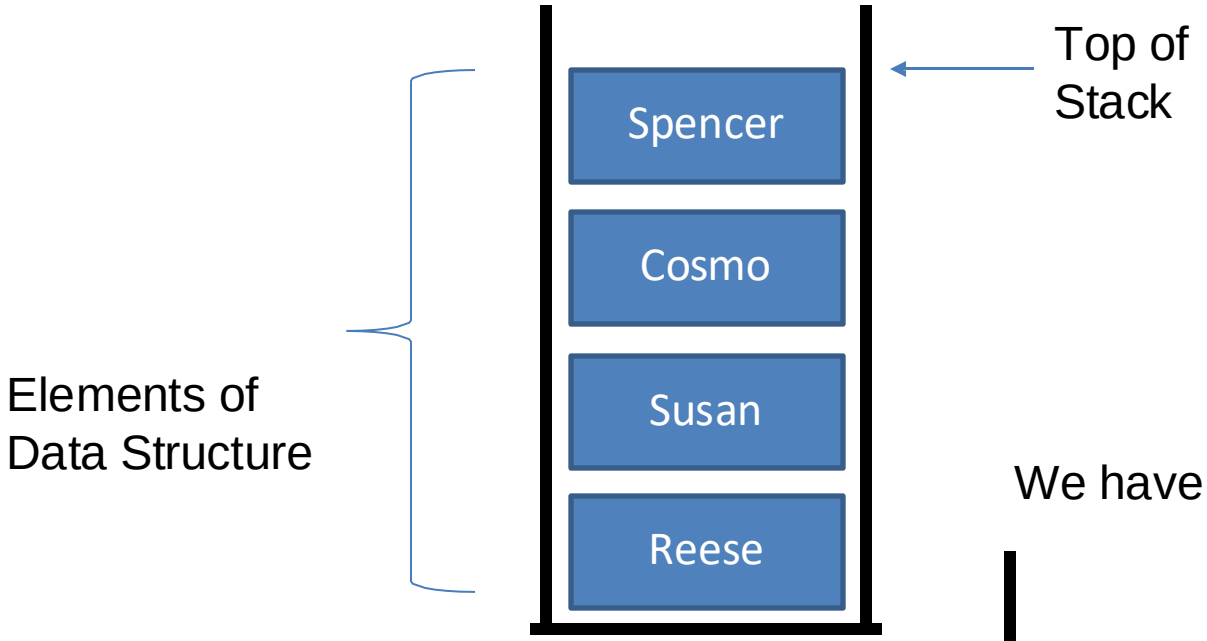

Our stack data structure needs to keep track of a few things

1. Something to hold our stack elements

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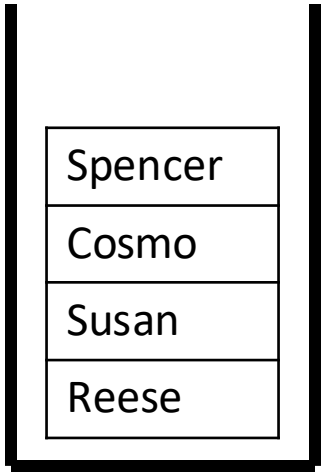
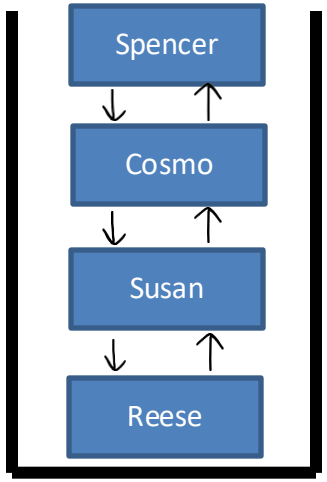


1. Array
2. ArrayList

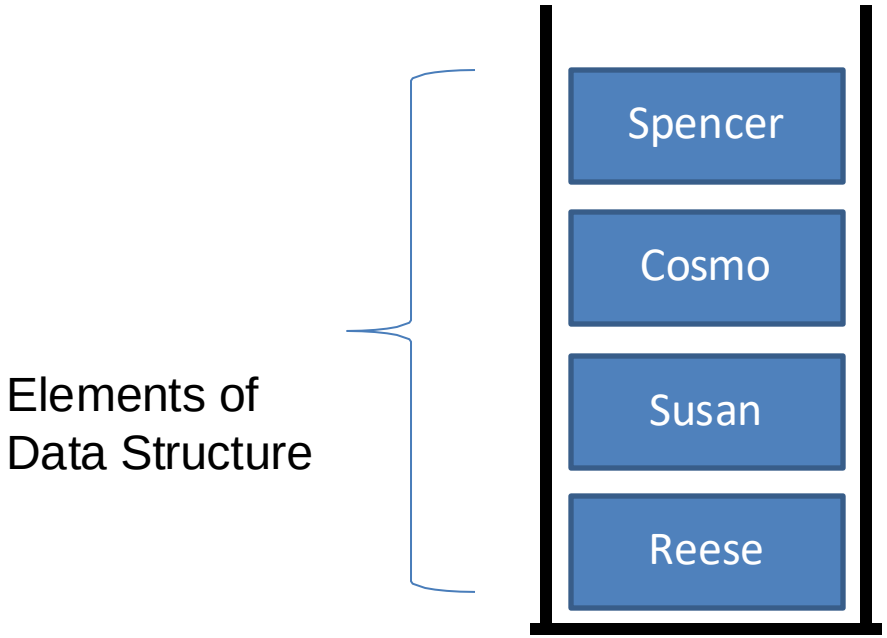


3. Linked List

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

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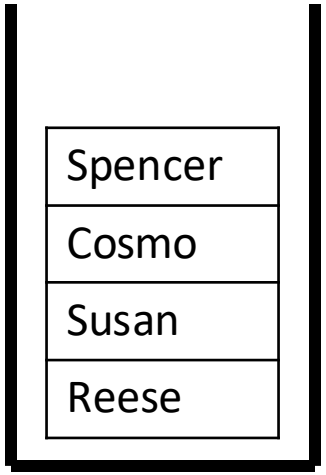
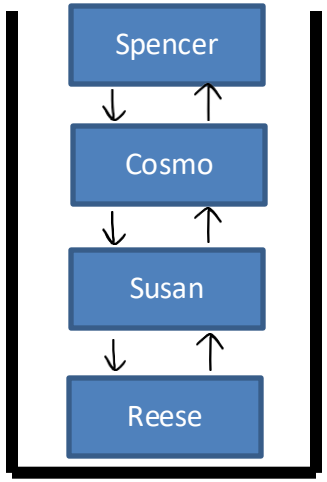


1. Array
2. ArrayList



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

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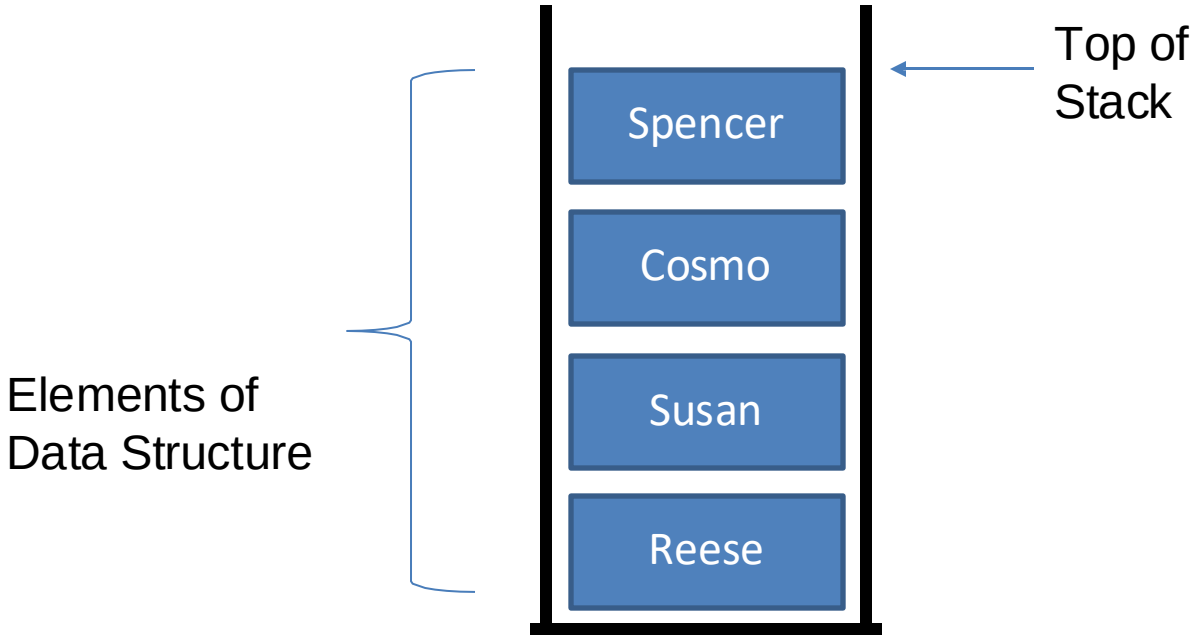
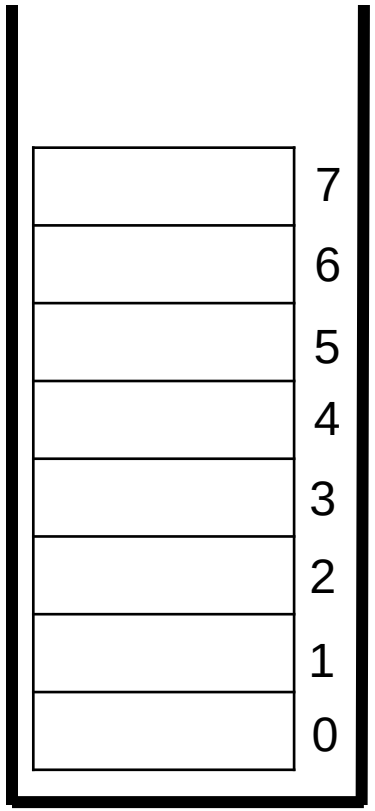


Our stack data structure needs to keep track of a few things

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)

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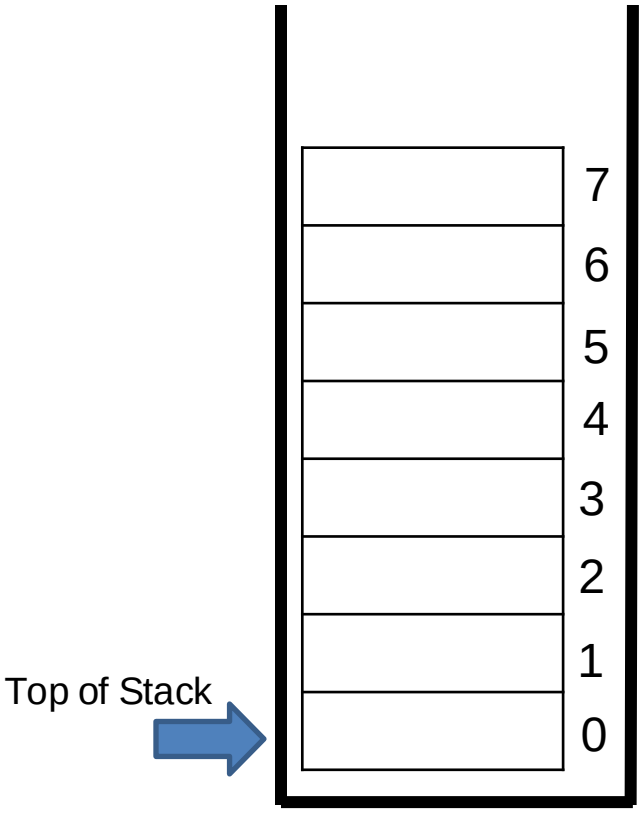

The bottom of the stack will always be at index 0, and grows towards the higher indices

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

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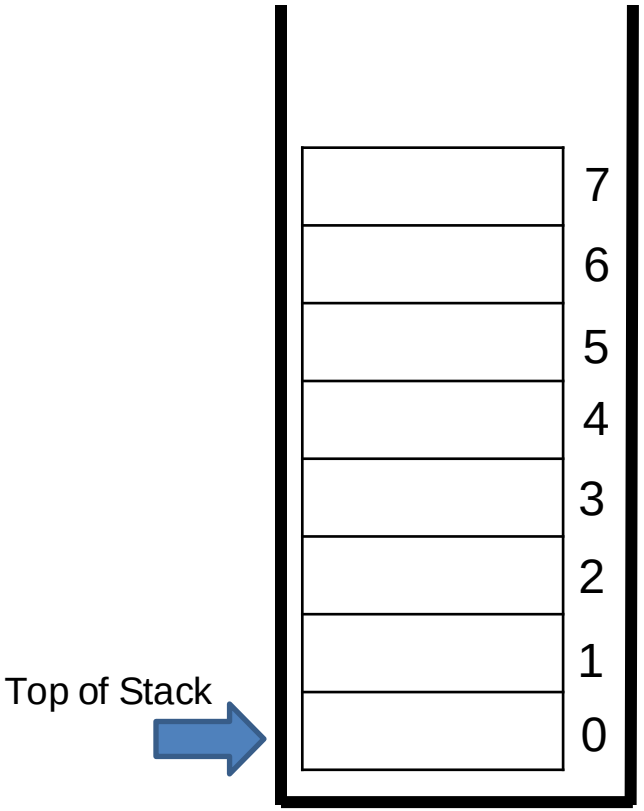


```
public void push(newElement){




}
```

To Do List:

- Push()
- Pop()
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Stack Instance Fields

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

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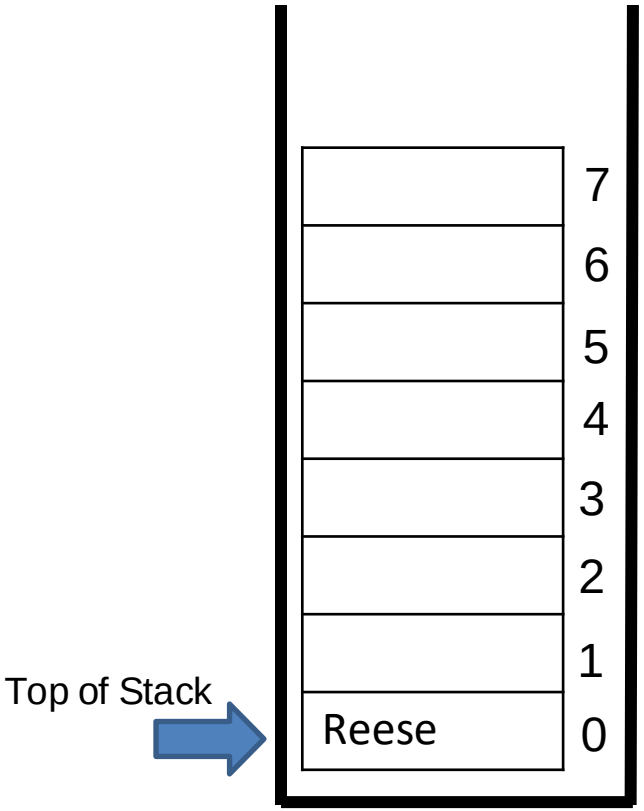


```
public void push(newElement){

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

    if stack if full: return

}
```

To Do List:

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

Stack Instance Fields

```
String[] data = new String[8]
top_of_stack = 0
size = 1
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Stack Implementation (Array)

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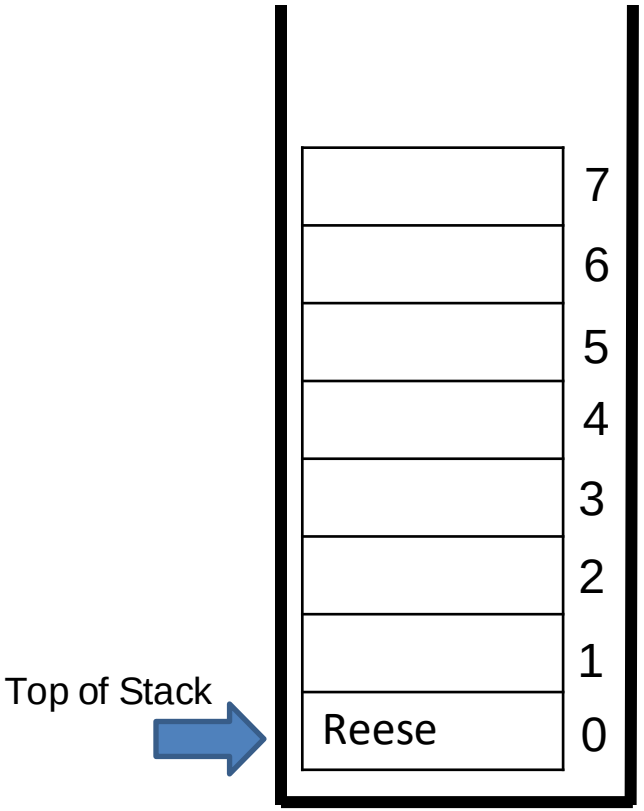


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}
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To Do List:

- Push()
- Pop()
- Peek()
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Stack Instance Fields

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String[] data = new String[8]
top_of_stack = 0
size = 1
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Stack Implementation (Array)

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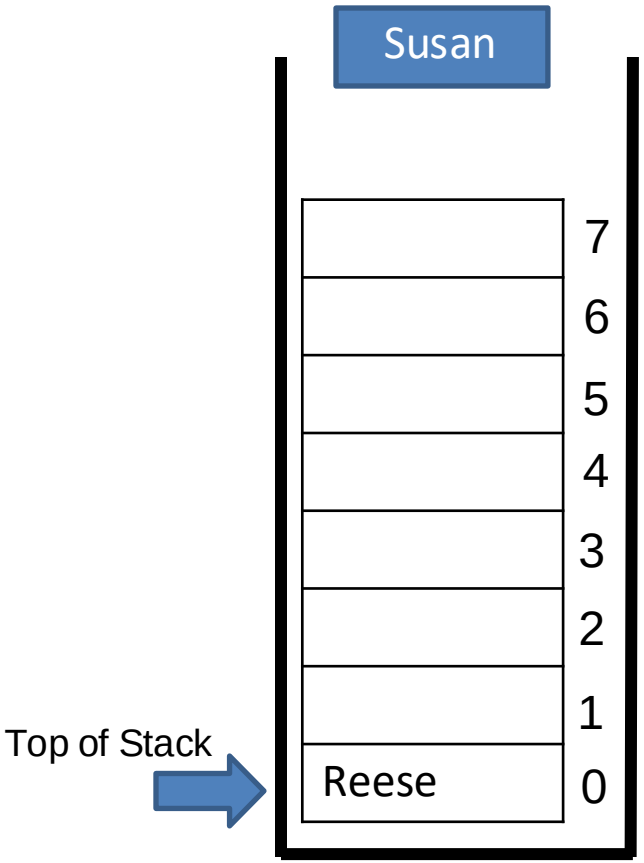


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}
```

Stack Instance Fields

String[] data = new String[8]

top_of_stack = 0

size = 1

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

Stack Implementation (Array)

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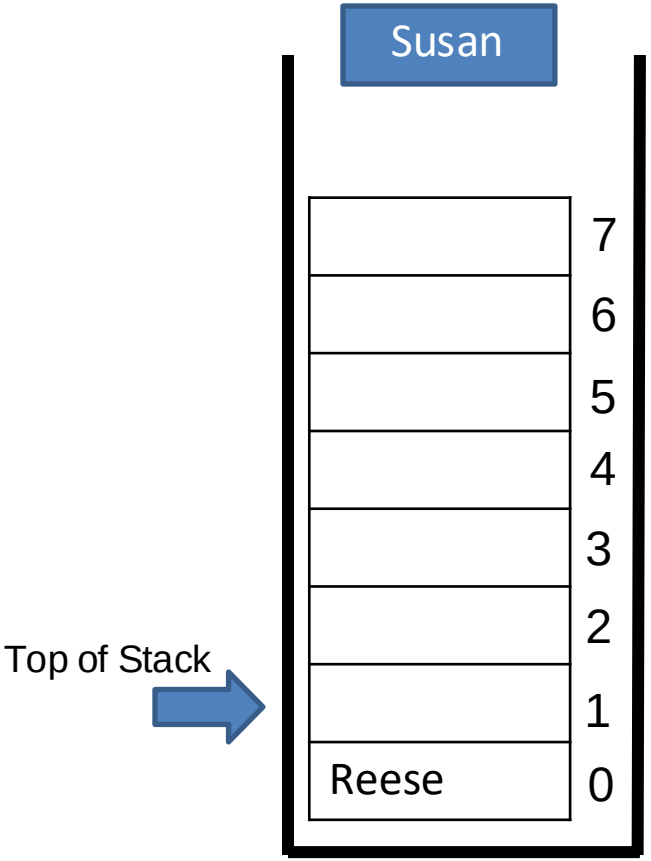


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stack.push("Susan")
```

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

Stack Instance Fields

String[] data = new String[8]

top_of_stack = 1

size = 1

Stack Implementation (Array)

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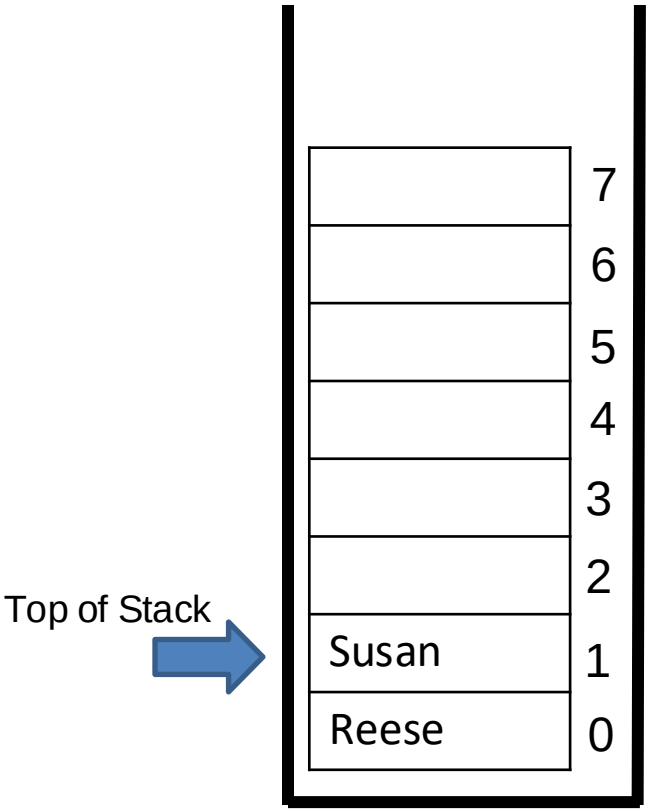


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To Do List:
- Push()
- Pop()
- Peek()
- IsEmpty()

Stack Instance Fields

String[] data = new String[8]

top_of_stack = 1

size = 1

Stack Implementation (Array)

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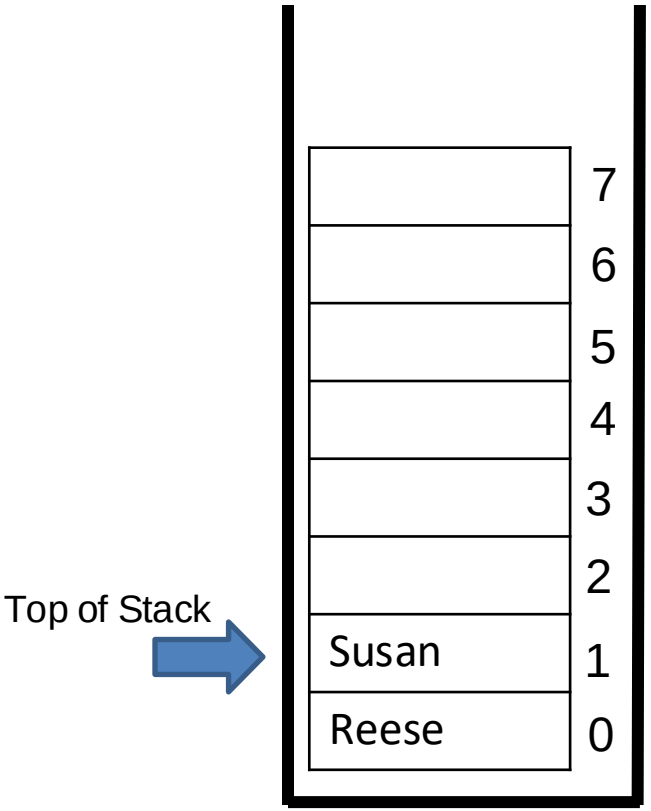


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}
```

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

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

Stack Instance Fields

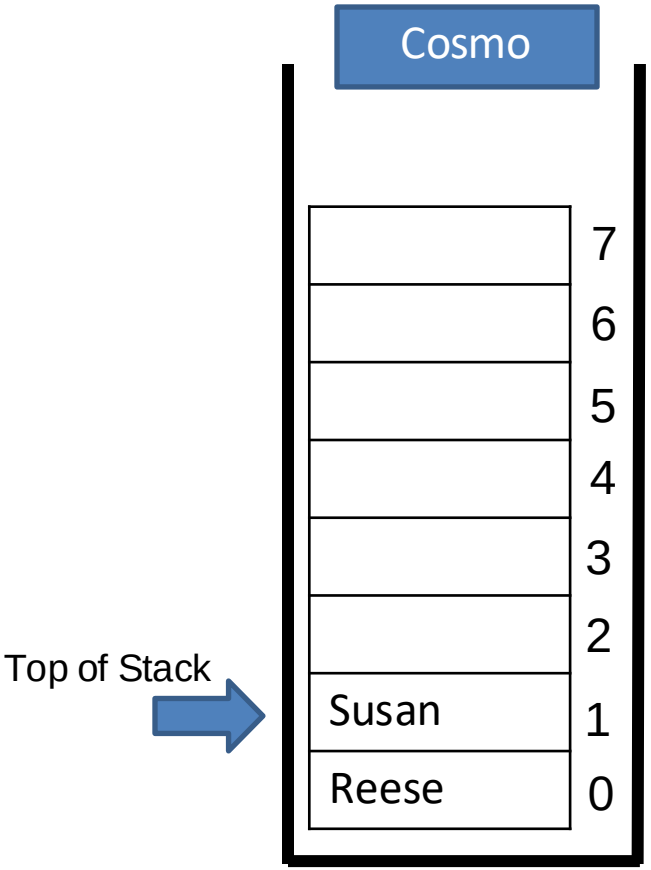
String[] data = new String[8]

top_of_stack = 1

size = 2

Stack Implementation (Array)

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

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}
```

`stack.push("Cosmo")`

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

Stack Instance Fields

String[] data = new String[8]

top_of_stack = 1

size = 2

Stack Implementation (Array)

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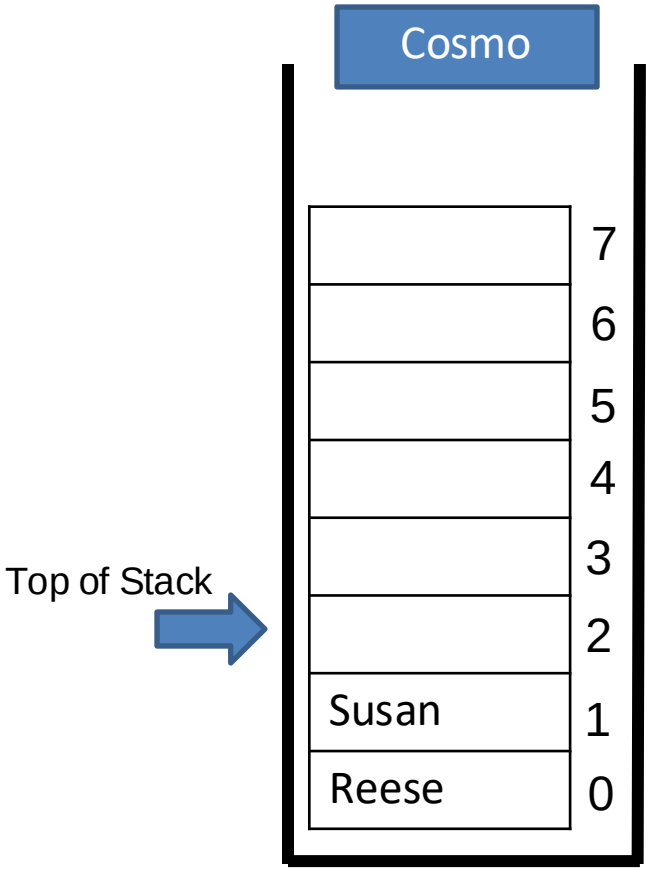


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    else:
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        place newElement at index top_of_stack
        size++
}
```

`stack.push("Cosmo")`

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

Stack Instance Fields

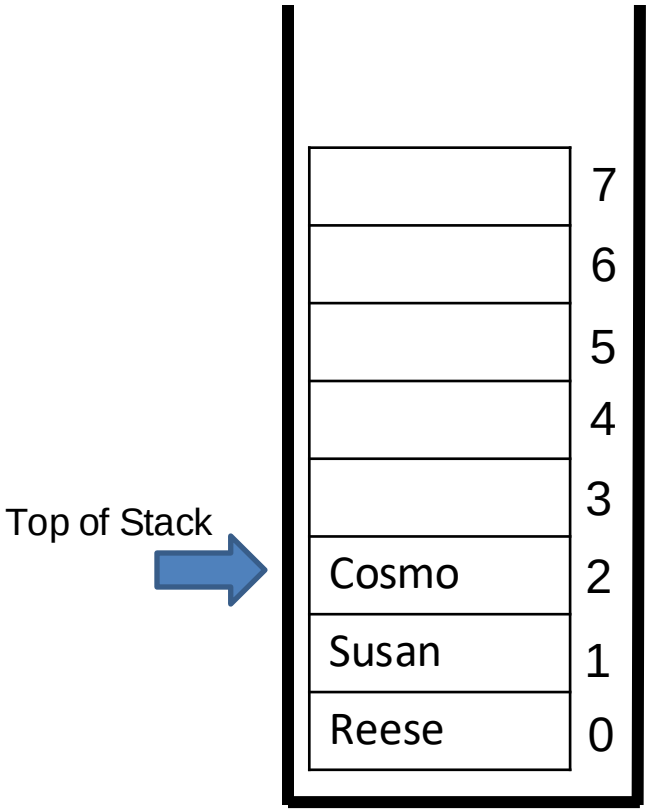
String[] data = new String[8]

top_of_stack = 2

size = 2

Stack Implementation (Array)

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

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        place newElement at index top_of_stack
        size++
}
```

```
stack.push("Cosmo")
```

To Do List:

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

Stack Instance Fields

String[] data = new String[8]

top_of_stack = 2

size = 3

Stack Implementation (Array)

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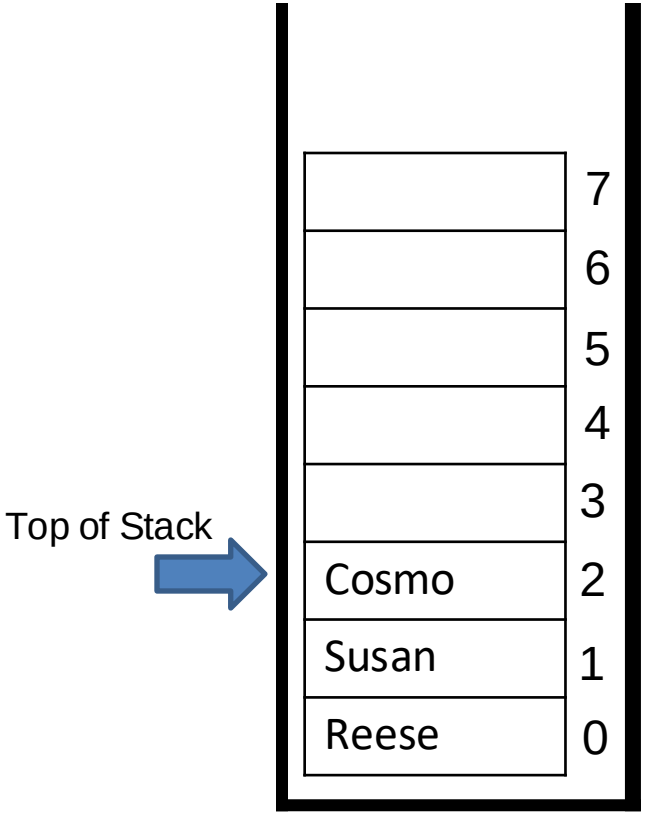



```
public void pop(){

}
```

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

To Do List:

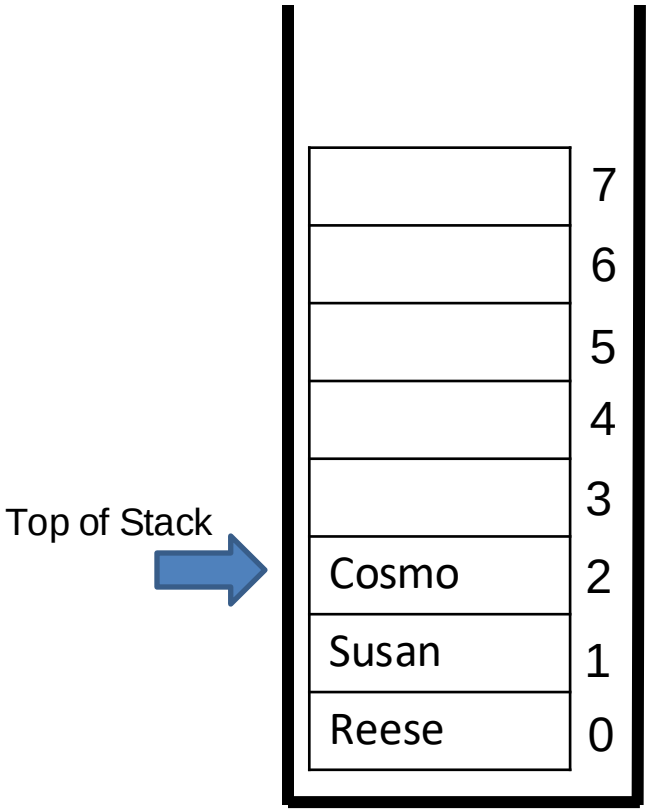
- Push()
- Pop()
- Peek()
- IsEmpty()

Stack Instance Fields

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

Stack Implementation (Array)

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--

}
```

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

Stack Instance Fields

String[] data = new String[8]

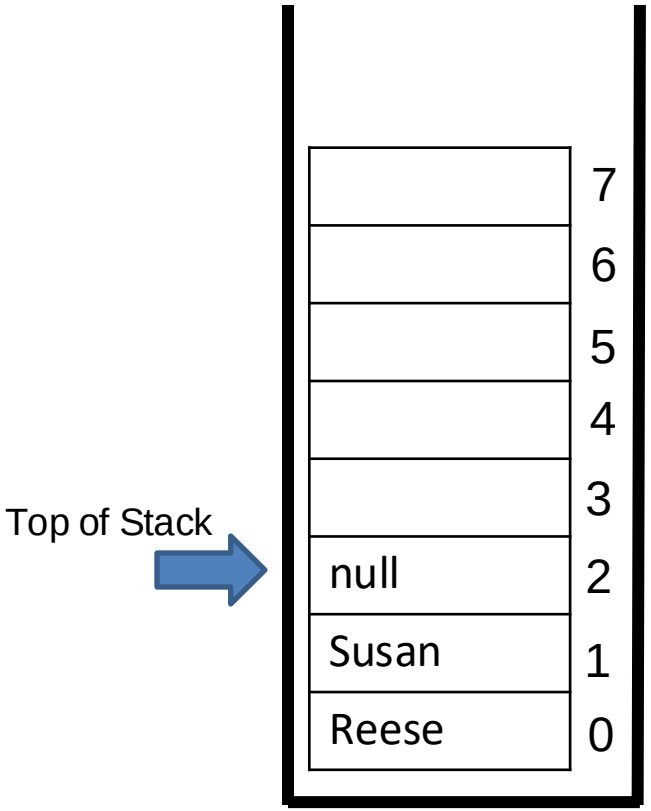
top_of_stack = 2

size = 3

`stack.pop()`

Stack Implementation (Array)

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--

}
```

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

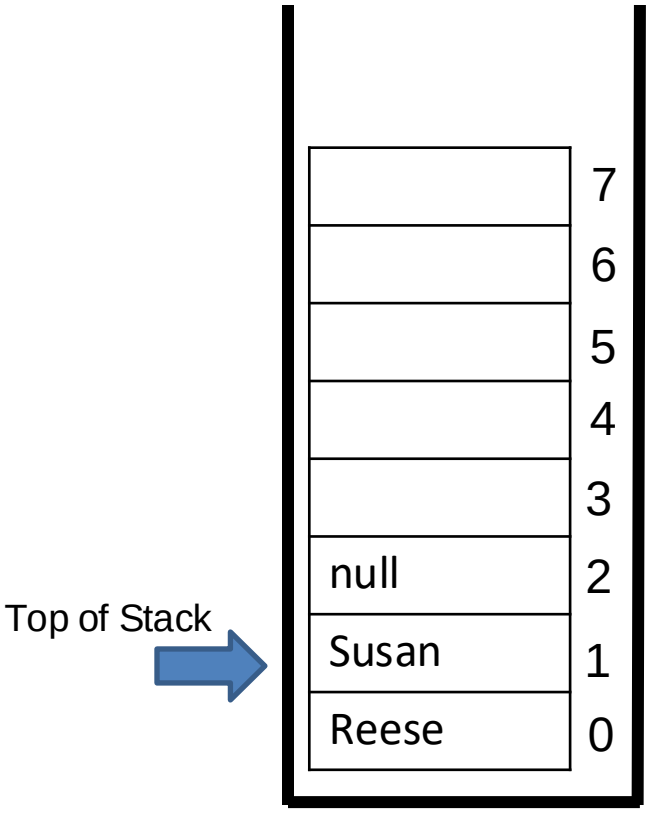
Stack Instance Fields

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

```
stack.pop()
```

Stack Implementation (Array)

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--

}
```

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

Stack Instance Fields

String[] data = new String[8]

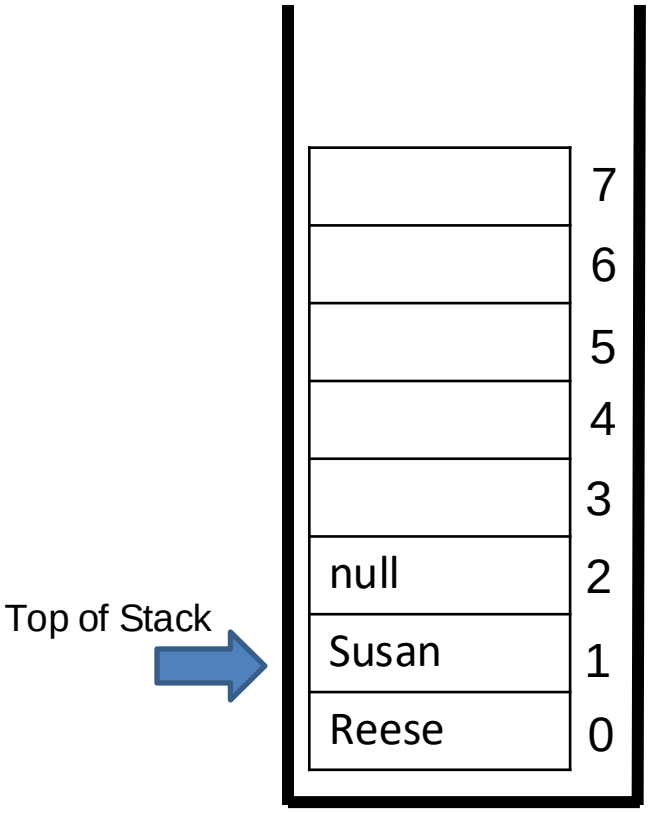
top_of_stack = 1

size = 3

```
stack.pop()
```

Stack Implementation (Array)

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--

}
```

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

Stack Instance Fields

String[] data = new String[8]

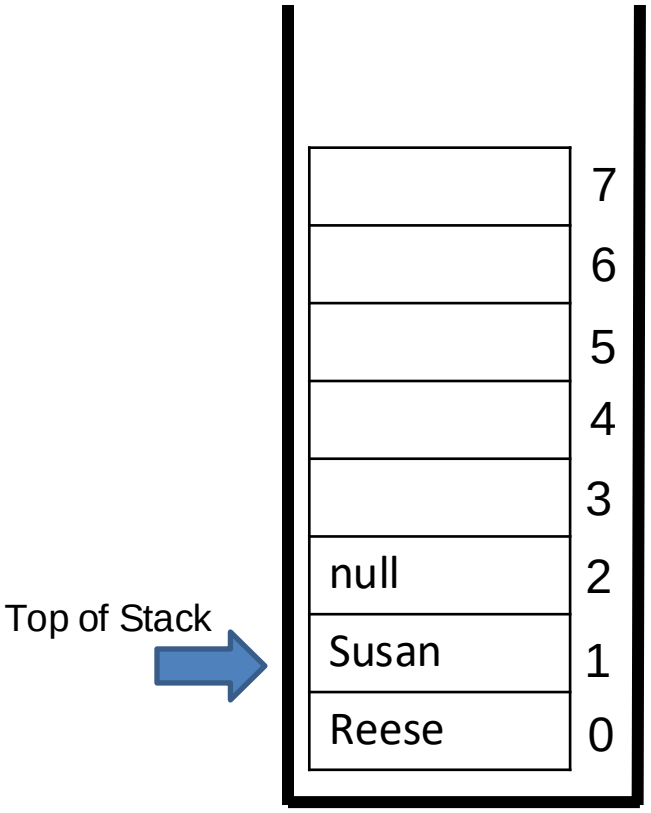
top_of_stack = 1

size = 2

```
stack.pop()
```

Stack Implementation (Array)

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--

}
```

To Do List:

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

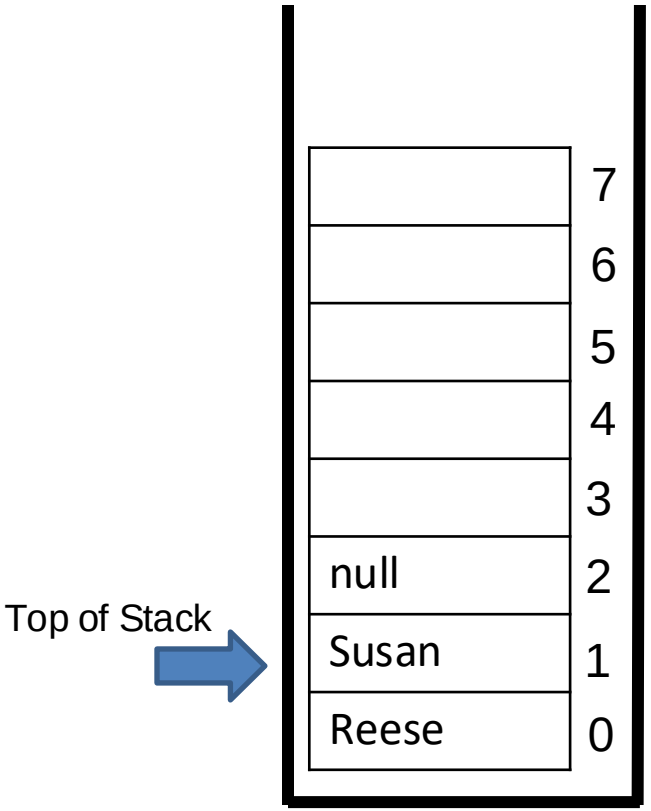
Stack Instance Fields

```
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)

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




```
public String peek(){

}
```

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

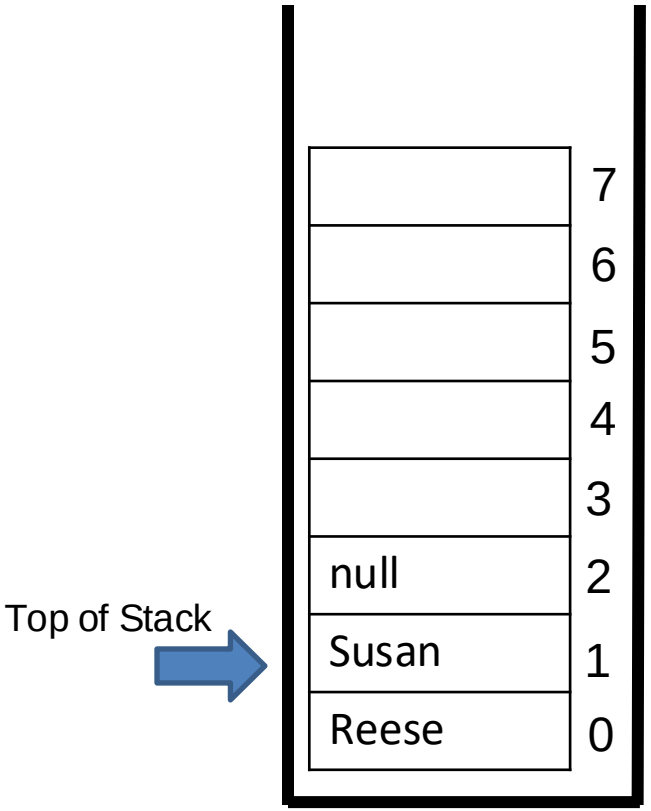
Stack Instance Fields

```
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




```
public String peek(){

    If stack is not empty: return
        data[top_of_stack]

}
```

To Do List:

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

Stack Instance Fields

String[] data = new String[8]

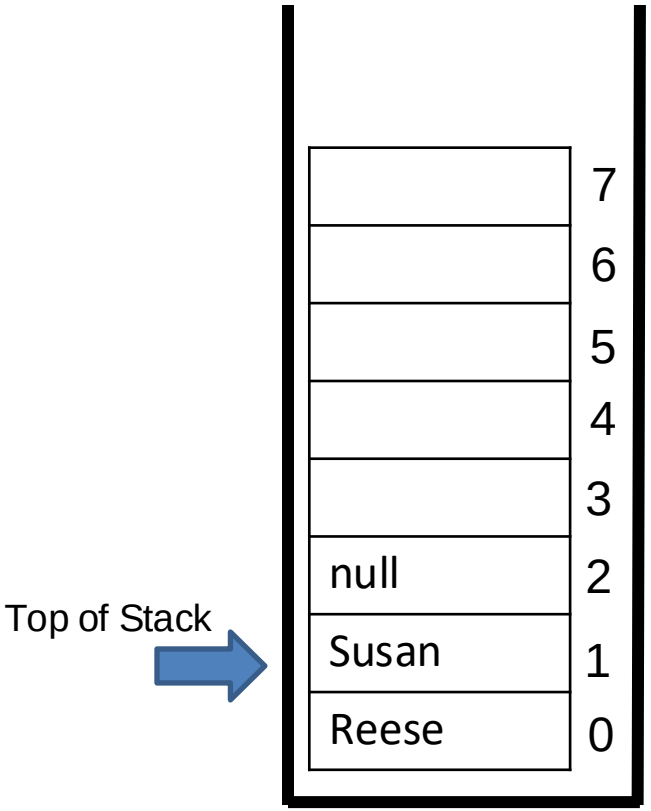
top_of_stack = 1

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




```
public boolean isEmpty(){


        if size == 0:
                return true

        else:
                return false
}
```

To Do List:

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

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