Classes Part 3

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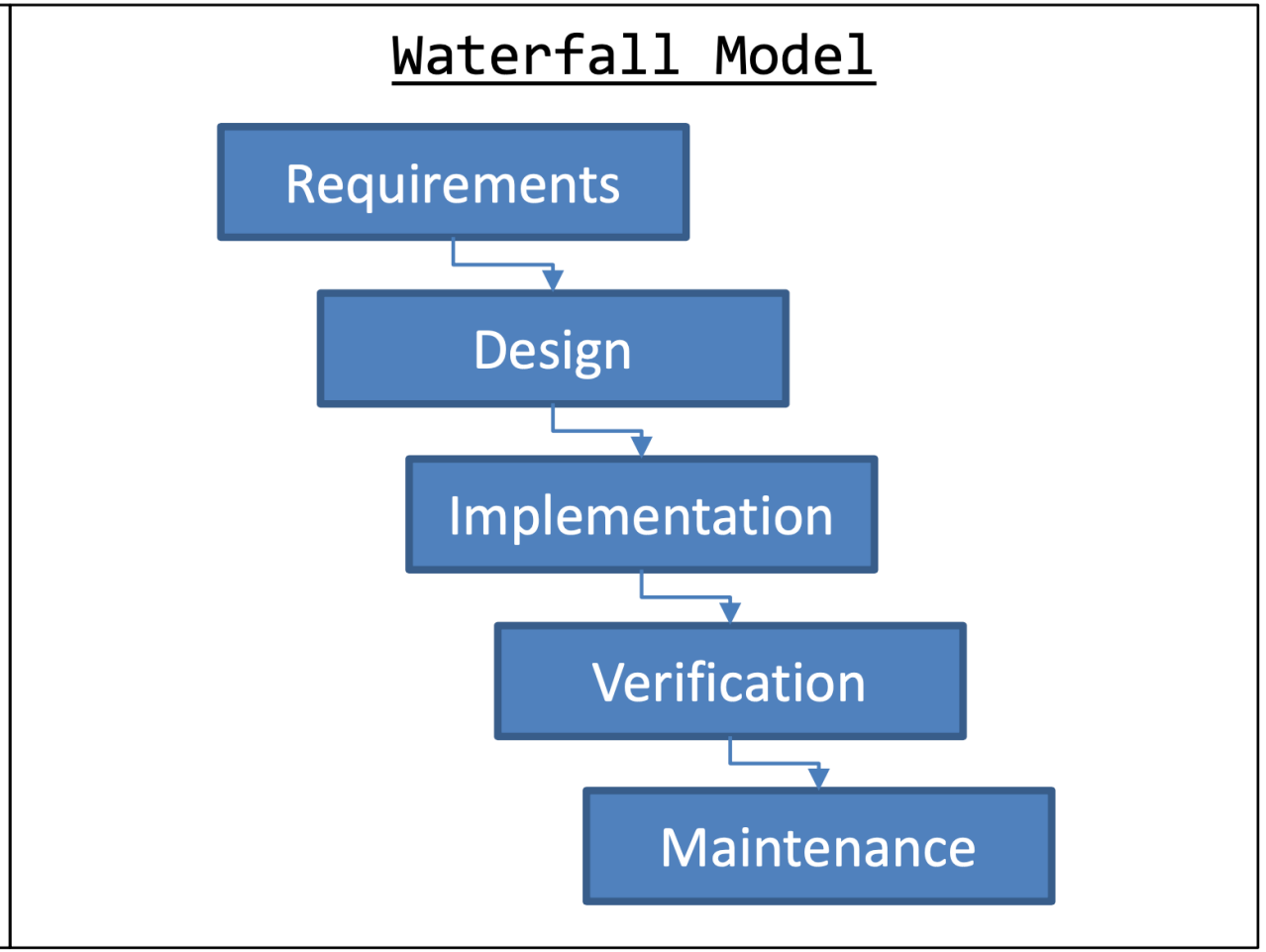
Waterfall Model

- Problem to Solve
  - Keep track of Tacos that I like
- Create Solutions to Problems
- Waterfall Model
  - Requirements
  - Design
  - Implement
  - Verification
  - Maintenance



Taco Problem

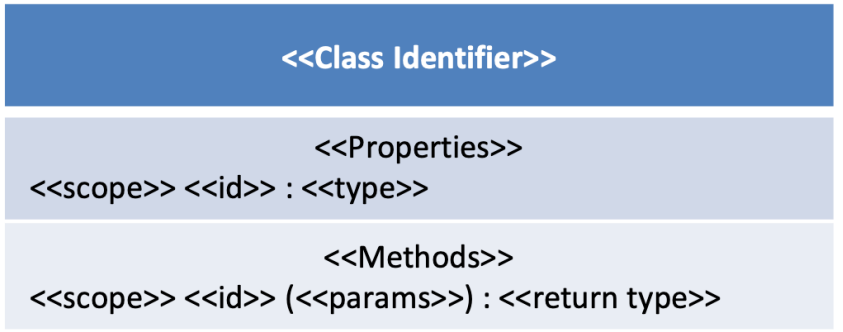
- Keep Track of important Taco Information
- Taco's Information
  - Name
  - Location
  - Price

- Should be able to
  - Add a Taco
  - Remove a Taco by Name
  - Sort by Price
  - Display all Taco information
- Clear and Simple Front End

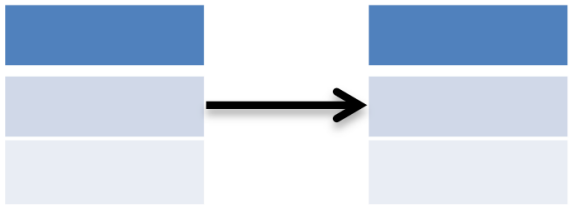
Front End/Back End

- Separate Front End from Back End
- UML Class Diagram
  - Boxes are Structures (like Classes)
  - Arrows are relationships between structures
- Classes
  - Name of the class
  - Properties
  - Methods
  - "+" / "-" means scope is public or private
- Arrows
  - Stick arrow is the Association or "has a"
    - Numeric values indicate the number of instances
- Static variables and method are underlined
  - Constants are all UPPER CASE

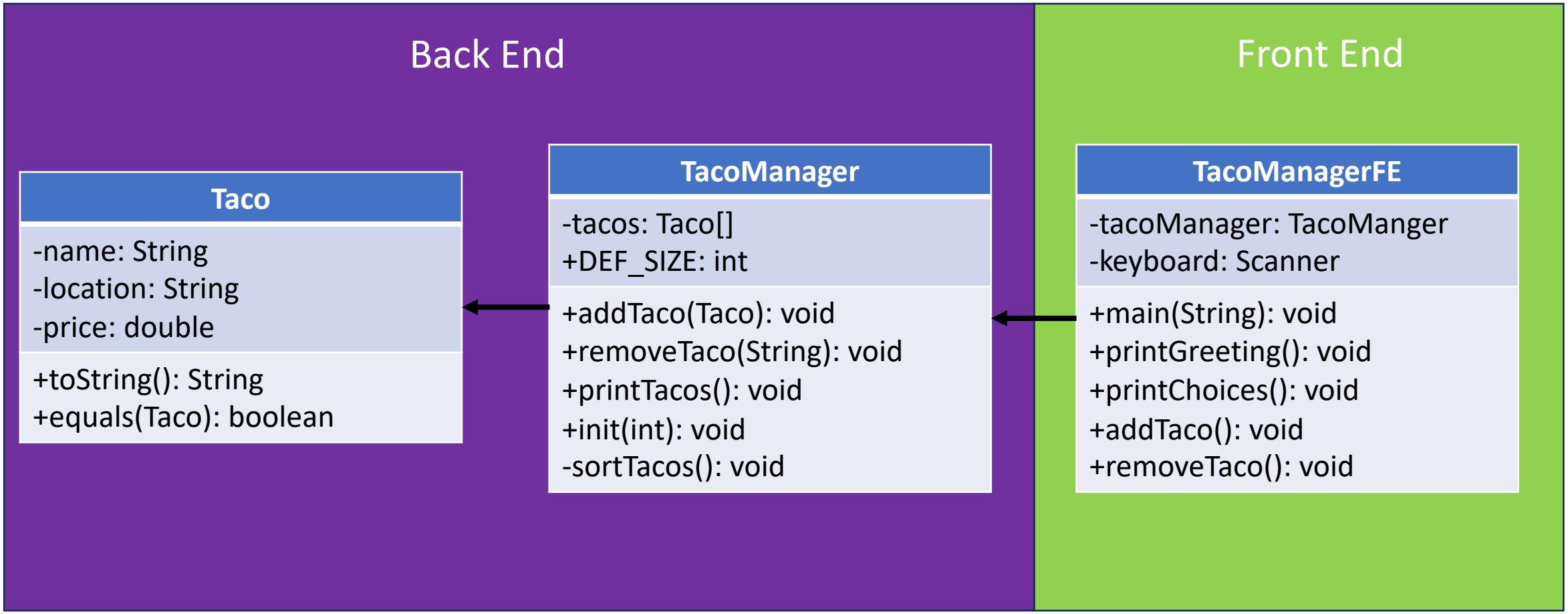
UML Class Diagram



UML Class Diagram Arrows



Association
"has a"



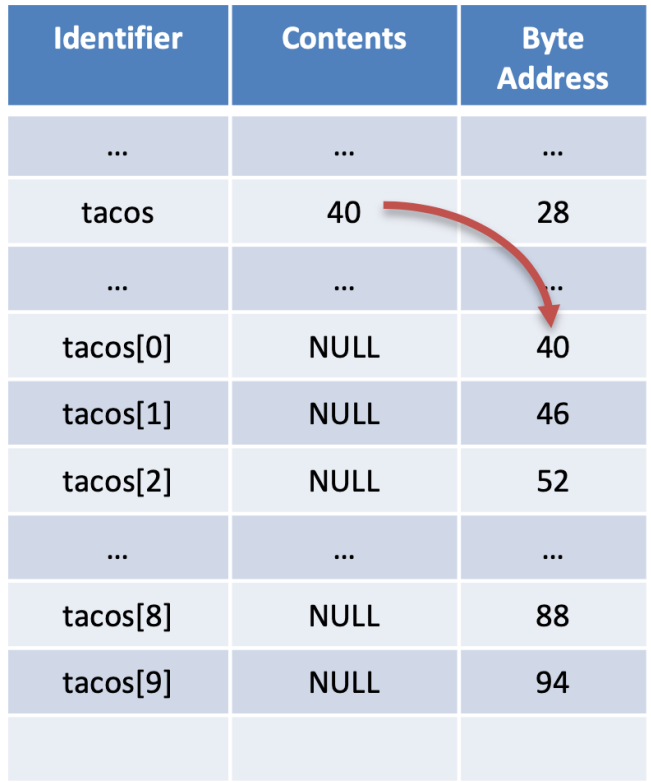
- private, +public

Front end: Parts with which the user interacts

Back end: Parts hidden from the user

Arrays

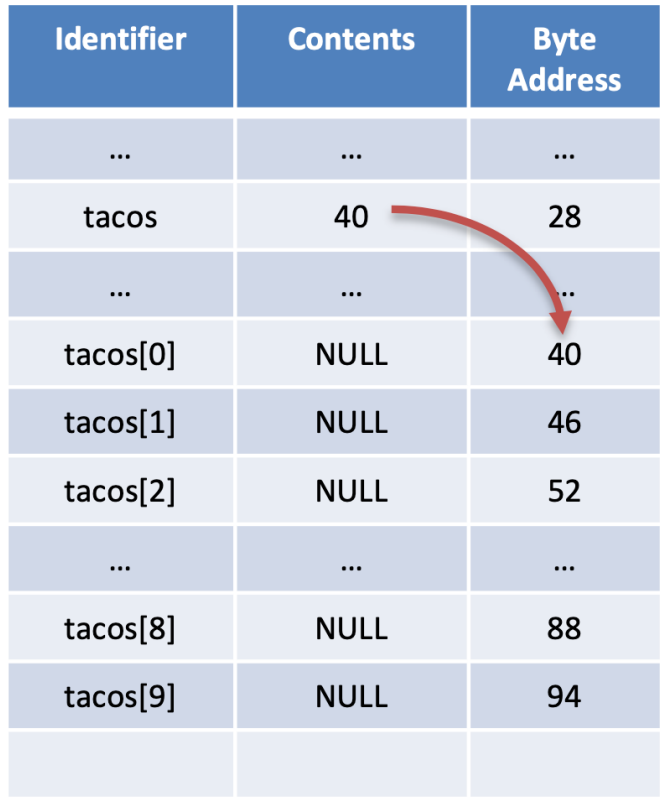
- Arrays of Objects are Arrays of Memory Addresses
- Arrays are considered Object Types in Java
- The Array's identifier points to the contents of the array
- The Array's indices point to the contents of the constructed Objects
- Default values for Object Arrays are considered NULL



Identifier	Contents	Byte Address
…	…	…
tacos	40	28
…	…	…
tacos[0]	NULL	40
tacos[1]	NULL	46
tacos[2]	NULL	52
…	…	…
tacos[8]	NULL	88
tacos[9]	NULL	94

TacoManager Behavior

- Keeping constructed Objects to one side
- No NULL elements in between constructed Objects
- First NULL Element means everything after that is also assumed NULL
- Adding
  - Start from the first Index
  - Find first null element
  - Assign value to there
- Removing
  - Start from the first Index
  - Find the element to remove's index
  - If not found then return
  - Then shift over by one (tacos[i] = tacos[i+1]
  - Set last element to NULL



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…	…	…
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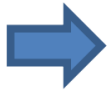

Identifier	Contents	Byte Address
…	…	…
tacos	40	28
…	…	…
tacos[0]	86	40
tacos[1]	NULL	46
tacos[2]	NULL	52
…	…	…
tacos[8]	NULL	88
tacos[9]	NULL	94

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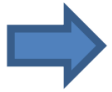

Identifier	Contents	Byte Address
…	…	…
tacos	40	28
…	…	…
tacos[0]	86	40
tacos[1]	283	46
tacos[2]	NULL	52
…	…	…
tacos[8]	NULL	88
tacos[9]	NULL	94

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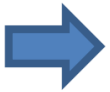

Identifier	Contents	Byte Address
…	…	…
tacos	40	28
…	…	…
tacos[0]	86	40
tacos[1]	283	46
tacos[2]	128	52
…	…	…
tacos[8]	NULL	88
tacos[9]	NULL	94

TacoManager Behavior

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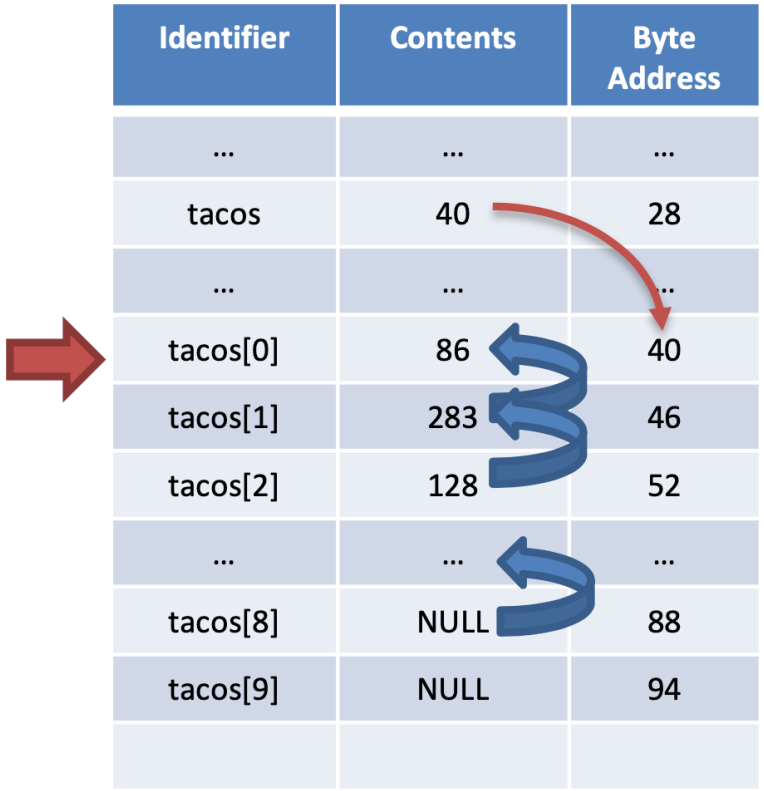

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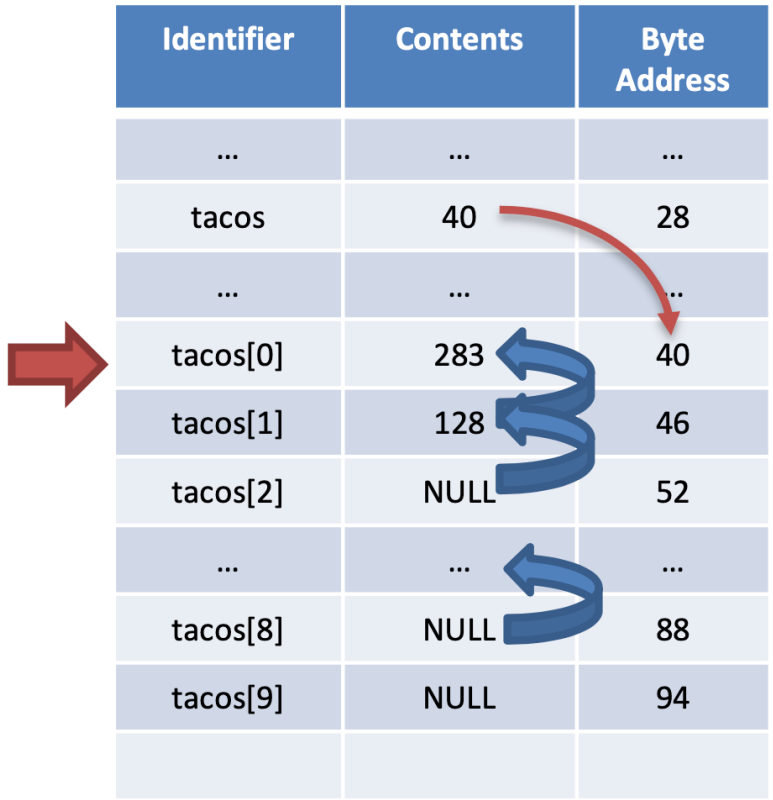

addTaco

```
public void init(int size)
{
    if(size >= 1)
        tacos = new Taco[size];
    else
        tacos = new Taco[DEF_SIZE];
}
public void addTaco(Taco aTaco)
{
    //Check if taco array is full
    if(tacos[tacos.length-1] != null)
    {
        System.out.println("The taco database is full");
        return;
    }
    //Find the first empty space
    for(int i=0;i<tacos.length;i++)
    {
        if(tacos[i] == null)
        {
            tacos[i] = aTaco;
            break;
        }
    }
    //sort it
```

Memory

Identifier	Contents	Byte Address
…	…	…
tacos	NULL	28

More Memory

Identifier	Contents	Byte Address
…	…	…

addTaco

4

```
public void init(int size)
{
    if(size >= 1)
        tacos = new Taco[size];
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}
public void addTaco(Taco aTaco)
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    //Check if taco array is full
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            break;
        }
    }
    //sort it
```

Memory

Identifier	Contents	Byte Address
...	...	...
tacos	64	28
...	...	...
tacos[0]	NULL	64
tacos[1]	NULL	70
tacos[2]	NULL	76
tacos[3]	NULL	82
...	...	...

More Memory

Identifier	Contents	Byte Address
...	...	...

addTaco

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```
public void init(int size)
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tacos[3]	NULL	82
…	…	…

More Memory

Identifier	Contents	Byte Address
…	…	…
aTaco	256	128
…	…	…
Taco		256
aTaco.name	“none”	
aTaco.location	“none”	
aTaco.price	0.0	

addTaco

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public void init(int size)
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i	0	93

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More Memory

Identifier	Contents	Byte Address
…	…	…
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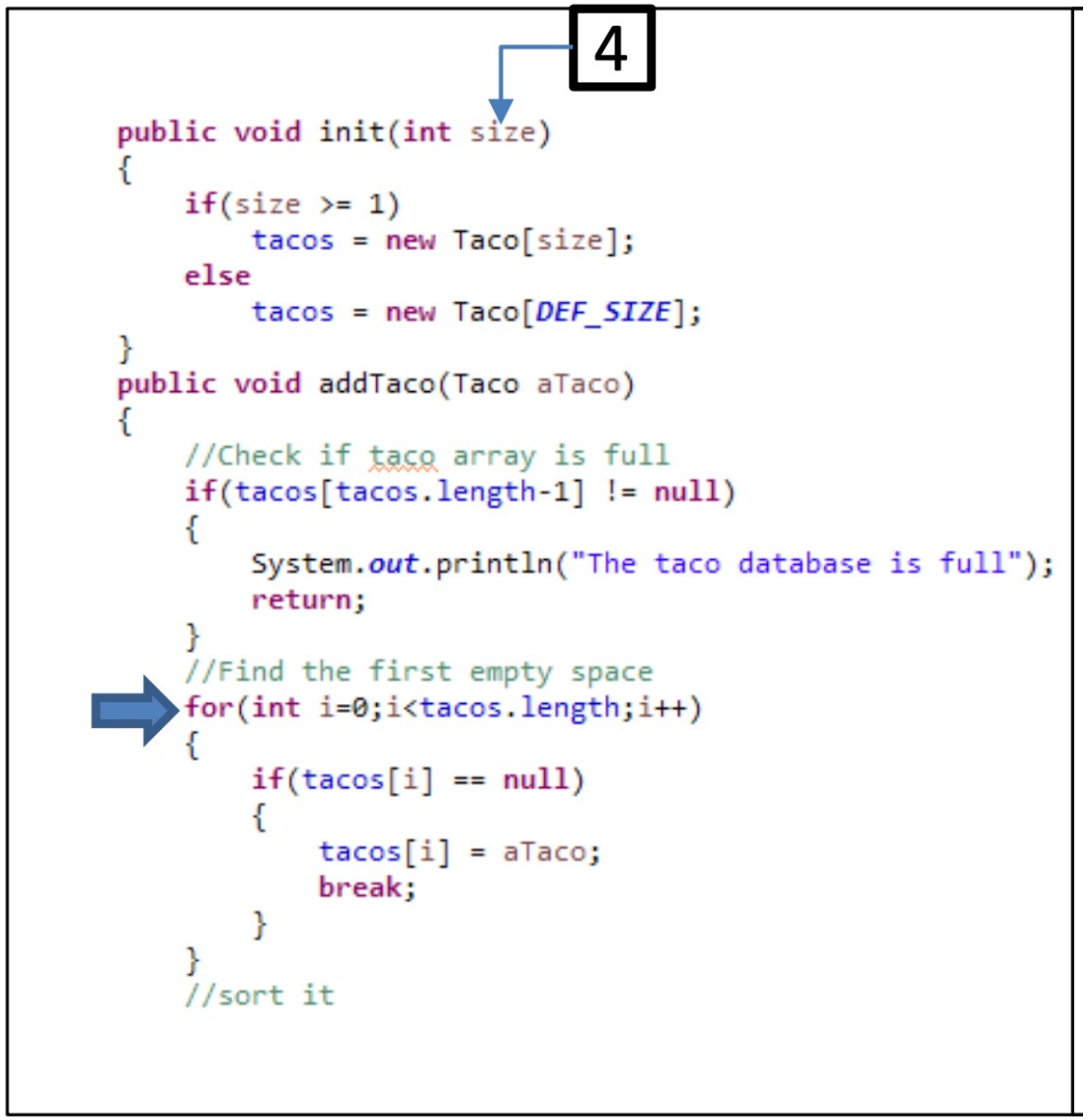
i	0	93

More Memory

Identifier	Contents	Byte Address
…	…	…
aTaco	326	128
…	…	…
Taco		256
aTaco.name	“none”	
aTaco.location	“none”	
aTaco.price	0.0	
…	…	…
Taco		326
aTaco.name	“asdf”	
…	…	…

Quick Quiz



- How can we write this for loop without a break statement?
- Feel free to create any helper methods that you want

addTaco

4

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Taco		256
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aTaco.location	“none”	
aTaco.price	0.0	
…	…	…
Taco		326
aTaco.name	“asdf”	
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…	…	…
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    if(tacos[tacos.length-1] != null)
    {
        System.out.println("The taco database is full");
        return;
    }
    //Find the first empty space
    for(int i=0;i<tacos.length;i++)
    {
        if(tacos[i] == null)
        {
            tacos[i] = aTaco;
            break;
        }
    }
    //sort it
```

Memory

Identifier	Contents	Byte Address
…	…	…
tacos	64	28
…	…	…
tacos[0]	**256**	64
tacos[1]	NULL	70
tacos[2]	NULL	76
tacos[3]	NULL	82
…	…	…
i	1	93

More Memory

Identifier	Contents	Byte Address
…	…	…
aTaco	326	128
…	…	…
Taco		256
aTaco.name	“none”	
aTaco.location	“none”	
aTaco.price	0.0	
…	…	…
Taco		326
aTaco.name	“asdf”	
…	…	…

addTaco

4

```
public void init(int size)
{
    if(size >= 1)
        tacos = new Taco[size];
    else
        tacos = new Taco[DEF_SIZE];
}
public void addTaco(Taco aTaco)
{
    //Check if taco array is full
    if(tacos[tacos.length-1] != null)
    {
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        return;
    }
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Memory

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addTaco

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addTaco

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More Memory

Identifier	Contents	Byte Address
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…	…	…
…	…	…
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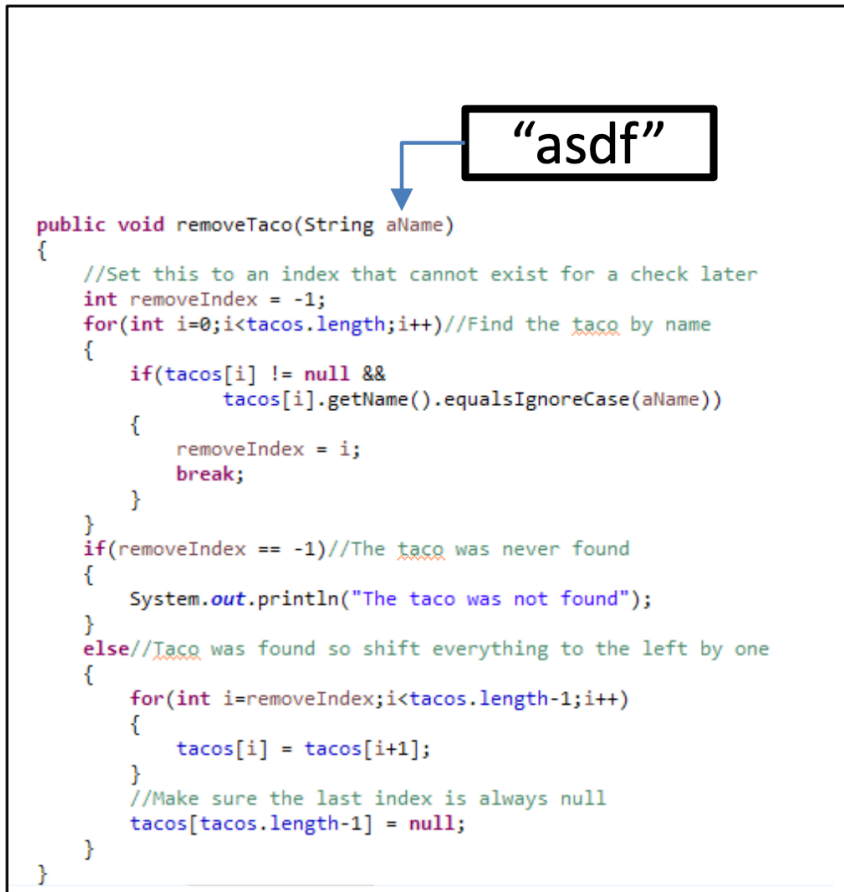
Taco		326
aTaco.name	“asdf”	
…	…	…

removeTaco



Memory

Identifier	Contents	Byte Address
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More Memory

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aTaco.price	0.0	
…	…	…
Taco		326
aTaco.name	“asdf”	
…	…	…

removeTaco

"asdf"

```
public void removeTaco(String aName)
{
    //Set this to an index that cannot exist for a check later
    int removeIndex = -1;
    for(int i=0;i<tacos.length;i++)//Find the taco by name
    {
        if(tacos[i] != null &&
                tacos[i].getName().equalsIgnoreCase(aName))
        {
            removeIndex = i;
            break;
        }
    }
    if(removeIndex == -1)//The taco was never found
    {
        System.out.println("The taco was not found");
    }
    else//Taco was found so shift everything to the left by one
    {
        for(int i=removeIndex;i<tacos.length-1;i++)
        {
            tacos[i] = tacos[i+1];
        }
        //Make sure the last index is always null
        tacos[tacos.length-1] = null;
    }
}
```

Memory

Identifier	Contents	Byte Address
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"asdf"

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            tacos[i] = tacos[i+1];
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        //Make sure the last index is always null
        tacos[tacos.length-1] = null;
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Memory

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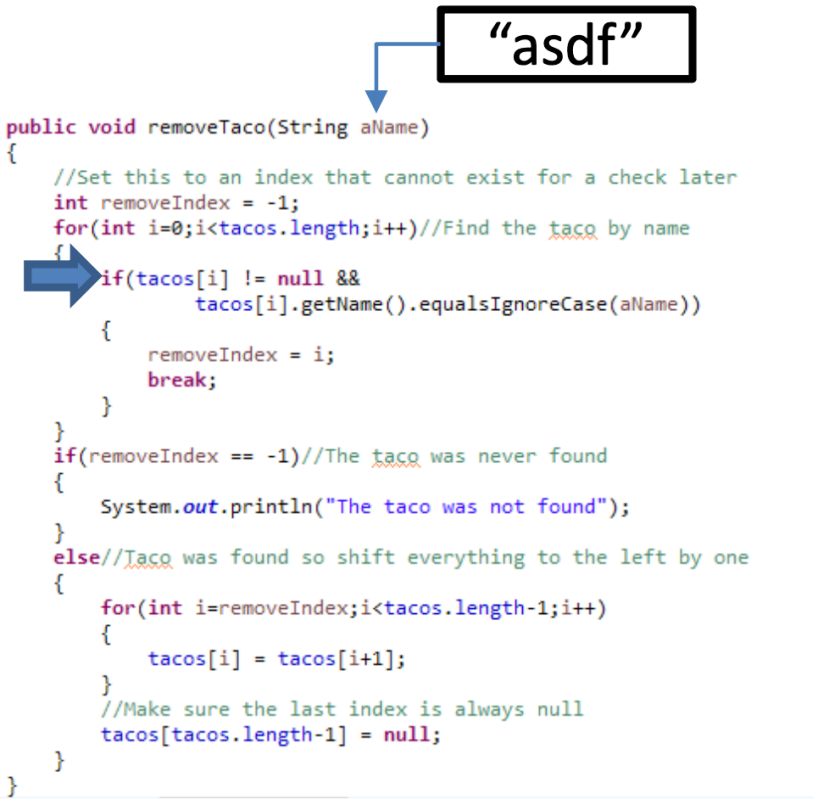
removeTaco



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Taco		326
aTaco.name	"asdf"	
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Remember: shortcut evaluation of Boolean expression

removeTaco

“asdf”

```
public void removeTaco(String aName)
{
    //Set this to an index that cannot exist for a check later
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    }
    if(removeIndex == -1)//The taco was never found
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    }
    else//Taco was found so shift everything to the left by one
    {
        for(int i=removeIndex;i<tacos.length-1;i++)
        {
            tacos[i] = tacos[i+1];
        }
        //Make sure the last index is always null
        tacos[tacos.length-1] = null;
    }
}
```

Memory

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removeTaco

"asdf"

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            tacos[i] = tacos[i+1];
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```

Memory

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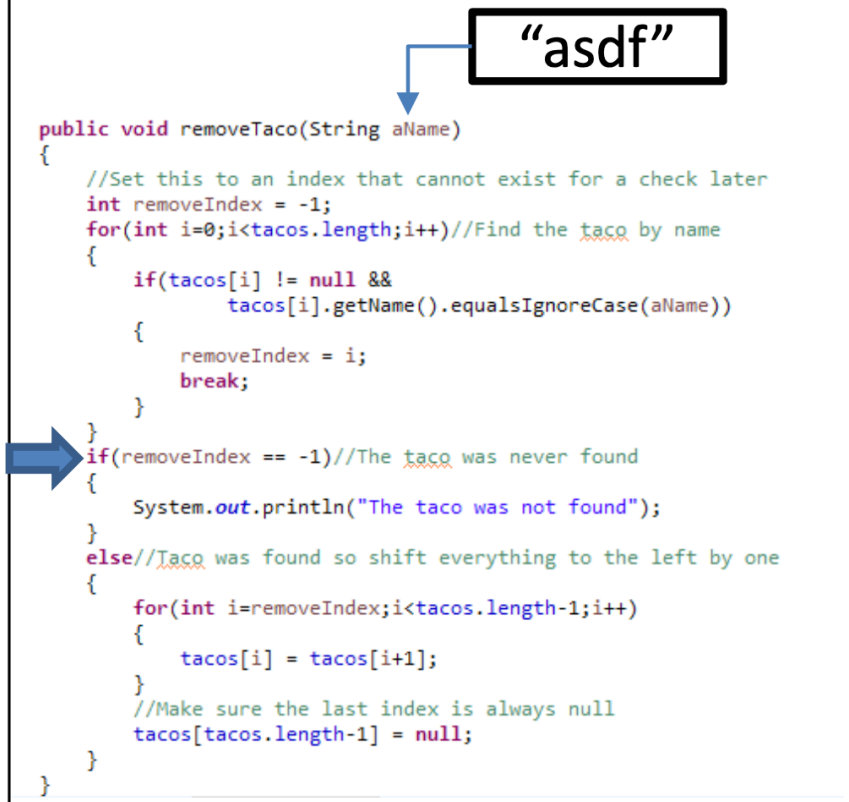

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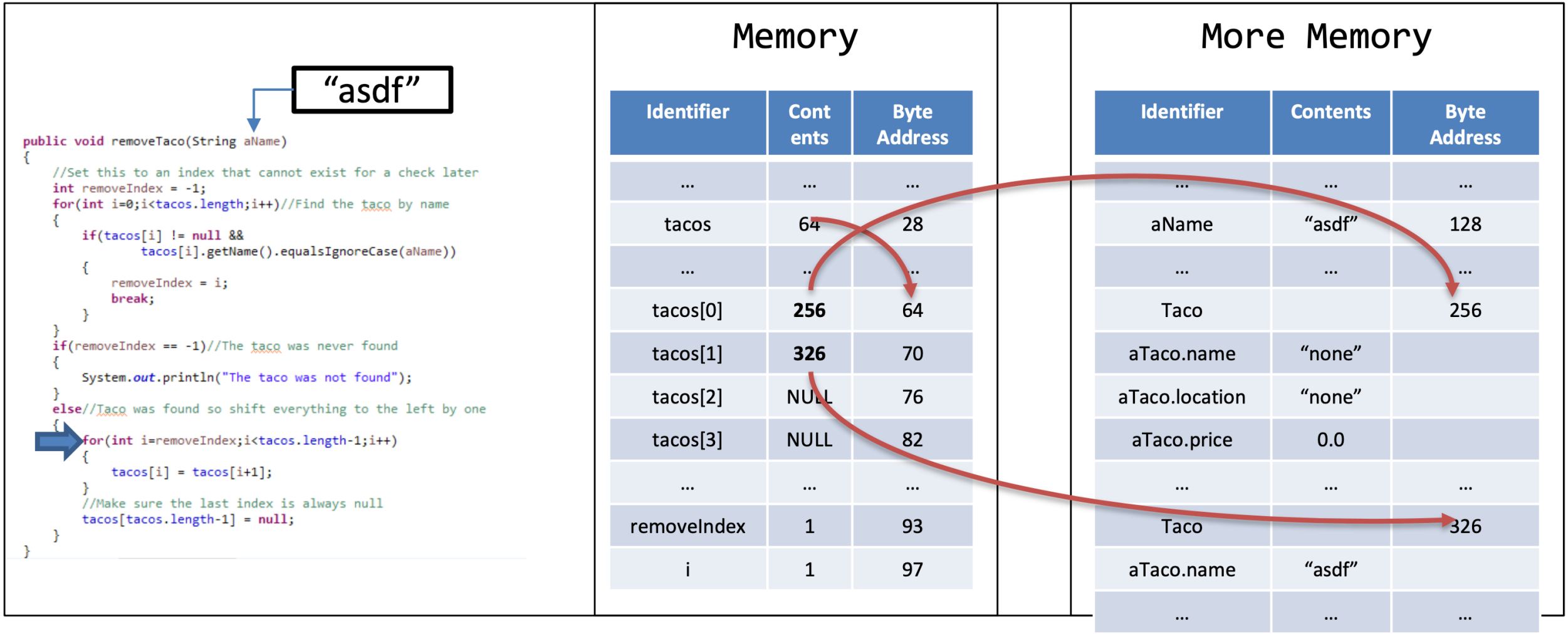
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if(tacos[i] != null &&
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removeIndex = i;
break;
}
}
if(removeIndex == -1)//The taco was never found
{
System.out.println("The taco was not found");
}
else//Taco was found so shift everything to the left by one
{
for(int i=removeIndex;i<tacos.length-1;i++)
{
tacos[i] = tacos[i+1];
}
//Make sure the last index is always null
tacos[tacos.length-1] = null;
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Memory
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tacos
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tacos[0]
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removeIndex
1
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i
1
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More Memory
Identifier
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Byte Address
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removeTaco

"asdf"

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removeTaco

“asdf”

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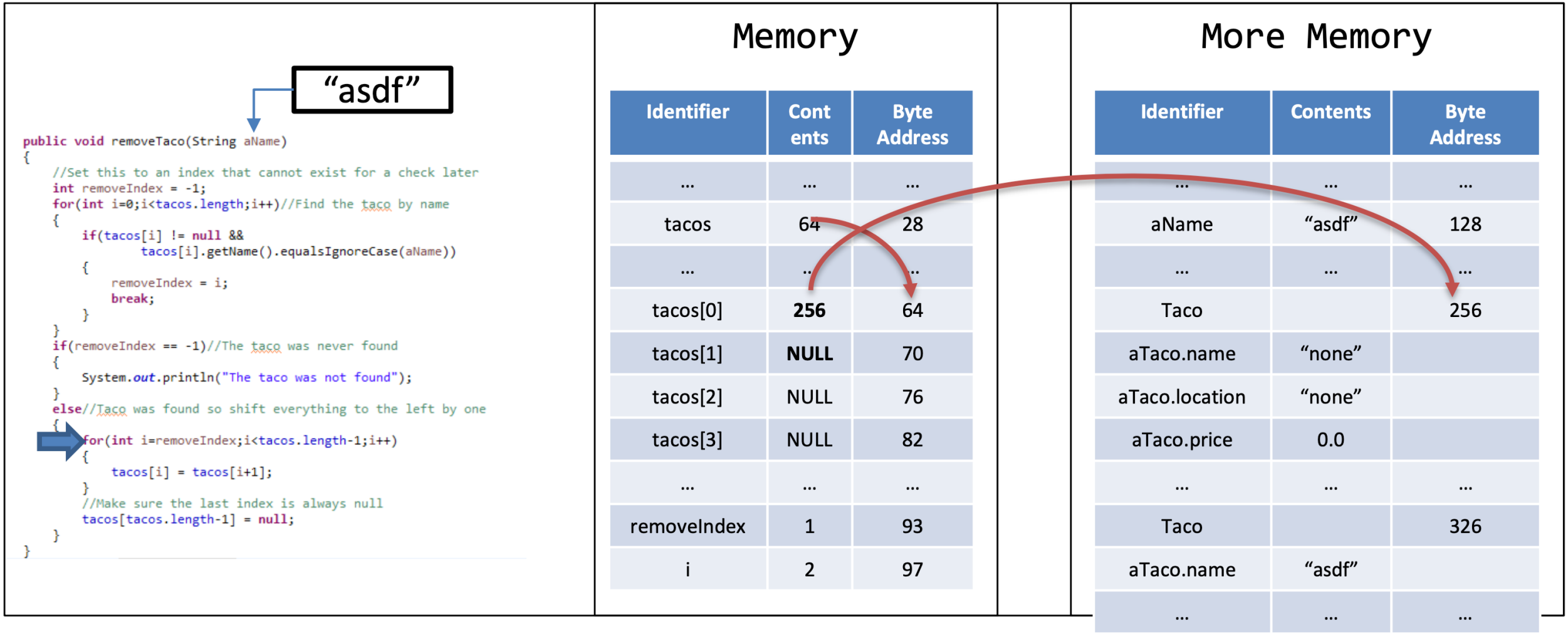
tacos[1]	**NULL**	70
tacos[2]	NULL	76
tacos[3]	NULL	82
…	…	…
removeIndex	1	93
i	1	97

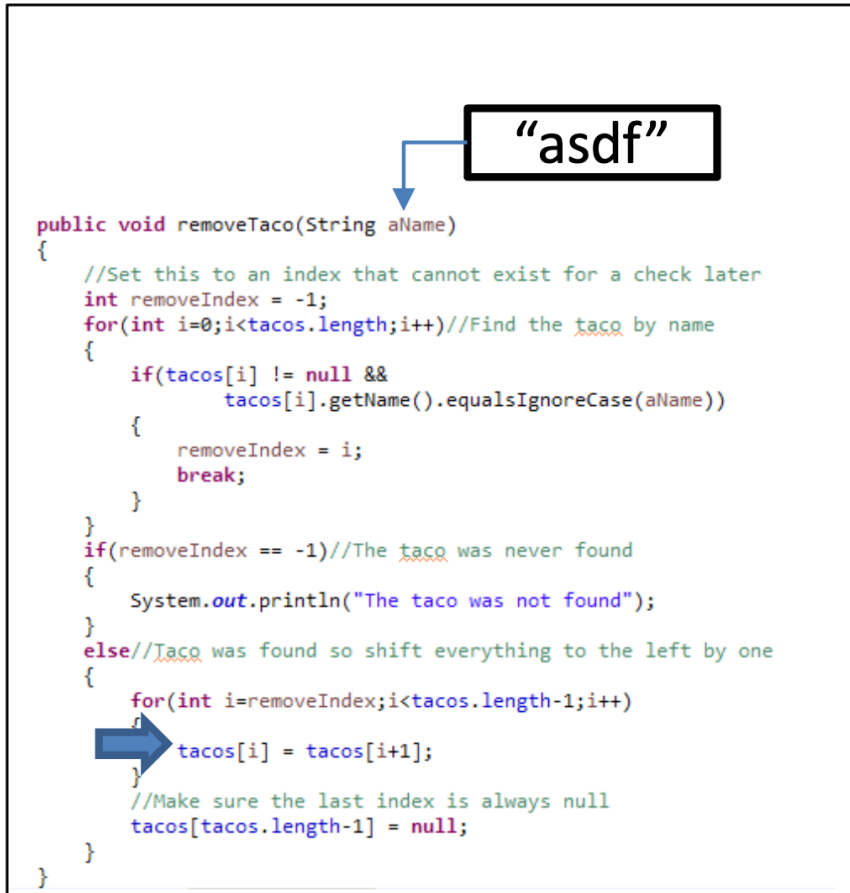
More Memory

Identifier	Contents	Byte Address
…	…	…
aName	“asdf”	128
…	…	…
Taco		256
aTaco.name	“none”	
aTaco.location	“none”	
aTaco.price	0.0	
…	…	…
Taco		326
aTaco.name	“asdf”	
…	…	…

removeTaco


"asdf"
public void removeTaco(String aName)
{
//Set this to an index that cannot exist for a check later
int removeIndex = -1;
for(int i=0;i<tacos.length;i++)//Find the taco by name
{
if(tacos[i] != null &&
tacos[i].getName().equalsIgnoreCase(aName))
{
removeIndex = i;
break;
}
}
if(removeIndex == -1)//The taco was never found
{
System.out.println("The taco was not found");
}
else//Taco was found so shift everything to the left by one
{
for(int i=removeIndex;i<tacos.length-1;i++)
{
tacos[i] = tacos[i+1];
}
//Make sure the last index is always null
tacos[tacos.length-1] = null;
}
}
Memory
Identifier
Contents
Byte Address
...
tacos
64
28
tacos[0]
256
64
tacos[1]
NULL
70
tacos[2]
NULL
76
tacos[3]
NULL
82
removeIndex
1
93
i
2
97
More Memory
Identifier
Contents
Byte Address
aName
"asdf"
128
Taco
256
aTaco.name
"none"
aTaco.location
"none"
aTaco.price
0.0
Taco
326
aTaco.name
"asdf"

removeTaco



Memory

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tacos	64	28
…	…	…
tacos[0]	**256**	64
tacos[1]	**NULL**	70
tacos[2]	**NULL**	76
tacos[3]	NULL	82
…	…	…
removeIndex	1	93
i	2	97

More Memory

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…	…	…
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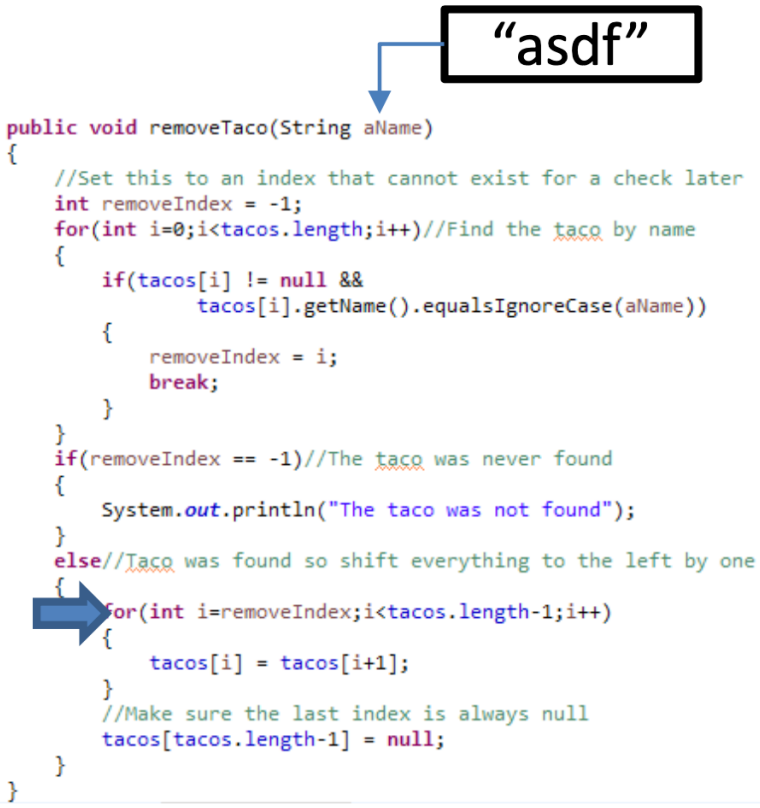
aTaco.location	"none"	
aTaco.price	0.0	
…	…	…
Taco		326
aTaco.name	"asdf"	
…	…	…

removeTaco



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…	…	…
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aTaco.name	"asdf"	
…	…	…

removeTaco

"asdf"

```
public void removeTaco(String aName)
{
    //Set this to an index that cannot exist for a check later
    int removeIndex = -1;
    for(int i=0;i<tacos.length;i++)//Find the taco by name
    {
        if(tacos[i] != null &&
                tacos[i].getName().equalsIgnoreCase(aName))
        {
            removeIndex = i;
            break;
        }
    }
    if(removeIndex == -1)//The taco was never found
    {
        System.out.println("The taco was not found");
    }
    else//Taco was found so shift everything to the left by one
    {
        for(int i=removeIndex;i<tacos.length-1;i++)
        {
            tacos[i] = tacos[i+1];
        }
        //Make sure the last index is always null
        tacos[tacos.length-1] = null;
}
```

Memory

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removeTaco

“asdf”

```
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{
    //Set this to an index that cannot exist for a check later
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    {
        for(int i=removeIndex;i<tacos.length-1;i++)
        {
            tacos[i] = tacos[i+1];
        }
        //Make sure the last index is always null
        tacos[tacos.length-1] = null;
    }
}
```

Memory

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…	…	…
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aTaco.price	0.0	
…	…	…

For-Each Loop

- Special version of a for-loop
- Store each element in a temporary variable
- Great of looping through every element in a collection (like an array)
- Should NOT use a for-each-loop when modifying the data structure
  - Should not use when adding new elements
  - Should not use when removing elements

For-Each-Loop Syntax

```
for(<<type>> <<id>> : <<type collection>>)
{
      //Body of the for-each-loop
}
```

Example

```
for(Taco t : tacos)
{
      System.out.println(t);
}
```

For-Each Loop

For-Loop Example

```
for(int i=0;i<tacos.length;i++)
{
    Taco t = tacos[i];
    System.out.println(t);
}
```

For-Each-Loop Example

```
for(Taco t : tacos)
{
    System.out.println(t);
}
```

Switch Statement

- Special version of an if, else-if, and else statement
- The argument is a “Controlling Value” corresponds to “Cases”
- The “Controlling Value” can either be
  - An integer type
  - A character type
  - An Enum
  - A String
- The “break” statement is needed to stop the execution of any following cases
  - Without the “break” the following cases’ statements will run or *fall through*

Switch-Statement Syntax

```
switch(<<Controlling Value>>)
{
      case <<value00>>:
            //Case00 Statements
      break;
      case <<value01>>:
            //Case01 Statements
      break;
      default:
            //Default Case
}
```

Switch Statement

If, Else-if, Else Example

```
int choice = keyboard.nextInt();
keyboard.nextLine();
if(choice == 1)
{
	addTaco();
}
else if(choice == 2)
{
	removeTaco();
}
else if(choice == 9)
{
	quit = true;
}
else
{
	System.out.println("Invalid Input");
}
```

Switch-Statement Example

```
int choice = keyboard.nextInt();
keyboard.nextLine();
switch(choice)
{
	case 1:
		addTaco();
		break;
	case 2:
		removeTaco();
		break;
	case 9:
		quit = true;
		break;
	default:
		System.out.println("Invalid Input");
}
```