CSCI 132:
Basic Data Structures and Algorithms

ArrayLists

Reese Pearsall

Spring 2023

Announcements

Lab 4 due **TUESDAY** at 11:59 PM

- Interfaces.

Gideon (8 AM, 10 AM) is out sick this week

```
Roses are Red,
Violets are Blue.

Unexpected ‘{’ on line 32.
```

What do you need to dig a hole?

Thank you to Sean Yaw (the goat) for the analogy

What do you need to dig a hole?

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	Pros	Cons
		
		
		

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What do you need to dig a hole?

	Pros	Cons
	• Cheap • Precise • No Training • Availability	• Slow • Labor
		
		

What do you need to dig a hole?

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	• Fast • Labor	• Expensive • Training
		

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	• Fast • Labor	• Expensive • Training
	• Really good at digging	• Takes up a lot of garage space

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Best tool for the job?

Burying your pet goldfish

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Best tool for the job?

Building Express tunnel to Bridger Bowl

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Best tool for the job?

Creating the foundation for a house

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Best tool for the job?

Digging a Well for water

Thank you to Sean Yaw (the goat) for the analogy

What do you need to dig a hole?

Best tool for the job?

Digging a Well for water

What do you need to dig a hole?

We can't use the best tool for the job unless we know that tool exists!

Best tool for the job?

Digging a Well for water

What do you need to dig a hole?

	Pros	Cons
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Best tool for the job?

Creating the foundation for a house

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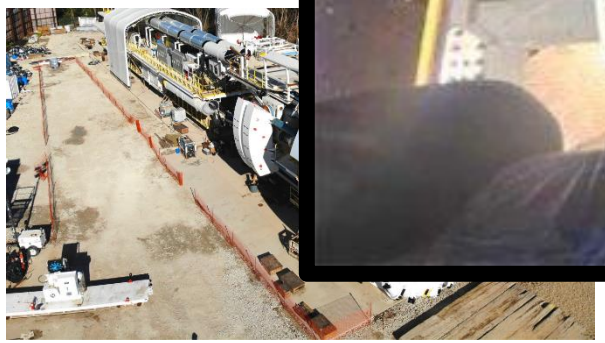
What do you need to dig a hole?

	Pros	Cons
		
		ve
		a lot of ace

Best tool for the job?

Creating the foundation for a house

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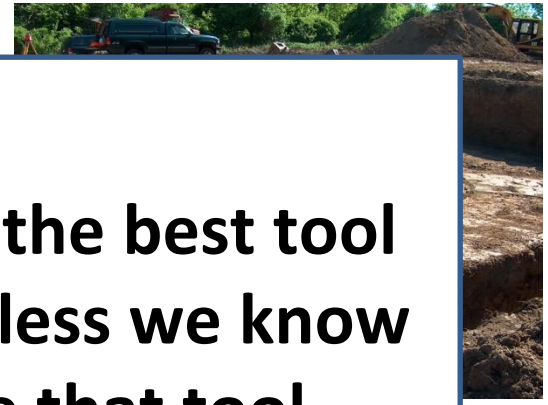
What do you need to dig a hole?

Pros	Cons
	• Slow • Labor

Best tool for the job?

Creating the foundation for a house

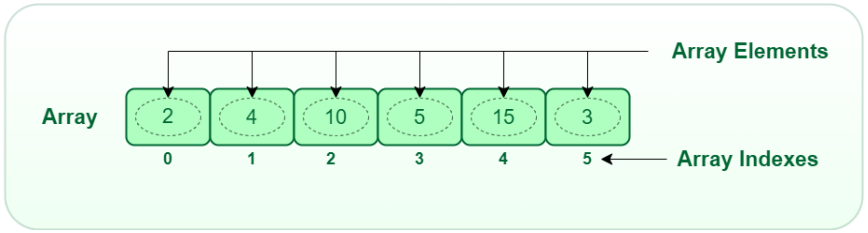


We can't use the best tool for the job unless we know how to use that tool

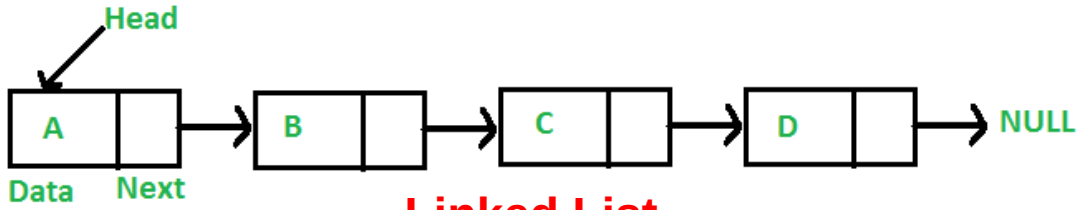
garage space

Thank you to Sean Yaw (the goat) for the analogy

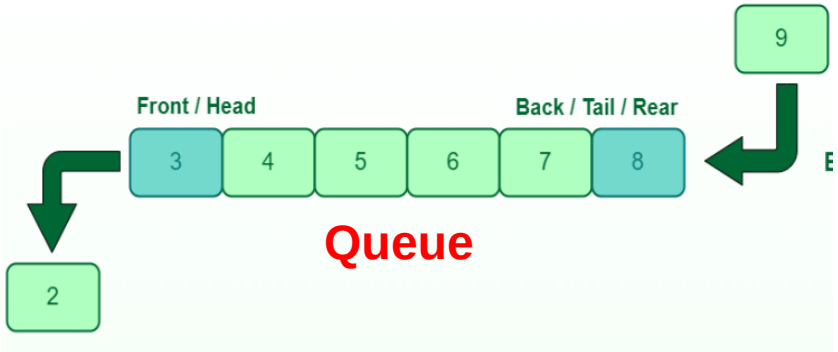
A **data structure** is a mechanism for storing and organizing data



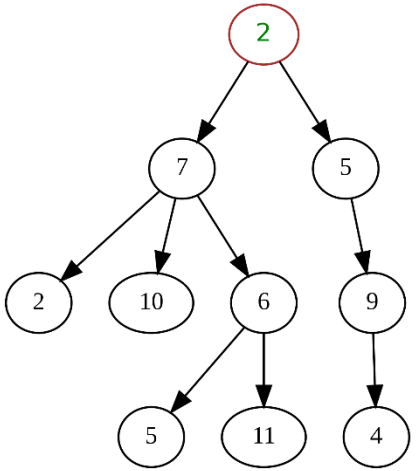
Arrays



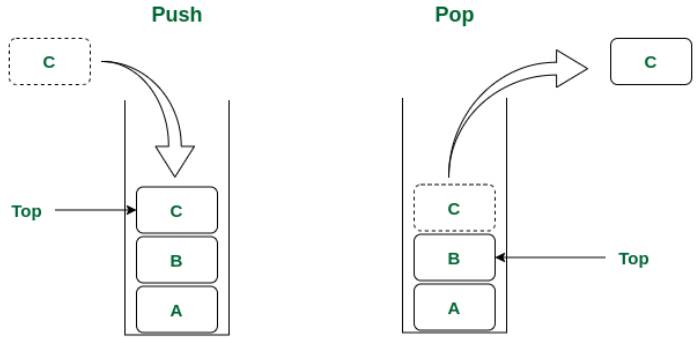
Linked List



Queue



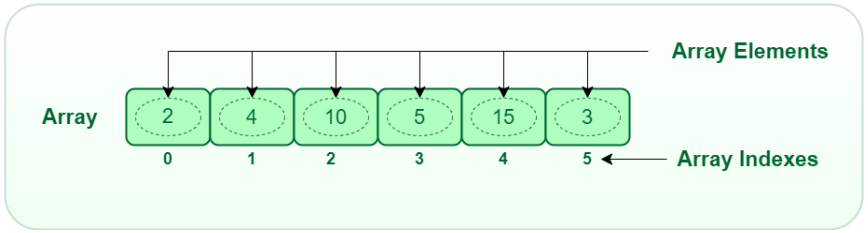
Trees



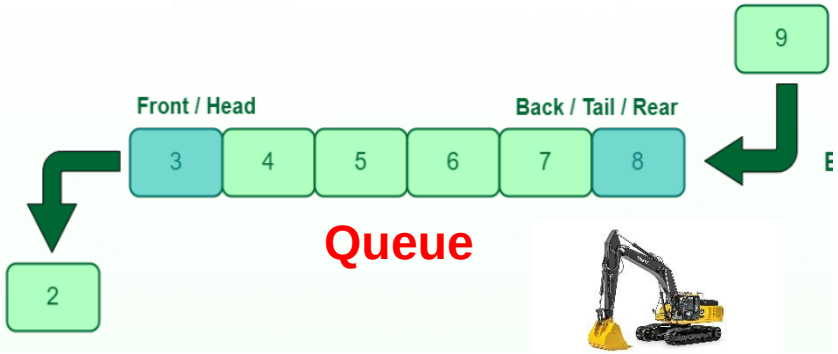
Stack

A **data structure** is a mechanism for storing and organizing data

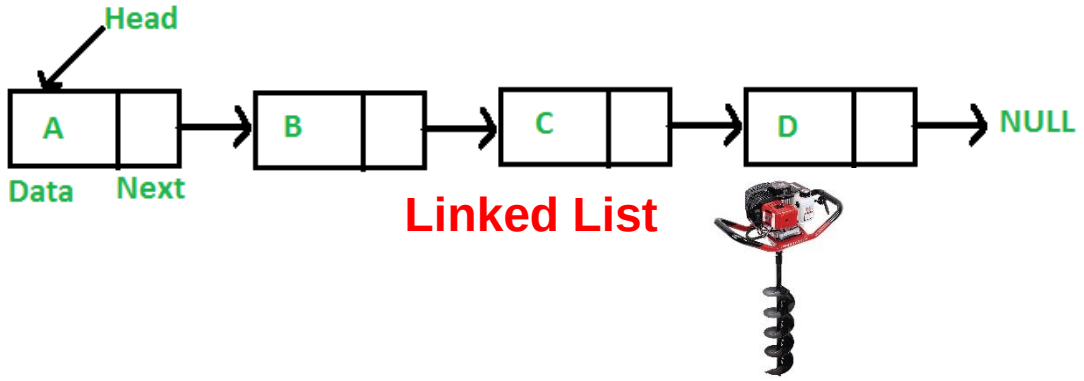
- We have structured ways of *accessing* and *managing* data



Arrays



Queue



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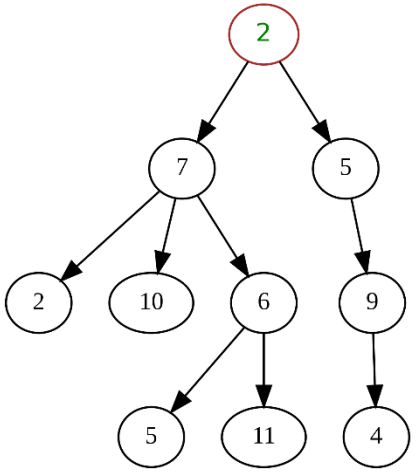
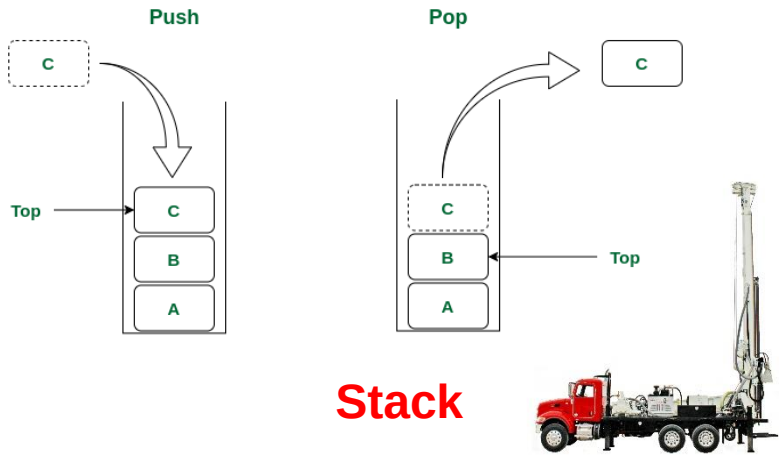


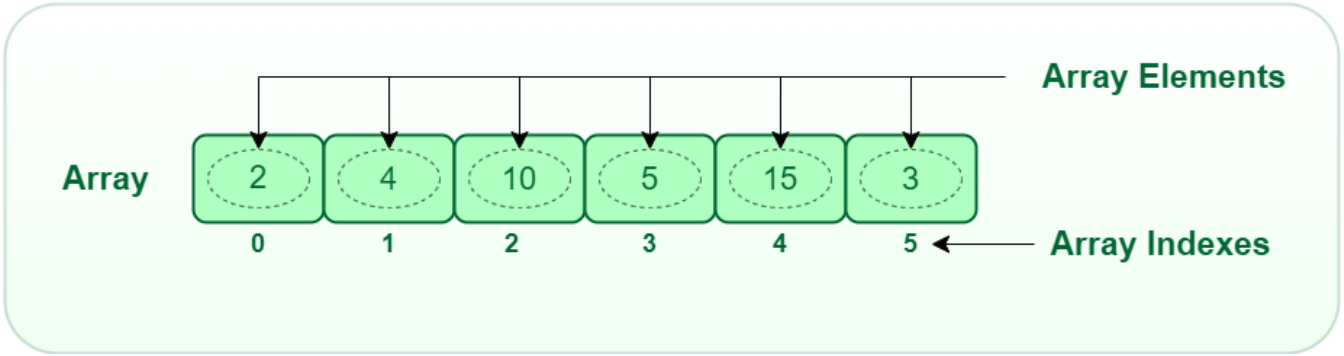
Trees



Stack

There are many types of data structure, and each data structure has its pros and cons

An **array** is a data structure that can hold multiple, similar values




```
String[] cars = {"Volvo", "BMW", "Ford", "Mazda"};

int[] myNum = {10, 20, 30, 40};
```

Pros

- Holds multiple pieces of information
- Information is ordered (by index)
- Can easily change what is stored in each slot
- Can store duplicate data
- Easy to iterate through

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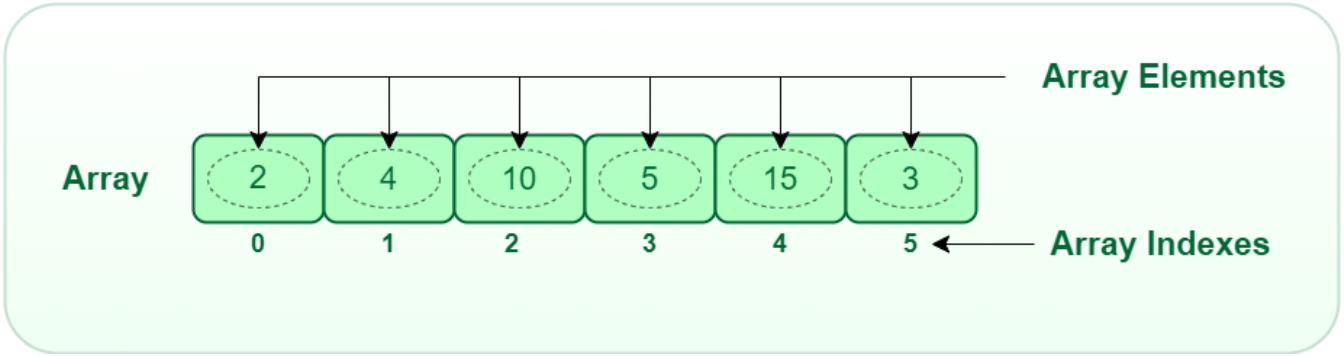


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- Can easily change what is stored in each slot
- Can store duplicate data
- Easy to iterate through

Cons

- Can’t change the length
- Can only store one data type

Array Limitations

Cons

- **Can't change the length** *What can we do about this?*
- Can only store one data type

```
int[] myArray = {1, 2, 3};
System.out.println(Arrays.toString(myArray));
```

What if we wanted to add 4 to the array?

Array Limitations

Cons

- **Can't change the length** *What can we do about this?*
- Can only store one data type

```
int[] myArray = {1, 2, 3};
System.out.println(Arrays.toString(myArray));


int[] newArray = new int[myArray.length + 1];          // Create a new array that is one spot bigger
for(int i = 0; i < myArray.length; i++) {
        newArray[i] = myArray[i];                      // Fill new array with contents of old array
}
```

Array Limitations

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```

```
int new_value = 4;
newArray[myArray.length] = new_value;                  // add new value to array
myArray = newArray;                                    // Update reference variable
```

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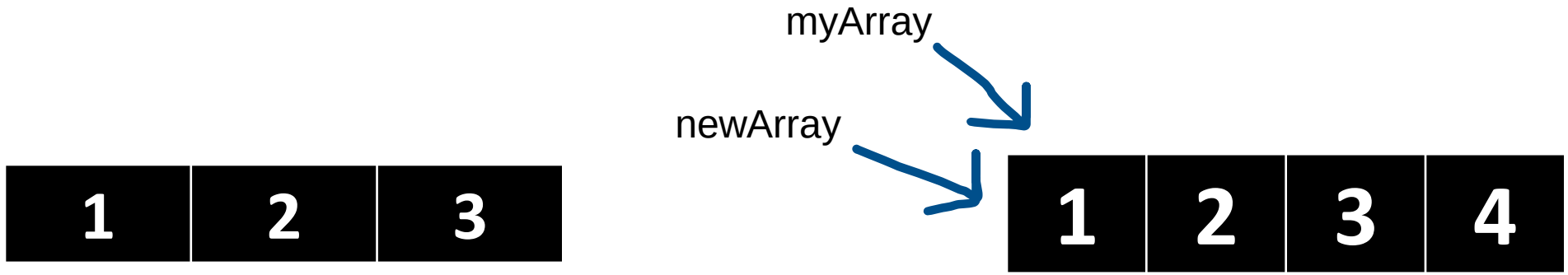
We updated our reference variable (`myArray`) to point to our new array with the new element



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This is an unused object

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Java has a mechanism called **Garbage Collection**, with deletes unused object to free up memory

(this runs automatically!)

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Java has a mechanism called **Garbage Collection**, with deletes unused object to free up memory

(this runs automatically!)

Java sees that we have an used/unreferenced object, so it will delete it!

Array Limitations

Cons

- **Can’t change the length**

  Solution

  Create new array, copy everything over
  (this can be expensive ☹)

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```

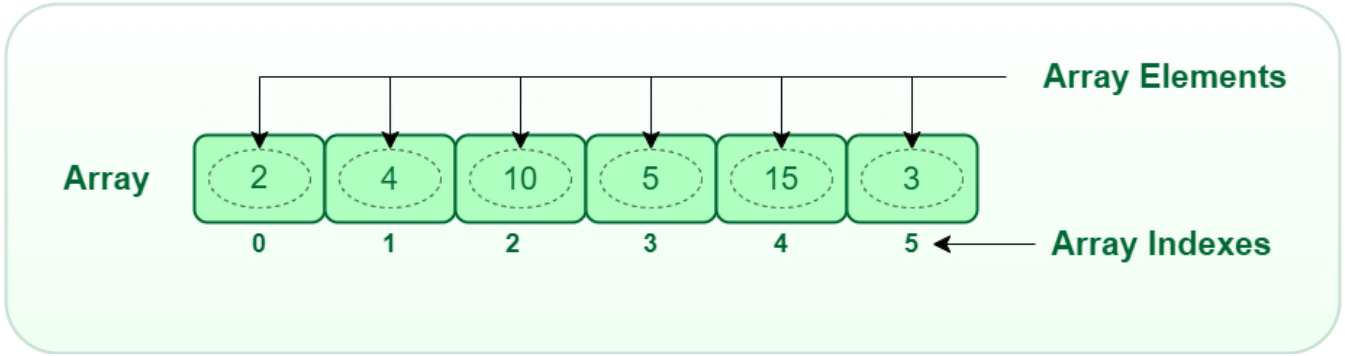
- **Can only store one data type**

  Solution

  Store an object, use two separate arrays, use a different data structure

An **ArrayList** is a data structure that can hold multiple, similar values (just like an array), BUT

- Dynamic, can easily resize
- Can easily add new elements and remove elements
- Like a Python list ☺



Somebody took `arrays`, and made them better

- Still have indices
- Still can only store one data type

Java **ArrayLists**

We first need to remember to import it ☺

```
import java.util.ArrayList;
```

Creating a new ArrayList

```
ArrayList<String> mylist = new ArrayList<String>();
```

We must specify what datatype the ArrayList will hold

Reference Variable

We never have to specify the size, because we can now easily grow/shrink our ArrayList!

Java **ArrayLists**

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We can add stuff to the ArrayList using the `.add()` method (built in method!)

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mylist.add("Jack");
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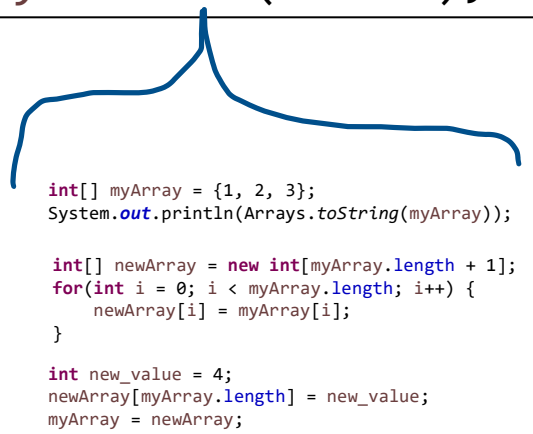

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Under the hood, it is

1. Creating a new array
2. Copy old contents
3. Add new element at the end
4. Updating reference variable

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To access elements in the array, we use the .get() method (we cannot use the square bracket index [ ])

```
System.out.println(mylist.get(2)); // this will print the String at index 2
```

Java **ArrayLists**

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```
System.out.println(mylist.get(2)); // this will print the String at index 2
```

We can remove stuff by index, or by searching for a specific element

```
mylist.remove("Eli");
mylist.remove(0);
```

Java **ArrayLists**

```
import java.util.ArrayList;
        public class ArrayListDemo {

        public static void main(String[] args) {
                ArrayList<String> mylist = new ArrayList<String>();

                mylist.add("Jack");
                mylist.add("Tory");
                mylist.add("Sam");
                mylist.add("Eli");

                System.out.println(mylist);
                System.out.println(mylist.get(2));

                mylist.remove("Eli");
                mylist.remove(0);

                System.out.println(mylist);
                System.out.println(mylist.isEmpty());
        }
}
```

Java **ArrayLists** Example

Let's write a program that will keep track of high scores on an arcade machine

Each entry will have the player name (String), and their score (Int)

The program should allow for

- Adding a new high score
- Removing a score
- Print out scoreboard
- Print out top N scores
- Search for score by name

And we must use an **ArrayList** to hold all this information!