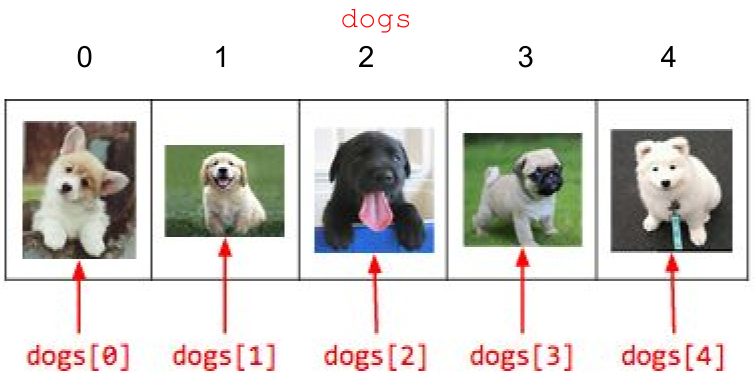
Lab 5 Reading

Arrays

As you know from lecture, an *array* is a data structure that holds a fixed number of elements of a certain type. When you initialize an array, you specify both its size and the type of element it stores. Arrays can be one-dimensional or multidimensional (a 2-dimensional array is just an array of arrays).

```
int[] numbers = new int[10]; // initializes 1D int array of size 10
HeadTA[] headtas = new HeadTA[4]; // 1D array of HeadTAs (size 4)
Square[][] chessBoard = new Square[8][8]; // 2D array of Squares
(8x8)
```

To access an element stored in an array, we access the array at a particular *index*. Arrays are 0-indexed: the first element is stored at index 0, and the nth element is stored at index n-1.



To access the fourth element in the array `dogs`, we say: `dogs[3]`. We can use this notation to call a method on an object stored at a particular index: for example, "`dogs[3].bark();`" tells the fourth `Dog` in the array to bark. We could use the same notation to store a particular `Dog` at that index: for example, "`dogs[3] = new Husky()`". The notation for multi-dimensional arrays is similar. We could access a particular `Square` in the 2D `chessBoard` array we created above with "`chessBoard[5][7]`".

Confused about arrays? Check out the [Oracle Java Tutorials]!

Looping Through Arrays

In Java, when we initialize an array, each of its elements is initialized to the default value of the array's element type. This means that when you initialize an array of `int`s with "`int[] numbers = new int[10];`", each element starts out as 0. When you initialize an array of `booleans`, each element starts out as `false`. When you initialize an array of objects, each element starts out as `null`.

Loops are a useful tool for navigating arrays. One use case is populating an array with the values we want to store. Here's a short code example that creates a 1-dimensional array of booleans and uses a `for` loop to set each element.

```
boolean[] myBoolArray = new boolean[5]; // declare, initialize array
for (int i = 0; i < myBoolArray.length; i++) { // loops thru whole array
      myBoolArray[i] = true; // set element at current index to true
}
```

The result of this code is an array that looks like: `[true, true, true, true, true]`. If at a later point we need to change any of the elements in the array, we can do so easily: for example, "`myBoolArray[1] = false;`" changes the second element of `myBoolArray`, making it: `[true, false, true, true, true].`

Check out the Loops lecture slides if you need a refresher on `for` loops before moving on!

Additional Uses for Arrays

Recall how we assign an initial value to variables of type `int` using the following syntax:
```
int x = 3;
```

Also recall that we can also store `int`s as static in the Constant class using the syntax:
```
public static final int x = 3;
```

Arrays are also able to take on an initial value! The following lines of code are both valid:
```
int[] myArray1 = {1, 2, 3};
int[][] myArray2 = {{4,5,7}, {9,0,3}, {2,6,9}};
```

Likewise, we can store arrays as constants in the `Constants` class:
```
public static final int[][] MY_FAVORITE_COORDINATES = {{3,7},{9,1}};
```

This has applications in programs where you want to store something as a constant that can't be expressed as just one integer (for example: coordinates to build a shape or positions in a 2D space).

ArrayLists

Arrays are handy when you know exactly how many elements you're going to be dealing with. But what if you want to model a collection of objects whose size may change?

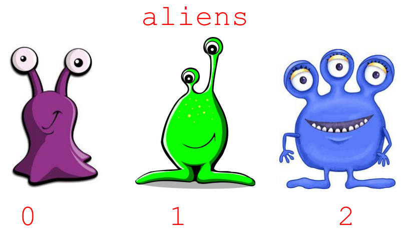
Luckily, the core Java library provides several implementations of "collections" of objects, whose size may change as elements are added and removed. One such implementation is the class `java.util.ArrayList`. Like an array, an `ArrayList` stores elements at "indices", and allows you to access and modify the element stored at a particular index. However, an `ArrayList` provides convenient methods for adding, removing, and modifying elements, and changes size automatically as elements are added and removed. We'll give a quick refresher on `ArrayLists` below-- check out the lecture slides for the full scoop.

When declaring an `ArrayList`, we need to specify what type of object it stores. We would declare and instantiate an `ArrayList` of `Aliens` like this:

```
ArrayList<Alien> aliens = new ArrayList<Alien>();
```

We put the type of object our `ArrayList` will store within the angle brackets. "`ArrayList<Alien>`" just means "an `ArrayList` of `Alien`s". When we initialize an array, it takes on the size we tell it to -- but when we initialize an `ArrayList`, we don't give it a size. Every `ArrayList` starts out empty (size 0). To add an element to the `ArrayList`, call the `add` method. Let's add a few `Aliens` to our `ArrayList`:

```
aliens.add(new PurpleAlien());
aliens.add(new GreenAlien());
aliens.add(new BlueAlien());
```



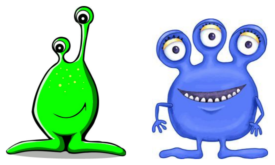
To access the element at a specific index in the `ArrayList`, use the `get` method. For example, to tell the second alien in the list to do something, we would write:

```
aliens.get(1).doSomething();
```

> **Note:** This is different from the array syntax, where we would write:
> `arrayName[1].doSomething();`

To remove the element at a specific index in the `ArrayList`, use the `remove` method. To remove the first `Alien` in the list, we would write:

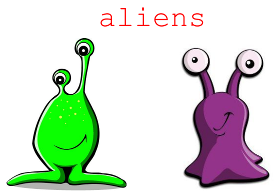
```
aliens.remove(0);
```



Note that since we removed the purple alien, the green alien is now the first in the list, meaning it is at index 0. The blue alien is now the second in the list, meaning it is at index 1.

To replace the element at a specific index in the list with another element, use the `set` method:

```
aliens.set(1, new PurpleAlien());
```



Looping through an `ArrayList` is pretty similar to looping through an array. For example, the following code replaces every element in the list with a `PurpleAlien`:

```
for (int i = 0; i < aliens.size(); i++) {
      aliens.set(i, new PurpleAlien());
}
```

To get the number of elements in your `ArrayList`, use the `size` method.

```
aliens.size();
```

To remove all elements from an `ArrayList`, use the `clear` method:

```
aliens.clear();
```

Check out the `ArrayList` Javadocs for more useful methods!