Java Data Structures: Arrays and ArrayLists

CPSC 233: Introduction to Computer Science for Computer Science Majors II
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Where are lists?

- Java has no Python lists (or tuples)
- It has **Arrays**
  - share syntax with python lists like index array[index] = 5;
  - Size can’t be changed
  - No syntax for slicing
  - No methods built in (can use java.util.Arrays library)

Arrays Library?

import java.util.Arrays;

- https://docs.oracle.com/en/java/javase/11/docs/api/java.base/java/util/Arrays.html
- Often useful for printing Arrays.toString(array);
- For sorting Arrays.sort(array);
- No syntax for slicing,
  - but can use java.util.Arrays.copyOfRange(array, start, end);

Where are lists?

- Java has no Python lists (or tuples)
- It also has **ArrayLists**
  - Closest functionally to python lists
  - Syntax uses longer to type methods like array_list.set(index, 5);
  - Size can change
  - Everything via methods built in (like .sort(), .size(), etc.)
  - No syntax slicing but array_list.subList(start, end)

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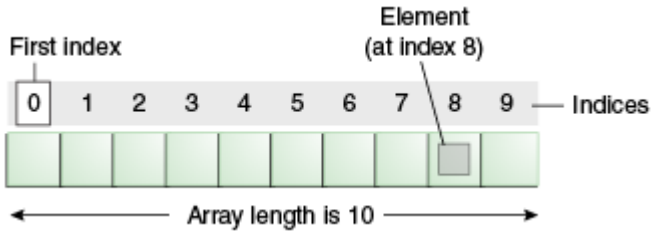
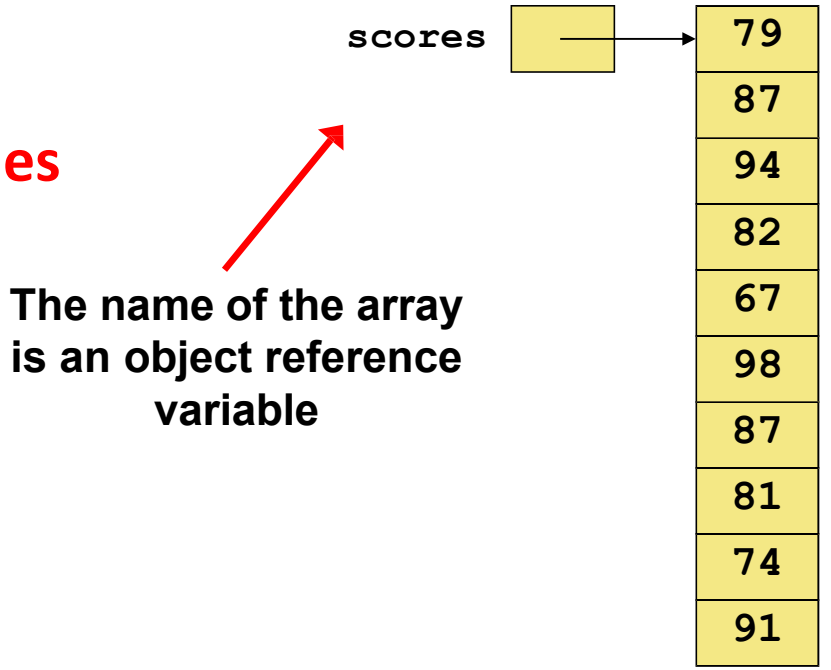
Arrays

Arrays

- Size is static (once you set it you are stuck with it)
  - Re-size by making new array and copying everything in
  - You can't remove primitives (just change their value)
  - You can remove objects but only by setting spot to null
- Are type limiting (all data must be the same)
- You can index into it (like python lists) , **no negative indicies**





Arrays

```
int[] array;                        //Create variable
array = new int[<size>];            //Create array (filled with 0's)
int x = array[index];               //Index access
array[index] = <new value>;         //Index assign

int[] array = {0,1,2,3,4,5,6,7,8,9};        //Create array all at once
```

String Arrays

```
String[] array;                    //Create variable
array = new String[<size>];        //Create array (filled with null)
String x = array[index];           //Index access
array[index] = <new value>;        //Index assign

String[] array = {“0”,”1”,”2”,”3”};        //Create array all at once
```

2D Arrays

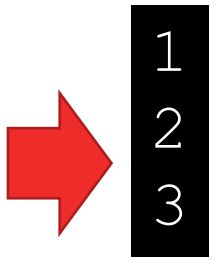
```
int[][] array;                                  //Create variable
array = new int[<size1>][<size2>];              //Create 2D array (filled with 0's)
int x = array[index1][index2];                  //Index access
array[index1][index2] = <new value>;            //Index assign

int[][] array = {{0,1,2},{3,4,5},{6,7,8}};      //Create array all at once
```

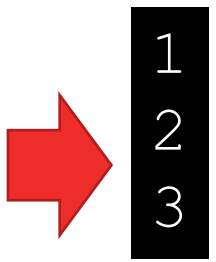
<size1> -> generally first dimension is called rows

<size2> -> generally second dimension is called columns

Looping Array

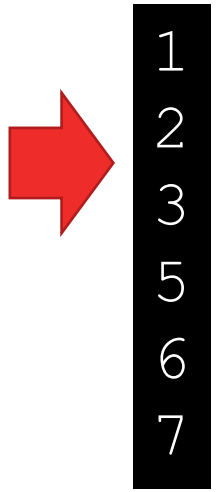
```
public static void main(String[] args) {
    int[] array = {1,2,3};
    for (int item : array) {
        System.out.println(item);
    }
    for (int i = 0; i < array.length; i++) {
        System.out.println(array[i]);
    }
}
```





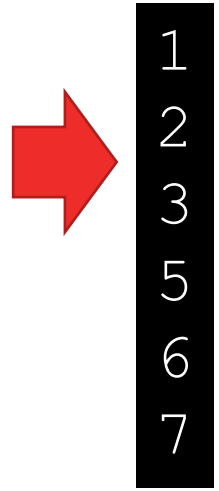
Looping Array

```
public static void main(String[] args) {
    int[][] array = {{1,2,3}, {4,5,6}};
    for (int i = 0; i < array.length; i++) {
        for (int j = 0; j < array[i].length; j++) {
            System.out.println(array[i][j]);
        }
    }
}
```



Looping Array

```
public static void main(String[] args) {
    int[][] array = {{1,2,3}, {4,5,6}};
    for (int row = 0; row < array.length; row++) {
        for (int col = 0; col < array[row].length; col++) {
            System.out.println(array[row][col]);
        }
    }
}
```



ArrayLists

ArrayLists

- Size changes as needed (technically an ArrayList is a wrapper of a hidden array)
- Only stores object types
- List size changes as you add/remove things
- Can be type limiting, using <Type> generics, otherwise everything is Object
- import java.util.ArrayList;
- https://docs.oracle.com/en/java/javase/11/docs/api/java.base/java/util/ArrayList.html

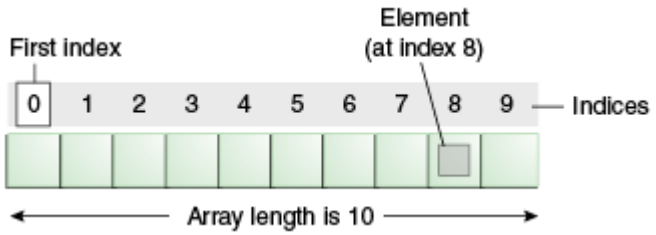
ArrayLists

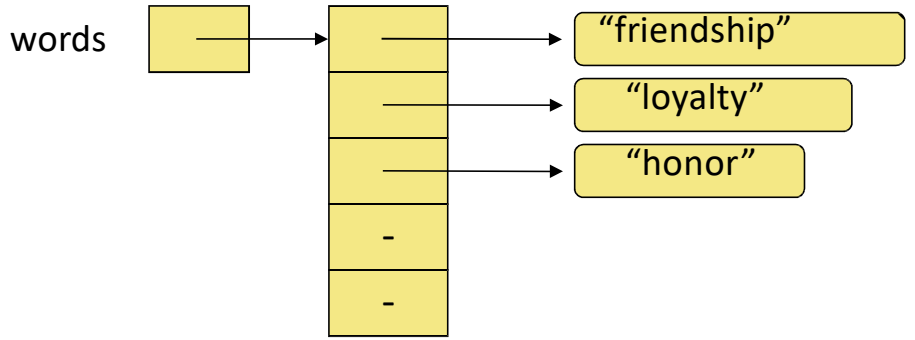
ArrayList<String> list; //Create variable

list = new ArrayList<String>(); //Create array (size=0)

String x = list.get(index); //Index access

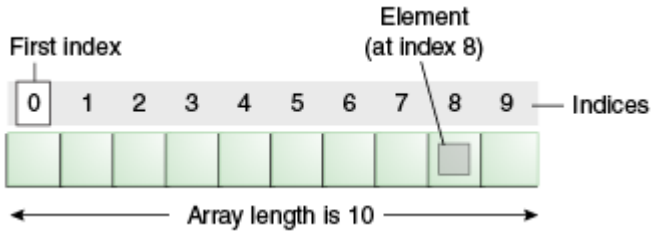
list.set(index, <new value>); //Index assign

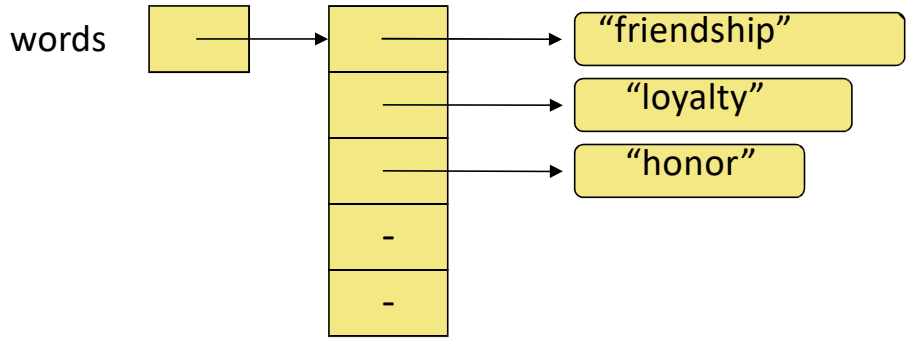




ArrayLists (Non-generic)

```
ArrayList list;    //Create variable
list = new ArrayList(); //Create array (size=0)
Object x = list.get(index);        //Index access
String y = (String) x;
list.set(index, <new value>);   //Index assign
```





ArrayLists - methods

Java	Java (desc)	Python	Python (desc)
list.add(index, item);	Insert item at index, shift left	list.insert(index, item)	same
list.addAll(list);	Insert all at index	list.extend(list)	same
list.clear();	Clear all	list.clear()	same
list.contains(item);	Check if item in list	item in list	same
list.indexOf(item);	Get first index of item	list.index(item)	same
list.remove(index);	Remove by index	list.pop(index)	same
list.remove(item);	Remove by item	list.remove(item)	same
list.size();	Size of list	len(list)	same
Collections.sort(list);	Sort list*	list.sort()	same

*import java.util.Collections;

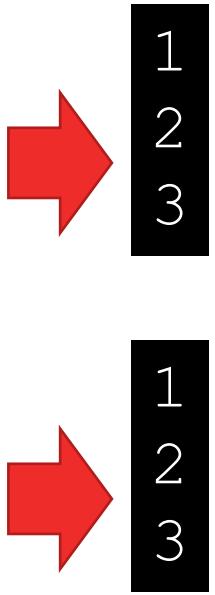
Simple operations

```
ArrayList<String> list = new ArrayList<String>();
list.add("3"); list.add("2"); list.add("1");

System.out.println(list);
Collections.sort(list);
System.out.println(list);
System.out.println(list.indexOf("2"));
list.remove("2");
System.out.println(list);
list.remove(0);
System.out.println(list);
```

```
[3, 2, 1]

[1, 2, 3]
1

[1, 3]

[3]
```

Looping ArrayList

```
ArrayList<String> list = new ArrayList<String>();
list.add("1"); list.add("2"); list.add("3");
for (String item : list) {
    System.out.println(item);
}
for (int i = 0; i < list.size(); i++) {
    System.out.println(list.get(i));
}
```



java.util.Collections

- Like java.util.Arrays (but for things like ArrayList, and HashSet/HashMap)

- https://docs.oracle.com/en/java/javase/11/docs/api/java.base/java/util/Collections.html

- min()
- max()
- sort()
- shuffle()
- reverse()
- replaceAll()

Onward to … HashSets and HashMaps.

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