Garfield AP CS

ArrayLists

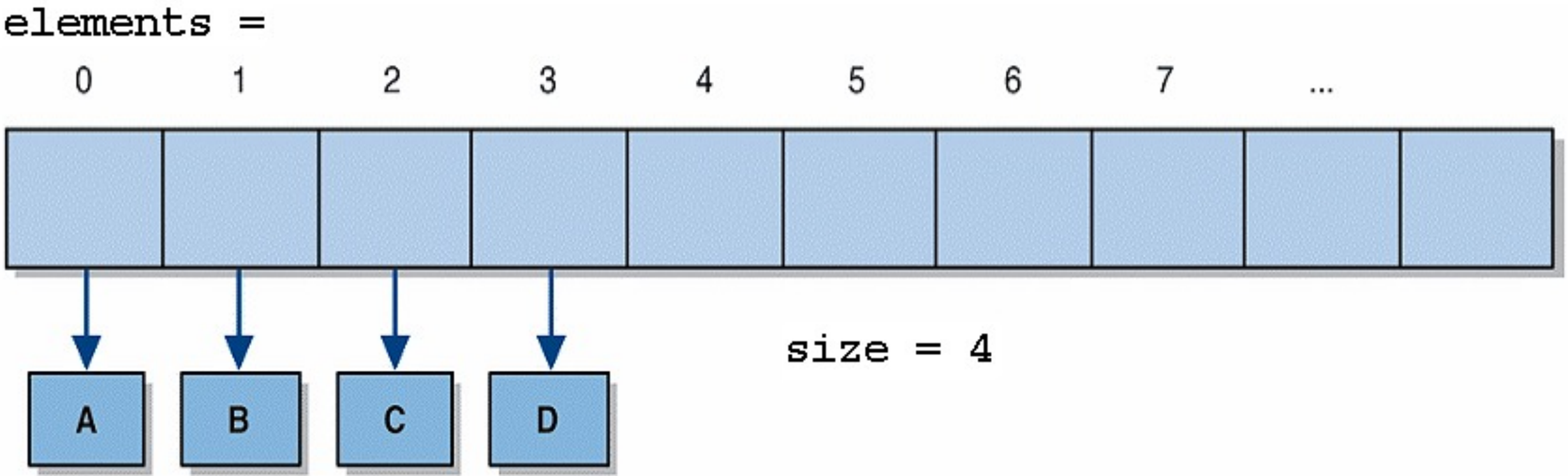
Array limitations

- You can't compare arrays using ==
- You can't use print or println on an array
- You can't dynamically change the size of an array during program execution

The `ArrayList` class

- Class `ArrayList<E>` implements the notion of a list using a partially-filled array
  - when you want to use `ArrayList`, remember to

```
import java.util.*;
```



`ArrayList` features

- think of it as an auto-resizing array that can hold any type of object, with many convenient methods
- maintains most of the benefits of arrays, such as fast random access
- frees us from some tedious operations on arrays, such as sliding elements and resizing
- can call `toString` on an `ArrayList` to print its elements
  - `[1, 2.65, Marty Stepp, Hello]`

Generic classes

- **generic class**: A type in Java that is written to accept another type as part of itself.

  - `ArrayList<`*E*`>` is a generic class.

    - The `<E>` is a placeholder in which you write the type of elements you want to store in the `ArrayList`.

  - Example:

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

    - Now the methods of `words` will manipulate and return `String`s.

`ArrayList` vs. array

- array

```
String[] names = new String[5];
names[0] = "Jennifer";
String name = names[0];
```

- `ArrayList`

```
ArrayList<String> namesList = new ArrayList<String>();
namesList.add("Jennifer");
String name = namesList.get(0);
```

Adding elements

- Elements are added dynamically to the list:

```
ArrayList<String> list = new ArrayList<String>();
System.out.println("list = " + list);
list.add("Tool");
System.out.println("list = " + list);
list.add("Phish");
System.out.println("list = " + list);
list.add("Pink Floyd");
System.out.println("list = " + list);
```

- Output:

```
list = []
list = [Tool]
list = [Tool, Phish]
list = [Tool, Phish, Pink Floyd]
```

Removing elements

- Elements can also be removed by index:

```
System.out.println("before remove list = " + list);
list.remove(0);
list.remove(1);
System.out.println("after remove list = " + list);
```

- Output:

```
before remove list = [Tool, U2, Phish, Pink Floyd]
after remove list = [U2, Pink Floyd]
```

  - Notice that as each element is removed, the others shift downward in position to fill the hole.
  - Therefore, the second `remove` gets rid of Phish, not U2.

Searching for elements

- You can search the list for particular elements:

```
if (list.contains("Phish")) {
    int index = list.indexOf("Phish");
    System.out.println(index + " " + list.get(index));
}
if (list.contains("Madonna")) {
    System.out.println("Madonna is in the list");
} else {
    System.out.println("Madonna is not found.");
}
```

- Output:

```
2 Phish
Madonna is not found.
```

  - `contains` tells you whether an element is in the list or not, and `indexOf` tells you at which index you can find it.

ArrayList methods

Method name	Description
`add(`*value*`)`	adds the given value to the end of the list
`add(`*index, value*`)`	inserts the given value before the given index
`clear()`	removes all elements
`contains(`*value*`)`	returns `true` if the given element is in the list
`get(`*index*`)`	returns the value at the given index
`indexOf(`*value*`)`	returns the first index at which the given element appears in the list (or -1 if not found)
`lastIndexOf(`*value*`)`	returns the last index at which the given element appears in the list (or -1 if not found)
`remove(`*index*`)`	removes value at given index, sliding others back
`set(`*index, value*`)`	replaces the element at position index with value and returns the element formerly at the specified position
`size()`	returns the number of elements in the list

ArrayList and for loop

- Enhanced for loop syntax ("for each loop") can be used to examine an `ArrayList`:

```
int sum = 0;
for (String s : list) {
    sum += s.length();
}
System.out.println("Total of lengths = " +
  sum);
```

Wrapper classes

- `ArrayList`s only contain objects, and primitive values are not objects.
  - e.g. `ArrayList<int>` is not legal

- If you want to store primitives in an `ArrayList`, you must declare it using a "wrapper" class as its type.

Primitive type	Wrapper class
`int`	`Integer`
`double`	`Double`
`char`	`Character`
`boolean`	`Boolean`

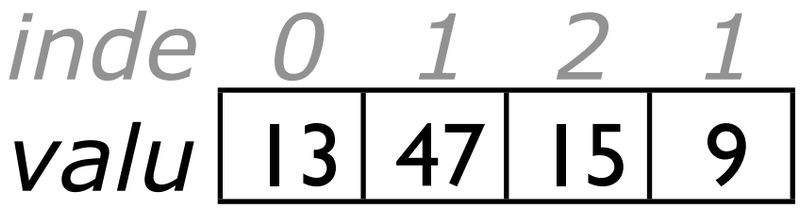
- example:

```
ArrayList<Integer> list = new ArrayList<Integer>();
```

Wrapper example

- The following list stores `int` values:

```
ArrayList<Integer> list = new ArrayList<Integer>();
list.add(13);
list.add(47);
list.add(15);
list.add(9);
int sum = 0;
for (int n : list) {
    sum += n;
}
System.out.println("list = " + list);
System.out.println("sum = " + sum);
```



- Output:

```
list = [13, 47, 15, 9]
sum = 84
```

- Though you must say `Integer` when declaring the list, you can refer to the elements as type `int` afterward.
- Java automatically converts between the two using techniques known as **boxing** and **unboxing**.