Building Java Programs

Chapter 15

`ArrayIntList`

reading: 15.1

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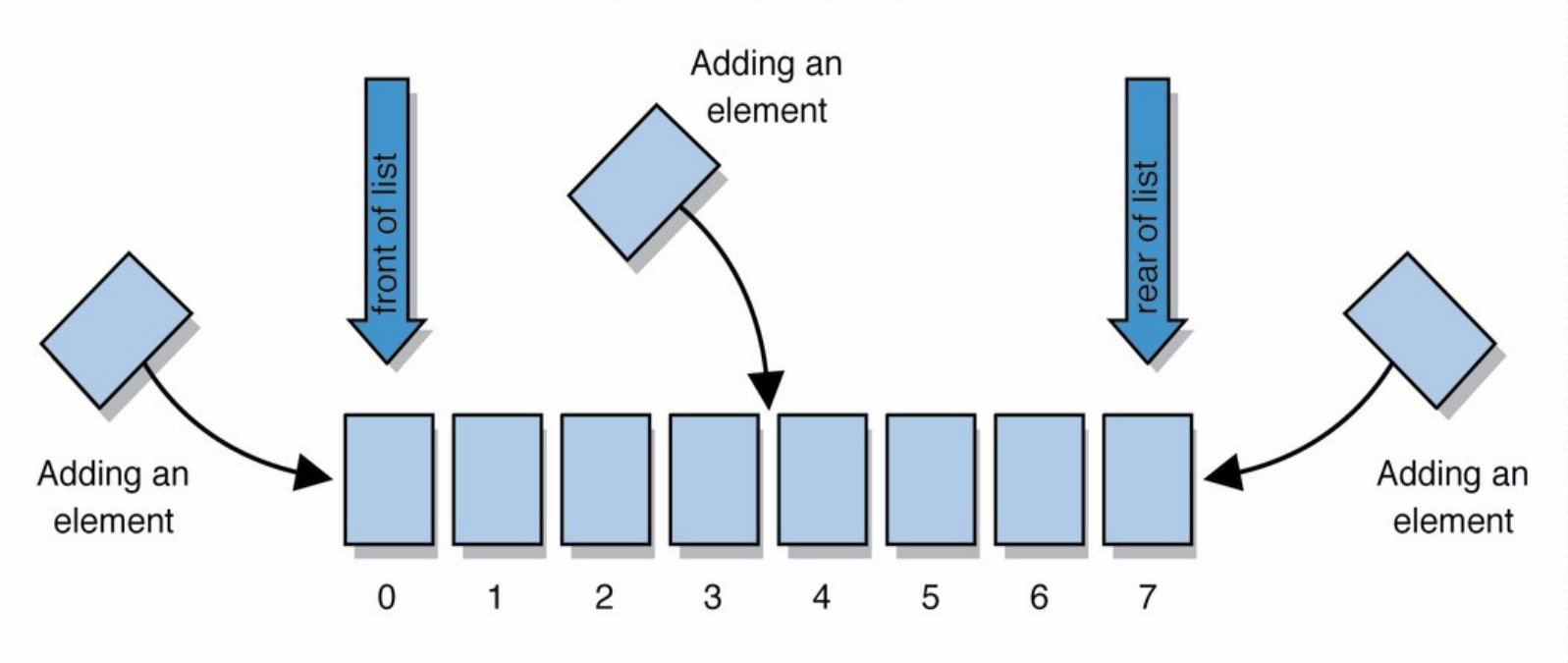
Lists

- **list**: a collection of elements with 0-based **indexes**
  - elements can be added to the front, back, or elsewhere
  - a list has a **size** (number of elements that have been added)
  - This is just a high level idea, haven't said how to do it in Java



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- Suppose we had the following method:

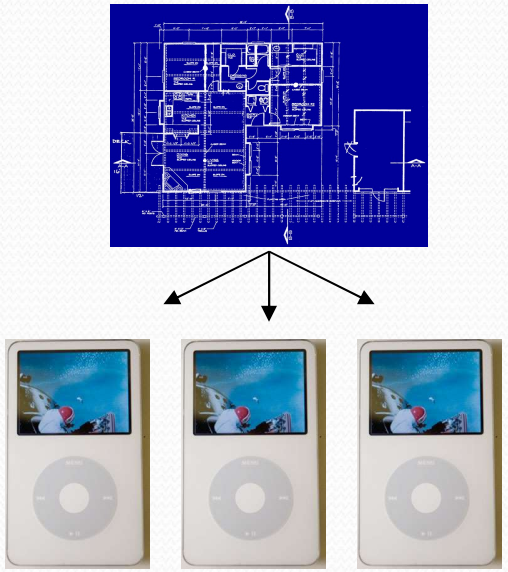
```
// Returns count of plural words in the given list.
public static int removePlural(ArrayList<String> list) {
    for (int i = 0; i < list.size(); i++) {
        String str = list.get(i);
        if (str.endsWith("s")) {
            list.remove(i);
        }
    }
}
```

- What would the output be after the method call?

```
ArrayList<String> list = …; // [a, bs, c, ds, es, f]
removePlural(list);
System.out.println(list);
```

Recall: classes and objects

- **class**: A program entity that represents:
  - A complete program or module, or
  - A template for a type of objects.
  - (`ArrayList` is a class that defines a type.)



- **object**: An entity that combines **state** and **behavior**.
  - **object-oriented programming (OOP)**: Programs that perform their behavior as interactions between objects.
  - **abstraction**: Separation between concepts and details. Objects provide abstraction in programming.

Elements of a class

```
public class BankAccount {
    private String name;
    private int id;
    private double balance;

    public BankAccount(String name, int id) {
        this.name = name;
        this.id = id;
        this.balance = 0.0;
    }

    public void deposit(double amount) {
        this.balance += amount;
    }
    ...
}
```

Client - Radio

Implementer - Radio

Client – ArrayList

ArrayList<String> list:

["a", "b", "c"]

Implementer - ArrayList

String[] elementData:

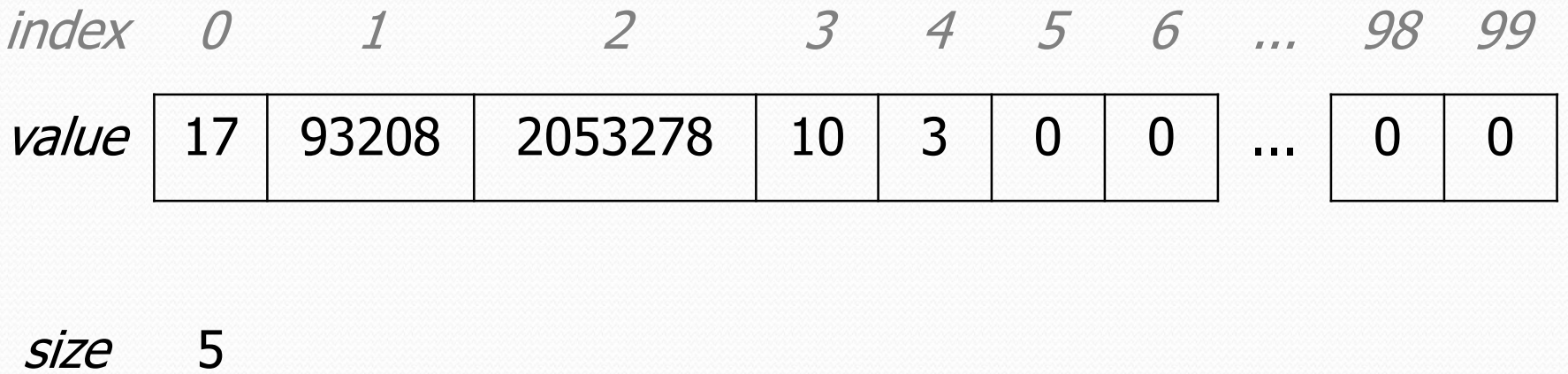
["a", "b", "c", null, null, null, null, null, null]

int size:

3

`ArrayList` implementation

- What is an `ArrayList`'s behavior?
  - add, remove, indexOf, etc
- What is an `ArrayList`'s state?
  - Many elements of the same type
  - For example, unfilled array



`ArrayIntList` implementation

- Simpler than `ArrayList<E>`
  - No generics (only stores `int`s)
  - Fewer methods: `add(`**`value`**`)`, `add(`**`index`**`, `**`value`**`)`, `get(`**`index`**`)`, `set(`**`index`**`, `**`value`**`)`, `size()`, `isEmpty()`, `remove(`**`index`**`)`, `indexOf(`**`value`**`)`, `contains(`**`value`**`)`, `toString()`,

- Fields?
  - `int[]`
  - `int` to keep track of the number of elements added
  - The default capacity (array length) will be 10

Implementing `add`

- How do we add to the end of a list?

```
public void add(int value) {   // just put the element
    list[size] = value;        // in the last slot,
    size++;                    // and increase the size
}
```

index	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
value	3	8	9	7	5	12	0	0	0	0
size	6									

  - `list.add(42);`

index	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
value	3	8	9	7	5	12	**42**	0	0	0
size	**7**									

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- Suppose we had the following method:

```
ArrayIntList list1 = new ArrayIntList();
ArrayIntList list2 = new ArrayIntList();
list1.add(1);
list2.add(2);
list1 = list2;
list1.add(3);
list2.add(4);
```

- What is the state of the lists after these calls?
  - `list1: [1, 3]` `list2: [2, 4]`
  - `list1: [2, 3]` `list2: [2, 4]`
  - `list1: [2, 3, 4]` `list2: [2, 3, 4]`
  - `list1: [1, 2, 3]` `list2: [4]`
  - `list1: [1, 2, 3, 4]` `list2: []`
  - Other

Printing an `ArrayIntList`

- Let's add a method that allows clients to print a list's elements.
  - You may be tempted to write a `print` method:

```
// client code
ArrayIntList list = new ArrayIntList();
...
list.print();
```

    - Why is this a bad idea? What would be better?

The `toString` method

- Tells Java how to convert an object into a `String`

```
ArrayIntList list = new ArrayIntList();
System.out.println("list is " + list);
            // ("list is " + list.toString());
```

- Syntax:

```
public String toString() {
    code that returns a suitable String;
}
```

- Every class has a `toString`, even if it isn't in your code.
  - The default is the class's name and a hex (base-16) number:

```
ArrayIntList@9e8c34
```

toString solution

```
// Returns a String representation of the list.
public String toString() {
    if (size == 0) {
        return "[]";
    } else {
        String result = "[" + elementData[0];
        for (int i = 1; i < size; i++) {
            result += ", " + elementData[i];
        }
        result += "]";
        return result;
    }
}
```