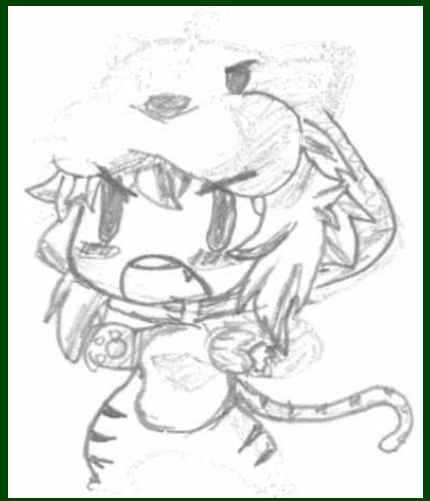
CSE 143

Computer Programming II

ArrayIntList

Questions From Last Time

- Increase Text Size in JGrasp (done!)
- I took CSE 142 a long time ago. What should I do?
  We're holding a review session of CSE 142 material sometime at the end of this week or the beginning of next week!
- Will slides be online? (yup!)
- Will programs from lecture be posted? (yup!)
- Can you repeat questions out loud? (yes, sorry!)
- Where is the IPL? (MGH room 334 & 342)
- What is your favorite color? (green)
- "Hello" (Hi!)



`int` vs. `Integer` `char` vs. `Character` `double` vs. `Double`

The lowercase versions are primitive types; the uppercase versions are "wrapper classes".

The following is valid code:

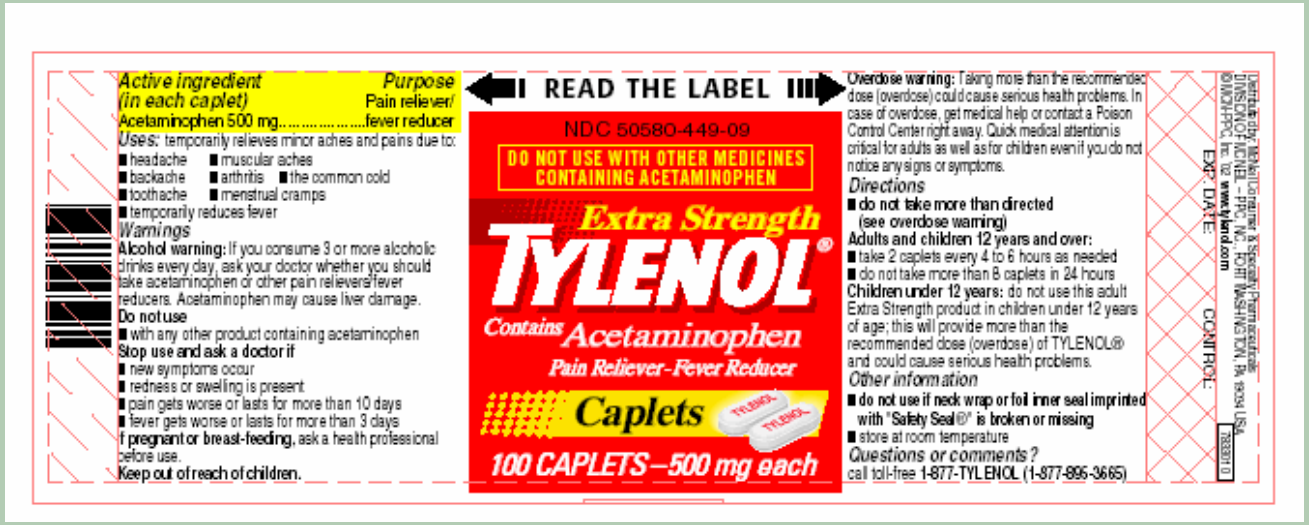
```
1 int a = 5;
2 Integer b = 10;
3 int c = a + b; //You can treat ints and Integers as the same
```

When we create `ArrayList`'s, we must use non-primitive types. So:

```
1 ArrayList<int> bad1 = new ArrayList<int>(); // This won't compile!
2 // v This will work.
3 ArrayList<Integer> better = new ArrayList<Integer>();
4 better.add(5); // We can add an 'int' to an 'Integer' ArrayList
```

Client vs. Implementor: Medication

For a tylenol pill, who is the client? Who is the implementor?



Java Examples

You've already been a client!

- `DrawingPanel`
- `ArrayList`

You've already been an implementor!

- `Critter`

Class

A **Class** is

- a complete program, or
- a "template" for a type

(Examples: `ArrayList`, `ReverseFile`, ...)

The class explains what an object is, an **instance** is a particular version of the object.

```
1 ArrayList<String> list1 = new ArrayList<String>();
2 ArrayList<String> list2 = new ArrayList<String>()
3 //list1 and list2 are instances of ArrayList
```

Object

An **Object** combines **state** and **behavior**.

Java is an "object-oriented" programming language (OOP); programs consist of objects interacting with each other.

A class is made up of field(s), constructor(s), and method(s).
Let's make an object `Circle` that represents a circle...

- with a size
- that can be moved right
- at a particular location

```
1  public class Circle {
2     /* Fields */
3     private int radius;
4     private int x;
5     private int y;
6
7     /* Constructor */
8     public Circle(int radius, int x, int y) {
9        this.radius = radius;
10       this.x = x;
11       this.y = y;
12    }
13
14    /* Methods */
15    public void moveRight(int numberOfUnits) {
16       this.x += numberOfUnits;
17    }
18 }
```

Implementor View of `ArrayList`

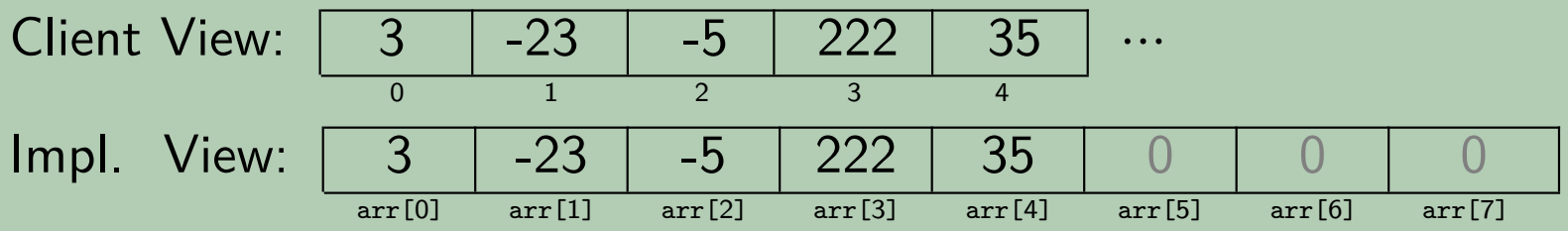
What behavior should we support? (Methods)

`add`, `remove`, `indexOf`, etc.

What state do we keep track of? (Fields)

- Elements stored in the `ArrayList` (probably stored as an array!)
- Size of `ArrayList`

Two Views of an `ArrayList`



- No generics (only stores ints)
- Fewer methods: `add`(value), `add`(index, value), `get`(index), `set`(index, value), `size`(), `isEmpty`(), `remove`(index), `indexOf`(value), `contains`(value), `toString`()

Implementing `add`

(size = 4)

3	8	2	45	0	0	0	0
`lst[0]`	`lst[1]`	`lst[2]`	`lst[3]`	`lst[4]`	`lst[5]`	`lst[6]`	`lst[7]`

`lst.add(222)`:

(size = 5)

3	8	2	45	**222**	0	0	0
`lst[0]`	`lst[1]`	`lst[2]`	`lst[3]`	`lst[4]`	`lst[5]`	`lst[6]`	`lst[7]`

How do we add to the end of the list?

- Put the element in the last slot
- Increment the size

```
1 public void add(int value) {
2    list[size] = value;
3    size++;
4 }
```

Printing an ArrayIntList

`System.out.println` automatically calls `toString` on the given object. `toString` looks like:

```
1  public String toString() {
2     ...
3  }
```

`ArrayIntList toString`:

```
1  public String toString() {
2     if (size == 0) {
3        return "[]";
4     }
5     else {
6        String result = "[" + list[0];
7        for (int i = 1; i < size; i++) {
8           result += ", " + list[i];
9        }
10       result += "]";
11       return result;
12    }
13 }
```

Implementing `add` #2

(size = 4)

3	8	2	45	0	0	0	0
list[0]	list[1]	list[2]	list[3]	list[4]	list[5]	list[6]	list[7]

`list.add(1, 222)`:

(size = 5)

3	**222**	8	2	45	0	0	0
list[0]	list[1]	list[2]	list[3]	list[4]	list[5]	list[6]	list[7]

How do we add to the middle of the list?

- Shift over all elements starting from the end
- Put the new element in its index
- Increment the size

```
1 public void add(int index, int value) {
2    for (int i = size; i > index; i--) {
3       list[i] = list[i - 1];
4    }
5    list[index] = value;
6    size++;
7 }
```