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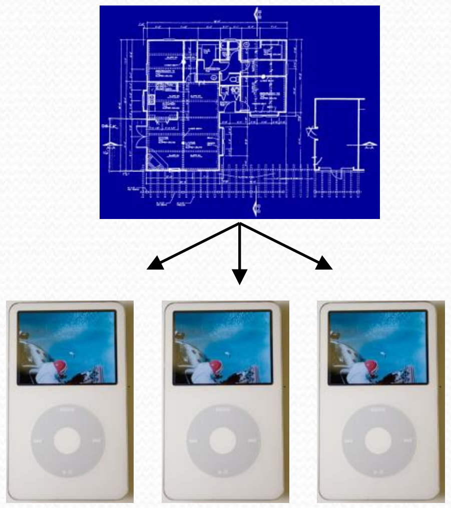
- Warm Up: What is the output of this code?

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

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.

Preconditions

- **precondition**: Something your method *assumes is true* at the start of its execution.
  - Often documented as a comment on the method's header:

```
// Returns the element at the given index.
// Precondition: 0 <= index < size
public int get(int index) {
    return elementData[index];
}
```

  - Stating a precondition doesn't really "solve" the problem, but it at least documents our decision and warns the client what not to do.
  - What if we want to actually enforce the precondition?

Throwing exceptions (4.4)

```
throw new ExceptionType();
throw new ExceptionType("message");
```

- Generates an exception that will crash the program, unless it has code to handle ("catch") the exception.

- Common exception types:
  - `ArithmeticException`, `ArrayIndexOutOfBoundsException`, `FileNotFoundException`, `IllegalArgumentException`, `IllegalStateException`, `IOException`, `NoSuchElementException`, `NullPointerException`, `RuntimeException`, `UnsupportedOperationException`

- Why would anyone ever *want* a program to crash?

Postconditions

- **postcondition**: Something your method *promises will be true* at the *end* of its execution.
  - Often documented as a comment on the method's header:

```
// Precondition : size() < capacity
// Postcondition: value is added at the end of the list
public void add(int value) {
    elementData[size] = value;
    size++;
}
```

  - If your method states a postcondition, clients should be able to rely on that statement being true after they call the method.

`this` keyword

- **`this`** : A reference to the *implicit parameter*
  (the object on which a method/constructor is called)

- Syntax:
  - To refer to a field: `this.`**field**
  - To call a method: `this.`**method**`(`**parameters**`);`
  - To call a constructor from another constructor: `this(`**parameters**`);`

`ArrayList` of primitives?

- The type you specify when creating an `ArrayList` must be an object type; it cannot be a primitive type.

```
// illegal -- int cannot be a type parameter
ArrayList<int> list = new ArrayList<int>();
```

- But we can still use `ArrayList` with primitive types by using special classes called *wrapper* classes in their place.

```
// creates a list of ints
ArrayList<Integer> list = new ArrayList<Integer>();
```

Wrapper classes

Primitive Type	**Wrapper Type**
`int`	`Integer`
`double`	`Double`
`char`	`Character`
`boolean`	`Boolean`

- A wrapper is an object whose sole purpose is to hold a primitive value.

- Once you construct the list, use it with primitives as normal:

```
ArrayList<Double> grades = new ArrayList<Double>();
grades.add(3.2);
grades.add(2.7);
...
double myGrade = grades.get(0);
```

Tips for testing

- You cannot test every possible input, parameter value, etc.
  - Think of a limited set of tests likely to expose bugs.

- Think about boundary cases
  - Positive; zero; negative numbers
  - Right at the edge of an array or collection's size

- Think about empty cases and error cases
  - 0, -1, null; an empty list or array

- test behavior in combination
  - Maybe `add` usually works, but fails after you call `remove`
  - Make multiple calls; maybe `size` fails the second time only