Static Class Members and Singletons

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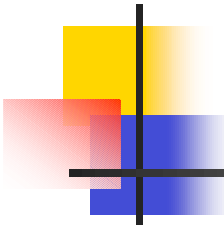
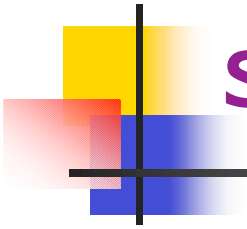


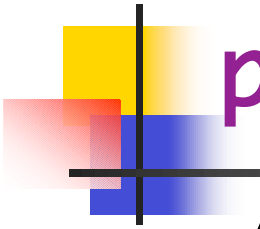
DrJava Intermediate Level

- Today we progress to the Intermediate Language Level. Beware of the fact that compilation conventions are incompatible. If you generate a test class with the langauge level set at Elementary, it will **not** compile if you save it as an Intermediate language (`.dj1`) file.
- At the Intermediate level, the `static`, `public`, and `private` attributes are enabled. The JUnit framework requires that test classes be public for no good reason. The DrJava Elementary Level prohibits the `static`, `public`, and `private` attributes in source text, but it generates the `public` attribute for test classes. The Intermediate level does not generate the `public` attribute for test classes, but includes it in the provided template.
- The Elementary and Intermediate levels make the same distinction with regard to `import` statements. `import` is prohibited and generated for unit tests at the Elementary level but enabled and not generated at the Intermediate level.



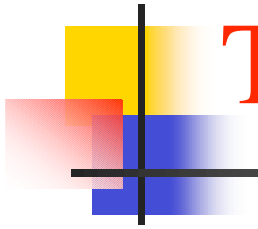
`static` Class Members

- Almost all of the fields and methods that we have seen thus far have been attached to Java classes, but fields and methods can be attached to Java classes rather than class instances. Such fields and methods and called `static` class members.
- We will defer discussing `static` methods. They are not supported at the Intermediate Level in DrJava. Starting with HW8, set your language level at Intermediate.
- `static` fields are used primarily to store constants associated with a class. Why `static`? Only need one copy of a constant. Wasteful to create a copy in every object of a class. You have already seen a few `static` fields in the context of Java libraries. The fields `MAX_VALUE` and `MIN_VALUE` in all of the wrapper classes except `Boolean` are `static`.



`private` Class Members

- Any `static` or dynamic (instance) field or method can be marked as `private`. A `private` field is *visible* only within the class in which it is defined. We use `private` much like Scheme `local` but confining a variable's scope to a class is much less restrictive that confining it to a function/method. We can test defer discussing `static` methods as we demonstrate once we introduce inner classes.
- `private` members are used primarily for methods and fields that only concern the class containing them, *e.g.* help methods. Note that in the context of the composite pattern, we cannot make a help method `private`.



The Singleton Pattern

- An important application of the `static` and `private` attributes is the *singleton pattern*. Each execution of the expression

  ```
  new EmptyIntList()
  ```

  creates a new object. In principle, there is only one empty list, just like there is only one number 0. Hence, we would like to represent the empty list by a single library.
- The *singleton pattern* is the mechanism that we use to create a unique instance of a class. This pattern consists of two chunks of code:
  - a `static` field in the class that holds the single instance of the class
  - a `private` attribute on the class constructor, so no client can create another instance of the class.

Singleton `IntList`

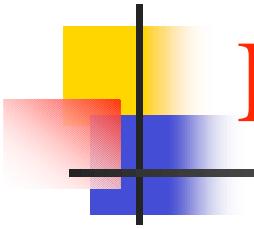
```
abstract class IntList {
  abstract IntList sort();
  IntList cons(int n) { return new ConsIntList(n, this); }
  abstract IntList insert(int n);
}

class EmptyIntList extends IntList {
  static EmptyIntList ONLY = new EmptyIntList();
  private EmptyIntList() { }
  IntList sort() { return this; }
  IntList insert(int n) { return cons(n); }
}

class ConsIntList extends IntList {
  int first;
  IntList rest;
  IntList sort() { return rest.sort().insert(first); }
  IntList insert(int n) {
    if (n <= first) return cons(n);
    else return rest.insert(n).cons(first);
  }
}
```

Static member holding the unique instance

Private constructor



For Next Class

- Labs this afternoon and tomorrow
- Easy Homework due Friday
- Reading: OO Design Notes, Ch 1.6-1.8.