CS61B Lecture #12

Today: Various odds and ends in support of abstraction.

Readings: At this point, we have looked at Chapters 1–8 of *Head First Java*. Today's lecture is about Chapters 9 and 11. For Friday, please read Chapter 10 and Chapter 3 ("Numbers") from *Assorted Material on Java*.

Parent constructors

- In lecture notes #5, talked about how Java allows implementer of a class to control all manipulation of objects of that class.

- In particular, this means that Java gives the constructor of a class the first shot at each new object.

- When one class extends another, there are two constructors—one for the parent type and one for the new (child) type.

- In this case, Java guarantees that one of the parent's constructors is called first. In effect, there is a call to a parent constructor at the beginning of every one of the child's constructors.

- You can call the parent's constructor yourself. By default, Java calls the "default" (parameterless) constructor.

```
class Figure {                      class Rectangle extends Figure {
  public Figure (int sides) {           public Rectangle () {
    ...                                     super (4);
  }...                                  }...
}                                   }
```

What to do About Errors?

- Large amount of any production program devoted to detecting and responding to errors.

- Some errors are external (bad input, network failures); others are internal errors in programs.

- When method has stated precondition, it's the client's job to comply.

- Still, it's nice to detect and report client's errors.

- In Java, we *throw exception objects,* typically:

      throw new *SomeException* (*optional description*);

- Exceptions are objects. By convention, they are given two constructors: one with no arguments, and one with a descriptive string argument (which the exception stores).

- Java system throws some exceptions implicitly, as when you dereference a null pointer, or exceed an array bound.

Catching Exceptions

- A **throw** causes each active method call to *terminate abruptly,* until (and unless) we come to a **try** block.

- Catch exceptions and do something corrective with **try**:

      ```
      try {
          Stuff that might throw exception;
      } catch (SomeException e) {
          Do something reasonable;
      } catch (SomeOtherException e) {
          Do something else reasonable;
      }
      Go on with life;
      ```

- When *SomeException* exception occurs in "Stuff...," we immediately "do something reasonable" and then "go on with life."

- Descriptive string (if any) available as `e.getMessage()` for error messages and the like.

Exceptions: Checked vs. Unchecked

- The object thrown by **throw** command must be a subtype of `Throwable` (in `java.lang`).
- Java pre-declares several such subtypes, among them
  - `Error`, used for serious, unrecoverable errors;
  - `Exception`, intended for all other exceptions;
  - `RuntimeException`, a subtype of `Exception` intended mostly for programming errors too common to be worth declaring.
- Pre-declared exceptions are all subtypes of one of these.
- Any subtype of `Error` or `RuntimeException` is said to be *unchecked.*
- All other exception types are *checked.*

Unchecked Exceptions

- Intended for
  - Programmer errors: many library functions throw `IllegalArgumentException` when one fails to meet a precondition.
  - Errors detected by the basic Java system: e.g.,
    * Executing `x.y` when `x` is null,
    * Executing `A[i]` when `i` is out of bounds,
    * Executing `(String) x` when `x` turns out not to point to a `String`.
  - Certain catastrophic failures, such as running out of memory.
- May be thrown anywhere at any time with no special preparation.

Checked Exceptions

- Intended to indicate exceptional circumstances that are not necessarily programmer errors. Examples:
  - Attempting to open a file that does not exist.
  - Input or output errors on a file.
  - Receiving an interrupt.
- Every checked exception that can occur inside a method must either be handled by a `try` statement, or reported in the method's declaration.
- For example,

  ```
  void myRead () throws IOException, InterruptedException { ... }
  ```

  means that myRead (or something it calls) *might* throw `IOException` or `InterruptedException`.
- Language Design: Why did Java make the following illegal?

  ```
  class Parent {              class Child extends Parent {
     void f () { ... }            void f () throws IOException { ... }
  }                           }
  ```

Good Practice

- Throw exceptions rather than using print statements and System.exit everywhere,
- ...because response to an problem may depend on the *caller,* not just method where problem arises.
- Nice to throw an exception when programmer violates preconditions.
- Particularly good idea to throw an exception rather than let bad input corrupt a data structure.
- Good idea to document when methods throw exceptions.
- To convey information about the cause of exceptional condition, put it into the exception rather than into some global variable:

  ```
  class MyBad extends Exception {          try { ...
     public IntList errs;                  } catch (MyBad e) {
     MyBad (IntList nums) { errs=nums; }      ... e.errs ...
  }                                        }
  ```