

CS61B Lecture #11: Examples: Comparable & Reader

- Java library provides an interface to describe Objects that have a *natural order* on them, such as String, Integer, BigInteger and BigDecimal:

```
public interface Comparable { // For now, the Java 1.4 version
    /** Returns value <0, == 0, or > 0 depending on whether
     * THIS is <, ==, or > OBJ. Exception if OBJ not of compatible type. */
    int compareTo (Object obj);
}
```

- Might use in a general-purpose max function:

```
/** The largest value in array A, or null if A empty. */
public static Comparable max (Comparable[] A) {
    if (A.length == 0) return null;
    Comparable result; result = A[0];
    for (int i = 1; i < A.length; i += 1)
        if (result.compareTo (A[i]) < 0) result = A[i];
    return result;
}
```

- Now `max(S)` will return maximum value in S if S is an array of Strings, or any other kind of Object that implements Comparable.

Examples: Implementing Comparable

```
// Extension to IntSequence from Lab #3.
class IntSequence implements Comparable {
    private int[] myValues;
    private int myCount;
    ...
    public int compareTo (Object obj) {
        IntSequence x = (IntSequence) obj; // Blows up if incomparable
        for (int i = 0; i < myCount && i < x.myCount; i += 1)
            if (myValues[i] < x.myValues[i])
                return -1;
            else if (myValues[i] > x.myValues[i])
                return 1;
        return myCount - x.myCount; // Umm. A bit tricky
    }
}
```

Also possible to add interface retroactively. If `IntSequence` did *not* implement `Comparable`, but did implement `compareTo`, could write

```
class ComparableIntSequence extends IntSequence implements Comparable {
    ...
}
```

Example: Readers

- Java class `java.io.Reader` abstracts *sources of characters*.
- Here, we present a revisionist version (not the real thing):

```
public interface Reader { // Real java.io.Reader is abstract class
    /** Release this stream: further reads are illegal */
    void close ();

    /** Read as many characters as possible, up to LEN,
     *  into BUF[OFF], BUF[OFF+1],..., and return the
     *  number read, or -1 if at end-of-stream. */
    int read (char[] buf, int off, int len);

    /** Short for read (BUF, 0, BUF.length). */
    int read (char[] buf);

    /** Read and return single character, or -1 at end-of-stream. */
    int read ();
}
```

- Can't write `new Reader()`; it's abstract. So what good is it?

Generic Partial Implementation

- According to their specifications, some of Reader's methods are related.
- Can express this with a *partial implementation*, which leaves key methods unimplemented and provides default bodies for others.
- Result still abstract: can't use **new** on it.

```
/** A partial implementation of Reader. Complete
 * implementations MUST override close and read(,,).
 * They MAY override the other read methods for speed. */
public abstract class AbstractReader implements Reader {
    public abstract void close ();
    public abstract int read (char[] buf, int off, int len);

    public int read (char[] buf) { return read(buf,0,buf.length); }

    public int read () { return (read (buf1) == -1) ? -1 : buf1[0]; }

    private char[] buf1 = new char[1];
}
```

Implementation of Reader: StringReader

The class StringReader reads characters from a String:

```
public class StringReader extends AbstractReader {
    private String str;
    private int k;
    /** A Reader delivering the characters in STR. */
    public StringReader (String str)
        { this.str = str; k = 0; }

    public void close () { str = null; }

    public int read (char[] buf, int off, int len) {
        if (k == str.length ())
            return -1;
        len = Math.min (len, str.length () - k);
        str.getChars (k, k+len, buf, off);
        k += len;
        return len;
    }
}
```

Using Reader

Consider this method, which counts words:

```
/** The total number of words in R, where a "word" is
 * a maximal sequence of non-whitespace characters. */
int wc (Reader r) {
    int c0, count;
    c0 = ' '; cnt = 0;
    while (true) {
        int c = r.read ();
        if (c == -1) return count;
        if (Character.isWhitespace ((char) c0) && ! Character.isWhitespace ((char) c))
            count += 1;
        c0 = c;
    }
}
```

This method works for *any* Reader:

```
// Number of words in the String someText:
wc (new StringReader (someText))
// Number of words in standard input.
wc (new InputStreamReader (System.in))
// Number of words in file named fileName:
wc (new FileReader (fileName))
```

} other implementations of Reader

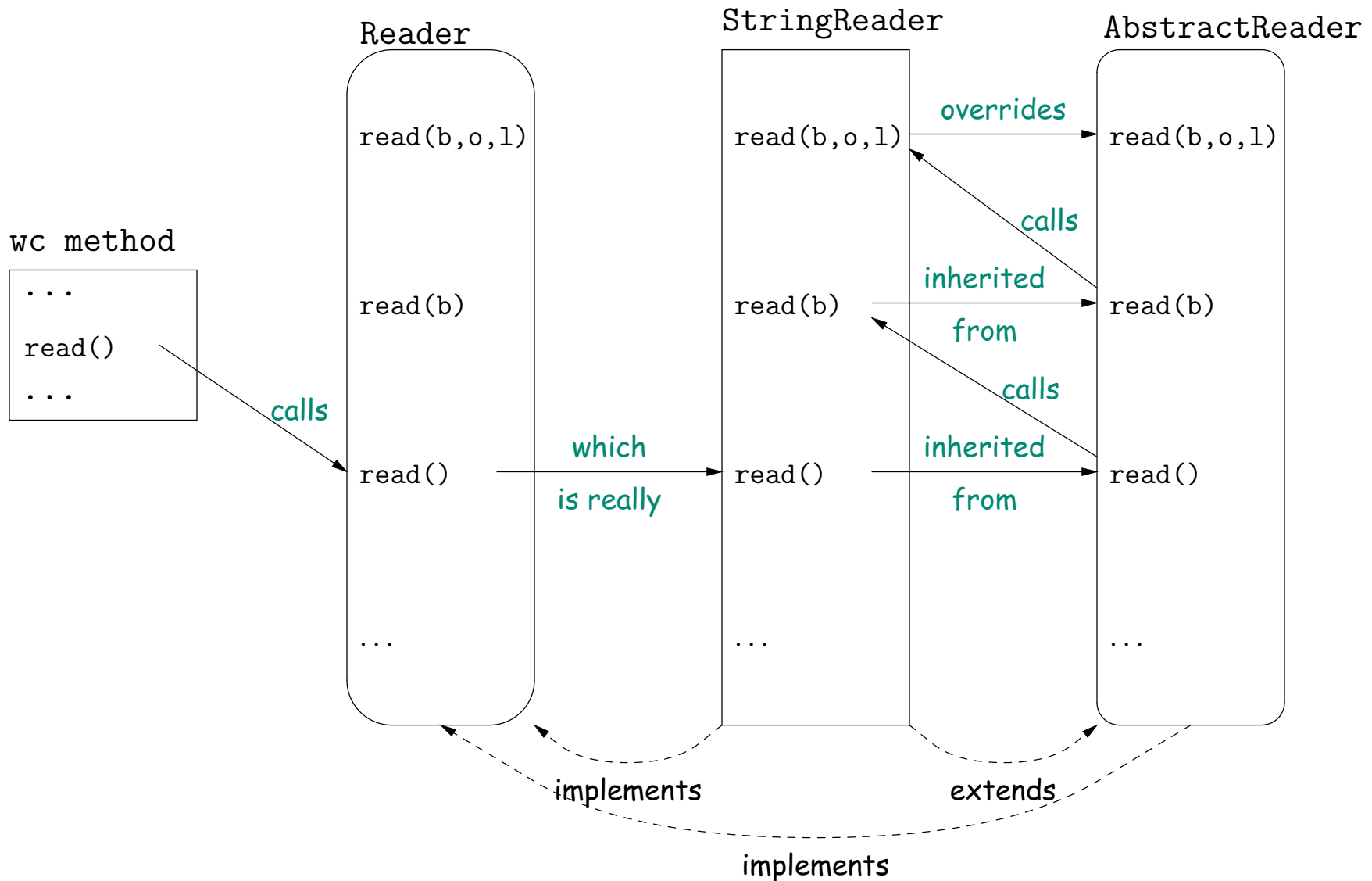
How It Fits Together

Client

Interface

Concrete Class

Abstract Template



Lessons

- The Reader interface class served as a *specification* for a whole set of readers.
- Ideally, most client methods that deal with Readers, like `wc`, will specify type `Reader` for the formal parameters, not a specific kind of `Reader`, thus assuming as little as possible.
- And only when a client creates a new `Reader` will it get specific about what subtype of `Reader` it needs.
- That way, client's methods are as *widely applicable* as possible.
- Finally, `AbstractReader` is a tool for implementors of non-abstract `Reader` classes, and not used by clients.
- Alas, Java library is not pure. E.g., `AbstractReader` is really just called `Reader` and there is no interface. In this example, we saw what they *should* have done!
- The `Comparable` interface allows definition of functions that depend only on a limited subset of the properties (methods) of their arguments (such as "must have a `compareTo` method").