its digits is deleted, and the resulting number is again divisible by 9.

a. Prove that actually dividing the resulting number by 9 results in deleting another digit.

b. Find all integers satisfying the conditions of this problem.

the Scores tab for results.

- Yes, you can resubmit. See the Course Info tab.
- In particular, *many* people need to do style fixes! Use `make style` or `style61b signpost/*.java` to check before submission.

1. By You Alone: All major submitted non-skeleton code should be written by you alone.
2. Do Not Possess or Share Code: Before a project deadline, you should never be in possession of solution code that you did not write, nor distribute your own code to others in the class.
3. Cite Your Sources: When you receive significant assistance on a project from someone else (other than the staff), cite that assistance somewhere in your source code.

- Discussion of approaches for solving a problem.
- Giving away or receiving significant ideas towards a problem solution, if cited.
- Discussion of specific syntax issues and bugs in your code.
- Using small snippets of code that you find online for solving tiny problems (e.g. googling "uppercase string java" may lead you to some sample code that you copy and paste. Cite these.

Requiring Great Caution:

- Looking at someone else's project code to assist with debugging.
- Looking at someone else's project code to understand a particular idea or part of a

in any form before a final deadline, or distributing your own.

- Possessing project solution code that you did not write yourself before a final deadline (e.g., from github, or from staff solution code found somewhere). Likewise, distributing such code.

scribe 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)
```

- 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.

```
class IntSequence implements Comparable {
       private int[] myValues;
       private int myCount;
       ...
       public int get(int k) { return myValues[k];
}

       @Override
       public int compareTo(Object obj) {
          IntSequence x = (IntSequence) obj; // Blows
up if obj not an IntSequence
          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;  // <0 iff myCount
< x.myCount
       }
```

tively.

- If IntSequence did not implement Comparable, but did implement compareTo (without @Override), we could write

```
   class ComparableIntSequence extends IntSequence
implements Comparable {

   }
```

- Java would then "match up" the compareTo in IntSequence with that in Comparable.

The current version uses a newer feature:
Java generic types:

```
public interface Comparable<T> {
    int compareTo(T x);
}
```

- Here, T is like a formal parameter in a method, except that its "value" is a *type*.
- Revised IntSequence (no casting needed):

```
  class IntSequence implements Comparable<IntSequence>
{
      ...
      @Override
      public int compareTo(IntSequence x) {
         for (int i = 0; i < myCount && i < x.myCount;
i += 1) {
             if (myValues[i] < x.myValues[i])
...

         return myCount - x.myCount;
```

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
```

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

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. Concrete
   *  implementations MUST override close and
read(,,).
   *  They MAY override the other read methods
for speed. */
  public abstract class AbstractReader implements
Reader {
     // Next two lines are redundant.
     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);
}
```

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

The class StringReader reads characters from a String:

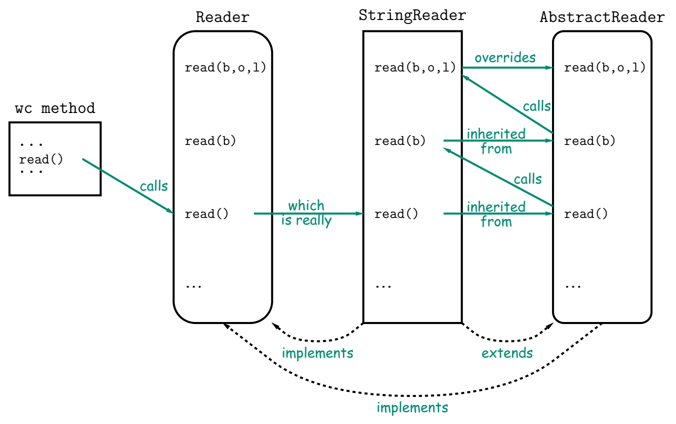
```
   public class StringReader extends AbstractReader
{
     private String str;
     private int k;
     /** A Reader that delivers the characters in
STR. */
     public StringReader(String s) {
         str = s; k = 0;
     }

     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);
```

```
             }
```

```
  /** 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 = ' '; count = 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:

```
wc(new StringReader(someText))        // #
words in someText
wc(new InputStreamReader(System.in))  // #
words in standard input
```



ification 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

subset of the properties (methods) of their arguments (such as "must have a `compareTo` method").