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Chapter 19. The JavaMail API

Email was the Internet's first killer app and still generates more Internet traffic than any protocol except HTTP. One of the most frequently asked questions about Java is how to send email from a Java applet or application. While it's certainly possible to write a Java program that uses sockets to communicate with mail servers, this requires detailed knowledge of some fairly complicated protocols, such as SMTP, POP, and IMAP. Just as the `URL` class makes interacting with HTTP servers a lot simpler than it would be with raw sockets, so too can a class library dedicated to handling email make writing email clients a lot simpler.

The JavaMail API is a standard extension to Java that provides a class library for email clients. It's a required component of the Java 2 Platform, Enterprise Edition (J2EE). The JavaMail API can be implemented in 100% Pure Java™ using sockets and streams, and indeed Sun's reference implementation is so implemented. Programs use the JavaMail API to communicate with SMTP, POP, and IMAP servers to send and receive email. By taking advantage of this API, you can avoid focusing on the low-level protocol details and focus instead on what you want to say with the message. Additional providers can add support for other mail systems such as Hotmail or MH. You can even install providers that add support for NNTP, the protocol used to transport Usenet news.

There's no limit to the uses Java programs have for the JavaMail API. Most obviously, you can write standard email clients such as Eudora. Or it can be used for email-intensive applications such as mailing list managers, like listproc. But the JavaMail API is also useful as a part of larger applications that simply need to send or receive a little email. For instance, a server-monitoring application such as Whistle Blower can periodically load pages from a web server running on a different host and email the webmaster if the web server has crashed. An applet can use email to send data to any process or person on the Internet that has an email address, in essence using the web server's SMTP server as a simple proxy to bypass the usual security restrictions about whom an applet is allowed to talk to. In reverse, an applet can talk to an IMAP server on the applet host to receive data from many hosts around the Net. A newsreader could be implemented as a custom service provider that treats NNTP as just one more means of exchanging messages. And that's just the beginning of the sort of programs the JavaMail API makes it very straightforward to write.

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19.1. What Is the JavaMail API?

The JavaMail API is a fairly high-level representation of the basic components of any email system. The components are represented by abstract classes in the `javax.mail` package. For instance, the abstract class `javax.mail.Message` represents an email message. It declares abstract methods to get and set various kinds of envelope information for the message, such as the sender and addressee, the date sent, and the subject of the message. The abstract class `javax.mail.Folder` represents a message container. It declares abstract methods to get messages from a folder, move messages between folders, and delete messages from a folder.

These classes are all abstract because they don't make many assumptions about how the email is stored or transferred between machines. For instance, they do not assume that messages are sent using SMTP or that they're structured as specified in RFC 822. Concrete subclasses of these classes specialize the abstract classes to particular protocols and mail formats. If you want to work with standard Internet email, you might use `javax.mail.MimeMessage` instead of `javax.mail.Message`, `javax.mail.InternetAddress` instead of `javax.mail.Address`, and `com.sun.mail.imap.IMAPStore` instead of `javax.mail.Store`. If you were writing code for a Lotus Notes-based system, you'd use different concrete implementation classes but the same abstract base classes.

The JavaMail API roughly follows the abstract factory design pattern. This pattern allows you to write your code based on the abstract superclasses without worrying too much about the lower-level details. The protocols and formats used and the associated concrete implementation classes are determined mostly by one line of code early in your program that names the protocol. Changing the protocol name goes 90% of the way to porting your program from one protocol (say, POP) to another (say, IMAP).

Service providers implement particular protocols. A service provider is a group of concrete subclasses of the abstract JavaMail API classes that specialize the general API to a particular protocol and mail format. These subclasses are probably (though not necessarily) organized into one package. Some of these (IMAP, SMTP) are provided by Sun with its reference implementation in the undocumented `com.sun.mail` package. Others (NNTP, MH) are available from third parties. And some (POP) are available from both Sun and third parties. The purpose of the abstract JavaMail API is to shield you from low-level details like this. You don't write code to access an IMAP server or a POP server. You write your programs to speak to the JavaMail API. Then, the JavaMail API uses the service provider to speak to the server using its native protocol. This is middleware for email. All you need to do to add a new protocol is install the service provider's JAR file. Simple, carefully designed programs that use only the core features of the JavaMail API may be able to use the new provider without even being recompiled. Of course, programs that make use of special features of individual protocols may need to be rewritten.

Since mail arrives from the network at unpredictable times, the JavaMail API relies on an event-based callback mechanism to handle incoming mail. This is exactly the same pattern (even using some of the same classes) found in the AWT and JavaBeans. The `javax.mail.event` package defines about half a dozen different kinds of mail events, as well as the associated listener interfaces and adapter classes for these events.

While many people still fondly recall the early days of ASCII email and even ASCII pictures, modern email messages contain a bewildering array of multilingual text and multimedia data encoded in formats such as Base64, quoted-printable, BinHex, and uuencode. To handle this, the JavaMail API uses the JavaBeans Activation Framework (JAF) to describe and display this content.

This chapter covers Version 1.3.1 of the JavaMail API, which is compatible with Java 1.1.8 and higher. The JavaMail API is a standard extension to Java, not part of the core JDK or JRE class library, even in Java 1.5. (It is a standard part of J2EE.) Consequently, you'll need to download it separately from Sun and install it on your system. It's freely available from http://java.sun.com/products/javamail. It comes as a Zip archive containing documentation, sample code, and the all-important *mail.jar* file. This file contains the actual *.class* files that implement the JavaMail API. To compile or run the examples in this chapter, you'll need to add this file to your class path, either by adding its path to the CLASSPATH environment variable or by placing *mail.jar* in your *jre/lib/ext* directory.

The JavaBeans Activation Framework is also a standard extension to Java, not part of the core API. You can download it from http://java.sun.com/products/javabeans/jaf/. This download contains the *activation.jar* archive, which you'll also need to place in your class path.

Finally, you may want to add some additional providers. Sun's implementation includes POP3, SMTP, and IMAP providers. However, third parties have written providers for other protocols such as Hotmail, NNTP, Exchange, and more. Table 19-1 lists some of these.

Table 19-1. Mail providers

Product (company)	URL	Protocols	License
JavaMail (Sun)	http://java.sun.com/products/javamail/	SMTP, IMAP, POP3	Free
JavaMail/Exchange Service Provider (JESP): (Intrinsyc Software)	http://support.intrinsyc.com/jesp/	Microsoft Exchange	Payware

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Product (company)	URL	Protocols	License
ICE MH JavaMail Provider (ICE Engineering, Inc.)	http://www.trustice.com/java/icemh	MH	Public domain
POPpers (Y. Miyadate)	http://www2s.biglobe.ne.jp/~dat/java/project/poppers/index_en.html	POP3	GPL
JDAVMail (Luc Claes)	http://jdavmail.sourceforge.net	Hotmail	LGPL
JHTTPMail (Laurent Michalkovic)	http://jhttpmail.sourceforge.net/	Hotmail	LGPL
GNU JavaMail	http://www.gnu.org/software/classpathx/javamail/	POP3, NNTP, SMTP, IMAP, mbox, maildir	GPL with library exception

19.2. Sending Email

Sending messages is the most basic email need of a Java program. While email clients like Eudora and mailing list managers like listproc are the only common programs that receive messages, all sorts of programs send messages. For instance, web browsers can submit HTML forms via email. Security scanning tools like Satan can run in the background and email their results to the administrator when they're done. When the Unix cron program detects a misconfigured *crontab* file, it emails the error to the owner. Books & Writers runs a popular service that tracks the sales rank of authors' books on Amazon.com and notifies them periodically via email. A massively parallel computation like the SETI@home project can submit individual results via email. Some multiplayer games like chess can be played across the network by emailing the moves back and forth (though this scheme wouldn't work for faster-moving games like Quake or even for speed chess). And these are just a few of the different kinds of programs that send email. In today's wired world, by far the simplest way to notify users of an event when they're not sitting in front of the computer that the program is running on is to send them email.

The JavaMail API provides everything programs need to send email. To send a message, a program follows these eight simple steps:

1. Set the `mail.host` property to point to the local mail server.
2. Start a mail session with the `Session.getInstance()` method.

3. Create a new `Message` object, probably by instantiating one of its concrete subclasses.
4. Set the message's From: address.
5. Set the message's To: address.
6. Set the message's Subject:.
7. Set the content of the message.
8. Send the message with the `Transport.send( )` method.

The order of these steps is not especially rigid. For instance, steps 4 through 7 can be performed in any order. Individually, each of the steps is quite simple.

The first step is to set up the properties for the mail session. The only property you have to set in order to send mail is `mail.host`. This is configured as a `java.util.Properties` object rather than an environment variable. For example, this code fragment sets the `mail.host` property to *mail.cloud9.net*:

```
Properties props = new Properties( );
props.put("mail.host", "mail.cloud9.net");
```

Your programs will of course have to set this property to the name of your own mail server. These properties are used to retrieve a `Session` object from the `Session.getInstance( )` factory method, like this:

```
Session mailConnection = Session.getInstance(props, null);
```

The `Session` object represents an ongoing communication between a program and one mail server. The second argument to the `getInstance( )` method, `null` here, is a `javax.mail.Authenticator` that will ask the user for a password if the server requests one. We'll discuss this more later in the section on password authentication. Most of the time, you do not need to provide a username and password to send email when using the local SMTP server, only to receive it.

The `Session` object is used to construct a new `Message` object:

```
Message msg = new MimeMessage(mailConnection);
```

I specify the `MimeMessage` class in particular since I know I'm sending Internet email. However, this is the one place where I do explicitly choose a format for the email message. In some cases, this may not be necessary if I can copy the incoming message format instead.

Now that I have a `Message` object, I need to set up its fields and contents. The From: address and To: address will each be `javax.mail.internet.InternetAddress` objects. You can provide either an email address alone or an email address and a real name:

```
Address bill = new InternetAddress("god@microsoft.com", "Bill Gates");
Address elliotte = new InternetAddress("elharo@metalab.unc.edu");
```


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The `setFrom( )` method allows us to say who's sending the message by setting the From: header. There's no protection against forgery. It's quite easy for me to masquerade as Bill Gates at a (presumably) fictitious email address:

```
msg.setFrom(bill);
```

The `setRecipient()` method is slightly more complex. You not only have to specify the address that the message will be sent to, but how that address is used; that is, as a To: field, a Cc: field, or a Bcc: field. These are indicated by three mnemonic constants of the `Message.RecipientType` class:

```
Message.RecipientType.TO
Message.RecipientType.CC
Message.RecipientType.BCC
```

For example:

```
msg.setRecipient(Message.RecipientType.TO, elliotte);
```

The subject is set as a simple string of text. For example:

```
msg.setSubject("You must comply.");
```

The body is also set as a single string of text. However, along with that text, you need to provide the MIME type of the text. The most common type is `text/plain`. For example:

```
msg.setContent("Resistance is futile. You will be assimilated!",
 "text/plain");
```

Finally, the static `Transport.send( )` method connects to the mail server specified by the `mail.host` property and sends the message on its way:

```
Transport.send(msg);
```

Example 19-1 puts all these steps together into a standalone program that sends the following message:

```
Date: Mon, 29 Nov 1999 15:55:42 -0500 (EST)
From: Bill Gates <god@microsoft.com>
To: elharo@metalab.unc.edu
Subject: You must comply.

Resistance is futile. You will be assimilated!
```

I've shown this message in standard RFC 822 format used for Internet email. However, that isn't necessary. The main point is that you need to know the addressee (elharo@metalab.unc.edu), the sender (god@microsoft.com), and the subject and body of the message.

Example 19-1. Sending a very simple mail message

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;

public class Assimilator {

  public static void main(String[] args) {

    try {
      Properties props = new Properties( );
      props.put("mail.host", "mail.cloud9.net");

      Session mailConnection = Session.getInstance(props, null);
      Message msg = new MimeMessage(mailConnection);

      Address bill = new InternetAddress("god@microsoft.com",
       "Bill Gates");
      Address elliotte = new InternetAddress("elharo@metalab.unc.edu");

      msg.setContent("Resistance is futile. You will be assimilated!",
       "text/plain");
      msg.setFrom(bill);
      msg.setRecipient(Message.RecipientType.TO, elliotte);
      msg.setSubject("You must comply.");

      Transport.send(msg);

    }
    catch (Exception ex) {
      ex.printStackTrace( );
    }

  }
}
```

19.2.1. Sending Email from an Application

Example 19-1 is a simple application that sends a fixed message to a known address with a specified subject. Once you see how to do this, it's straightforward to replace the strings that give the message address, subject, and body with data read from the command line, a GUI, a database, or some other source. For instance, Example 19-2 is a very simple GUI for sending email. Figure 19-1 shows the program running. The mail code is all tied up in the `actionPerformed( )` method and looks very similar to the `main( )` method of Example 19-1. The big difference is that now the host, subject, From: address, To: address, and text of the message are all read from the GUI components at runtime rather than being hardcoded as string literals in the source code. The rest of code is related to setting up the GUI and has little to do with the JavaMail API.

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Example 19-2. A graphical SMTP client

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;
import javax.swing.*;
import java.awt.event.*;
import java.awt.*;

public class SMTPClient extends JFrame {

  private JButton     sendButton   = new JButton("Send Message");
  private JLabel      fromLabel    = new JLabel("From: ");
  private JLabel      toLabel      = new JLabel("To: ");
  private JLabel      hostLabel    = new JLabel("SMTP Server: ");
  private JLabel      subjectLabel = new JLabel("Subject: ");
  private JTextField  fromField    = new JTextField(40);
  private JTextField  toField      = new JTextField(40);
  private JTextField  hostField    = new JTextField(40);
  private JTextField  subjectField = new JTextField(40);
  private JTextArea   message      = new JTextArea(40, 72);
  private JScrollPane jsp          = new JScrollPane(message);

  public SMTPClient( ) {

    super("SMTP Client");
    Container contentPane = this.getContentPane( );
    contentPane.setLayout(new BorderLayout( ));

    JPanel labels = new JPanel( );
    labels.setLayout(new GridLayout(4, 1));
    labels.add(hostLabel);

    JPanel fields = new JPanel( );
    fields.setLayout(new GridLayout(4, 1));
    String host = System.getProperty("mail.host", "");
    hostField.setText(host);
    fields.add(hostField);

    labels.add(toLabel);
    fields.add(toField);

    String from = System.getProperty("mail.from", "");
    fromField.setText(from);
    labels.add(fromLabel);
    fields.add(fromField);

    labels.add(subjectLabel);
    fields.add(subjectField);

    Box north = Box.createHorizontalBox( );
    north.add(labels);
    north.add(fields);

    contentPane.add(north, BorderLayout.NORTH);

    message.setFont(new Font("Monospaced", Font.PLAIN, 12));
    contentPane.add(jsp, BorderLayout.CENTER);

    JPanel south = new JPanel( );
    south.setLayout(new FlowLayout(FlowLayout.CENTER));
    south.add(sendButton);
    sendButton.addActionListener(new SendAction( ));
    contentPane.add(south, BorderLayout.SOUTH);

    this.pack( );
```


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```
    }

    class SendAction implements ActionListener {

      public void actionPerformed(ActionEvent evt) {

        try {
          Properties props = new Properties( );
          props.put("mail.host", hostField.getText( ));

          Session mailConnection = Session.getInstance(props, null);
          final Message msg = new MimeMessage(mailConnection);

          Address to = new InternetAddress(toField.getText( ));
          Address from = new InternetAddress(fromField.getText( ));

          msg.setContent(message.getText( ), "text/plain");
          msg.setFrom(from);
          msg.setRecipient(Message.RecipientType.TO, to);
          msg.setSubject(subjectField.getText( ));

          // This can take a non-trivial amount of time so
          // spawn a thread to handle it.
          Runnable r = new Runnable( ) {
            public void run( ) {
              try {
                Transport.send(msg);
              }
              catch (Exception ex) {
                ex.printStackTrace( );
              }
            }
          };
          Thread t = new Thread(r);
          t.start( );

          message.setText("");
        }
        catch (Exception ex) {
          // I should really bring up a more specific error dialog here.
          ex.printStackTrace( );
        }

      }

    }

    public static void main(String[] args) {

      SMTPClient client = new SMTPClient( );
      // Next line requires Java 1.3 or later. I want to set up the
      // exit behavior here rather than in the constructor since
      // other programs that use this class may not want to exit
      // the application when the SMTPClient window closes.
      client.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
      client.show( );

    }
  }
```

This is far from an ideal program. The GUI could be more cleanly separated from the mailing code. And it would be better to bring up an error dialog if something went wrong rather than just printing a stack trace of the exception on `System.err`. However, since none of that would teach us anything about the JavaMail API, I leave it all as an exercise for the interested reader.

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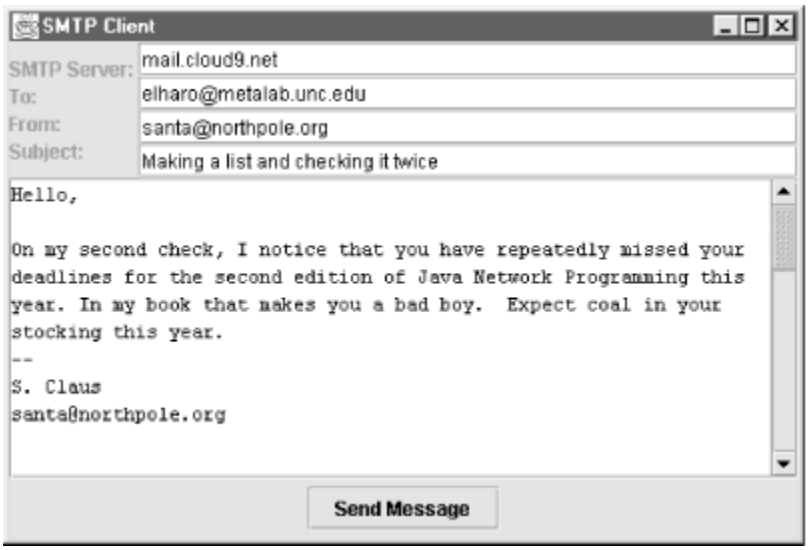
Figure 19-1. A simple GUI mail program



19.2.2. Sending Email from an Applet

In terms of GUIs and the JavaMail API, there's no difference between sending email from an applet and an application. However, the browser's security manager can get in your way. Like everything else in this book, the JavaMail API can't get around the normal restrictions on network connections from applets and other remotely loaded code. An applet that wants to send email can still talk only to the host the applet itself came from.

Fortunately, however, many hosts that run web servers also run SMTP servers. If this is the case, it's quite straightforward for an applet to send email. The JavaMail API and the Java Activation Framework on which it depends aren't included with most browsers, but since they're implemented in pure Java in the `javax` package, browsers can download the necessary classes from the server. For example, this `APPLET` element references not only the applet's own code but also the *mail.jar* and *activation.jar* files for the JavaMail API and the Java Activation Framework, respectively:

```
<APPLET CODE=SMTPApplet ARCHIVE="activation.jar,mail.jar"
        WIDTH=600 HEIGHT=400>
  <PARAM NAME="to" VALUE="hamp@sideview.mtsterling.ky.us">
  <PARAM NAME="subject" VALUE="Hay Orders">
  <PARAM NAME="from" VALUE="noone">
</APPLET>
```

Example 19-3 is a simple applet that sends email. The address to send email to and the subject are read from `PARAM` tags. The address to send email from is also read from a `PARAM` tag, but the user has the option to change it. The text to send is typed into a text area by the user. Finally, the server is determined by looking at the applet's codebase.

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Example 19-3. An applet that sends email

```
import java.applet.*;
import javax.mail.*;
import javax.mail.internet.*;
import java.util.Properties;
import java.awt.event.*;
import java.awt.*;

public class SMTPApplet extends Applet {

  private Button    sendButton   = new Button("Send Message");
  private Label     fromLabel    = new Label("From: ");
  private Label     subjectLabel = new Label("Subject: ");
  private TextField fromField    = new TextField(40);
  private TextField subjectField = new TextField(40);
  private TextArea  message      = new TextArea(30, 60);

  private String toAddress = "";

  public SMTPApplet( ) {

    this.setLayout(new BorderLayout( ));

    Panel north = new Panel( );
    north.setLayout(new GridLayout(3, 1));

    Panel n1 = new Panel( );
    n1.add(fromLabel);
    n1.add(fromField);
    north.add(n1);

    Panel n2 = new Panel( );
    n2.add(subjectLabel);
    n2.add(subjectField);
    north.add(n2);

    this.add(north, BorderLayout.NORTH);

    message.setFont(new Font("Monospaced", Font.PLAIN, 12));
    this.add(message, BorderLayout.CENTER);

    Panel south = new Panel( );
    south.setLayout(new FlowLayout(FlowLayout.CENTER));
    south.add(sendButton);
    sendButton.addActionListener(new SendAction( ));
    this.add(south, BorderLayout.SOUTH);

  }

  public void init( ) {

    String subject = this.getParameter("subject");
    if (subject == null) subject = "";
    subjectField.setText(subject);

    toAddress = this.getParameter("to");
    if (toAddress == null) toAddress = "";

    String fromAddress = this.getParameter("from");
    if (fromAddress == null) fromAddress = "";
    fromField.setText(fromAddress);

  }
```

```
    class SendAction implements ActionListener {

      public void actionPerformed(ActionEvent evt) {

        try {
          Properties props = new Properties( );
          props.put("mail.host", getCodeBase( ).getHost( ));

          Session mailConnection = Session.getInstance(props, null);
          final Message msg = new MimeMessage(mailConnection);

          Address to = new InternetAddress(toAddress);
          Address from = new InternetAddress(fromField.getText( ));

          msg.setContent(message.getText( ), "text/plain");
          msg.setFrom(from);
          msg.setRecipient(Message.RecipientType.TO, to);
          msg.setSubject(subjectField.getText( ));

          // This can take a non-trivial amount of time so
          // spawn a thread to handle it.
          Runnable r = new Runnable( ) {
            public void run( ) {
              try {
                Transport.send(msg);
              }
              catch (Exception ex) {
                ex.printStackTrace( );
              }
            }
          };
          Thread t = new Thread(r);
          t.start( );

          message.setText("");
        }
        catch (Exception ex) {
          // We should really bring up a more specific error dialog here.
          ex.printStackTrace( );
        }
      }
    }
  }
```

Figure 19-2 shows this applet running in Internet Explorer 4.0.1 on the Macintosh. I've been careful to only use methods and classes available in Java 1.1 so this applet runs across the most web browsers possible. I also avoided using Swing so that there'd be one less large JAR file to download. As it is, the *mail.jar* and *activation.jar* files that this applet requires take up almost 300K, more than I'm comfortable with, but manageable on a fast connection.

Figure 19-2. The SMTP applet

Proper behavior of this applet depends on several external factors:

- The browser must support at least Java 1.1 with a security model no stricter than the default.
- The *mail.jar* and *activation.jar* files must be available in the applet's codebase.
- The web server that serves the applet must also be an SMTP server willing to relay mail from the client system to the receiver system. These days, most open SMTP relays have been shut down to avoid abuse by spammers, so this can be a sticking point. If it is, you'll get an exception like this:

  ```
  javax.mail.SendFailedException: 550 <hamp@sideview.mtsterling.ky.us>...
  Relaying denied
  ```

  However, you should at least be able to send email to addresses in the web server's domain. You may be able to set up one of these addresses to automatically forward the messages to their eventual recipient.

19.3. Receiving Mail

Receiving mail is considerably more complex than sending it. For instance, where a simple HELO command is sufficient to access most SMTP servers (a fact that is the source of much forged email and spam), retrieving email generally requires providing both a username and a password. SMTP uses only 14 different commands, and a simple email client can be implemented with just five of them. POP3, however, has 12 commands, almost all of which a client must be able to handle; IMAP4 has 24 different commands.

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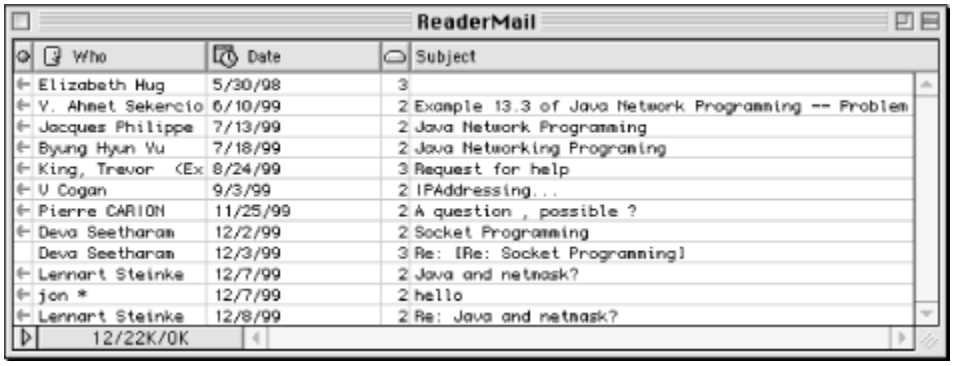
The JavaMail API is designed around the idea that you're retrieving messages from an IMAP or perhaps an NNTP server. That is, it assumes the server can return headers separate from the messages they belong to, search through mailboxes, provide the storage for the messages rather than the client, and so forth. The JavaMail API provides less of what you need for client-oriented mail access protocols, such as POP3, that assume the client stores and manages the mail archive, but it still gives you the tools to download the mail from the server. You just have to implement your own storage system on the client.

We'll begin with the simpler POP protocol, then move on to IMAP. From the perspective of JavaMail, IMAP can be viewed largely as POP plus some commands for manipulating folders. For simple programs that operate only on the INBOX folder, POP and IMAP clients are more or less the same.

There are about 12 steps to reading a remote mailbox (the number of steps can vary a little, since some steps are optional or can be combined with or replaced by others):

1. Set up the properties you'll use for the connection.
2. Construct the `Authenticator` you'll use for the connection.
3. Get a `Session` object with `Session.getDefaultInstance( )`.
4. Use the session's `getStore( )` method to return a `Store`.
5. Connect to the store.
6. Get the INBOX folder from the store with the `getFolder()` method.
7. Open the INBOX folder.
8. Open the folder you want inside the INBOX folder. Repeat as many times as necessary to reach the folder you're seeking.
9. Get the messages from the folder as an array of `Message` objects.
10. Iterate through the array of messages, processing each one in turn using the methods of the `Message` class. For instance, you might print out each message or simply display the sender, subject, and other vital information in a GUI for the user to select from, as in Figure 19-3.
11. Close the folder.
12. Close the store.

Figure 19-3. A GUI for selecting mail messages



Each of these steps is individually quite simple. The first is to set up the properties for the mail session. Properties you might want to set include `mail.host`, `mail.store.protocol`, `mail.user`, `mail.pop3.user`, and `mail.pop3.host`. However, you don't absolutely need

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to set any of these. If the `Session` will only be used to retrieve mail, an empty `Properties` object is enough. For example:

```
Properties props = new Properties( );
```

Next, you'll want to create an instance of the `javax.mail.Authenticator` class (more properly, an instance of a concrete subclass of the abstract `Authenticator` class) that can ask the user for a password. For now, we'll simply hardcode those values and pass `null` instead of an actual `Authenticator`. We'll fix this later when we discuss authentication:

```
Authenticator a = null;
```

Next, use these `Properties` and `Authenticator` objects to get a `Session` instance, like this:

```
Session session = Session.getDefaultInstance(props, a);
```

Ask the session for a store for the provider. Here, we want a provider for POP3:

```
Store store = session.getStore("POP3");
```

Finally, you're ready to actually connect to the store using the `connect( )` method. You'll need to provide the host to connect to and the username and password to use:

```
store.connect("mail.cloud9.net", "elharo", "my_password");
```

You can pass `null` for the password to indicate that the previously specified `Authenticator` should be queried for the password.

Now that the store is connected, you're ready to open a folder in the store. This step is really more oriented to IMAP than POP, since POP servers don't keep track of different folders. They simply provide all of a user's incoming mail as one undifferentiated amalgam. For purposes of the JavaMail API, POP3 providers use the folder name INBOX:

```
Folder inbox = store.getFolder("INBOX");
```

The folder is closed when you get it. You can perform some operations on a closed folder including deleting or renaming it, but you can't get the messages out of a closed folder. First you have to open it. You can open a folder for read access by passing the mnemonic constant `Folder.READ_ONLY` to the `open( )` method for read access, or `Folder.READ_WRITE` for read/write access:

```
inbox.open(Folder.READ_ONLY);
```

Now you're ready to download the messages with the `getMessages( )` method, which returns an array containing all the messages in the folder:

```
Message[] messages = inbox.getMessages( );
```

(If you were using IMAP instead of POP, this step would not actually download the messages. Each one would stay on the server until you accessed it specifically. You'd just get a pointer to the actual message.)

The `Message` class provides many methods for working with individual messages. It has methods to get the various header fields of the message, get the content of the message, reply to the message, and more. We'll discuss these soon, when we talk about the `Message` and `MimeMessage` classes. For now, we'll do just about the simplest thing imaginable—print each message on `System.out` using the message's `writeTo( )` method:

```
for (int i = 0; i < messages.length; i++) {
  System.out.println("------------ Message " + (i+1)
   + " ------------");
   messages[i].writeTo(System.out);
}
```

Once you're done with the messages, close the folder and then close the message store with the aptly named `close()` methods:

```
inbox.close(false);
store.close( );
```

The `false` argument to the folder's `close( )` method indicates that we do not want the server to actually expunge any deleted messages in the folder. We simply want to break our connection to this folder.

Example 19-4 puts this all together with a simple program that downloads and prints out the contents of a specified POP mailbox. Messages are simply dumped on `System.out` in the default encoding. The servers, usernames, and so forth are all hardcoded. However, Example 19-4 quickly demonstrates most of the key points of receiving mail with the JavaMail API. A more advanced program would include an appropriate GUI.

Example 19-4. POP3Client

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;
import java.io.*;

public class POP3Client {

  public static void main(String[] args) {
```


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```
        Properties props = new Properties( );

        String host = "utopia.poly.edu";
        String username = "eharold";
        String password = "mypassword";
        String provider = "pop3";

        try {

          // Connect to the POP3 server
          Session session = Session.getDefaultInstance(props, null);
          Store store = session.getStore(provider);
          store.connect(host, username, password);

          // Open the folder
          Folder inbox = store.getFolder("INBOX");
          if (inbox == null) {
            System.out.println("No INBOX");
            System.exit(1);
          }
          inbox.open(Folder.READ_ONLY);

          // Get the messages from the server
          Message[] messages = inbox.getMessages( );
          for (int i = 0; i < messages.length; i++) {
            System.out.println("------------ Message " + (i+1)
             + " ------------");
            messages[i].writeTo(System.out);
          }

          // Close the connection
          // but don't remove the messages from the server
          inbox.close(false);
          store.close( );

        }
        catch (Exception ex) {
          ex.printStackTrace( );
        }
      }
    }
```

Here's some sample output I got when I pointed it at an account I don't use much:

```
D:\JAVA\JNP3\examples\19>java POP3Client
------------ Message 1 ------------
Received: (from eharold@localhost)
        by utopia.poly.edu (8.8.8/8.8.8) id QAA05728
        for eharold; Tue, 30 Nov 1999 16:14:29 -0500 (EST)
Date: Tue, 30 Nov 1999 16:14:29 -0500 (EST)
From: Elliotte Harold <eharold@utopia.poly.edu>
Message-Id: <199911302114.QAA05728@utopia.poly.edu>
To: eharold@utopia.poly.edu
Subject: test
Content-Type: text
X-UIDL: 87e3f1ba71738c8f772b15e3933241f0
Status: RO

hello you

------------ Message 2 ------------
Received: from russian.cloud9.net (russian.cloud9.net [
.4])
        by utopia.poly.edu (8.8.8/8.8.8) with ESMTP id OAA28428
        for <eharold@utopia.poly.edu>; Wed, 1 Dec 1999 14:05:06 -0500 (
Received: from [168.100.203.234] (macfaq.dialup.cloud9.net [168.100.203
        by russian.cloud9.net (Postfix) with ESMTP id 24B93764F
        for <eharold@utopia.poly.edu>; Wed,  1 Dec 1999 14:02:50 -0500
```


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```
Mime-Version: 1.0
X-Sender: macfaq@mail.cloud9.net
Message-Id: <v04210100b46b1f97969d@[168.100.203.234]>
Date: Wed, 1 Dec 1999 13:55:40 -0500
To: eharold@utopia.poly.edu
From: Elliotte Rusty Harold <elharo@macfaq.com>
Subject: New system
Content-Type: text/plain; charset="us-ascii" ; format="flowed"
X-UIDL: 01fd5cbcf1768fc6c28f9c8f934534b5

Just thought you'd be happy to know that now that I've got my desk
moved over from my old apartment, I've finally ordered the Windows NT
system I've been promising for months.
--
David
```

About the only change you'd need to make to port this program to IMAP would be setting the `provider` variable to `imap` instead of `pop3`.

19.4. Password Authentication

Hardcoding passwords in source code, as Example 19-4 does, is a very bad idea to say the least. If a password is required, you should ask the user for it at runtime. Furthermore, when the user types the password, it should not be displayed on the screen. Ideally, it should not even be transmitted in clear text across the network, although in fact many current clients and servers do exactly that.

When you open a connection to a message store, the JavaMail API allows you to provide a `javax.mail.Authenticator` object that it can use to get the username and password. `Authenticator` is an abstract class:

```
public abstract class Authenticator extends Object
```

When the provider needs to know a username or password, it calls back to the `getPasswordAuthentication()` method in a user-defined subclass of `Authenticator`. This returns a `PasswordAuthentication` object containing this information:

```
protected PasswordAuthentication getPasswordAuthentication( )
```

These two classes are almost exactly the same as the `java.net.Authenticator` and `java.net.PasswordAuthentication` classes discussed in Chapter 7. However, those classes are available only in Java 1.2 and later. To make

the JavaMail API work in Java 1.1, Sun had to duplicate their functionality in the `javax.mail` package. Sun could have included `java.net.Authenticator` and `java.net.PasswordAuthentication` in *mail.jar*, but that would have meant that the JavaMail API could not be certified as 100% Pure Java. However, everything you learned about `java.net.Authenticator` and `java.net.PasswordAuthentication` in Chapter 7 is true of `javax.mail.Authenticator` and `javax.mail.PasswordAuthentication` in this chapter. The only thing you have to watch out for is that if you import both `java.net.*` and `javax.mail.*` in a class, your source code will have to use fully qualified names like `java.net.Authenticator` instead of short names like `Authenticator`.

To add runtime password authentication to your programs, subclass `Authenticator` and override `getPasswordAuthentication( )` with a method that knows how to securely ask the user for a password. One useful tool for this process is the `JPasswordField` component from Swing. Example 19-5 demonstrates a Swing-based `Authenticator` subclass that brings up a dialog to ask the user for their username and password.

Example 19-5. A GUI authenticator

```
import javax.mail.*;
import javax.swing.*;
import java.awt.*;
import java.awt.event.*;


public class MailAuthenticator extends Authenticator {

  private JDialog passwordDialog = new JDialog(new JFrame( ), true);
  private JLabel mainLabel = new JLabel(
   "Please enter your user name and password: ");
  private JLabel userLabel = new JLabel("User name: ");
  private JLabel passwordLabel = new JLabel("Password: ");
  private JTextField usernameField = new JTextField(20);
  private JPasswordField passwordField = new JPasswordField(20);
  private JButton okButton = new JButton("OK");

  public MailAuthenticator( ) {
    this("");
  }

  public MailAuthenticator(String username) {

    Container pane = passwordDialog.getContentPane( );
    pane.setLayout(new GridLayout(4, 1));
```


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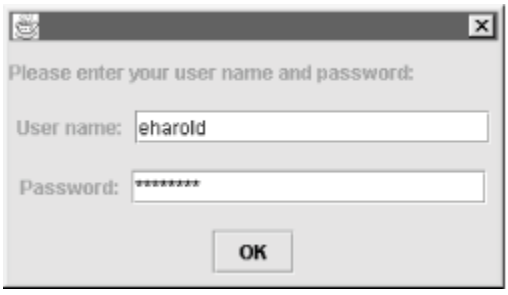
```
        pane.add(mainLabel);
        JPanel p2 = new JPanel( );
        p2.add(userLabel);
        p2.add(usernameField);
        usernameField.setText(username);
        pane.add(p2);
        JPanel p3 = new JPanel( );
        p3.add(passwordLabel);
        p3.add(passwordField);
        pane.add(p3);
        JPanel p4 = new JPanel( );
        p4.add(okButton);
        pane.add(p4);
        passwordDialog.pack( );

        ActionListener al = new HideDialog( );
        okButton.addActionListener(al);
        usernameField.addActionListener(al);
        passwordField.addActionListener(al);

      }

      class HideDialog implements ActionListener {

        public void actionPerformed(ActionEvent e) {
          passwordDialog.hide( );
        }

      }

      public PasswordAuthentication getPasswordAuthentication( ) {

        passwordDialog.show( );

        // getPassword( ) returns an array of chars for security reasons.
        // We need to convert that to a String for
        // the PasswordAuthentication( ) constructor.
        String password = new String(passwordField.getPassword( ));
        String username = usernameField.getText( );
        // Erase the password in case this is used again.
        // The provider should cache the password if necessary.
        passwordField.setText("");
        return new PasswordAuthentication(username, password);

      }
    }
```

Most of this code is just for handling the GUI. Figure 19-4 shows the rather simple dialog box this produces.

Figure 19-4. An authentication dialog



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Interestingly, `JPasswordField` takes more pains to be secure than `PasswordAuthentication` does. `JPasswordField` stores passwords as an array of chars so that when you're done with the password, you can overwrite it with nulls. This means the password exists in memory for less time and the virtual memory system is less likely to swap the program out to disk and leave the password there in clear text. However, `PasswordAuthentication` stores passwords as strings, which are immutable and therefore may be unintentionally stored on the disk.

Modifying the POP client to support this style of authentication is straightforward, as Example 19-6 demonstrates. We replace the hardcoded username and password with nulls and pass an instance of `MailAuthenticator` as the second argument to `connect( )`. The only other change is that we call `System.exit( )` at the end of the `main( )` method, since the program will no longer exit when the `main( )` method returns once the AWT thread has been started.

Example 19-6. A POP client that asks the user for the password as necessary

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;
import java.io.*;


public class SecurePOP3Client {

  public static void main(String[] args) {

    Properties props = new Properties( );

    String host = "utopia.poly.edu";
    String provider = "pop3";

    try {

      // Connect to the POP3 server
      Session session = Session.getDefaultInstance(props,
       new MailAuthenticator( ));
      Store store = session.getStore(provider);
      store.connect(host, null, null);

      // Open the folder
      Folder inbox = store.getFolder("INBOX");
      if (inbox == null) {
        System.out.println("No INBOX");
        System.exit(1);
      }
      inbox.open(Folder.READ_ONLY);

      // Get the messages from the server
      Message[] messages = inbox.getMessages( );
      for (int i = 0; i < messages.length; i++) {
        System.out.println("------------ Message " + (i+1)
         + " ------------");
        messages[i].writeTo(System.out);
      }
```


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```
        // Close the connection
        // but don't remove the messages from the server
        inbox.close(false);
        store.close( );

      }
      catch (Exception ex) {
        ex.printStackTrace( );
      }

      // since we brought up a GUI returning from main( ) won't exit
      System.exit(0);

    }
  }
```

19.5. Addresses

The `javax.mail.Address` class is very simple. It's an abstract class that exists mainly to be subclassed by other, protocol-specific address classes:

```
public abstract class Address extends Object
```

There are two of these subclasses in the standard JavaMail API: `InternetAddress` for SMTP email and `NewsAddress` for Usenet newsgroups:

```
public class InternetAddress extends Address
public class NewsAddress extends Address
```

Providers of other mail protocols would also subclass `Address` with classes that represented their style of address.

19.5.1. The Address Class

The `Address` class itself is extremely simple. It has only three methods, all abstract, two of which are simple utility methods that override the corresponding methods in `java.lang.Object`:

```
public abstract String getType( )
public abstract String toString( )
public abstract boolean equals(Object o)
```

Since all three of these methods are abstract, there aren't any guarantees about the methods' semantics, since all must be overridden in subclasses. However, this does require that subclasses provide their own implementations of `equals( )` and `toString( )` rather than relying on the rather generic implementations available from `java.lang.Object`. In general, the `getType`

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( ) method returns a string such as "rfc822" or "news" that indicates the kind of `Address` object this is.

19.5.2. The InternetAddress Class

An `InternetAddress` object represents an RFC 822-style email address. This is the standard Internet-style email address that is rapidly supplanting all other proprietary formats. It looks like elharo@metalab.unc.edu or ask_tim@oreilly.com. However, it can contain a name as well—for instance, *ask_tim@oreilly.com (Tim O'Reilly)*.

The state of an `InternetAddress` object is maintained by three protected fields:

```
protected String address
protected String personal
protected String encodedPersonal
```

The `address` field is the actual email address—for example, *ask_tim@oreilly.com*. The `personal` field is the name—for example, *Tim O'Reilly*. Although Java strings are pure Unicode that can express names like Erwin Schrödinger or 藤沢 淳, the strings used in mail headers must be pure ASCII in order to pass through most existing mail software. Consequently, Java's Unicode strings need to be converted to pure ASCII using a sort of hexadecimal escape. The details of this conversion are described in RFC 2047, *MIME (Multipurpose Internet Mail Extensions) Part Three: Message Header Extensions for Non-ASCII Text*. The encoded string is placed in the `encodedPersonal` field. All of these fields will be initially set in the constructor. There are four overloaded constructors for `InternetAddress` objects:

```
public InternetAddress(  )
public InternetAddress(String address) throws AddressException
public InternetAddress(String address, String personal)
 throws UnsupportedEncodingException
public InternetAddress(String address, String personal, String charset)
 throws UnsupportedEncodingException
```

They are used exactly as you'd expect. For example:

```
Address tim = new InternetAddress("ask_tim@oreilly.com", "Tim O'Reilly");
```

Although two of these methods are declared to throw `UnsupportedEncodingException`, this should happen only in the last method and then only if the name of the character set is not recognized by the VM. (For example, Java 1.1 does not recognize "ASCII", although in that case, you don't really need to specify a character set.)

There are nine instance methods in this class—three setter methods, three getter methods, and three utility methods:

```
public void setAddress(String address)
public void setPersonal(String name, String charset)
 throws UnsupportedEncodingException
public void setPersonal(String name)
 throws UnsupportedEncodingException
public String getAddress( )
public String getPersonal( )
public String getType( )
public String toString( )
public boolean equals(Object o)
public int hashCode( )
```

The `setAddress( )` method sets the `address` field of the object to the specified value. The `setPersonal( )` method sets the `personal` and `encodedPersonal` fields to the specified value (after encoding it, as necessary). The `getAddress( )` and `getPersonal()` methods return the values of the `address` and `personal` or decoded `encodedPersonal` fields, respectively. Finally, the `getType( )` method returns the string "rfc822".

The `toString( )` method returns an email address suitable for use in a To: or From: field of an RFC 822 email message. The `equals( )` and `hashCode( )` methods have their usual semantics.

There are also five static utility methods, four of which convert addresses to and from strings:

```
public static String toString(Address[] addresses)
 throws ClassCastException
public static String toString(Address[] addresses, int used)
 throws ClassCastException
public static InternetAddress[] parse(String addressList)
 throws AddressException
public static InternetAddress[] parse(String s, boolean strict)
 throws AddressException
```

The `InternetAddress.toString( )` methods convert an array of `Address` objects into a comma-separated list of addresses encoded in pure ASCII, possibly folded onto multiple lines. The optional `used` argument gives the number of characters that will precede this string in the header field, such as To: or Cc:, into which this string will be inserted. This information lets `toString( )` decide where it needs to break the lines. A `ClassCastException` is thrown if any of the `Address` objects in the array are not more specifically `InternetAddress` objects.

The two `parse( )` methods perform this operation in reverse, converting a comma-separated `String` of addresses into an array of `InternetAddress` objects. Setting the optional `strict` argument to `false` changes the behavior so that strings that use whitespace instead of commas (or whitespace and commas) to separate email addresses are also understood. All four of these methods are useful for message header fields that contain multiple addresses; for example, a Cc: that's directed to six people.

Finally, the `getLocalAddress( )` method checks several system properties (`mail.from`, `mail.user`, `mail.host`, and `user.name`) as well as `InetAddress.getLocalName ( )` to determine the email address of the current user:

```
public static InternetAddress getLocalAddress(Session session)
```

For example, this code fragment tries to use the user's own email address rather than one hardcoded into the program as a string:

```
msg.setFrom(InternetAddress.getLocalAddress( ));
```

However, there's no guarantee that any of these properties will necessarily give the user's true address.

19.5.3. The NewsAddress Class

Perhaps a little surprisingly, with an appropriate service provider, the JavaMail API can also access Usenet news. The API is mostly the same as for reading a POP or IMAP mailbox. However, instead of using an `InternetAddress`, you use a `NewsAddress`:

```
public class NewsAddress extends Address
```

A `NewsAddress` object represents a Usenet newsgroup name, such as *comp.lang.java.machine*. It may include the hostname for the news server as well. The state of a `NewsAddress` object is maintained by two protected fields:

```
protected String newsgroup
protected String host
```

The `newsgroup` field contains the name of the newsgroup—for example, *netscape.devs-java*. The `host` field is either null or contains the hostname of the news server—for example, *secnews.netscape.com*. Both of these fields are set in the constructor. There are three overloaded constructors for `NewsAddress` objects:

```
public NewsAddress( )
public NewsAddress(String newsgroup)
public NewsAddress(String newsgroup, String host)
```

They are used exactly as you'd expect. For example:

```
Address netscape_java = new NewsAddress("netscape.devs-java.",
 "secnews.netscape.com");
```


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There are eight instance methods in this class—three getter methods, two setter methods, and three utility methods:

```
public String  getType( )
public String  getHost( )
public String  getNewsgroup( )
public void    setNewsgroup(String newsgroup)
public void    setHost(String host)
public String  toString( )
public boolean equals(Object o)
public int     hashCode( )
```

The `setNewsgroup( )` and `setHost()` methods set the `newsgroup` and `host` fields of the object to the specified values. The `getNewsgroup( )` and `getHost( )` methods return the values of the `newsgroup` and `host` fields. Finally, the `getType( )` method returns the string "news".

The `toString( )` method returns the newsgroup name in a form suitable for the Newsgroups: header field of a Usenet posting. The `equals( )` and `hashCode()` methods have their usual semantics.

There are also two static utility methods for converting addresses to and from strings:

```
public static String toString(Address[] addresses)
 throws ClassCastException
public static NewsAddress[] parse(String newsgroups)
 throws AddressException
```

The `toString( )` method converts an array of `Address` objects into a comma-separated list of newsgroup names. A `ClassCastException` is thrown if any of the `Address` objects in the array are not more specifically `NewsAddress` objects. The `parse( )` method reverses this operation, converting a comma-separated `String` of newsgroup names, such as "comp.lang.java.programmer,comp.lang.java.gui,comp.lang.java.help", into an array of `NewsAddress` objects. It throws an `AddressException` if the newsgroups argument is not a comma-separated list of newsgroup names.

Sun's implementation of the JavaMail API does not include a service provider for news, however; so although you can create news addresses, before you can actually read and post news, you'll need to install a service provider that does support it. Table 19-1 lists some possible sources of news providers. Once you've got one, reading news is as straightforward as talking to an IMAP server.

19.6. The URLName Class

`javax.mail.URLName` represents the name of a URL; that is, it treats a URL as a string, but does not attempt to connect to or resolve any of the parts of the string. URL names are mainly used as convenient ways to identify folders and stores with nonstandard URLs, such as *pop3://elharo:mypassword@mail.metalab.unc.edu:110/INBOX*, that don't have a matching protocol handler:

```
public class URLName Object
```

The methods of `URLName` are very similar to those of `java.net.URL` discussed in Chapter 7, except that all those involving actual connections have been deleted. What's left is a bunch of methods for breaking a URL string into its component parts or building a URL from pieces.

19.6.1. The Constructors

There are three overloaded `URLName` constructors. One takes the individual pieces of a URL as arguments, another takes a `java.net.URL` object, and a third takes a `String` containing a URL:

```
public URLName(String protocol, String host, int port, String file,
 String userName, String password)
public URLName(URL url)
public URLName(String url)
```

Constructing a `URLName` doesn't require a protocol handler for the scheme be available. All the operations on the `URLName` take place with simple substring manipulation, allowing the `URLName` class to support nonstandard URLs like pop3://eharold:password@utopia.poly.edu/INBOX or imap://elharo@metalab.unc.edu/Speaking/SD2005West. These `URLName` objects can be used to refer to particular folders on the server.

19.6.2. Parsing Methods

These seven getter methods are the main purpose for this class. They return individual pieces of the URL:

```
public int    getPort( )
public String getProtocol( )
public String getFile( )
public String getRef( )
public String getHost( )
```


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```
public String getUsername( )
public String getPassword( )
```

These methods can all be easily understood by analogy with the similarly named methods in `java.net.URL`. Except for `getPort( )`, these methods all return `null` if the piece is missing. `getPort()` returns -1 if the port is not explicitly included in the URL.

There's also a `getURL( )` method that converts a `URLName` to a `java.net.URL`. Since doing so requires that Java have a protocol handler for the URL's scheme, this method can throw a `MalformedURLException`:

```
public URL getURL( ) throws MalformedURLException
```

Finally, there are the usual three utility methods with the usual semantics:

```
public boolean equals(Object o)
public int     hashCode( )
public String  toString( )
```

The `toString( )` method simply returns the string form of the URL. The `equals( )` method is underspecified but in practice any two `URLName` objects that are character by character identical will compare equal. However, JavaMail does not consider case to be significant in domain names. `http://www.example.com` and `http://WWW.EXAMPLE.COM` are equal. Surprisingly, it does consider case to be significant in URL schemes. That is, `http://www.example.com` is not equal to `HTTP://www.example.com`. Finally, JavaMail recognizes `/` as the default path; for example, `http://www.example.com` is equal to `http://www.example.com/`. The `hashCode()` method is implemented accordingly.

We can use the `URLName` class to provide an interface for an email client that is completely protocol-independent. All information about protocol, host, and other details is provided by a URL read from the command line. Example 19-7 demonstrates.

Example 19-7. A protocol-independent mail client

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;
import java.io.*;

public class MailClient {

  public static void main(String[] args) {

    if (args.length == 0) {
      System.err.println(
       "Usage: java MailClient protocol://username:password@host/foldername");
      return;
    }
```


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```
        URLName server = new URLName(args[0]);

        try {

          Session session = Session.getDefaultInstance(new Properties( ),
           null);

          // Connect to the server and open the folder
          Folder folder = session.getFolder(server);
          if (folder == null) {
            System.out.println("Folder " + server.getFile( ) + " not found.");
            System.exit(1);
          }
          folder.open(Folder.READ_ONLY);

          // Get the messages from the server
          Message[] messages = folder.getMessages( );
          for (int i = 0; i < messages.length; i++) {
            System.out.println("------------ Message " + (i+1)
             + " ------------");
            messages[i].writeTo(System.out);
          }

          // Close the connection
          // but don't remove the messages from the server
          folder.close(false);

        }
        catch (Exception ex) {
          ex.printStackTrace( );
        }
      }
    }
```

`URLName` does make the code a little more compact since it moves some information from the source code to the command line. Besides eliminating the obvious variables and string literals for username, host, and so forth, we've managed to eliminate any direct reference to the `Store` class. A typical run starts like this:

```
% java MailClient pop3://eharold:mypassword@utopia.poly.edu/INBOX
------------ Message 1 ------------
Received: (from eharold@localhost)
        by utopia.poly.edu (8.8.8/8.8.8) id QAA05728
        for eharold; Tue, 30 Nov 1999 16:14:29 -0500 (EST)
Date: Tue, 30 Nov 1999 16:14:29 -0500 (EST)
From: Elliotte Harold <eharold@utopia.poly.edu>
Message-Id: <199911302114.QAA05728@utopia.poly.edu>
To: eharold@utopia.poly.edu
Subject: test
Content-Type: text
X-UIDL: 87e3f1ba71738c8f772b15e3933241f0
Status: RO

hello you
```

For demonstration purposes, this program includes the password in the URL. In general, however, that's a huge security risk. It would be much better to use a runtime `Authenticator`, as Example 19-6 did. Of course, ultimately it's very questionable whether this is really a superior interface to Example 19-6 and its ilk.

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19.7. The Message Class

The `javax.mail.Message` class is the abstract superclass for all individual emails, news postings, and similar messages:

```
public abstract class Message extends Object implements Part
```

There's one concrete `Message` subclass in the standard JavaMail API, `javax.mail.internet.MimeMessage`. This is used for both email and Usenet news messages. Service providers are free to add classes for their own message formats. For instance, IBM might provide a `NotesMessage` class for Lotus Notes.

The `Message` class mainly declares abstract getter and setter methods that define the common properties of most messages. These properties include the addressees of the message, the recipients of the message, the subject and content of the message, and various other attributes. You can think of these as properties of the envelope that contains the message.

Furthermore, the `Message` class implements the `Part` interface. The `Part` interface mostly handles the body of an email message. It declares methods for getting and setting the content type of the message body, getting and setting the actual message body content, getting and setting arbitrary headers from the message, and getting input streams that are fed by the message body. The main body part of a message can contain other parts. This is used to handle attachments, message bodies that are available in multiple formats, and other multipart emails. Since the `Message` class is abstract and needs to be subclassed by concrete classes such as `MimeMessage`, most of these methods are not actually redeclared in `Message` but can be invoked by any actual instance of `Message`. We'll begin by discussing the methods actually declared in `Message`, then move on to those declared in `Part`.

19.7.1. Creating Messages

The `Message` class has three constructors:

```
protected Message( )
protected Message(Folder folder, int messageNumber)
protected Message(Session session)
```

Since all the constructors are protected, they are primarily for the use of subclasses such as `MimeMessage`. If you're sending a message, you'll use one of the constructors in the subclass

instead. If you're reading messages, the `Folder` or `Session` you're reading from will create the `Message` objects and pass them to you.

19.7.1.1. Replying to messages

If you already have a `Message` object, one way to create a new `Message` object is to reply to the existing one using the `reply( )` method:

```
public abstract Message reply(boolean replyToAll)
 throws MessagingException
```

This method creates a new `Message` object with the same subject prefixed with "Re:", and addressed to the sender of the original message. If `replyToAll` is `true`, the message is addressed to all known recipients of the original message. The content of the message is empty. If you want to quote the original message, you'll have to do that yourself.

19.7.1.2. Getting messages from folders

You've already seen that when you're reading email, the JavaMail API creates `Message` objects to represent the messages it finds on the server. The primary means of doing this are the `getMessage()` and `getMessages()` methods in the `Folder` class:

```
public abstract Message getMessage(int messageNumber)
 throws MessagingException
public Message[] getMessages(int start, int end)
 throws MessagingException
public Message[] getMessages(int[] messageNumbers)
 throws MessagingException
public Message[] getMessages( ) throws MessagingException
```

The first three methods require the caller to specify which messages it wants. The last simply returns all messages in the folder. What's actually returned are stubs holding the places of the actual messages. The text and headers of the message won't necessarily be retrieved until some method of the `Message` class is invoked that requires this information.

19.7.2. Basic Header Info

A typical RFC 822 message contains a header that looks something like this:

```
From levi@blazing.sunspot.noao.edu Fri Aug  5 10:57:08 1994
Date: Fri, 27 Aug 2004 10:57:04 +0700
From: levi@blazing.sunspot.noao.edu (Denise Levi)
```

```
To: volleyball@sunspot.noao.edu
Subject: Apologies
Content-Length: 517
Status: RO
X-Lines: 13
```

The exact fields in the header can vary, but most messages contain at least a From: field, a To: field, a Date: field, and a Subject: field. Other common fields include Cc: (carbon copies) and Bcc: (blind carbon copies). In general, these will be accessible through getter and setter methods.

19.7.2.1. The From address

These four methods get and set the From: field of a message:

```
public abstract Address[] getFrom( ) throws MessagingException
public abstract void setFrom( ) throws MessagingException,
 IllegalWriteException, IllegalStateException
public abstract void setFrom(Address address)
 throws MessagingException, IllegalWriteException, IllegalStateException
public abstract void addFrom(Address[] addresses)
 throws MessagingException, IllegalWriteException, IllegalStateException
```

The `getFrom( )` method returns an array of `Address` objects, one for each address listed in the From: header. (In practice, it's rare for a message to be *from* more than one address. It's quite common for a message to be addressed *to* more than one address.) It returns `null` if the From: header isn't present in the message. It throws a `MessagingException` if the From: header is malformed in some way.

The noargs `setFrom( )` and `addFrom( )` methods set and modify the From: headers of outgoing email messages. The noargs `setFrom( )` method sets the header to the current value of the `mail.user` property or, as a fallback, the `user.name` property. The `setFrom()` method with arguments sets the value of the From: header to the listed addresses. The `addFrom( )` method adds the listed addresses to any addresses that already exist in the header. All three of these methods can throw a `MessagingException` if one of the addresses they use isn't in the right format. They can also throw an `IllegalWriteException` if the From: field of the given `Message` object cannot be changed or an `IllegalStateException` if the entire `Message` object is read-only.

19.7.2.2. The Reply-to address

Some messages contain a Reply-to: header indicating that any replies should be sent to a different address than the one that sent the message. There are two methods to set and get these addresses:

```
public Address[] getReplyTo( ) throws MessagingException
public void setReplyTo(Address[] addresses) throws MessagingException,
```

```
MethodNotSupportedException, IllegalWriteException,
IllegalStateException
```

The semantics of these methods are the same as for the equivalent `getFrom( )` and `setFrom( )` methods—in fact, the default implementation of `getReplyTo( )` simply returns `getFrom( )`—with the single caveat that an implementation that doesn't support separate Reply-to: addresses may throw a `MethodNotSupportedException` when `setReplyTo( )` is invoked.

19.7.2.3. The recipient addresses

Whereas the sender of the message is generally found only in the From: header, the recipients of the message are often split across the To:, Cc:, and Bcc: fields. Rather than providing separate methods for each of these fields, the various `getRecipients( )` and `setRecipients( )` methods rely on a `Message.RecipientType` argument to determine which field's value is desired. `RecipientType` is a public inner class in `javax.mail.Message` whose private constructor limits it to exactly these three static objects:

```
Message.RecipientType.TO
Message.RecipientType.CC
Message.RecipientType.BCC
```

There are two methods to find the addressees of the `Message`:

```
public abstract Address[] getRecipients(Message.RecipientType type)
 throws MessagingException
public Address[] getAllRecipients( ) throws MessagingException
```

The `getRecipients( )` method returns an array of `Address` objects, one for each address listed in the specified header. It returns `null` if the specified header isn't present in the message. It throws a `MessagingException` if the specified header is malformed in some way. The `getAllRecipients( )` method does the same thing, except that it combines the contents of the To:, Cc:, and Bcc: headers.

There are two methods to set the recipients of the message while replacing any previous recipients and two methods to add recipients to the message:

```
public abstract void setRecipients(Message.RecipientType type,
 Address[] addresses) throws MessagingException, IllegalWriteException,
 IllegalStateException
public void setRecipient(Message.RecipientType type, Address address)
 throws MessagingException, IllegalWriteException
public abstract void addRecipients(Message.RecipientType type,
 Address[] addresses) throws MessagingException,
 IllegalWriteException, IllegalStateException
public void addRecipient(Message.RecipientType type, Address address)
 throws MessagingException, IllegalWriteException
```


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All four of these methods can throw a `MessagingException`, typically because one of the addresses isn't in the right format. They can also throw an `IllegalWriteException` if the specified field of the given `Message` object cannot be changed or an `IllegalStateException` if the entire `Message` object is read-only.

19.7.2.4. The subject of the message

Since the subject is simply a single string of text, it's easy to set and get with these two methods:

```
public abstract String getSubject( ) throws MessagingException
public abstract void   setSubject(String subject) throws
 MessagingException, IllegalWriteException, IllegalStateException
```

As with earlier setter methods, `null` is returned if the subject field isn't present in the message. An `IllegalWriteException` is thrown if the program isn't allowed to set the value of the Subject: field and an `IllegalStateException` is thrown if the program isn't allowed to change the message at all.

19.7.2.5. The date of the message

Messages also have sent and received dates. Three methods allow programs to access these fields:

```
public abstract Date getSentDate( ) throws MessagingException
public abstract void setSentDate(Date date) throws MessagingException,
 IllegalWriteException, IllegalStateException
public abstract Date getReceivedDate( ) throws MessagingException
```

The underlying implementation is responsible for converting the textual date format found in a message header like "Fri, 20 Aug 2004 10:57:04 +0700" to a `java.util.Date` object. As usual, a `MessagingException` indicates some problem with the format of the underlying message, an `IllegalWriteException` indicates that the field cannot be changed, and an `IllegalStateException` indicates that the entire message cannot be changed.

Example 19-8 is a simple example program that follows the basic pattern of the last several mail-reading programs. However, this one no longer uses `writeTo( )`. Instead, it uses the methods in this section to print just the headers. Furthermore, it prints them in a particular order regardless of their order in the actual message on the server. Finally, it ignores the less important headers such as X-UIDL: and Status:. The static `InternetAddress.toString( )` method converts the arrays that most of these methods return into simple, comma-separated strings.

Example 19-8. A program to read mail headers

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;

public class HeaderClient {

  public static void main(String[] args) {
    if (args.length == 0) {
      System.err.println(
       "Usage: java HeaderClient protocol://username@host/foldername");
      return;
    }

    URLName server = new URLName(args[0]);

    try {

      Session session = Session.getDefaultInstance(new Properties( ),
       new MailAuthenticator(server.getUsername( )));

      // Connect to the server and open the folder
      Folder folder = session.getFolder(server);
      if (folder == null) {
        System.out.println("Folder " + server.getFile( ) + " not found.");
        System.exit(1);
      }
      folder.open(Folder.READ_ONLY);

      // Get the messages from the server
      Message[] messages = folder.getMessages( );
      for (int i = 0; i < messages.length; i++) {
        System.out.println("------------ Message " + (i+1)
         + " ------------");
        // Here's the big change...
        String from = InternetAddress.toString(messages[i].getFrom( ));
        if (from != null) System.out.println("From: " + from);
        String replyTo = InternetAddress.toString(
         messages[i].getReplyTo( ));
        if (replyTo != null) System.out.println("Reply-to: "
         + replyTo);
        String to = InternetAddress.toString(
         messages[i].getRecipients(Message.RecipientType.TO));
        if (to != null) System.out.println("To: " + to);
        String cc = InternetAddress.toString(
        messages[i].getRecipients(Message.RecipientType.CC));
        if (cc != null) System.out.println("Cc: " + cc);
        String bcc = InternetAddress.toString(
         messages[i].getRecipients(Message.RecipientType.BCC));
        if (bcc != null) System.out.println("Bcc: " + to);
        String subject = messages[i].getSubject( );
        if (subject != null) System.out.println("Subject: " + subject);
        Date sent = messages[i].getSentDate( );
        if (sent != null) System.out.println("Sent: " + sent);
        Date received = messages[i].getReceivedDate( );
        if (received != null) System.out.println("Received: " + received);

        System.out.println( );
      }

      // Close the connection
      // but don't remove the messages from the server
      folder.close(false);

    }
    catch (Exception ex) {
```


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```
          ex.printStackTrace( );
        }

        // Since we may have brought up a GUI to authenticate,
        // we can't rely on returning from main( ) to exit
        System.exit(0);

      }
    }
```

Here's some typical output. Several of the requested strings were `null` because the fields simply weren't present in the messages in the INBOX; for instance, Cc: and Bcc:. `HeaderClient` checks for the fields and simply omits them if they're not present.

```
% java HeaderClient pop3://eharold@utopia.poly.edu/INBOX
------------ Message 1 ------------
From: Elliotte Harold <eharold@utopia.poly.edu>
Reply-to: Elliotte Harold <eharold@utopia.poly.edu>
To: eharold@utopia.poly.edu
Subject: test
Sent: Tue Nov 30 13:14:29 PST 1999

------------ Message 2 ------------
From: Elliotte Rusty Harold <elharo@macfaq.com>
Reply-to: Elliotte Rusty Harold <elharo@macfaq.com>
To: eharold@utopia.poly.edu
Subject: New system
Sent: Wed Dec 01 10:55:40 PST 1999

------------ Message 3 ------------
From: Dr. Mickel <Greatsmiles@mail.com>
Reply-to: Dr. Mickel <Greatsmiles@mail.com>
To: eharold@utopia.poly.edu
Subject: Breath RX Products now available Online!
Sent: Thu Dec 02 03:45:52 PST 1999
```

Notice that none of these messages have received dates. That's because the receive time is not part of the message envelope itself. It has to be provided by the server, and POP servers don't provide it. An IMAP server would be much more likely to include a received date, as will be shown in Example 19-9.

19.7.2.6. Saving changes

When you invoke one of the previous set or add methods, some implementations store the changes immediately. Others, however, may not. The `saveChanges()` method commits the changes made to a `Message` object:

```
public abstract void saveChanges( ) throws MessagingException,
 IllegalWriteException, IllegalStateException
```

This is not quite a flush. The actual changes may not be committed to disk until the folder containing the message is closed. However, this method does ensure that the changes are stored in the folder and will be saved when the folder is saved.

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19.7.3. Flags

Mail programs can save extra information about the messages that are not part of the messages themselves. For instance, Pine lets me know whether I've replied to or read a message, and so on. As Figure 19-5 shows, this information is indicated by symbols and letters in the lefthand column. D means a message has been deleted; A means it's been answered; N is a new message that hasn't been read yet; and so forth. In the JavaMail API, these are all represented as *flags*. A flag is an instance of the `javax.mail.Flags` class:

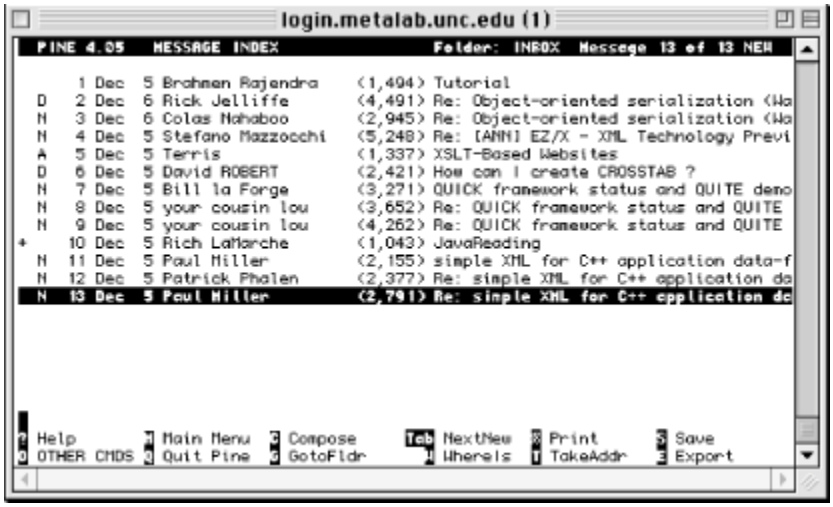
```
public class Flags extends Object implements Cloneable
```

Seven flags are predefined as instances of the public static inner class `Flags.Flag`. These are:

```
Flags.Flag.ANSWERED
Flags.Flag.DELETED
Flags.Flag.DRAFT
Flags.Flag.FLAGGED
Flags.Flag.RECENT
Flags.Flag.SEEN
Flags.Flag.USER
```

In addition, some implementations may allow arbitrary user-defined flags. If so, the USER flag is set.

Figure 19-5. Pine shows flags as letters in the lefthand column



The `getFlags( )` method returns the flags of a particular message:

```
public abstract Flags getFlags( ) throws MessagingException
```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The `isSet( )` method tests whether a specified flag is set for the given message:

```
public boolean isSet(Flags.Flag flag) throws MessagingException
```

Finally, the `setFlags()` and `setFlag( )` methods set or unset (depending on the second argument) the flag indicated by the first argument:

```
public abstract void setFlags(Flags flag, boolean set)
 throws MessagingException, IllegalWriteException,
 IllegalStateException
public void setFlag(Flags.Flag flag, boolean set) throws
 MessagingException, IllegalWriteException, IllegalStateException
```

You delete messages by setting their `Flags.Flag.DELETED` flag to `true`. For example, to delete `message`:

```
message.setFlag(Flags.Flag.DELETED, true);
```

This only marks the message as deleted. It does not actually expunge it from the file on the server. Until the message is expunged, it can still be undeleted by setting `Flags.Flag.DELETED` back to `false`.

Example 19-9 is a slight modification of Example 19-8, `HeaderClient`, which prints the flags as well. As a general rule, POP servers won't report flags. Only a protocol that stores messages and forwards them, such as IMAP or mbox, will report flags.

Example 19-9. A program to read mailbox flags

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;

public class FlagsClient {

  public static void main(String[] args) {

    if (args.length == 0) {
      System.err.println(
       "Usage: java FlagsClient protocol://username@host/foldername");
      return;
    }

    URLName server = new URLName(args[0]);

    try {

      Session session = Session.getDefaultInstance(new Properties( ),
       new MailAuthenticator(server.getUsername( )));

      // Connect to the server and open the folder
      Folder folder = session.getFolder(server);
```


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```
        if (folder == null) {
          System.out.println("Folder " + server.getFile( ) + " not found.");
          System.exit(1);
        }
        folder.open(Folder.READ_ONLY);

        // Get the messages from the server
        Message[] messages = folder.getMessages( );
        for (int i = 0; i < messages.length; i++) {
          System.out.println("------------ Message " + (i+1)
           + " ------------");
          // Get the headers
          String from = InternetAddress.toString(messages[i].getFrom( ));
          if (from != null) System.out.println("From: " + from);
          String replyTo = InternetAddress.toString(
           messages[i].getReplyTo( ));
          if (replyTo != null) System.out.println("Reply-to: "
           + replyTo);
          String to = InternetAddress.toString(
           messages[i].getRecipients(Message.RecipientType.TO));
          if (to != null) System.out.println("To: " + to);
          String cc = InternetAddress.toString(
          messages[i].getRecipients(Message.RecipientType.CC));
          if (cc != null) System.out.println("Cc: " + cc);
          String bcc = InternetAddress.toString(
           messages[i].getRecipients(Message.RecipientType.BCC));
          if (bcc != null) System.out.println("Bcc: " + to);
          String subject = messages[i].getSubject( );
          if (subject != null) System.out.println("Subject: " + subject);
          Date sent = messages[i].getSentDate( );
          if (sent != null) System.out.println("Sent: " + sent);
          Date received = messages[i].getReceivedDate( );
          if (received != null) System.out.println("Received: " + received);

          // Now test the flags:
          if (messages[i].isSet(Flags.Flag.DELETED)) {
            System.out.println("Deleted");
          }
          if (messages[i].isSet(Flags.Flag.ANSWERED)) {
            System.out.println("Answered");
          }
          if (messages[i].isSet(Flags.Flag.DRAFT)) {
            System.out.println("Draft");
          }
          if (messages[i].isSet(Flags.Flag.FLAGGED)) {
            System.out.println("Marked");
          }
          if (messages[i].isSet(Flags.Flag.RECENT)) {
            System.out.println("Recent");
          }
          if (messages[i].isSet(Flags.Flag.SEEN)) {
            System.out.println("Read");
          }
          if (messages[i].isSet(Flags.Flag.USER)) {
            // We don't know what the user flags might be in advance
            // so they're returned as an array of strings
            String[] userFlags = messages[i].getFlags( ).getUserFlags( );
            for (int j = 0; j < userFlags.length; j++) {
              System.out.println("User flag: " + userFlags[j]);
            }
          }

          System.out.println( );
        }

        // Close the connection
        // but don't remove the messages from the server
        folder.close(false);
```


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```
        }
        catch (Exception ex) {
          ex.printStackTrace( );
        }

        // Since we may have brought up a GUI to authenticate,
        // we can't rely on returning from main( ) to exit
        System.exit(0);

      }
    }
```

Here's a sample run. The first message has been read and deleted. The second message has no set flags; it hasn't been read, deleted, or answered. The third message has been read and answered but not deleted. Notice that I'm using an IMAP server instead of a POP server:

```
% java FlagsClient imap://elharo@mail.metalab.unc.edu/INBOX
------------ Message 1 ------------
From: Mike Hall <mikehall@spacestar.com>
Reply-to: Mike Hall <mikehall@spacestar.com>
To: mrj-dev@public.lists.apple.com
Subject: Re: dialog box, parents & X-platform
Sent: Mon Dec 13 05:24:38 PST 1999
Received: Mon Dec 13 06:33:00 PST 1999
Deleted
Read

------------ Message 2 ------------
From: Kapil Madan <kapil.madan@MIT-MISYS.COM>
Reply-to: XML-INTEREST@JAVA.SUN.COM
To: XML-INTEREST@JAVA.SUN.COM
Subject: Re: first mail to the list!
Sent: Mon Dec 13 06:19:46 PST 1999
Received: Mon Dec 13 06:40:00 PST 1999

------------ Message 3 ------------
From: Jim Jackl-Mochel <jmochel@foliage.com>
Reply-to: Jim Jackl-Mochel <jmochel@foliage.com>
To: elharo@metalab.unc.edu
Subject: CPreProcessorStream
Sent: Mon Dec 13 07:14:00 PST 1999
Received: Mon Dec 13 07:08:00 PST 1999
Answered
Read
```

19.7.4. Folders

Messages received from the network (as opposed to sent to the network) generally belong to some `Folder`. The `getFolder( )` method returns a reference to the `Folder` object that contains this `Message`:

```
public Folder getFolder( )
```

It returns `null` if the message isn't contained in a folder.

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Within a folder, messages are organized from first (message 1) to last. The `getMessageNumber()` method returns the relative position of this `Message` in its `Folder`:

```
public int getMessageNumber( )
```

Messages that aren't in any folder have number 0. Message numbers may change while a program is running if other messages are added to or deleted from a folder.

There's also a protected `setMessageNumber()` method, but it's only for service providers, not for user code:

```
protected void setMessageNumber(int number)
```

We'll talk more about folders and what they can do at the end of this chapter. One of the things you can do with a folder is expunge messages from it. This physically deletes the message if it's already been marked as deleted. (A merely deleted message can be "undeleted", whereas an expunged message cannot be.) If a message is expunged, there may still be a `Message` object pointing to the message, but almost all methods on the message will throw a `MessagingException`. Thus, it may be important to check whether a message has been expunged before working with it. The `isExpunged( )` method does that:

```
public boolean isExpunged( )
```

There's also a protected `setExpunged()` method, but it's only for service providers, not for user code:

```
protected void setExpunged(boolean expunged)
```

19.7.5. Searching

The final method left in the `Message` class is `match( )`. The `match( )` method determines whether a `Message` satisfies particular search criteria. We'll discuss this more in a bit when we talk about searching folders:

```
public boolean match(SearchTerm term) throws MessagingException
```

19.8. The Part Interface

Both `Message` and `BodyPart` implement the `Part` interface. Every `Message` is a `Part`. However, some parts may contain other parts. The `Part` interface declares three kinds of methods:

- Methods for getting and setting the attributes of the part
- Methods for getting and setting the headers of the part
- Methods for getting and setting the contents of the part

The attributes of the part are things such as the size of the message or the date it was received, details that aren't explicitly specified in the message's header. The headers, by contrast, are name-value pairs included at the front of the part. Finally, the content of the part is the actual data that the message is trying to transmit.

19.8.1. Attributes

The JavaMail API defines five attributes for parts:

Size
: The approximate number of bytes in the part

Line count
: The number of lines in the part

Disposition
: Whether the part is an attachment or should be displayed inline

Description
: A brief text summary of the part

Filename
: The name of the file that the attachment came from

Not all parts have all attributes. For instance, a part that does not represent an attached file is unlikely to have a filename attribute. Each attribute is mapped to a getter method:

```
public int    getSize( ) throws MessagingException
public int    getLineCount( ) throws MessagingException
public String getDisposition( ) throws MessagingException
public String getDescription( ) throws MessagingException
public String getFileName( ) throws MessagingException, ParseException
```

Generally, the getter method returns null or -1 if a part doesn't possess the requested attribute. It throws a `MessagingException` if there's some problem retrieving the message; for instance, if the connection goes down while the message is being retrieved.

The `getSize( )` method returns the approximate number of bytes in the part. Depending on the server and protocol, this may or may not account for changes in the size caused by operations such as Base64 encoding the data.

The `getLineCount()` method returns the approximate number of lines in the content of the part or -1 if the number of lines isn't known. Again, the number returned may or may not account for changes in the size of the part caused by the part's encoding.

The `getDisposition()` method returns a string indicating whether the content should be presented inline or as an attachment. The value returned should either be `null` (the disposition is not known) or one of the two named constants `Part.INLINE` or `Part.ATTACHMENT`:

```
public static final String ATTACHMENT = "attachment";
public static final String INLINE     = "inline";
```

If the disposition is `Part.ATTACHMENT`, `getFileName( )` should return the name of the file to save the attachment in. Otherwise, `getFileName()` probably returns `null`. However, some email clients, including Netscape 4.5 for Windows, do not properly set the Content-disposition header for attachments. Consequently, when receiving messages with attachments that were sent by Navigator, you'll often get a `null` disposition but a non-null filename. In practice, it seems more reliable to assume that any body part with a non-null filename is an attachment regardless of the Content-disposition header, and any body part with no filename and no Content-disposition header should be displayed inline if possible. If it's not possible—for instance, if you can't handle the MIME type—you can either ask the user for a filename or pick some reasonable default, such as *attachment1.tif*.

Normally, the filename includes only the actual name of the file but not any of the directories the file was in. It's up to the application receiving the message to decide where to put the incoming file. For instance, Eudora generally stores attachments in the Attachments folder inside the Eudora folder. However, the user has an option to pick a different location. Since it's not uncommon to receive multiple attachments with the same name over time, check to see whether a file with the attached file's name already exists before writing out the attachment. If a similarly named file does exist, you'll have to rename the attachment in some reasonable fashion—for instance, by appending a 1 or a 2 to it: e.g., *vcard1.vcf*, *vcard2.vcf*, and so on.

The description, disposition, and filename attributes also have setter methods. However, the size and line count attributes are determined by the content of the part rather than a setter method:

```
public void setDisposition(String disposition) throws
 MessagingException, IllegalWriteException, IllegalStateException
public void setFileName(String filename) throws MessagingException,
 IllegalWriteException, IllegalStateException
public void setDescription(String description) throws
 MessagingException, IllegalWriteException, IllegalStateException
```

The setter methods all throw a `MessagingException` if there's some problem while changing the message. They can also throw an `IllegalWriteException` if the relevant attribute of the part cannot be modified or an `IllegalStateException` if the part belongs to a read-only folder.

The `setDisposition()` method determines whether the part is to be viewed inline or as an attachment. Although it's declared to take a `String` as an argument, this `String` should be one of the two named constants, `Part.INLINE` or `Part.ATTACHMENT`. Parts that are attachments generally have a filename included in their metainformation. This name can be set with the `setFileName()` method. Finally, the `setDescriptionMethod()` can take any `String` at all to add a description to the part.

Example 19-10 is a simple program that connects to a mail server and reads the attributes of the messages in the mailbox. Since each message is itself a part (even if it contains other parts), we can invoke these methods on the entire message.

Example 19-10. A program to read mail attributes

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;

public class AttributeClient {

  public static void main(String[] args) {

    if (args.length == 0) {
      System.err.println(
       "Usage: java AttributeClient protocol://username@host/foldername");
      return;
    }

    URLName server = new URLName(args[0]);

    try {

      Session session = Session.getDefaultInstance(new Properties( ),
       new MailAuthenticator(server.getUsername( )));

      // Connect to the server and open the folder
      Folder folder = session.getFolder(server);
      if (folder == null) {
        System.out.println("Folder " + server.getFile( ) + " not found.");
        System.exit(1);
      }
      folder.open(Folder.READ_ONLY);

      // Get the messages from the server
      Message[] messages = folder.getMessages( );
      for (int i = 0; i < messages.length; i++) {
        System.out.println("------------ Message " + (i+1)
         + " ------------");
        String from = InternetAddress.toString(messages[i].getFrom( ));
```


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```
            if (from != null) System.out.println("From: " + from);
            String to = InternetAddress.toString(
             messages[i].getRecipients(Message.RecipientType.TO));
            if (to != null) System.out.println("To: " + to);
            String subject = messages[i].getSubject( );
            if (subject != null) System.out.println("Subject: " + subject);
            Date sent = messages[i].getSentDate( );
            if (sent != null) System.out.println("Sent: " + sent);

            System.out.println( );
            // Here's the attributes...
            System.out.println("This message is approximately "
             + messages[i].getSize( ) + " bytes long.");
            System.out.println("This message has approximately "
             + messages[i].getLineCount( ) + " lines.");
            String disposition = messages[i].getDisposition( );
            if (disposition == null) ; // do nothing
            else if (disposition.equals(Part.INLINE)) {
              System.out.println("This part should be displayed inline");
            }
            else if (disposition.equals(Part.ATTACHMENT)) {
              System.out.println("This part is an attachment");
              String fileName = messages[i].getFileName( );
              if (fileName != null) {
                System.out.println("The file name of this attachment is "
                + fileName);
              }
            }
            String description = messages[i].getDescription( );
            if (description != null) {
              System.out.println("The description of this message is "
               + description);
            }

          }

          // Close the connection
          // but don't remove the messages from the server
          folder.close(false);

        }
        catch (Exception ex) {
          ex.printStackTrace( );
        }

        // Since we may have brought up a GUI to authenticate,
        // we can't rely on returning from main( ) to exit
        System.exit(0);

      }
    }
```

Here's some typical output. I used an IMAP server because most of these methods don't work nearly as well with POP servers. IMAP servers can give you the attributes of a message without making you download the entire message, but POP servers aren't that sophisticated:

```
% java AttributeClient imap://elharo@mail.sunsite.unc.edu/INBOX
------------ Message 1 ------------
From: "Richman, Jeremy" <jrichman@hq.ileaf.com>
To: 'xsl-list' <XSL-List@mulberrytech.com>
Subject: Re: New twist: eliminating nodes with duplicate content
Sent: Mon Dec 06 08:37:51 PST 1999

This message is approximately 3391 bytes long.
This message has approximately 87 lines.
```

```
------------ Message 2 ------------
From: schererm@us.ibm.com
To: Unicode List <unicode@unicode.org>
Subject: Re: Number ordering
Sent: Mon Dec 06 11:00:28 PST 1999

This message is approximately 1554 bytes long.
This message has approximately 18 lines.
------------ Message 3 ------------
From: John Posner <jjp@connix.com>
To: 'Nakita Watson' <nakita@oreilly.com>
Subject: RE: Another conference Call
Sent: Mon Dec 06 11:16:38 PST 1999
This message is approximately 1398 bytes long.
This message has approximately 19 lines.
```

19.8.2. Headers

Classes that implement the `Part` interface—for example, `Message`—generally declare methods to return specific headers such as To: or From:. The `Part` interface, by contrast, declares methods to get and set arbitrary headers regardless of name.

The `getHeader( )` method gets the values of all the headers with a name that matches the `name` argument. Some headers such as Received: can have multiple values and can be included in a message multiple times, so this method returns those values as an array of strings. It returns `null` if no header with that name is present in this `Part`:

```
public String[] getHeader(String name) throws MessagingException
```

The `setHeader( )` method adds a new header to an outgoing message:

```
public void setHeader(String name, String value) throws
 MessagingException, IllegalWriteException, IllegalStateException
```

If there's already a header with this name, that header is deleted and the new one inserted in its place—unless the folder in which the message resides is read-only, in which case an `IllegalStateException` is thrown.

By contrast, the `addHeader()` method adds a header with the specified name but does not replace any that exist:

```
public void addHeader(String name, String value) throws
 MessagingException, IllegalWriteException, IllegalStateException
```

The `removeHeader()` method deletes all instances of the named header from this `Part`:

```
public void removeHeader(String name) throws MessagingException,
 IllegalWriteException, IllegalStateException
```


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The `getAllHeaders()` method returns a `java.util.Enumeration` object containing all the headers in this message:

```
public Enumeration getAllHeaders( ) throws MessagingException
```

The `Enumeration` contains one `javax.mail.Header` object for each header in the message:

```
public class Header extends Object
```

The `Header` class is very simple, with just a constructor to set the name and value of the header, and `getName( )` and `getValue( )` methods to return them:

```
public Header(String name, String value)
public String getName( )
public String getValue( )
```

Finally, the `getMatchingHeaders()` method returns an `Enumeration` containing all the headers in this message with names that are one of the strings in the argument `names` array. The `getNonMatchingHeaders()` method returns an `Enumeration` containing all the headers in this message with names that are *not* one of the strings in the argument `names` array. Again, the `Enumeration` contains `Header` objects:

```
public Enumeration getMatchingHeaders(String[] names)
 throws MessagingException
public Enumeration getNonMatchingHeaders(String[] names)
 throws MessagingException
```

You may recall that Example 19-8, `HeaderClient`, printed only a few prespecified headers, such as To: and From:. With the methods of the `Part` interface (that `Message` implements), it's easy to expand this to cover all headers in the message, whether known in advance or not. Example 19-11 demonstrates. This ability is important because Internet email can contain arbitrary headers; it's not limited to just a few headers mentioned in the relevant RFCs. For instance, some graphical mail clients for X Windows use a completely nonstandard X-Face: header, whose value is a 48-pixel by 48-pixel, black-and-white, uuencoded bitmap of the sender's countenance. Other clients use custom headers for purposes both more serious and sillier.

Example 19-11. A program to read mail headers

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;


public class AllHeaderClient {
```


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```
    public static void main(String[] args) {

      if (args.length == 0) {
        System.err.println(
         "Usage: java AllHeaderClient protocol://username@host/foldername");
        return;
      }

      URLName server = new URLName(args[0]);

      try {

        Session session = Session.getDefaultInstance(new Properties( ),
         new MailAuthenticator(server.getUsername( )));

        // Connect to the server and open the folder
        Folder folder = session.getFolder(server);
        if (folder == null) {
          System.out.println("Folder " + server.getFile( ) + " not found.");
          System.exit(1);
        }
        folder.open(Folder.READ_ONLY);

        // Get the messages from the server
        Message[] messages = folder.getMessages( );
        for (int i = 0; i < messages.length; i++) {
          System.out.println("------------ Message " + (i+1)
           + " ------------");
          // Here's the difference...
          Enumeration headers = messages[i].getAllHeaders( );
          while (headers.hasMoreElements( )) {
            Header h = (Header) headers.nextElement( );
            System.out.println(h.getName( ) + ": " + h.getValue( ));
          }
          System.out.println( );
        }

        // Close the connection
        // but don't remove the messages from the server
        folder.close(false);

      }
      catch (Exception ex) {
        ex.printStackTrace( );
      }

      // Since we may have brought up a GUI to authenticate,
      // we can't rely on returning from main( ) to exit
      System.exit(0);

    }
  }
```

Here's a typical run:

```
% java AllHeaderClient pop3://eharold@utopia.poly.edu/INBOX
------------ Message 1 ------------
Received: (from eharold@localhost)
        by utopia.poly.edu (8.8.8/8.8.8) id QAA05728
        for eharold; Tue, 30 Nov 1999 16:14:29 -0500 (EST)
Date: Tue, 30 Nov 1999 16:14:29 -0500 (EST)
From: Elliotte Harold <eharold@utopia.poly.edu>
Message-Id: <199911302114.QAA05728@utopia.poly.edu>
To: eharold@utopia.poly.edu
Subject: test
Content-Type: text
```


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```
X-UIDL: 87e3f1ba71738c8f772b15e3933241f0
Status: RO

------------ Message 2 ------------
Received: from russian.cloud9.net (russian.cloud9.net [168.100.1.4])
        by utopia.poly.edu (8.8.8/8.8.8) with ESMTP id OAA28428
        for <eharold@utopia.poly.edu>; Wed, 1 Dec 1999 14:05:06 -0500 (EST)
Received: from [168.100.203.234] (macfaq.dialup.cloud9.net [168.100.203.234])
        by russian.cloud9.net (Postfix) with ESMTP id 24B93764F8
        for <eharold@utopia.poly.edu>; Wed,  1 Dec 1999 14:02:50 -0500 (EST)
Mime-Version: 1.0
X-Sender: macfaq@mail.cloud9.net
Message-Id: <v04210100b46b1f97969d@[168.100.203.234]>
Date: Wed, 1 Dec 1999 13:55:40 -0500
To: eharold@utopia.poly.edu
From: Elliotte Rusty Harold <elharo@macfaq.com>
Subject: New system
Content-Type: text/plain; charset="us-ascii" ; format="flowed"
X-UIDL: 01fd5cbcf1768fc6c28f9c8f934534b5
Status: RO

------------ Message 3 ------------
Received: from russian.cloud9.net (russian.cloud9.net [168.100.1.4])
        by utopia.poly.edu (8.8.8/8.8.8) with ESMTP id HAA17345
        for <eharold@utopia.poly.edu>; Thu, 2 Dec 1999 07:55:04 -0500 (EST)
Received: from [168.100.203.234] (macfaq.dialup.cloud9.net [168.100.203.234])
        by russian.cloud9.net (Postfix) with ESMTP id C036A7630E
        for <eharold@utopia.poly.edu>; Thu,  2 Dec 1999 07:54:58 -0500 (EST)
Mime-Version: 1.0
X-Sender: elharo@luna.oit.unc.edu
Message-Id: <v04210100b46c0c686ecc@[168.100.203.234]>
Date: Thu, 2 Dec 1999 06:45:52 -0500
To: eharold@utopia.poly.edu
From: "Dr. Mickel" <Greatsmiles@mail.com>(by way of Elliotte Rusty Harold)
Subject: Breath RX Products now available Online!
Sender: elharo@metalab.unc.edu
Content-Type: text/plain; charset="us-ascii" ; format="flowed"
X-UIDL: 40fa8af2aca1a8c11994f4c56b792720
Status: RO
```

19.8.3. Content

Every part has content that can be represented as a sequence of bytes. For instance, in a part that's a simple email message, the content is the body of the message. However, in multipart messages, this content may itself contain other parts. The content of each of these parts can be represented as a sequence of bytes. Furthermore, this sequence of bytes may represent some more specific content type, such as a uuencoded GIF image or a Base64-encoded WAV audio clip.

19.8.3.1. Reading the contents of the part

The `Part` interface declares two methods for determining a part's MIME content type. The `getContentType()` method returns the MIME content type of the part as a string; for example: `text/plain; charset="us-ascii"; format= "flowed"`. It returns `null` if the content type can't be determined:

```
public String getContentType( ) throws MessagingException
```


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The `isMimeType( )` method returns `true` if this part has the specified MIME type and subtype. Additional parameters, such as charset, are ignored:

```
public boolean isMimeType(String mimeType) throws MessagingException
```

The `Part` interface also declares several methods that return the content as a variety of different Java objects, including `InputStream`, `String`, `DataHandler`, and more. The `getInputStream()` method returns an `InputStream` from which the part's content can be read:

```
public InputStream getInputStream( ) throws IOException,
 MessagingException
```

If the part's content has been encoded in some way—for example, Base64-encoded—then the `InputStream` reads the decoded content. The JavaMail API supports all common encodings except the BinHex format used for Macintosh files. If it encounters a BinHex-encoded attachment, it strips the MIME headers but otherwise leaves the BinHex data untouched. BinHex documents are tough to deal with on most platforms because of the unusual two-fork nature of a Mac file. Unless you're a real Mac expert, you're probably better off using a third-party utility such as StuffIt Expander (http://www.stuffit.com/) to decode the file.

Another possibility is to request a `DataHandler` for the content with the `getDataHandler ( )` method. The `DataHandler` class comes from the Java Activation Framework. It declares methods to help decide what to do with the content—for instance, by finding the right Java bean or helper application to display the content:

```
public javax.activation.DataHandler getDataHandler( )
 throws MessagingException
```

A third possibility is to request the content as an unspecified Java object using the `getContent ()` method:

```
public Object getContent( ) throws IOException, MessagingException
```

This is reminiscent of the `getContent( )` method of `java.net.URL`. However, rather than relying on the poorly designed content handler mechanism, this `getContent()` method uses the Java Activation Framework, so the behavior is a little more clearly specified. Most of the time, if the content type is `text/plain`, a `String` will be returned. If the content type is multipart, then regardless of the subtype, a `javax.mail.Multipart` object is returned. If the content type is some other type that is recognized by the underlying `DataHandler`, an appropriate Java object is returned. Finally, if the type is unrecognized, an `InputStream` is returned.

You can change which objects are returned for which content types by providing your own `DataHandler`, installed with the `setDataHandler( )` method:

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```
public void setDataHandler(javax.activation.DataHandler  handler)
 throws MessagingException, IllegalWriteException, IllegalStateException
```

Although this method is declared to throw the usual group of exceptions, it's perhaps a little less likely to actually do so, since setting the `DataHandler` only affects the `Message` object rather than the actual message stored on the server.

19.8.3.2. Writing the contents of the part

When sending a message, you naturally must set the message's contents. Since email messages are text, the most straightforward way is just to provide the text of the part with `setText( )`:

```
public void setText(String text) throws MessagingException,
 IllegalWriteException, IllegalStateException
```

The `setText( )` method sets the MIME type to `text/plain`. Other objects can be made into content as well, provided the part has a `DataHandler` that understands how to convert them to encoded text. This is done with the `setContent( )` method:

```
public void setContent(Object o, String type) throws
 MessagingException, IllegalWriteException, IllegalStateException
```

Another way to write the contents of a part is by using an `OutputStream`. The `writeTo()` method writes the content of the `Part` onto an `OutputStream`. If necessary, it will encode the content using Base64, quoted-printable, or some other format as specified by the `DataHandler`:

```
public void writeTo(OutputStream out) throws IOException,
 MessagingException
```

In fact, this not only writes the content of this `Part`, it also writes the attributes and headers of the part. Example 19-4 used this to provide a simple way of getting an entire email message in one fell swoop. It's most convenient, though, when you want to send an entire message to an SMTP server in one method call.

Finally, multiple parts can be added to a part by wrapping them in a `Multipart` object and passing that to `setContent( )`:

```
public void setContent(Multipart mp) throws MessagingException,
 IllegalWriteException, IllegalStateException
```

In this case, the entire message typically has a content type such as `multipart/mixed`, `multipart/signed`, or `multipart/alternative`. The individual parts of the message

are all enclosed in one envelope but each part of the message has its own content type, content encoding, and data. The multiple parts may be used to present different forms of the same document (e.g., HTML and plain-text mail), a document and metainformation about the document (e.g., a message and the MD5 digest of the message), or several different documents (e.g., a message and several attached files). The next section expands on this process.

19.9. Multipart Messages and File Attachments

The way all the different text and binary file types are encoded into raw text that can be passed through 7-bit email gateways is fairly ingenious and rather detailed. Fortunately, the JavaMail API shields you from those details, interesting as they are. To send a multipart message using the JavaMail API, all you have to do is add the parts to a `MimeMultipart` object, then pass that object to the `Message`'s `setContent( )` method. To receive a multipart message, you simply process each of the parts individually.

Most of the methods for building and deconstructing multipart messages are in the abstract `javax.mail.Multipart` class:

```
public abstract class Multipart extends Object
```

However, since this class is abstract, you'll generally start with a `javax.mail.internet.MimeMultipart` object instead:

```
public class MimeMultipart extends Multipart
```

Each part you add to a `Multipart` is an instance of the abstract `javax.mail.BodyPart` class that implements the `Part` interface of the last section:

```
public abstract class BodyPart extends Object implements Part
```

In Internet email, the concrete subclass of `BodyPart` you'll use is `javax.mail.internet.MimeBodyPart`:

```
public class MimeBodyPart extends BodyPart implements MimePart
```

Most of the methods you need in the `MimeBodyPart` and `BodyPart` classes are the ones you're already familiar with from the `Part` interface, methods such as `setContent( )` and `setDataHandler( )`. There are also three methods to read the contents of a `Multipart` object:

```
public String   getContentType( )
public int      getCount( ) throws MessagingException
public BodyPart getBodyPart(int index)
 throws IndexOutOfBoundsException, MessagingException
```

The `getContentType()` method returns the MIME media type of the entire `Multipart`, which is typically something like `multipart/mixed` or `multipart/alternative`. This is not the same as the MIME types of the individual parts, which are something like `text/plain` or `image/gif`.

The `getCount( )` method returns the number of parts in this `Multipart`. The `getBodyPart( )` method returns a particular part. Parts are numbered starting at 0, like the components of an array. Example 19-12 is very similar to Example 19-11, `AllHeaderClient`. However, Example 19-12 adds the necessary code to handle the body of the message. If the message is a single-part message, it's simply printed on `System.out`. However, if the message has multiple parts, each part is handled separately. If the part has a multipart content type itself, `processMultipart()` is called recursively. If the part has no filename, does not have the disposition `Part.ATTACHMENT`, and has MIME type `text/plain`, it's assumed to be an inline message and is printed on `System.out`. Otherwise, it's assumed to be an attachment and is saved into an appropriate file. If necessary, the static `File.createTempFile( )` method generates a reasonable name for the file.

Example 19-12. A mail client that handles multipart messages with attached files

```
import javax.mail.*;
import javax.mail.internet.*;
import java.util.*;
import java.io.*;

public class AllPartsClient {

  public static void main(String[] args) {

    if (args.length == 0) {
      System.err.println(
       "Usage: java AllPartsClient protocol://username@host:port/foldername");
      return;
    }
    URLName server = new URLName(args[0]);

    try {

      Session session = Session.getDefaultInstance(new Properties( ),
       new MailAuthenticator(server.getUsername( )));

      // Connect to the server and open the folder
      Folder folder = session.getFolder(server);
      if (folder == null) {
        System.out.println("Folder " + server.getFile( ) + " not found.");
        System.exit(1);
      }
      folder.open(Folder.READ_ONLY);
```

```
      // Get the messages from the server
      Message[] messages = folder.getMessages( );
      for (int i = 0; i < messages.length; i++) {
        System.out.println("------------ Message " + (i+1)
         + " ------------");

        // Print message headers
        Enumeration headers = messages[i].getAllHeaders( );
        while (headers.hasMoreElements( )) {
          Header h = (Header) headers.nextElement( );
          System.out.println(h.getName( ) + ": " + h.getValue( ));
        }
        System.out.println( );

        // Enumerate parts
        Object body = messages[i].getContent( );
        if (body instanceof Multipart) {
          processMultipart((Multipart) body);
        }
        else { // ordinary message
          processPart(messages[i]);
        }

        System.out.println( );

      }

      // Close the connection
      // but don't remove the messages from the server
      folder.close(false);

    }
    catch (Exception ex) {
      ex.printStackTrace( );
    }

    // Since we may have brought up a GUI to authenticate,
    // we can't rely on returning from main( ) to exit
    System.exit(0);

  }

  public static void processMultipart(Multipart mp)
   throws MessagingException {

    for (int i = 0; i < mp.getCount( ); i++) {
      processPart(mp.getBodyPart(i));
    }

  }

  public static void processPart(Part p) {

    try {
      String fileName = p.getFileName( );
      String disposition = p.getDisposition( );
      String contentType = p.getContentType( );
      if (contentType.toLowerCase( ).startsWith("multipart/")) {
            processMultipart((Multipart)  p.getContent( ) );
      }
      else if (fileName == null
       && (Part.ATTACHMENT.equalsIgnoreCase(disposition)
       || !contentType.equalsIgnoreCase("text/plain"))) {
        // pick a random file name. This requires Java 1.2 or later.
        fileName = File.createTempFile("attachment", ".txt").getName( );
      }
      if (fileName == null) { // likely inline
        p.writeTo(System.out);
```


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```
        }
        else {
          File f = new File(fileName);
          // find a file that does not yet exist
          for (int i = 1; f.exists( ); i++) {
            String newName = fileName + " " + i;
            f = new File(newName);
          }
          OutputStream out = new BufferedOutputStream(new FileOutputStream(f));

          // We can't just use p.writeTo( ) here because it doesn't
          // decode the attachment. Instead we copy the input stream
          // onto the output stream which does automatically decode
          // Base-64, quoted printable, and a variety of other formats.
          InputStream in = new BufferedInputStream(p.getInputStream( ));
          int b;
          while ((b = in.read( )) != -1) out.write(b);
          out.flush( );
          out.close( );
          in.close( );
        }
      }
      catch (Exception ex) {
        System.err.println(e);
        ex.printStackTrace( );
      }
    }
  }
```

You can also get a part from a multipart message by passing an `OutputStream` to the part's `writeTo( )` method:

```
public abstract void writeTo(OutputStream out)
 throws IOException, MessagingException
```

However, this differs from the approach taken in Example 19-12 in that it does not decode the part before writing it. It leaves whatever Base64, BinHex, or quoted-printable encoding the sender applied to the attachment alone. Instead, it simply writes the raw data.

Attaching files (or other documents) to messages you send is more complicated. To attach a file to a message, you first have to wrap the data in a `BodyPart` object and add it to the `Multipart` using one of the two `addBodyPart( )` methods:

```
public void addBodyPart(BodyPart part)
 throws IllegalWriteException, MessagingException
public void addBodyPart(BodyPart part, int index)
 throws IllegalWriteException, MessagingException
```

The first variant simply appends the part to the end of the message. The second variant adds the given part at the specified position. If the position is greater than the number of parts in the message, the part is simply added to the end. If it's added somewhere in the middle, this may cause the positions of other parts to change. If the message can't be changed, an `IllegalWriteException` is thrown.

The tricky part is creating the `BodyPart` object. You first need to guess a reasonable MIME content type for the file (`text/plain` and `application/octet-stream` are the most common types). Next, read the file and convert it into some class of Java object. Then install a `javax.activation.DataHandler` class that knows how to convert your data class according to your chosen MIME type. Once you've done all this, you can create a new `MimeBodyPart` object and use the various methods of the `Part` interface to set attributes such as the filename and the content disposition.

There are also two `removeBodyPart()` methods that delete a specified part from the message, although these aren't as commonly used:

```
public boolean removeBodyPart(BodyPart part)
 throws IllegalWriteException, MessagingException
public void removeBodyPart(int index)
 throws IndexOutOfBoundsException, MessagingException
```

If the message can't be changed, an `IllegalWriteException` is thrown. If the specified index doesn't identify a part, an `IndexOutOfBoundsException` is thrown. If the specified part isn't present in the message, a `MessagingException` is thrown.

19.10. MIME Messages

MIME was designed mainly for Internet email and specifically organized to be backward-compatible with existing protocols and software. Therefore, a typical Internet email message is in fact a MIME message. The only concrete subclass of `Message` in the JavaMail API is `javax.mail.internet.MimeMessage`:

```
public class MimeMessage extends Message implements MimePart
```

This class declares almost 70 public and protected methods. However, with the natural exception of the constructors, almost all of these either override methods from the `Message` superclass or implement methods declared by the `Part` interface. The only new methods are a baker's dozen declared in the `MimePart` interface, a subinterface of `Part`:

```
public interface MimePart extends Part
```

Most of these methods are very similar to methods in `Part` or `Message`. However, they have features that are unlikely to be found in non-MIME messages. For instance, a MIME part may have an MD5 digest, which would be encoded as an extra header inside the part. Thus, the `MimePart` interface declares and the `MimeMessage` class implements two methods to set and get this digest:

```
public String getContentMD5( ) throws MessagingException
public void   setContentMD5(String md5) throws MessagingException,
 IllegalWriteException, IllegalStateException
```

The `addHeaderLine()` method adds a string of text to the header of the message. It's up to you to make sure that this string will actually make sense in the header:

```
public void addHeaderLine(String line) throws
 MessagingException, IllegalWriteException, IllegalStateException
```

The `getHeader( )` method returns the value of every header in the message with the given name. If there are multiple headers with this name, the string separates the values of the different headers with the specified `delimiter` string:

```
public String getHeader(String name, String delimiter)
 throws MessagingException
```

The `getAllHeaderLines()` method returns a `java.util.Enumeration` containing every header in the message. The `Enumeration` contains `String` objects, one per header. Each `String` contains the full name and value; for example, "Subject: Re: Java 5 support". It is not divided into a separate name and value:

```
public Enumeration getAllHeaderLines( ) throws MessagingException
```

The `getMatchingHeaderLines()` method returns all header lines with names given in the `names` argument array. The `getNonMatchingHeaderLines( )` method does the reverse; it returns the header lines with a name not mentioned in the `names` argument:

```
public Enumeration getMatchingHeaderLines(String[] names)
 throws MessagingException
public Enumeration getNonMatchingHeaderLines(String[] names)
 throws MessagingException
```

The `getEncoding( )` method returns the encoding of this MIME part as a `String` as given by the Content-transfer-encoding: header. The typical encoding for a plain-text email is seven-bit or perhaps eight-bit or quoted-printable. The typical encoding for a file attachment is Base64:

```
public String getEncoding( ) throws MessagingException
```

The `getContentID()` method returns a string that uniquely identifies this part as given by the part's Content-ID: field. A typical ID might look like `<Pine.LNX.4.10.9912290930220.8058@akbar.nevex.com>`. It returns `null` if the part doesn't have a content ID:

```
public String getContentID( ) throws MessagingException
 IllegalWriteException, IllegalStateException
```


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The `getContentLanguage()` method returns the value of the Content-language: header. This is a comma-separated list of two (or more) letter abbreviations for languages, as defined by RFC 1766. For example, English is "en" and French is "fr". It returns `null` if the part doesn't have a Content-language: header.

```
public String[] getContentLanguage( ) throws MessagingException
```

There's also a `setContentLanguage()` method that you might use when sending a message:

```
public void setContentLanguage(String[] languages) throws
 MessagingException, IllegalWriteException, IllegalStateException
```

Finally, the two `setText()` methods set the content of the part with the MIME type `text/plain`. The second `setText( )` method also lets you specify the character set—for example, us-ascii or ISO 8859-1:

```
public void setText(String text) throws MessagingException
public void setText(String text, String charset)
 throws MessagingException
```

19.11. Folders

So far, we've worked mostly with the INBOX folder. This is the default folder in which most mail resides until the user filters or saves it into some other folder. On some systems, it may actually reside in a file called INBOX. On other systems, it may be called something different. Nonetheless, you can always access it from the JavaMail API using the name INBOX.

Most mail programs allow you to organize your messages into different folders. These folders are hierarchical; that is, one folder may contain another folder. In particular, in the IMAP protocol, servers store the messages in different folders from which clients retrieve and manipulate the messages as necessary. POP servers, by contrast, generally send all the messages to the user when the user connects and rely on the client to store and manage them. The primary advantage of the IMAP approach over POP is that it allows users to easily access their entire email archives from multiple client machines.

The JavaMail API represents IMAP-like folders as instances of the abstract `Folder` class:

```
public abstract class Folder extends Object
```

This class declares methods for requesting named folders from servers, deleting messages from folders, searching for particular messages in folders, listing the messages in a folder, and so forth. Most of these methods are declared abstract. When you ask a session, a store, or a folder to give

you one of the folders it contains, it will give you an instance of a concrete subclass appropriate for the protocol in use: IMAP, POP, mbox, or whatever. The reference implementation of the JavaMail API knows how to do these operations only for IMAP servers. However, some third-party implementations provide these operations in local mailbox folders stored on the client's filesystem as well.

19.11.1. Opening Folders

You cannot create folders directly. The only constructor is protected:

```
protected Folder(Store store)
```

Instead, you get a `Folder` from a `Session`, a `Store`, or another `Folder` like this:

```
Folder outbox = container.getFolder("sent-mail");
```

There are actually three `getFolder()` methods, one each in the `Session`, `Store`, and `Folder` classes. They all have the same signature and behave similarly:

```
public abstract Folder getFolder(String name) throws MessagingException
```

These methods share an annoying idiosyncrasy with the `File` class. Getting a `Folder` object doesn't imply that the named `Folder` actually exists on the server. To tell whether the folder is really present, you have to test for it with the `exists( )` method:

```
public boolean exists( ) throws MessagingException
```

When you first get a folder, it's closed. Before you can read the messages it contains, you have to open the folder using the `open( )` method:

```
public abstract void open(int mode)
 throws FolderNotFoundException, MessagingException
```

The `mode` argument should be one of the two named constants `Folder.READ_ONLY` or `Folder.READ_WRITE`. Some but not all implementations allow you to open multiple read-only connections to one real folder using multiple `Folder` objects. However, all implementations allow at most one `Folder` object to have write access to a folder at one time.

Some operations discussed in this section, such as searching or retrieving messages from a folder, can only be performed on an open folder. Others, such as deleting or changing the name of a folder, can only be done to a closed folder. The `isOpen()` method returns `true` if the folder is open, `false` if it's closed:

```
public abstract boolean isOpen( )
```

Generally, trying to do something with a closed folder that requires the folder to be open or vice versa will throw a `java.lang.IllegalStateException`. This is a runtime exception, so it doesn't need to be explicitly caught or declared.

When you're done with a folder, close it using the `close( )` method:

```
public abstract void close(boolean expunge)
 throws FolderNotFoundException, MessagingException
```

If the `expunge` argument is `true`, any deleted messages in the folder are deleted from the actual file on the server. Otherwise, they're simply marked as deleted, but the message can still be undeleted.

19.11.2. Basic Folder Info

The `Folder` class has eight methods that return basic information about a folder:

```
public abstract String getName( )
public abstract String getFullName( )
public URLName         getURLName( ) throws MessagingException
public abstract Folder getParent( ) throws MessagingException
public abstract int    getType( ) throws MessagingException
public int             getMode( ) throws IllegalStateException
public Store           getStore( )
public abstract char   getSeparator( )
 throws FolderNotFoundException, MessagingException
```

The `getName( )` method returns the name of the folder, such as "Reader Mail", whereas the `getFullName( )` method returns the complete hierarchical name from the root, such as "books/JNP3E/Reader Mail". The `getURLName( )` method includes the server; for instance, "imap://elharo@mail.metalab.unc.edu/books/JNP3E/Reader Mail". In this example, the slash character is the separator between nested folders. The separator can vary from implementation to implementation, but the `getSeparator()` method always tells you what it is.

The `getParent( )` method returns the name of the folder that contains this folder; e.g., "JNP3E" for the previous Reader Mail example.

The `getType( )` method returns an `int` indicating whether the folder can contain messages and/or other folders. If it can contain messages but not folders, `getType( )` returns the named constant `Folder.HOLDS_MESSAGES`. If it can contain folders but not messages, `getType( )` returns the named constant `Folder.HOLDS_FOLDERS`. If it can contain both folders and messages,

`getType()` returns the bitwise union `Folder.HOLDS_FOLDERS & Folder.HOLDS_MESSAGES`.

The `getMode( )` method tells you whether a folder allows writing. It returns one of the two named constants (`Folder.READ_ONLY` or `Folder.READ_WRITE`) or -1 if the mode is unknown. Finally, the `getStore()` method returns the `Store` object from which this folder was retrieved.

19.11.3. Managing Folders

The `create( )` method creates a new folder in this folder's `Store`:

```
public abstract boolean create(int type) throws MessagingException
```

The type of the folder should be one of the named constants `Folder.HOLDS_MESSAGES` or `Folder.HOLDS_FOLDERS`, depending on whether it will hold other folders or messages. It returns `true` if the creation succeeded, `false` if it didn't.

The `delete( )` method deletes this folder, but only if the folder is closed. Otherwise, it throws an `IllegalStateException`:

```
public abstract boolean delete(boolean recurse) throws
 IllegalStateException, FolderNotFoundException, MessagingException
```

If there are messages in this folder, they are deleted along with the folder. If the folder contains subfolders, the subfolders are deleted if the `recurse` argument is `true`. If the `recurse` argument is not `true`, the folder will only be deleted if it does not contain any subfolders. If it does contain subfolders, the delete fails. If the folder does contain subfolders and also contains messages, it's implementation-dependent whether the messages will be deleted even though the folder itself isn't. If the delete succeeds, the method returns `true`; otherwise, it returns `false`.

The `renameTo( )` method changes the name of this folder. A folder must be closed to be renamed. Otherwise, an `IllegalStateException` is thrown. This method returns `true` if the folder is successfully renamed, `false` if it isn't:

```
public abstract boolean renameTo(Folder f) throws
 IllegalStateException, FolderNotFoundException, MessagingException
```


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19.11.4. Managing Messages in Folders

On occasion, you may find a need to put a message in a folder. There's only one method to do this, `appendMessages()`:

```
public abstract void appendMessages(Message[] messages)
 throws FolderNotFoundException, MessagingException
```

As the name implies, the messages in the array are placed at the end of this folder.

The `copyMessages()` method copies messages into this folder from a specified folder given as an argument:

```
public void copyMessages(Message[] messages, Folder destination) throws
 IllegalStateException, FolderNotFoundException, MessagingException
```

The copied messages are appended to the destination folder. They are not removed from the source folder. To move a message, you have to copy it from the source to the destination, delete it from the source folder, and finally expunge the source folder.

To delete a message from a folder, set its `Flags.Flag.DELETED` flag to `true`. To physically remove deleted messages from a folder, you have to call its `expunge( )` method:

```
public abstract Message[] expunge( ) throws MessagingException,
 IllegalStateException, FolderNotFoundException
```

After a message has been expunged, there may still be `Message` objects that refer to it. In this case, almost any method call on such an object, except `isExpunged( )` and `getMessageNumber( )`, will throw an exception.

19.11.5. Subscriptions

Some implementations (though not the default IMAP implementation) allow you to subscribe to particular folders. This would be most appropriate for an NNTP provider, where a typical server offers thousands of newsgroups, but the typical user will want to retrieve messages from a few dozen of these, at most. Each newsgroup would be represented as a `Folder` object. A subscription to the newsgroup's `Folder` indicates that the user wants to retrieve messages from that newsgroup:

```
public boolean isSubscribed( )
public void    setSubscribed(boolean subscribe)
 throws FolderNotFoundException, MethodNotSupportedException,
 MessagingException
```

If a provider doesn't support subscription, `setSubscribed( )` throws a `MethodNotSupportedException` and `isSubscribed( )` returns `false`.

19.11.6. Listing the Contents of a Folder

Folders are hierarchical. That is, a folder can contain other folders. There are four methods to list the folders that a folder contains:

```
public Folder[] list( )
 throws FolderNotFoundException, MessagingException
public Folder[] listSubscribed( )
 throws FolderNotFoundException, MessagingException
public abstract Folder[] list(String pattern)
 throws FolderNotFoundException, MessagingException
public Folder[] listSubscribed(String pattern)
 throws FolderNotFoundException, MessagingException
```

The first method returns an array listing the folders that this folder contains. The second method returns an array listing all the subscribed folders that this folder contains.

The third and fourth methods repeat these first two, except they allow you to specify a pattern. Only folders whose full names match the pattern will be in the returned array. The pattern is a string giving the name of the folders that match. However, the string can contain the % character, which is a wildcard that matches any sequence of characters not including the hierarchy separator, and *, which matches any sequence of characters including the hierarchy separator.

19.11.7. Checking for Mail

The `getMessageCount()` method returns the number of messages in this folder:

```
public abstract int getMessageCount( )
 throws FolderNotFoundException, MessagingException
```

This method can be invoked on an open or closed folder. However, in the case of a closed folder, this method may (or may not) return -1 to indicate that the exact number of messages isn't easily available.

The `hasNewMessages()` method returns `true` if new messages have been added to the folder since it was last opened (not since the last time you checked!):

```
public abstract boolean hasNewMessages( )
 throws FolderNotFoundException, MessagingException
```

The `getNewMessageCount()` method uses a slightly different approach for determining how many new messages there are. It checks the number of messages in the folder whose RECENT flag is set:

```
public int getNewMessageCount( )
 throws FolderNotFoundException, MessagingException
```

Unlike `hasNewMessages( )`, `getNewMessageCount( )` can be invoked on either an open or a closed folder. However, in the case of a closed folder, `getNewMessageCount( )` may return -1 to indicate that the real answer would be too expensive to obtain.

The `getUnreadMessageCount()` method is similar but returns the number of messages in the folder that do not have a SEEN flag set:

```
public int getUnreadMessageCount( )
 throws FolderNotFoundException, MessagingException
```

Like `getNewMessageCount( )`, `getUnreadMessageCount( )` can be invoked on either an open or a closed folder. However, in the case of a closed folder, it may return -1 to indicate that the real answer would be too expensive to obtain.

19.11.8. Getting Messages from Folders

The `Folder` class provides four methods for retrieving messages from open folders:

```
public abstract Message getMessage(int messageNumber) throws
 IndexOutOfBoundsException, FolderNotFoundException,
 IllegalStateException, MessagingException
public Message[] getMessages( ) throws FolderNotFoundException,
 IllegalStateException, MessagingException
public Message[] getMessages(int start, int end) throws
 IndexOutOfBoundsException, FolderNotFoundException,
 IllegalStateException, MessagingException
public Message[] getMessages(int[] messageNumbers) throws
 IndexOutOfBoundsException, FolderNotFoundException,
 IllegalStateException, MessagingException
```

The `getMessage( )` method returns the n^{th} message in the folder. The first message in the folder is number 1 (not 0). Message numbers may change when messages are expunged from the folder. An `IndexOutOfBoundsException` is thrown if you ask for message *n* and there are *n - 1* or fewer messages in the folder.

The first `getMessages()` method returns an array of `Message` objects representing all the messages in this folder. The second `getMessages( )` method returns an array of `Message` objects from the folder, beginning with `start` and finishing with `end`, inclusive. The third

`getMessages()` method returns an array containing only those messages specifically identified by number in the `messageNumbers` array.

All four of these methods only create the `Message` objects and fill in the minimal number of fields in those objects. The actual text and other content of the message will only be fetched from the server when the `Message`'s methods that use those things are invoked. This means, for example, that you can't get all the messages from the server, then hang up your PPP connection and work with them offline. There is, however, a `fetch( )` method, which fills in certain parts of the `Message` objects with actual data from the server:

```
public void fetch(Message[] messages, FetchProfile fp)
 throws IllegalStateException, MessagingException
```

The `messages` argument is an array containing the `Message` objects to be prefetched. The `FetchProfile` argument specifies which headers in the messages to prefetch. However, this is still just a suggestion. Implementations are free to ignore this request and fetch the message content only when it's actually needed.

You can request prefetching of individual headers such as Subject: by name. You can also request prefetching of three predefined blocks of information: the envelope (essentially the subject and addressees of the message), the flags of the message, or the content info of the messages. The three groups you can ask for are given as constant `FetchProfile.Item` objects. They are `FetchProfile.Item.ENVELOPE`, `FetchProfile.Item.FLAGS`, and `FetchProfile.Item.CONTENT_INFO`.

The `FetchProfile` class has a simple noargs constructor as well as methods for constructing a new profile, adding particular items and headers to the profile, and testing whether a particular item is part of a particular profile:

```
public FetchProfile( )
public void add(FetchProfile.Item item)
public void add(String headerName)
public boolean contains(FetchProfile.Item item)
public boolean contains(String headerName)
public FetchProfile.Item[] getItems( )
public String[] getHeaderNames( )
```

For example, suppose you wanted to download just the subjects, the To: addresses, and the content information of a block of messages. Fetch them like this:

```
Message[] messages = folder.getMessages( );
FetchProfile fp = new FetchProfile( );
fp.add(FetchProfile.Item.CONTENT_INFO);
fp.add("Subject");
fp.add("To");
```

19.11.9. Searching Folders

If the server supports searching (as many IMAP servers do and most POP servers don't), it's easy to search a folder for the messages meeting certain criteria. The criteria are encoded in `SearchTerm` objects:

```
public abstract class SearchTerm extends Object
```

The `SearchTerm` class is abstract, but the JavaMail API provides many subclasses for performing common searches:

```
public abstract class    AddressTerm       extends SearchTerm
public abstract class    FlagTerm          extends SearchTerm
public abstract class    StringTerm        extends SearchTerm
public final    class    FromTerm          extends AddressTerm
public final    class    FromStringTerm    extends AddressStringTerm
public final    class    ReceipientTerm    extends AddressTerm
public final    class    AddressStringTerm extends StringTerm
public final    class    BodyTerm          extends StringTerm
public final    class    HeaderTerm        extends StringTerm
public final    class    MessageIDTerm     extends StringTerm
public final    class    SubjectTerm       extends StringTerm
public abstract class    DateTerm          extends ComparisonTerm
public final    class    ReceivedDateTerm  extends DateTerm
public final    class    SentDateTerm      extends DateTerm
```

It also provides several classes for combining searches:

```
public final    class AndTerm           extends SearchTerm
public abstract class ComparisonTerm    extends SearchTerm
public final    class NotTerm           extends SearchTerm
public final    class OrTerm            extends SearchTerm
```

And of course, you can write your own subclasses that implement your own search logic. To implement a search, write a subclass and override the subclass's `match( )` method to describe your search:

```
public abstract boolean match(Message message)
```

This method returns `true` if the `message` argument satisfies the search and `false` if it doesn't.

Set up a `SearchTerm` matching your desired parameters and pass it to one of these two `search( )` methods in the `Folder` class:

```
public Message[] search(SearchTerm term) throws SearchException,
 FolderNotFoundException, IllegalStateException, MessagingException
public Message[] search(SearchTerm term, Message[] messages)
 throws SearchException, FolderNotFoundException,
 IllegalStateException, MessagingException
```


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A `SearchException` indicates that the search term is more complicated than the implementation can handle. For example, this search term seeks out all messages from billg@microsoft.com:

```
Address billg   = new InternetAddress("billg@microsoft.com");
SearchTerm term = new FromTerm(billg);
```

This search term looks for all messages from billg@microsoft.com after 2003:

```
Address billg    = new InternetAddress("billg@microsoft.com");
SearchTerm term1 = new FromTerm(billg);
Date millennium  = Calendar.getInstance( ).set(2004, 0, 1).getTime( );
SearchTerm term2 = new SentDateTerm(ComparisonTerm.GE, millennium);
SearchTerm term  = new AndTerm(term1, term2);
```

Example 19-13 is a simple variation of the `MailClient` program in Example 19-7. It allows the user to list email addresses on the command line after the initial URL, like this:

```
% java SearchClient imap://elharo@mail.metalab.unc.edu/INBOX
            willis@nvx.com billg@microsoft.com
```

Only messages from the specified users will be returned. However, if no email addresses are given, all messages will be returned.

Example 19-13. A mail client that searches by From: address

```
import javax.mail.*;
import javax.mail.search.*;
import javax.mail.internet.*;
import java.util.*;
import java.io.*;

public class SearchClient {
  public static void main(String[] args) {

    if (args.length == 0) {
      System.err.println(
       "Usage: java SearchClient protocol://username@host/foldername");
      return;
    }

    URLName server = new URLName(args[0]);

    try {

      Session session = Session.getDefaultInstance(new Properties( ),
       new MailAuthenticator(server.getUsername( )));

      // Connect to the server and open the folder
      Folder folder = session.getFolder(server);
      if (folder == null) {
        System.out.println("Folder " + server.getFile( ) + " not found.");
        System.exit(1);
      }
      folder.open(Folder.READ_ONLY);
```


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```
      SearchTerm term = null;
      if (args.length > 1) {
        SearchTerm[] terms = new SearchTerm[args.length-1];
        for (int i = 1; i < args.length; i++) {
          Address a = new InternetAddress(args[i]);
          terms[i-1] = new FromTerm(new InternetAddress(args[i]));
        }
        if (terms.length > 1) term = new OrTerm(terms);
        else term = terms[0];
      }

      // Get the messages from the server
      Message[] messages;
      if (term == null)  {
        messages = folder.getMessages( );
      }
      else {
        messages = folder.search(term);
      }
      for (int i = 0; i < messages.length; i++) {
        System.out.println("------------ Message " + (i+1)
         + " ------------");

        // Print message headers
        Enumeration headers = messages[i].getAllHeaders( );
        while (headers.hasMoreElements( )) {
          Header h = (Header) headers.nextElement( );
          System.out.println(h.getName( ) + ": " + h.getValue( ));
        }
        System.out.println( );

        // Enumerate parts
        Object body = messages[i].getContent( );
        if (body instanceof Multipart) {
          processMultipart((Multipart) body);
        }
        else { // ordinary message
          processPart(messages[i]);
        }

        System.out.println( );

      }

      // Close the connection
      // but don't remove the messages from the server
      folder.close(false);

    }
    catch (Exception ex) {
      ex.printStackTrace( );
    }

    // Since we may have brought up a GUI to authenticate,
    // we can't rely on returning from main( ) to exit
    System.exit(0);

  }

  public static void processMultipart(Multipart mp)
   throws MessagingException {

    for (int i = 0; i < mp.getCount( ); i++) {
      processPart(mp.getBodyPart(i));
    }

  }
```


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```
    public static void processPart(Part p) {

      try {
        // I'd prefer to test the Content-Disposition header here.
        // However, too many common email clients don't use it.
        String fileName = p.getFileName( );
        if (fileName == null) { // likely inline
          p.writeTo(System.out);
        }
        else if (fileName != null) {
          File f = new File(fileName);
          // find a version that does not yet exist
          for (int i = 1; f.exists( ); i++) {
            String newName = fileName + " " + i;
            f = new File(newName);
          }
          FileOutputStream out = new FileOutputStream(f);

          // We can't just use p.writeTo( ) here because it doesn't
          // decode the attachment. Instead we copy the input stream
          // onto the output stream which does automatically decode
          // Base-64, quoted printable, and a variety of other formats.
          InputStream in = new BufferedInputStream(p.getInputStream( ));
          int b;
          while ((b = in.read( )) != -1) out.write(b);
          out.flush( );
          out.close( );
          in.close( );
        }
      }
      catch (Exception ex) {
        System.err.println(e);
        ex.printStackTrace( );
      }
    }
  }
```

19.11.10. Flags

It's sometimes useful to be able to change the flags for an entire group of messages at once. The `Folder` class has two methods for doing this:

```
public void setFlags(Message[] messages, Flags flag, boolean value)
 throws IllegalStateException, MessagingException
public void setFlags(int start, int end, Flags flag, boolean value)
 throws IllegalStateException, MessagingException
public void setFlags(int[] messageNumbers, Flags flag, boolean value)
 throws IndexOutOfBoundsException, IllegalStateException,
 MessagingException
```

Ultimately, these are just conveniences. There's nothing you can do with these methods that you can't do by setting the flags on each message individually with the `setFlags( )` method of the `Message` class. In fact, the default implementation simply invokes that method on each message in the specified block of messages.

The `Folder` class also has a `getPermanentFlags( )` method to return the flags that this folder will supply for all messages. This includes all the flags except the user-defined flags, which

are applied only to particular messages that the user has flagged. For instance, not all folder implementations track whether messages have been answered:

```
public abstract Flags getPermanentFlags( )
```

19.11.11. Event Handling

Many email programs can be configured to periodically check for incoming email in the background. One way to structure an email program is as a series of responses to unpredictable events. This is much like programming for a graphical user interface, and indeed the JavaMail API uses the same basic patterns to handle mail events that the AWT and Swing use to handle GUI events.

The JavaMail API defines six different kinds of mail events, all in the `javax.mail.event` package. They are all subclasses of `MailEvent`:

```
public abstract class MailEvent extends EventObject
```

The six concrete kinds of mail events, the first four of which involve folders, are:

`ConnectionEvent`
: A `Folder` (or `Store` or `Transport`) has been opened, closed, or disconnected.

`FolderEvent`
: A `Folder` has been created, deleted, or renamed.

`MessageChangedEvent`
: The message's envelope or flags have changed.

`MessageCountEvent`
: A message was added to or deleted from a `Folder`.

`StoreEvent`
: A notification or alert from a `Store`.

`TransportEvent`
: A notification from a `Transport` that a message was delivered, partially delivered, or failed to be delivered.

There are six listener interfaces corresponding to the six kinds of events:

```
public interface ConnectionListener     extends EventListener
public interface FolderListener         extends EventListener
public interface MessageChangedListener extends EventListener
public interface MessageCountListener   extends EventListener
public interface StoreListener          extends EventListener
public interface TransportListener      extends EventListener
```

Each of these interfaces declares one or more methods that must be provided by implementing classes. For example, the `ConnectionListener` class declares these three methods:

```
public void opened(ConnectionEvent e)
public void disconnected(ConnectionEvent e)
public void closed(ConnectionEvent e)
```


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The `FolderListener` interface declares these three methods:

```
public void folderCreated(FolderEvent e)
public void folderDeleted(FolderEvent e)
public void folderRenamed(FolderEvent e)
```

Four of these events can be fired by folders. Consequently, there are 14 `add`*`XXX`*`Listener()`, `remove`*`XXX`*`Listener()`, and `notify`*`XXX`*`Listener()` methods in the `Folder` class:

```
public    void addConnectionListener(ConnectionListener l)
public    void removeConnectionListener(ConnectionListener l)
protected void notifyConnectionListeners(int type)
public    void addFolderListener(FolderListener l)
public    void removeFolderListener(FolderListener l)
protected void notifyFolderListeners(int type)
protected void notifyFolderRenamedListeners(Folder folder)
public    void addMessageCountListener(MessageCountListener l)
public    void removeMessageCountListener(MessageCountListener l)
protected void notifyMessageAddedListeners(Message[] messages)
protected void notifyMessageRemovedListeners(boolean removed,
 Message[] messages)
public    void addMessageChangedListener(MessageChangedListener l)
public    void removeMessageChangedListener(MessageChangedListener l)
protected void notifyMessageChangedListeners(int type, Message message)
```

The `add`*`XXX`*`Listener()` methods add an implementation of the particular interface to the list of listeners. The `remove`*`XXX`*`Listener()` methods remove an implementation from that list. The `notify`*`XXX`*`Listener()` methods are not used directly; instead, they're used by instances of `Folder` and its subclasses to notify registered listeners of particular events. All of this works exactly as it does in the AWT and Swing, just with different events.

19.11.12. Utility Methods

Finally, for completeness's sake, I'll note that the `Folder` class overrides two methods from `java.lang.Object`, `finalize( )` and `toString( )`:

```
protected void finalize( ) throws Throwable
public String toString( )
```

Neither of these is especially important to the client programmer.