Lab 10

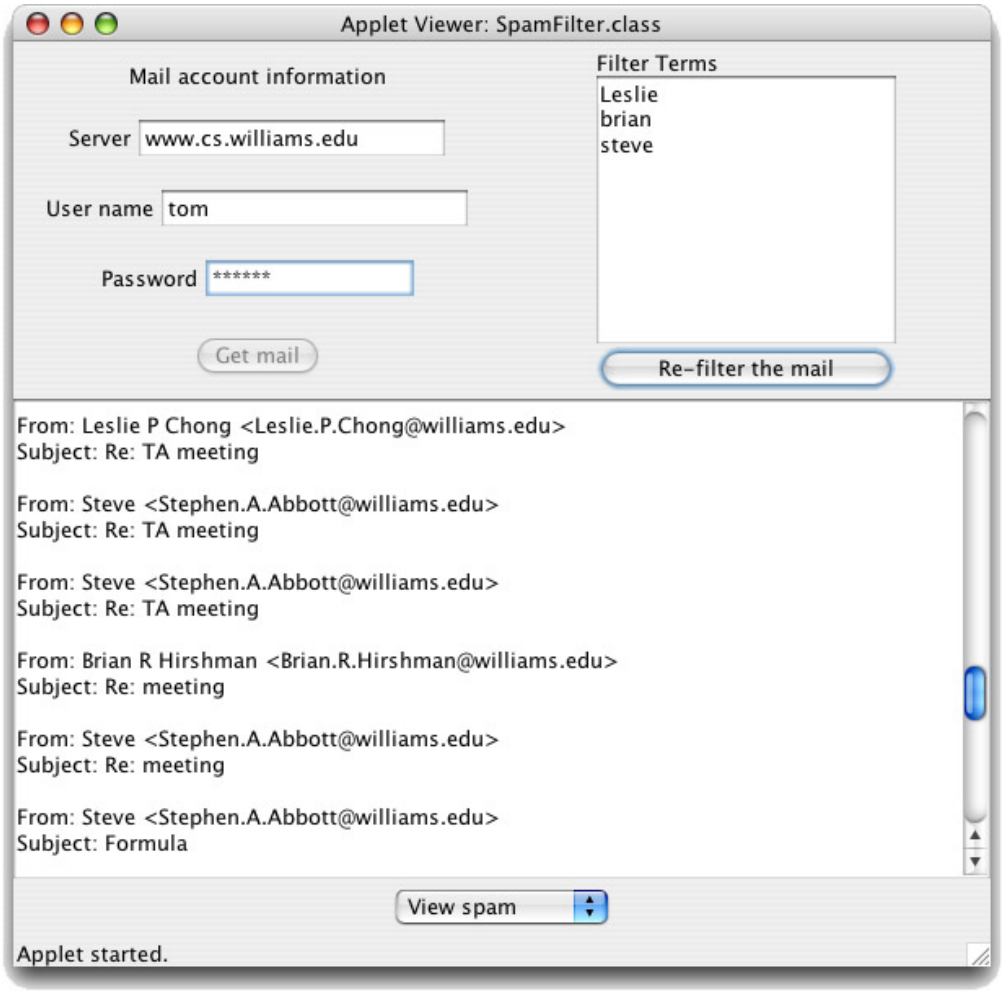
Spam, Spam, Spam

Objective To gain experience with Strings.

Before the mid-90s, Spam was a canned "meat" product. These days, the term "spam" means just one thing — unwanted email.

This week we build a program that provides insights into how mail programs filter spam. Our spam filter is rather simple. The user provides a list of words called the *filter list*. The program searches the "from" and "subject" headers of all your mail messages and divides your mail into a *good list* and a *spam list*. The spam list contains all the messages that contain one ore more words from the filter list, and the good list contains the messages that do not contain any filter words.

The user interface for the SpamFilter program is shown below:



The text fields on the top, left side window are specify the machine and account from which mail will be fetched. When the "Get mail" button is pressed, the program connects to the mail server and downloads the headers of all available messages.

The program then decides whether each fetched message is a good message or spam based on what the user enters in the `JTextArea` labeled "Filter Terms." (`JTextArea`s are just like `JTextFields` except that they display more than one line of text.) Each line of text entered in this `JTextArea` is treated as an indicator of spam. If the "from" field or the "subject" field of a mail message contains a substring that is identical to one of these lines, the message is considered spam.

The `JComboBox` at the bottom of the screen allows the user to switch between displaying the good mail or the spam in the `JTextArea` that occupies the center of the program window.

You can use this program to connect to your actual mailbox and filter your own mail by entering your mail server name, username and password into the user interface. We provide the code to actually communicate with a mail server, and there our code does not modify the mailbox on the server in any way. As a result, you do not need to worry about errors in your program causing problems with your real mailbox.

If you don't want to use your actual mailbox, we have set up temporary mailboxes for you to use on the mail server `cortland.cs.williams.edu`. You would connect with the same username and password that you use to log in on our lab machines. These mailboxes are currently empty, and you will need to send yourself a few short pieces of mail to test out your program. Your address will have the form `09abc@cortland.cs.williams.edu`, where `09abc` is replaced with your user name.

If using your own computer, PurpleAir will prevent you from connecting to our server. The wired network may work, although you may have better luck working in the lab.

Program Structure

Your program will consist of 4 main classes:

SpamFilter. This will be the controller class for your program, and we will provide all of the code for it. This class creates the components of the interface and defines event handling methods for them.

Since this program does not use the canvas, it extends `Controller` instead of `WindowController`.

MailConnection. This class provides methods to contact a mail server through the network and download messages from the server. We will provide the code for this class.

To talk to a mail server, you must first construct a `MailConnection` object. The constructor for this class expects three `String`s as parameters. The first must be the name of the mail server to contact. If you want to use the campus mailserver this parameter's value should be `mailhost.williams.edu`. To access your account on our server you would use `cortland.cs.williams.edu` instead. The other two parameters to the constructor must be your user name and your password.

When you construct a `MailConnection` it attempts to connect to the mail server. There are a number of reasons why it might fail. For example, the user might mistype the login id or password or the mail server might not be running for some reason. If any of these failures occur, a dialog box will pop up to inform the user. Your program must also be aware that the connection failed because it will not be possible to look at the mail if there is no connection. For that reason, we provide the `isConnected` method.

Once you have constructed a `MailConnection` you can use the following methods to access your mail.

`public boolean isConnected()` Returns true if the program currently has a connection to the mail server.

`public void disconnect()` Closes the connection to the mail server. This does nothing if there is no active connection.

`public int getNumMsgs()` Returns the number of messages in the mailbox you are connected to. This returns 0 if there is no active connection.

`public String header (int msg)` Returns the headers of a mail message identified by the number passed in. Unlike Java, mailboxes number messages beginning with 1 and going up to the number of messages contained in the mailbox.

The mail headers are returned in one long string, such as:

```
Return-Path: <lrobinson@cs.williams.edu>
Received: from [137.165.8.62] (tcl303.cs.williams.edu [137.165.8.62])
by bull.cs.williams.edu (8.12.3p3/8.12.3) with ESMTP id hADDU9NG013481
for <colloquium@cs.williams.edu>; Thu, 13 Apr 2008 08:30:09 -0500 (EST)
(envelope-from lrobinson@bull.cs.williams.edu)
Mime-Version: 1.0
Message-Id: <a05200f02bbd9370948a5@[137.165.8.62]>
Date: Thu, 13 Apr 2008 08:30:01 -0500
To: colloquium@cs.williams.edu
From: Lorraine Robinson <lrobinson@cs.williams.edu>
Subject: April 14 colloquium
Content-Type: multipart/alternative; boundary="=======_-1143392286==_ma======="
Status: RO
```

Your spam filter will look at only the "From" and "Subject" headers. Part of your job, described below, is to extract just those headers from the long header list that `header` returns.

The `header` method returns an empty string if it is called when there is no connection.

Message. You will construct a `Message` object for each mail message downloaded from the server. The class is simple. It has a constructor and three accessor methods:

- `public Message(String headers)`: The constructor expects a `String` containing the message (or at least its header) as a parameter
- `public String getFrom()`: Returns the "From:" line found in the header of this message.
- `public String getSubject()`: Returns the "Subject:" line found in the header of this message.
- `public String toString()`: Returns the "From" and "Subject" headers as a single string with a newline between them and a newline at the end.

MessageList. A `MessageList` holds a list of mail `Message`s. Internally, it uses an array to keep track of the members of the collection. To make it possible to create an array of an appropriate size, the constructor takes the maximum size of the collection as a parameter.

We provide the necessary constructor and an `add` method to add messages to a message list. You should write three methods:

`public String toString()` This method invokes the `toString` method of the `Message` class to obtain `String`s describing each of the messages in the list. It concatenates all of these descriptions together (separated from one another by extra newlines) and return this large `String` as its result.

`public MessageList getSpam(String[] filterWords)` This method takes an array of `String`s containing one `String` for each line entered in the filter `JTextArea`. It returns the spam. To do this, it creates a new `MessageList` and adds to it any messages that are spam.

`public MessageList getGood(String[] filterWords)` This method should take an array of `String`s containing one `String` for each line entered in the filter `JTextArea`. It does the same thing as `getSpam`, except that it returns the good messages.

Suggestions For Designing These Classes.

- Extracting the "From" and "Subject" headers from the long string that `header` returns is part of your task. As shown earlier, the String that `header` returns actually contains multiple headers with a newline between each. To find just one header, you should find a string that begins with a newline character `\n` followed by "From:" or "Subject:" and ending at the next newline character. Be sure to handle the special case where the header you are looking for is the last header and does not end with a newline! You should use a case-sensitive comparison when looking for these strings.
- You will need to determine if a header is spam. You should use `String` methods to search the header for the presence of any `String` in the filter list. You should use a case-insensitive comparison for your spam comparisons.

  Note that the user may have inadvertently added blank lines to the filter area. When you look for matches in the filtering methods, you should ignore any empty strings in the array of filter terms.
- You may find it useful to introduce other private methods to keep your code simple and to prevent repetitive code in several places.

Design

This week we will again require that you prepare a written design for your program before lab. At the beginning of the lab, the instructor will briefly examine each of your designs to make sure you are on the right track.

Your design should include the following:

1. A design for the `Message` class and its three methods.
2. A design for the three methods in the `MessageList` class. We suggest that you think about writing an additional method in `MessageList` that you can use in both filtering methods with the following declaration:

   ```
   private boolean matchExists(String[] terms, String searchString)
   ```

   This method will return true if any of the terms appear in `searchString`.

The more time you spend on your design, the faster you will be able to proceed.

Implementation Strategy

We suggest that you approach this problem in the following order:

- Download the starter code for this project from the handouts web page.
- Define the `Message` class. The `SpamFilter` class is initially set up to use a `MailConnection` to download the first message's header. This header string is used to create a new `Message`, and the `SpamFilter` then displays the results of calling `getFrom`, `getSubject`, and `toString` on that message. Once you implement the `Message` methods, the appropriate information should be displayed for it in the text area. However, none of the filter components will behave properly yet.
- Once you finish the `Message` class, open the `SpamFilter` class and add the following code where it says "INSERT CODE HERE":

  ```
  int numMessages = connection.getNumMsgs();
  allMessages = new MessageList(numMessages);
  for (int i = 0; i < numMessages; i++) {
      Message m = new Message(connection.header(i + 1));
      allMessages.add(m);
  }
  filterMessageList();
  ```

  This will make the spam filter download all of the messages and then filter the message list according to which filter is currently selected. You will also need to comment out the lines before it that downloaded the first message for the previous step.
- Start working on the `MessageList` and write the `toString` method. Once the `toString` method is implemented, the from and subject lines for all messages downloaded from the server should appear in the window when you get your mail.
- The last step is to write the two filtering methods. The starter code in the message list contains a `getGood` that returns a message list of all messages and `getSpam` that returns an empty message list. Change the filter methods in the message list to work properly.

We also include some ideas for optional extensions at the end of this handout.

Submitting Your Work

Once you have saved your work in BlueJ, please perform the following steps to submit your assignment. Don't forget to change the name of your folder to include your last name.

- First, return to the Finder.
- Click "Go" and select "Connect to Server."
- For the server address, type in "Cortland" and click "Connect."
- Select the button next to "Guest" and click "Connect."
- A selection box should appear. Select "Courses" and click "Ok."
- You should now see a Finder window with a "cs134" folder. Open this folder.
- You should now see the drop-off folders for the three labs sections. Drag your program folder into the appropriate lab section folder. When you do this, the Mac will warn you that you will not be able to look at this folder. That is fine. Just click "OK."
- Log off of the computer before you leave.

You can submit your work up to 11 p.m. two days after your lab (11 p.m. Wednesday for those in the Monday Labs, and 11 p.m. Thursday for those in the Tuesday Lab). If you submit and later discover that your submission was flawed, you can submit again. We will grade the latest submission made before the 11 p.m. deadline. The Mac will not let you submit again unless you change the name of your folder slightly. It does this to prevent another student from accidentally overwriting one of your submissions. Just add something to the folder name (like "v2") and the resubmission will work fine.

Grading Guidelines

As on labs, we will evaluate your program for both style and correctness. Here are some specific items to keep in mind and focus on while writing your program:

Style
Descriptive comments
Good names
Good use of constants
Appropriate formatting

Design
General correctness/design/efficiency issues
conditionals and loops
Parameters, variables, and scoping
Good correct use of arrays
Good use of private methods
Good use of strings

Correctness
Downloading mail and saving it
Extracting from and subject headers
displays message list properly
getGood filter
getSpam filter

Starter Code

You will write the `Message` class from scratch, and the following starter code will be given to you for `MessageList`. You may examine the `SpamFilter` code by downloading the starter project, but you should not need to read that file to complete your design.

```
public class MessageList {

    // array of message objects to keep the list
    private Message messages[];

    // number of entries being used in the messages array
    private int count = 0;

    // Constructrs a new message with the given maximum size.
    public MessageList(int maxSize) {
        messages = new Message[maxSize];
    }

    // Add a new message to the list
    public void add(Message newMessage) {
        if (count < messages.length) {
            messages[count] = newMessage;
            count++;
        } else {
            System.out.println("No More Space in Message List!!!");
        }
    }

    public String toString() {
        return "Complete MessageList.toString()";
    }

    /*
     * Change This Method
     * It currently just returns all of the messages.
     */
    public MessageList getGood(String[] filterTerms) {
        MessageList resultList = new MessageList(messages.length);
        for (int i = 0; i < count; i++) {
            resultList.add(messages[i]);
        }
        return resultList;
    }

    /*
     * Change This Method
     * It currently just returns an empty list.
     */
    public MessageList getSpam(String[] filterTerms) {
        return new MessageList(0);
    }
}
```

Optional Extensions

If you wrap up early and would like to extend the SpamFilter, here are two ideas.

Thresholds. Most spam filters only filter mail whose "spam content" is deemed high. A message with a single spam word may not be spam, but one with perhaps 3 or more almost certainly is. This helps reduce false positives, in which good mail is marked as spam.

Add a threshold to you filter. In particular, change your program so that it only marks a message as spam if its headers contain n or more occurrences of spam words. You should change the `SpamFilter`'s interface so that the user can configure the threshold n to anywhere between 1 and perhaps 5. (A `JSlider` or choice box might work well for this.)

Experimenting with Inheritance. Your program's interface includes several `JTextField`s each of which must be placed next to a `JLabel` describing its function. Rather than creating each of these separately in your program's `init` method, define a new class of GUI components that combines a `JLabel` and a text field in such a way that you can treat them as a single GUI component.

You can create a new class of GUI components that can hold several other components together by defining a class that extends `JPanel`. To understand how this works, think about what you would have done if you decided to create the needed `JLabels` and `JTextField`s separately in your init method. To ensure that they were kept together in the program's interface you would create a `JPanel` and add them both to the `JPanel` (which would then in turn be added to the content pane).

Suppose now, that you instead want to define a new class named `LabeledTextField` designed to combine a `JLabel` and a `JTextField`. If you define the new class as an extension of `JPanel` this is quite easy. Since any object of the new class is a `JPanel`, Swing will let you add the object to the content pane. Also, since the object is a `JPanel`, you can include code in the constructor for the new class that creates a `JLabel` and a `JTextField` and adds them to the object being created. Finally, if you associate the `JTextField` with an instance variable then you can define a `getText` method for the new class which simply returns the result of invoking `getText` on the `JTextField` associated with the instance variable.

Alas, things are made a bit more complicated by the fact that your program requires two `JTextField`s and one `JPasswordField`, all of which need to have `JLabel`s attached to them. You could just define two separate classes that extend `JPanel` as described above, but to maximize your exploration of inheritance we have something more elegent in mind.

First, define a class named `LabeledTextComponent`. This class has a single purpose: to be extended by `LabeledTextField` and `LabeledPasswordField`. The `LabeledTextComponent` class should extend `JPanel`. It should include an instance variable of type `JTextField` and a `getText` method that returns the `String` obtained by invoking `getText` on the instance variable. Its constructor, however, will not actually create a text field. Instead, all it will do is create a `JLabel` and add it to the `JPanel`. As a result, the only parameter to the constructor for this class will be the `String` to use when creating the `JLabel`. Thus, the following is a complete implementation of `LabeledTextComponent`:

```
class LabeledTextComponent extends JPanel {

    protected JTextField textField;

    public LabeledTextComponent(String label) {
        add(new JLabel(label));
    }

    public String getText() {
        return textField.getText();
    }
}
```

You will define the two desired classes, `LabeledTextField` and `LabeledPasswordField` as extensions of `LabeledTextComponent`. Each of the constructors for these two classes will take an integer that determines how wide the field should be and a `String` that determines what is initally displayed in the field, as well as the label necessary for the super class. The constructor for `LabeledTextField` will create a `JTextField` and add it to the object being constructed. The constructor for `LabeledPasswordField` will create a `JPasswordField` and add it to the object being constructed. Both classes will inherit `getText` from `LabeledTextComponent`.

Add these three classes, and change the `SpamFilter` to use them when building the interface components in `init`.