Implementing a Web Client

(Week 3 Lectures)

Lecture Objectives

- Understand the basic requirements in implementing a web client.

- Use the LWP library in Perl to write a simple web client.

Lecture Objectives

- Relevance to unit objectives:
  - Learning objective 2: Writing software
- Relevance to assessments:
  - Lab week 4
  - assignment 1

Lecture Outline

- Perl’s LWP library
- A Basic Web Client
- HTTP::Request, HTTP::Response, and LWP::UserAgent

The LWP Library

- The Library for Web access in Perl (LWP)
  - a set of modules which provides a unified API for interacting through the Web.
  - Also includes other important Internet services like FTP.
- The library contains a set of classes to support:
  - requesting documents from web servers
  - posting data to a web server
  - parse HTML documents
  - handle cookies
  - etc.

The LWP Library

- Besides the main LWP module, the LWP distribution file (`libwww*`) usually contains a whole lot of other important modules as well, such as HTTP.

A Basic Web Client (get_url.pl)

```
#!/usr/bin/perl

# file get_url.pl
# Fetch a URL using LWP's object-oriented interface

use strict;
use LWP;

my $url = shift;

my $agent    = LWP::UserAgent->new;
my $request  = HTTP::Request->new(GET => $url);

my $response = $agent->request($request);
$response->is_success or die "$url: ",$response->message,"\n";

print $response->content;
```

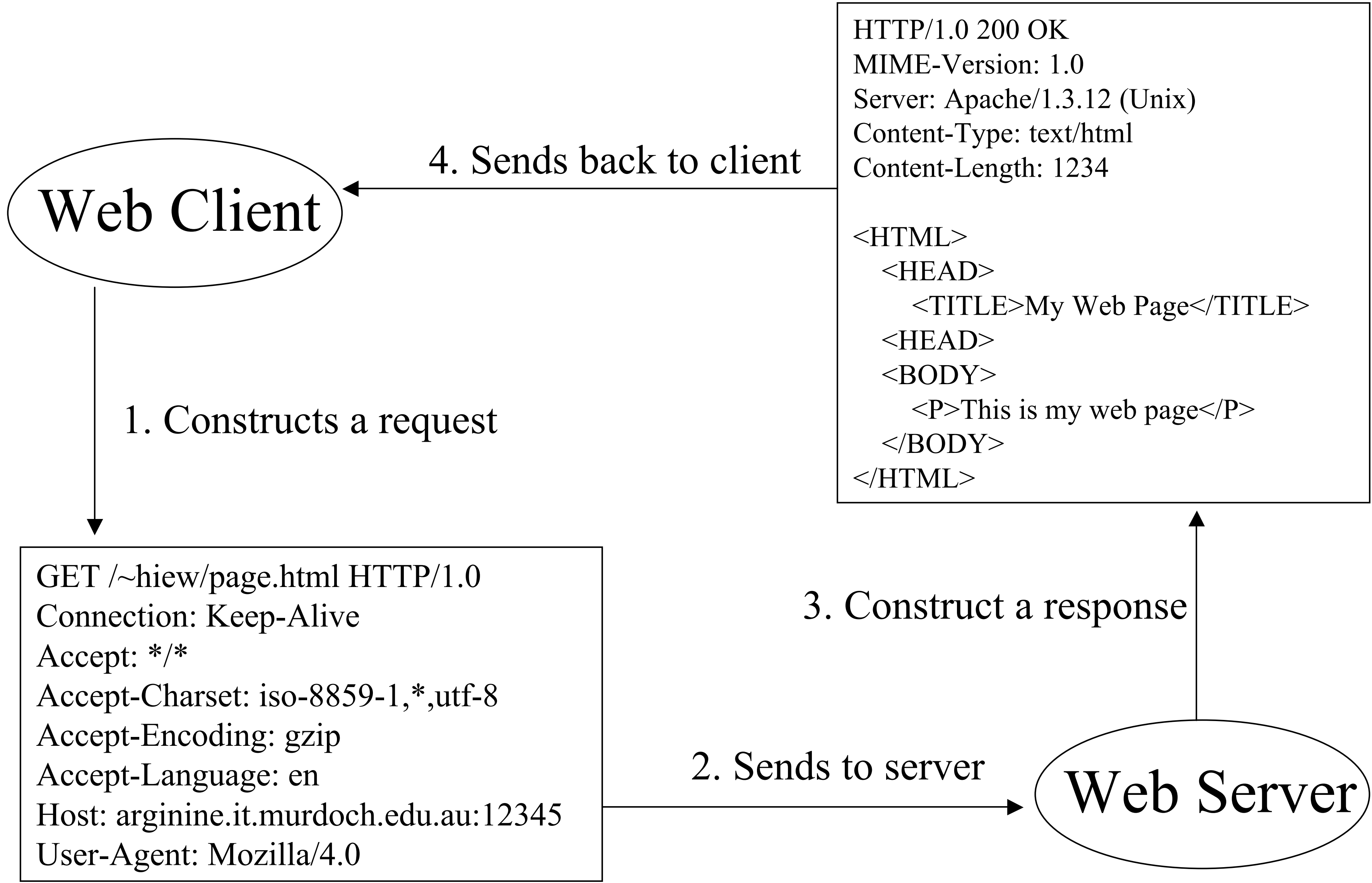
Acknowledgement

- The get_url.pl script was written by Lincoln Stein (a very influencial Perl programmer).

- It was published in the book “Network Programming with Perl”.
  - Sections of the book is available in your Unit Reader.

The Basic Web Client

- The script does something very simple, which all web browsers do:
  - fetch the resource specified by a URL.
    - Send a HTTP request message, then
    - Wait for a response, then
    - Process the response when it arrives
  - It uses HTTP to do the transport - this means it will only be able to communicate with a HTTP server.


HTTP/1.0 200 OK
MIME-Version: 1.0
Server: Apache/1.3.12 (Unix)
Content-Type: text/html
Content-Length: 1234
<HTML>
<HEAD>
<TITLE>My Web Page</TITLE>
<HEAD>
<BODY>
<P>This is my web page</P>
</BODY>
</HTML>
4. Sends back to client
Web Client
1. Constructs a request
GET /~hiew/page.html HTTP/1.0
Connection: Keep-Alive
Accept: */*
Accept-Charset: iso-8859-1,*,utf-8
Accept-Encoding: gzip
Accept-Language: en
Host: arginine.it.murdoch.edu.au:12345
User-Agent: Mozilla/4.0
3. Construct a response
2. Sends to server
Web Server

The Basic Web Client

- The basic structure of the script (from page 7) is:

```
<COMMENTS - don't care for now!>

<LOAD MODULES - take for granted for now!>

<DETERMINE URL GIVEN TO THE SCRIPT>

<CREATE A USER-AGENT CAPABLE OF COMMUNICATING WITH A HTTP SERVER>
<CREATE A REQUEST OBJECT USING THE URL>

<HAVE THE USER_AGENT USE THE REQUEST OBJECT TO GET A RESPONSE>

<IF THE RESPONSE IF SUCCESSFUL, DISPLAY THE CONTENTS OF THE
RESPONSE>
```

HTTP::Request

- When sending out a HTTP request, you must at least specify:
  - the method (GET, POST, HEAD, etc)
  - the URL (or the more general term URI, Universal Resource *Identifier*) you want to retrieve.

- Refer back to lectures in week 1 for information about methods and URLs.

Basic syntax for creating a new HTTP::Request object

```
$r = HTTP::Request->new($method, $uri, [$header, [$content]]) ;
```

- Eg.

```
$request = HTTP::Request->new
        (HEAD, 'http://www.murdoch.edu.au') ;

$request = HTTP::Request->new
        (GET => 'http://red.murdoch.edu.au:15678') ;
```

Request headers + content in a string

```
$request->as_string ;
```

- Eg.

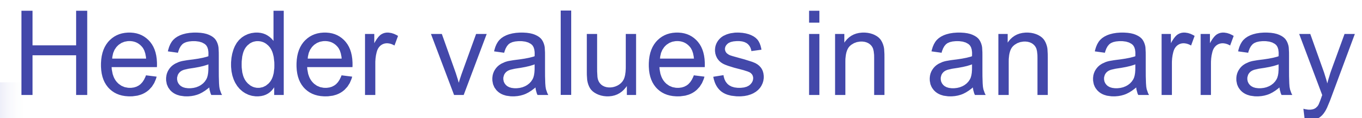
```
$request = HTTP::Request->new
        (HEAD, 'http://www.murdoch.edu.au') ;
print $request->as_string ;
```

Accessing the headers of a HTTP::Request object

```
@values = $r->header($field1)
```

- Eg.

```
$request = HTTP::Request->new
     (GET => 'http://www.murdoch.edu.au') ;
my @values = $request->header('Content-Type') ;
```



Header values in an array

- The standard return value for the header() method is as an array of strings.
  - This is because the standard HTTP header can potentially contain more than one value.
  - If a header contain only one value, it will be in the first element of the array.

All Request Headers in a string

- Eg.

```
$request = HTTP::Request->new
        (HEAD, 'http://www.murdoch.edu.au') ;
print $request->headers_as_string ;
```

To process every header in a HTTP::Request object

```
$request->scan (\&sub)
```

- Example script:

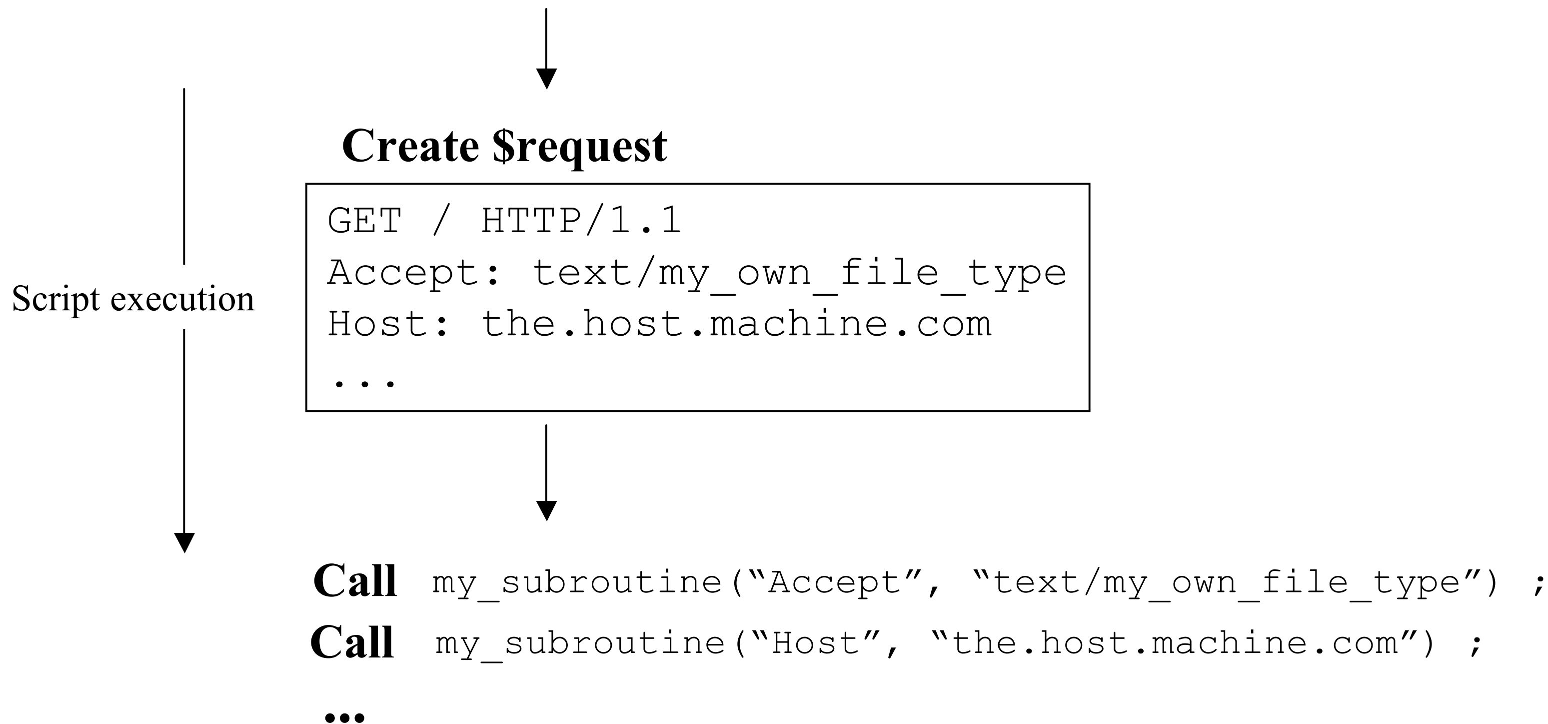
```
$request = HTTP::Request->new
           (GET => 'http://www.murdoch.edu.au') ;
$request->header(Accept => 'text/my_own_file_type') ;
$request->header(Host => 'the.host.machine.com') ;

$request->scan (\&my_subroutine) ;

sub my_subroutine {
        my ($fieldname, $fieldvalue) = @_ ;
        …
}
```

HTTP::Request->scan

- What happens to the previous example script?



Note: what `my_subroutine` does with the parameters is for you to define yourself.

HTTP::Response

- HTTP::Request is a class for encapsulating request messages. The equivalent for response messages is HTTP::Response.

- Some common HTTP::Response status
  - See page 254 of Unit Reader 4.

To get data about the status line of the HTTP::Response

```
$str = $response->status_line ;
$code = $response->code ;
```

- Example script:

```
if (($response->code < 300) &&
      ($response->code > 199))
{
      ...
}
```

Another way to check the status of the HTTP::Response

- Example script:

```
if ($response->is_success) {
        ...
} elsif ($response->is_redirect) {
        ...
```

Header information in the HTTP::Response object

- Since both HTTP::Request and HTTP::Response both contain the HTTP::Header object, all the header manipulation methods we mentioned before for HTTP::Request is relevant for HTTP::Response as well.

Example methods for HTTP::Response

```
print $response->as_string ;
```

```
print $request->headers_as_string ;
```

```
my @svr= $response->header('Server') ;
print "The name and version of the server is
       $svr[0]\n" ;
```

LWP::UserAgent

- The LWP::UserAgent class is responsible for
  - submitting HTTP::Request objects to HTTP servers, and
  - receiving and encapsulating the response.

Example additions to the basic client

- To repeated request from a certain web server
  - Eg. Used for stress testing a web server.

```
#!/usr/bin/perl

use strict ;
use LWP ;

my $url = shift ;

my $agent = LWP::UserAgent->new ;
my $request = HTTP::Request->new(GET => $url) ;

my $n = 0 ;
while (1) {
  sleep 1 ;
  my $response = $agent->request($request) ;
  if ($response->is_success) {
    print "Request number $n from $url\n" ;
    $n++ ;
  } else {
    die "$url: ", $response->message,"\n" ;
  }
}

# print $response->content ;
```

An Even Simpler Web Client

- The following script does everything `get_url.pl` does!

```
#!/usr/bin/perl

use LWP::Simple;

my $url = shift;
getprint($url);
```

- But doesn’t allow you to manipulate the requests and responses.

Is there more to a Web Client?

- What we saw today is NOT all that a web client does. It does A LOT MORE!
    - And not just fancy graphic displays.
    - Look at some of the other example code in section 3 of your Unit Reader for other things a web client should handle.

- However, what we saw today does serve to illustrate one of the most important aspects of a web client: the ability to create a HTTP request, and to receive and handle the HTTP response.

A Graphical User Interface?

- To keep things simple, we will not deal with a graphical user interface (GUI) for our client
  - We will use basic input-output through the command line only.
- Those of you already familiar with GUI programming will find it is not that hard to build a GUI around what we will develop in this unit
  - In Perl, you can add a GUI using windowing toolkits like Tk.
  - Here is an example simple graphical web browser in Java
    - http://www.cafeaulait.org/slides/gsdc/wcp/

SimpleWebBrowser.java

```
import javax.swing.text.*;
import javax.swing.*;
import java.io.*;
import java.awt.*;

public class SimpleWebBrowser {

  public static void main(String[] args) {

    // get the first URL
    String initialPage = "http://metalab.unc.edu/javafaq/";
    if (args.length > 0) initialPage = args[0];

    // set up the editor pane
    JEditorPane jep = new JEditorPane();
    jep.setEditable(false);
    jep.addHyperlinkListener(new LinkFollower(jep));

    try {
      jep.setPage(initialPage);
    }
    catch (IOException e) {
      System.err.println("Usage: java SimpleWebBrowser url");
      System.err.println(e);
      System.exit(-1);
    }

    // set up the window
    JScrollPane scrollPane = new JScrollPane(jep);
    JFrame f = new JFrame("Simple Web Browser");
    f.setDefaultCloseOperation(WindowConstants.DISPOSE_ON_CLOSE);
    f.getContentPane().add(scrollPane);
    f.setSize(512, 342);
    f.show();
    }
}
```

A simple Web Browser in Java (with GUI)

Ref: http://www.cafeaulait.org/slides/gsdc/wcp/122.html

Handling Links for by SimpleWebBrowser.java

LinkFollower.java

```
import javax.swing.*;
import javax.swing.event.*;


public class LinkFollower implements HyperlinkListener {

  private JEditorPane pane;

  public LinkFollower(JEditorPane pane) {
    this.pane = pane;
  }

  public void hyperlinkUpdate(HyperlinkEvent evt) {

    if (evt.getEventType() == HyperlinkEvent.EventType.ACTIVATED) {
      try {
        pane.setPage(evt.getURL());
      }
      catch (Exception e) {
      }
    }
  }
}
```

Ref: http://www.cafeaulait.org/slides/gsdc/wcp/121.html

JAVA Web Browser

- For the curious: to get the previous example JAVA browser working, just
  - find a Java enabled machine,
  - create the two .java files (cut-and-paste from the previous pages)
  - Run the commands

```
javac LinkFollower.java
javac SimpleWebBrowser.java
java SimpleWebBrowser
```

- It's not the world's most sophisticated browser, but it does follow links when you click on them!
- Try changing "http://metalab.unc.edu/javafaq" to a URL you are familiar with.

Is a GUI always necessary?

- Sometimes a GUI for a web client is neither necessary nor **desirable**.
  - Many web clients are not used manually
  - Eg. spiders used by search engines.
  - Eg. I can call get_url.pl from another script, or redirect/pipe the results from get_url.pl to another script, etc.
- This same principle applies to keeping the script I/O to standard input and standard output.
  - Avoid adding a text-based interactive user menu, such as those some of you learnt in B102 or B104.

Trying out the scripts

- The perl scripts given in this lecture is available in the account ~hiew on gryphon. To copy, execute and modify the scripts, do the following:

```
gryphon:~> cp  ~hiew/examples/web/*  .
gryphon:~> perl  get_url.pl  http://www.murdoch.edu.au
...
gryphon:~> pico  get_url.pl
...
```

Further Reading

- Required Reading
  - Unit Reader 3: Web Clients
- LWP and HTTP module references
  - In the documentation that comes with your Perl installation or from CPAN.

In next week's lecture...

- Example perl code for a web server.