Yaws - Yet Another Web Server

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Chapter 1

Introduction

YAWS is an ERLANG web server. It's written in ERLANG and it uses ERLANG as its embedded language similar to PHP in Apache or Java in Tomcat.

The advantages of ERLANG as an embedded web page language as opposed to Java or PHP are many.

- Speed - Using ERLANG for both implementing the web server itself as well as embedded script language gives excellent dynamic page generation performance.
- Beauty - Well this is subjective
- Scalability - due to the light weight processes of ERLANG , YAWS is able to handle a very large number of concurrent connections

YAWS has a wide feature set, it supports:

1. HTTP 1.0 and HTTP 1.1
2. Static content page delivery
3. Dynamic content generation using embedded ERLANG code in the HTML pages
4. Common Log Format traffic logs
5. Virtual hosting with several servers on the same IP address
6. Multiple servers on multiple IP addresses.

7. HTTP tracing for debugging
8. An interactive interpreter environment in the Web server while developing and debugging the web site.
9. RAM caching of commonly accessed pages.
10. Full streaming capabilities of both up and down load of dynamically generated pages.
11. SSL
12. Support for WWW-Authenticated pages.
13. Support API for cookie based sessions.
14. Application Modules where virtual directory hierarchies can be made.
15. Embedded mode

1.1 Prerequisites

This document requires that the reader:

- Is well acquainted with the ERLANG programming language
- Understands basic Web technologies.

1.2 A tiny example

We introduce YAWS by help of a tiny example. The web server YAWS serves and delivers static content pages similar to any old web server, except that YAWS does this much faster than most web servers. It's the dynamic pages that makes YAWS interesting. Any page with the suffix ".yaws" is considered a dynamic YAWS page. A YAWS page can contain embedded ERLANG snippets that are executed while the page is being delivered to the WWW browser.

Example 1.1 is the HTML code for a small YAWS page.

It illustrates the basic idea behind YAWS . The HTML code can contain <erl> and </erl> tags and inside these tags an ERLANG function called out/1 gets called and the output of that function is inserted into the HTML document, dynamically.

It is possible to have several chunks of HTML code together with several chunks of ERLANG code in the same YAWS page.

The `Arg` argument supplied to the automatically invoked `out/1` function is an ERLANG record that contains various data which is interesting when generating dynamic pages. For example the HTTP headers which

```
<html>

<p> First paragraph

<erl>
out(Arg) ->
    {html, "<p>This string gets inserted into HTML document dynamically"}.
</erl>

<p> And here is some more HTML code

</html>
```

Figure 1.1: Example 1.1

were sent from the WWW client, the actual TCP/IP socket leading to the WWW client. This will be elaborated on throughly in later chapters.

The `out/1` function returned the tuple `{html, String}` and `String` gets inserted into the HTML output. There are number of different return values that can be returned from the `out/1` function in order to control the behavior and output from the YAWS web server.

Chapter 2

Compile, Install, Config and Run

This chapter is more of a "Getting started" guide than a full description of the YAWS configuration. YAWS is hosted on Sourceforge at `http://sourceforge.net/projects/erlyaws/`. This is where the source code resides in a CVS repository and the latest unreleased version is available through anonymous CVS through the following commands:

```
# export CVS_RSH=ssh
# export CVSROOT=:pserver:anonymous@cvs.erlyaws.sourceforge.net:/cvsroot/erlyaws
# cvs  login
# cvs -z3 co .
```

Released version of YAWS are available either at the Sourceforge site or at `http://yaws.hyber.org/download`.

2.0.1 Compile and Install

To compile and install a YAWS release one of the prerequisites is a properly installed ERLANG system. YAWS runs on ERLANG releases OTP R8 and later. Get ERLANG from `http://www.erlang.org/`

Compile and install is straight forward:

```
# cd /usr/local/src
# tar xfz yaws-X.XX.tar.gz
# cd yaws
# ./configure && make
# make install
```

The make command will compile the YAWS web server with the `erlc` compiler found by the configure script.

make install - will install the executable - called `yaws` in /usr/local/bin/ and a working configuration file in */etc/yaws.conf*

make local_install will install the executable in $HOME/bin and a working configuration file in $HOME/yaws.conf

While developing a YAWS site, it's typically most convenient to use the local_install and run YAWS as a non privileged user.

2.0.2 Configure

Let's take a look at the config file that gets written to $HOME after a local_install.

```
# first we have a set of globals

logdir = .
ebin_dir = /home/klacke/yaws/yaws/examples/ebin
include_dir = /home/klacke/yaws/yaws/examples/include

# and then a set of servers

<server localhost>
        port = 8000
        listen = 127.0.0.1
        docroot = /home/klacke/yaws/yaws/scripts/../www
</server>
```

Figure 2.1: Minimal Local Configuration

The configuration consists of an initial set of global variables that are valid for all defined servers.

The only global directive we need to care about for now is the logdir. YAWS produces a number of log files and they will - using the Configuration from Figure 2.1 - end up in the current working directory. We start YAWS interactively as

```
# ~/bin/yaws -i
Erlang (BEAM) emulator version 5.1.2.b2 [source]

Eshell V5.1.2.b2  (abort with ^G)
1>
=INFO REPORT==== 30-Oct-2002::01:38:22 ===
```

```
Using config file /home/klacke/yaws.conf
=INFO REPORT==== 30-Oct-2002::01:38:22 ===
Listening to 127.0.0.1:8000 for servers ["localhost:8000"]

1>
```

By starting YAWS in interactive mode (using the command switch *-i* we get a regular ERLANG prompt. This is most convenient when developing YAWS /http pages. For example we:

- Can dynamically compile and load optional helper modules we need.
- Get all the crash and error reports written directly to the terminal.

The configuration in Example 2.1 defined one HTTP server on address 127.0.0.1:8000 called "localhost". It is important to understand the difference between the name and the address of a server. The name is the expected value in the client Host: header. That is typically the same as the fully qualified DNS name of the server whereas the address is the actual IP address of the server.

Since YAWS support virtual hosting with several servers on the same IP address, this matters.

Nevertheless, our server listens to *127.0.0.1:8000* and has the name "localhost", thus the correct URL for this server is *http://localhost:8000*.

The document root (docroot) for the server is set to the www directory in the YAWS source code distribution. This directory contains a bunch of examples and we should be able to run all those example now on the URL *http://localhost:8000*.

Instead of editing and adding files in the YAWS www directory, we create yet another server on the same IP address but a different port number - and in particular a different document root where we can add our own files.

```
# mkdir ~/test
# mkdir ~/test/logs
```

Now change the config so it looks like this:

```
logdir = /home/klacke/test/logs
ebin_dir = /home/klacke/test
include_dir = /home/klacke/test

<server localhost>
        port = 8000
        listen = 127.0.0.1
        docroot = /home/klacke/yaws/yaws/www
```

```
</server>

<server localhost>
        port = 8001
        listen = 127.0.0.1
        docroot = /home/klacke/test
</server>
```

We define two servers, one being the original default and a new pointing to a document root in our home directory.

We can now start to add static content in the form of HTML pages, dynamic content in the form of .yaws pages or ERLANG .beam code that can be used to generate the dynamic content.

The load path will be set so that beam code in the directory `~/test` will be automatically loaded when referenced.

It is best to run YAWS interactively while developing the site. In order to start the YAWS as a daemon, we give the flags:

```
# yaws -D -heart
```

The *-D* flags instructs YAWS to run as a daemon and the *-heart* flags will start a heartbeat program called heart which restarts the daemon if it should crash or if it stops responding to a regular heartbeat.

Once started in daemon mode, we have very limited ways of interacting with the daemon. It is possible to query the daemon using:

```
# yaws -S
```

This command produces a simple printout of Uptime and number of hits for each configured server.

If we change the configuration, we can HUP the daemon using the command:

```
# yaws -h
```

This will force the daemon to reread the configuration file.

Chapter 3

Static content

YAWS acts very much like any regular web server while delivering static pages. By default YAWS will cache static content in RAM. The caching behavior is controlled by a number of global configuration directives. Since the RAM caching occupies memory, it may be interesting to tweak the default values for the caching directives or even to turn it off completely.

The following configuration directives control the caching behavior

- *max_num_cached_files = Integer* YAWS will cache small files such as commonly accessed GIF images in RAM. This directive sets a maximum number on the number of cached files. The default value is 400.
- *max_num_cached_bytes = Integer* This directive controls the total amount of RAM which can maximally be used for cached RAM files. The default value is 1000000, 1 megabyte.
- *max_size_cached_file = Integer*

  This directive sets a maximum size on the files that are RAM cached by YAWS . The default value i 8000, 8 batters.

It may be considered to be confusing, but the numbers specified in the above mentioned cache directives are local to each server. Thus if we have specified `max_num_cached_bytes = 1000000` and have defined 3 servers, we may actually use $3 * 1000000$ bytes.

Chapter 4

Dynamic content

Dynamic content is what YAWS is about. Most web servers are designed with HTTP and static content in mind whereas YAWS is designed for dynamic pages from the start. Most large sites on the Web today make heavy use of dynamic pages.

4.1 Introduction

When the client GETs a a page that has a .yaws suffix. The YAWS server will read that page from the hard disk and divide it in parts that consist of HTML code and ERLANG code. Each chunk of ERLANG code will be compiled into a module. The chunk of ERLANG code must contain a function `out/1`. If it doesn't the YAWS server will insert a proper error message into the generated HTML output.

When the YAWS server ships a .yaws page it will process it chunk by chunk through the .yaws file. If it is HTML code, the server will ship that as is, whereas if it is ERLANG code, the YAWS server will invoke the `out/1` function in that code and insert the output of that `out/1` function into the stream of HTML that is being shipped to the client.

YAWS will (of course) cache the result of the compilation and the next time a client requests the same .yaws page YAWS will be able to invoke the already compiled modules directly.

4.2 EHTML

There are two ways to make the `out/1` function generate HTML output. The first and most easy to understand is by returning a tuple `{html, String}` where `String` then is regular HTML data (possibly as a deep list of strings and/or binaries) which will simply be inserted into the output stream. An example:

```
<html>
<h1> Example 1 </h1>
```

```
<erl>
out(A) ->
    Headers = A#arg.headers,
    {html, io_lib:format("You say that you're running ~p",
                         [Headers#headers.user_agent])}.

</erl>

</html>
```

The second way to generate output is by returning a tuple `{ehtml, EHTML}`. The term `EHTML` must adhere to the following structure:

$EHTML = [EHTML] | \{TAG, Attrs, Body\} | \{TAG, Attrs\} | \{TAG\} | binary() | character()$

$TAG = atom()$

$Attrs = [\{HtmlAttribute, Value\}]$

$HtmlAttribute = atom()$

$Value = string() | atom()$

$Body = EHTML$

We give an example to show what we mean: The tuple

```
{ehtml, {table, [{bgcolor, grey}],
         [
          {tr, [],
           [
            {td, [], "1"},
            {td, [], "2"},
            {td, [], "3"}
           ],
           {tr, [],
            [{td, [{colspan, "3"}], "444"}]}]}]}.
```

Would be expanded into the following HTML code

```
<table bgcolor="grey">
  <tr>
    <td> 1 </td
    <td> 2 </td>
    <td> 3 </td>
```

```
  </tr>
  <tr>
    <td colspan="3"> 444 </td>
  </tr>
</table>
```

At a first glance it may appears as if the HTML code is more beautiful than the ERLANG tuple. That may very well be the case from a purely aesthetic point of view. However the ERLANG code has the advantage of being perfectly indented by editors that have syntax support for ERLANG (read Emacs). Furthermore, the ERLANG code is easier to manipulate from an ERLANG program.

As an example of some more interesting ehtml we could have an `out/1` function that prints some of the HTTP headers.

In the www directory of the YAWS source code distribution we have a file called `arg.yaws`. The file demonstrates the Arg #arg record parameter which is passed to the `out/1` function.

But before we discuss that code, we describe the Arg record in detail.

Here is the `yaws_api.hrl` file which is in included by default in all YAWS files. The #arg record contains many fields that are useful when processing HTTP request dynamically. We have access to basically all the information which associated to the client request such as:

- The actual socket leading back to the HTTP client
- All the HTTP headers - parsed into a #headers record.
- The HTTP request - parsed into a #http_request record
- clidata - Data which is POSTed by the client
- querydata - This is the remainder of the URL following the first occurrence of a ? character - if any.
- docroot - The absolute path to the docroot of the virtual server that is processing the request.

```
-record(arg, {
          clisock,        %% the socket leading to the peer client
          headers,        %% headers
          req,            %% request
          clidata,        %% The client data (as a binary in POST requests)
          querydata,      %% Was the URL on the form of ...?query (GET reqs)
          appmoddata,     %% the remainder of the path leading up to the query
          docroot,        %% where's the data
          fullpath,       %% full path to yaws file
```

```
          cont,           %% Continuation for chunked multipart uploads
          state,          %% State for use by users of the out/1 callback
          pid,            %% pid of the yaws worker process
          opaque          %% useful to pass static data
         }).


-record(http_request, {method,
                       path,
                       version}).


-record(headers, {
          connection,
          accept,
          host,
          if_modified_since,
          if_match,
          if_none_match,
          if_range,
          if_unmodified_since,
          range,
          referer,
          user_agent,
          accept_ranges,
          cookie = [],
          keep_alive,
          content_length,
          content_type,
          authorization,
          other = []   %% misc other headers
         }).
```

There are a number of *advanced* fields in the #arg record such as `appmod`, `opaque` that will be discussed in later chapters.

Now, we show some code which displays the content of the Arg #arg record. The code is available in yaws/www/arg.yaws and after a a `local_install` a request to *http://localhost:8000/arg.yaws* will run the code.

```
<html>
```

```
<h2> The Arg </h2>

<p>This page displays the Arg #argument structure
supplied to the out/1 function.

<erl>


out(A) ->
    Req = A#arg.req,
    H = yaws_api:reformat_header(A#arg.headers),
    {ehtml,
     [{h4,[], "The headers passed to us were:"},
      {hr},
      {ol, [],lists:map(fun(S) -> {li,[], {p,[],S}} end,H)},

      {h4, [], "The request"},
      {ul,[],
       [{li,[], f("method: ~s",  [Req#http_request.method])},
        {li,[], f("path: ~p",    [Req#http_request.path])},
        {li,[], f("version: ~p", [Req#http_request.version])}]},

      {hr},
      {h4, [], "Other items"},
      {ul,[],
       [{li,[], f("clisock from: ~p", [inet:peername(A#arg.clisock)])},
        {li,[], f("docroot: ~s",      [A#arg.docroot])},
        {li,[], f("fullpath: ~s",     [A#arg.fullpath])}]},
      {hr},
      {h4, [], "Parsed query data"},
      {pre,[], f("~p", [yaws_api:parse_query(A)])},
      {hr},
      {h4,[], "Parsed POST data "},
      {pre,[],  f("~p", [yaws_api:parse_post(A)])}]}.

</erl>

</html>
```

The code utilizes 4 functions from the `yaws_api` module. `yaws_api` is a general purpose www api module that contains various functions that are handy while developing YAWS code. We will see many more of those functions during the examples in the following chapters.

The functions used are:

- `yaws_api:f/2` alias for io_lib:format/2. The `f/1` function is automatically `-includeed` in all YAWS code.
- `yaws_api:reformat_header/1` - This function takes the #headers record and unparses it, that is reproduces regular text.
- `yaws_api:parse_query/1` - The topic of next section.
- `yaws_api:parse_post/1` – Ditto.

4.3 POSTs

4.3.1 Queries

The user can supply data to the server in many ways. The most common is to give the data in the actual URL. If we invoke:

```
GET http://localhost:8000/arg.yaws?kalle=duck&goofy=unknown
```

we pass two parameters to the *arg.yaws* page. That data is URL-encoded by the browser and the server can retrieve the data by looking at the remainder of the URL following the ? character. If we invoke the `arg.yaws` page with the above mentioned URL we get as the result of `yaws_parse_query/1`:

$kalle = duck$

$goofy = unknown$

In ERLANG terminology, the call `yaws_api:parse_query(Arg)` returns the list:

```
[{kalle, "duck"}, {goofy, "unknown"}]
```

Note that the first element is transformed into an atom, whereas the value is still a string.

hence, a web page can contain URLs with a query and thus pass data to the web server. This scheme works both with GET and POST requests. It is the easiest way to pass data to the Web server since no FORM is required in the web page.

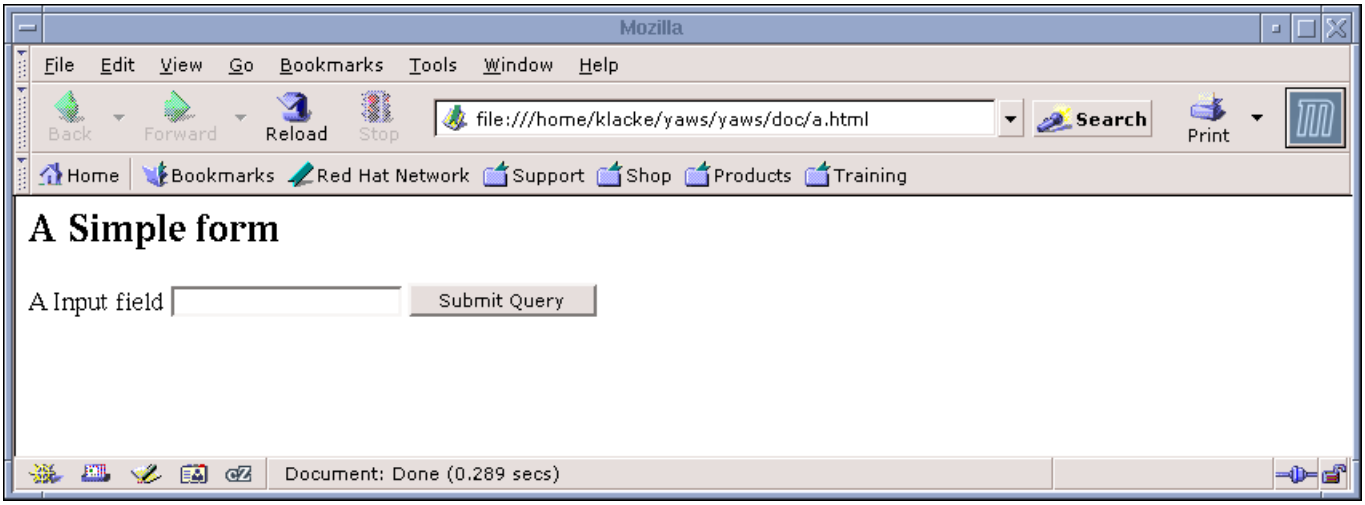
4.3.2 Forms

In order to POST data a FORM is required, say that we have a page called `form.yaws` that contain the following code:

```
<html>
<form action="/post_form.yaws"
      method="post"

<p> A Input field
<input name="xyz" type="text">
<input type="submit">
</form>
</html>
```

This will produce a page with a simple input field and a Submit button.



If we enter something - say “Hello there “ - in the input field and click the Submit button the client will request the page indicated in the “action” attribute, namely `post_form.yaws`.

If that YAWS page has the following code:

```
out(A) ->
   L = yaws_api:parse_post(A),
   {html, f("~p", [L])}
```

The user will see the output

```
[{xyz, "Hello there"}]
```

The differences between using the query part of the URL and a form are the following:

- Using the query arg only works in GET request. We parse the query argument with the function `yaws_api:parse_query(Arg)`

- If we use a form and POST the user data the client will transmit the user data in the body of the request. That is - the client sends a request to get the page using the POST method and it then attaches the user data - encoded - into the body of the request.

  A POST request can have a query part in its URL as well as user data in the body.

4.4 POSTing files

It is possible to upload files from the client to the server by means of POST. We indicate this in the form by telling the browser that we want a different encoding, here is a form that does this:

```
out(A) ->
    Form =
        {form, [{enctype, "multipart/form-data"},
                {method, post},
                {action, "file_upload_form.yaws"}],
                [{input, [{type, submit}, {value, "Upload"}]},
                 {input, [{type,file}, {width, "50"}, {name, foo}]}]},
    {ehtml, {html,[], [{h2,[], "A simple file upload page"},
                       Form]}}.
```

The page delivers the entire HTML page with enclosing `html` markers. It looks like:

The user get an option to browse the local host for a file or the user can explicitly fill in the file name in the input field. The file browsing part is automatically taken care of by the browser.

The action field in the form states that the client shall POST to a page called `file_upload_form.yaws`. This page will get the contents of the file in the body of the POST message. Here we have one easy case and one hard case. YAWS will read the data from the client. However if the file is large the entire contents of the file will not be part of the read operation. It is not acceptable to let YAWS continue to read the full

POST body and then when that is done, invoke the POST page. YAWS must feed the page with the chunks of the file as they arrive.

First the easy case:

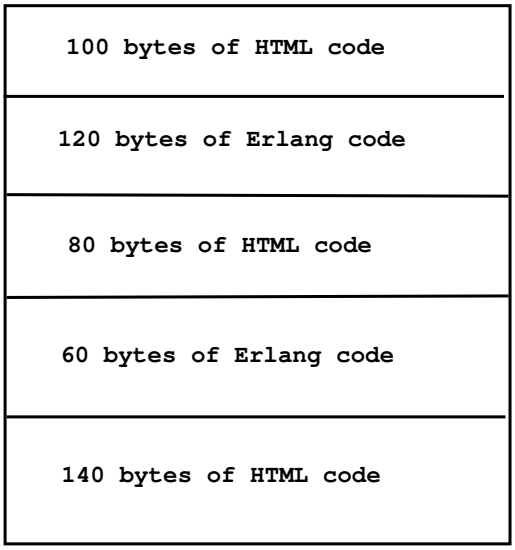
Not YET Written ... . fill this in later .....

Chapter 5

Mode of operation

5.1 On the fly compilation

When the client requests a YAWS page, YAWS will look in its caches (there is one cache per virtual server) to see if it finds the requested page in the cache. If YAWS doesn't find the page in the cache, it will compile the page. This only happens the first time a page is requested. Say that the page is 400 bytes big has the following layout:



The YAWS server will then parse the file and produce a structure which makes it possible to deliver the page in a readily fashion the next time the same page is requested.

When shipping the page it will

1. Ship the first 100 bytes from the file

2. Evaluate the first ERLANG chunk in the file and ship the output from the `out/1` function in that chunk. It will also jump ahead in the file and skip 120 bytes.
3. Ship 80 bytes of HTML code
4. Again evaluate an ERLANG chunk, this time the second and jump ahead 60 bytes in the file.
5. And finally ship 140 bytes of HTML code to the client

YAWS writes the source output of the compilation into a directory /tmp/yaws/$UID. The beam files are never written to a file. Sometimes it can be useful to look at the generated source code files, for example if the YAWS /ERLANG code contains a compilation error which is hard to understand.

5.2 Evaluating the YAWS code

All client requests will execute in their own ERLANG process. For each group of virtual hosts on the same IP:PORT pair one ERLANG process listens for incoming requests.

This process spawns acceptor processes for each incoming request. Each acceptor process reads and parses all the HTTP headers from the client. It then looks at the Host: header to figure out which virtual server to use, i.e. which docroot to use for this particular request. If the Host: header doesn't match any server from *yaws.conf* with that IP:PORT pair, the first one from *yaws.conf* is chosen.

By default YAWS will not ship any data at all to the client while evaluating a YAWS page. The headers as well as the generated content are accumulated and not shipped to the client until the entire page has been processed.

Chapter 6

SSL

SSL - Secure Socket Layer is a protocol used on the Web for delivering encrypted pages to the WWW client. SSL is widely deployed on the Internet and virtually all bank transactions as well as all on-line shopping today is done with SSL encryption. There are many good sources on the net that describes SSL in detail - and I will not try to do that here. There is for example a good document at: `http://www.tldp.org/HOWTO/SSL-Certificates-HOWTO/` which describes how to manage certificates and keys.

In order to run an SSL server we must have a certificate. Either we can create a so called self-signed certificate ourselves or buy a certificate from one of the many CA's (Certificate Authority's) on the net. YAWS use the otp interface to openssl.

To setup a YAWS server with SSL we could have a *yaws.conf* file that looks like:

```
 logdir = /var/log/yaws

<server www.funky.org>
               port = 443
               listen = 192.168.128.32
               docroot = /var/yaws/www.funky.org
               <ssl>
                  keyfile = /etc/funky.key
                  certfile = /etc/funky.cert
                  password = gazonk
               </ssl>
       </server>
```

This is the easiest possible SSL configuration. The configuration refers to a certificate file and a key file. The certificate file must contain the name "www.funky.org" as it "Common Name".

The keyfile is the private key file and it is encrypted using the password "gazonk".

Chapter 7

Applications

YAWS is well suited for Web applications. In this chapter we will describe a number of application templates. Code and strategies that can be used to build Web applications.

There are several ways of starting applications from YAWS .

- The first and most easy variant is to specify the `-r Module` flag to the YAWS startup script. This will `apply(Module,start,[])`
- We can also specify runmods in the *yaws.conf* file. It is possible to have several modules specified if want the same YAWS server to run several different applications.

```
runmod = myapp
runmod = app_number2
```

- It is also possible to do it the other way around, let the main application start YAWS . We call this embedded mode and that will be discussed in a later chapter,

7.1 Login scenarios

Many Web applications require the user to login. Once the user has logged in the server sets a Cookie and then the user will be identified by help of the cookie in subsequent requests.

7.1.1 The session server

The cookie is passed in the headers and is available to the YAWS programmer in the Arg #arg record. The YAWS session server can help us to maintain a state for a user while the user is logged in to the application. The session server has the following 5 api functions to aid us:

1. `yaws_api:new_cookie_session(Opaque)` This function initiates a new cookie based session. The Opaque data is typically some application specific structure which makes it possible for the application to read a user state, or it can be the actual user state itself.
2. `yaws_api:cookieval_to_opaque(Cookie)` This function maps a cookie to a session.
3. `yaws_api:replace_cookie_session(Cookie, NewOpaque)` Replace the Opaque user state in the session server.
4. `yaws_api:delete_cookie_session(Cookie)` This function should typically be called when the user logs out or when our web application decides to auto logout the user.

All cookie based applications are different but they have some things in common. In the example that follow we assume the existence of a function `myapp:auth(UserName, Passwd)` and it returns `ok` or `{error, Reason}`

Furthermore - let's have a record:

```
-record(session, {user,
                  passwd,
                  udata = []}).
```

The following function is a good template function to check the cookie.

```
get_cookie_val(CookieName, Arg) ->
    H = Arg#arg.headers,
    yaws_api:find_cookie_val(CookieName, H#headers.cookie).



check_cookie(A, CookieName) ->
    case get_cookie_val(CookieName, A) of
        []  ->
            {error, "not logged in"};
        Cookie ->
            yaws_api:cookieval_to_opaque(Cookie)
    end.
```

So what we need to do is the following: We want to check all requests and make sure the the session_server has our cookie registered as an active session.

If a request comes in without a working cookie we want to present a login page instead of the page the user requested.

Another quirky issue is that the pages necessary for display of the login page must be shipped without checking the cookie.

7.1.2 Arg rewrite

In this section we describe a feature whereby the user is allowed to rewrite the Arg at an early stage in the YAWS server. We do that by specifying an `arg_rewrite_mod` in the *yaws.conf* file.

```
arg_rewrite_mod = myapp
```

Then in the `myapp` module we have:

```
arg_rewrite(Arg) ->
    OurCookieName = "myapp_sid"
    case check_cookie(A, OurCookieName) of
        {error, _} ->
            do_rewrite(Arg);
        {ok, _Session} ->
            %return Arg untouched
            Arg
    end.

%% these pages must be shippable without a good cookie
login_pages() ->
    ["/banner.gif", "/login.yaws", "/post_login.yaws"].

do_rewrite(Arg) ->
    Req = Arg#arg.req,
    {abs_path, Path} = Req#http_request.path,
    case lists:member(Path, login_pages()) of
        true ->
            Arg;
        false ->
            Arg#arg{req = Req#http_request{path = {abs_path, "/login.yaws"}},
                    state =  {abs_path, Path}}
    end.
```

Our arg rewrite function lets all Args go through untouched that either have a good cookie or belong to a set of predefined pages that are acceptable to get without being logged in. If we decode that the user must log

in, we change the path of the request, thereby making the YAWS server ship a login page instead of the page the user requested. We also set the original path in the Arg state argument so that the login page can redirect the user to the original page - once the login procedure is finished.

7.1.3 Authenticating

Now we're approaching the `login.yaws` page, the page that displays the login prompt to the user. The login page consists of two parts, one part that displays the login data as a form and one form processing page that reads the data the user entered in the login fields and performs the actual authentication.

The login page performs a tiny well known Web trick where it passes the original URL request in a hidden field in the login page and thereby passing that information to the form processing page.

The page `login.yaws`:

```
<erl>

out(A) ->
    {ehtml,
     {html,[],
      [{h2, [], "Login page"},
       {hr},
       {form, [{action,"/login_post.yaws"},
               {method,post}],

        [{p,[], "Username"}, {input, [{type,text},{name,uname}]},
         {p,[],"Password"},  {input, [{type,password},{name,passwd}]},
         {input, [{type,submit},{value,"Login"}]},
         {input, [{type,hidden},{name,url},
                  {value, A#arg.state}]}]}]}}.

</erl>
```

The form processing page which gets the POST data from the code above looks like:

```
<erl>

-include("myapp.hrl").
%% we have the session record there
%% we must set the include_path in the yaws.conf file
%% in order for the compiler to find that file
```

```
kv(K,L) ->
    {value, {K, V}} = lists:keysearch(K,1,L),
    V.

out(A) ->
    L = yaws_api:parse_post(A),
    User = kv(user, L),
    Pwd =  kv(passwd, L),
    case myapp:auth(User, Pwd) of
        ok ->
            S = #session{user = User,
                         passwd = Pwd,
                         udata = []},
            %% Now register the session to the session server
            Cookie = yaws_api:new_cookie_session(S),
            [{redirect_local, kv(url, L)},
              yaws_api:setcookie("myapp_sid",Cookie)]
        Err ->
            {ehtml,
             {html, [],
              {p, [], f("Bad login: ~p",[Err])}}}
    end.

</erl>
```

The function returns a list of two new previously not discussed return values: Instead of returning HTML output as in `{html, Str}` or `{ehtml,Term}` we return a list of two new values. There are many different possible return values from the `out/1` function and they will all be described later.

1. The tuple `{redirect_local, Path}`. This particular redirect return value will make the YAWS web server return a 303 redirect to the specified Path.
2. `yaws_api:setcookie("myapp_sid",Cookie)` generates a `Set-Cookie` header

Now if we put all this together we have a full blown cookie based login system. The last thing we did in the form processing code was to register the session with the session server thereby letting any future requests go straight through the `Arg` rewriter.

This way both YAWS pages as well as all or some static content is protected by the cookie login code.

7.1.4 Database driven applications

We can use code similar to the code in the previous section to associate a user session to entries in a database. Mneisa fits perfectly together with YAWS and keeping user persistent state in Mnesia is both easy and convenient.

Once the user has logged in we can typically use the user name as key into the database. We can mix ram_tables and disc_tables to our liking. The Mneisa database must be initialized by means of `create_table/2` before it can be used. This is typically done while installing the web application on a machine.

Another option is to let the application check that Mnesia is initialized whenever the application starts.

If we don't want or need to use Mnesia, it's of course possible to use a simple `dets` file or a text file as well.

7.2 Appmods

Appmods is mechanism to invoke different applications based upon the URL. A URL - as presented to the web server in a request - has a path part and a query part.

It is possible to install several appmods in the *yaws.conf* file as:

```
appmods = foo myapp
```

Now, if the user requests a URL where any component in the directory path is an appmod, the parsing of the URL will terminate there and instead of reading the actual file from the disk, YAWS will invoke the appmod with the remainder of the path inserted into `Arg#arg.appmoddata`.

Say the user requests the URL *http://www.funky.org/myapp/xx/bar.html* YAWS will not ship the file `bar.html` to the client, instead it will invoke `myapp:out(Arg)` with `Arg#arg.appmoddata` set to the string `xx/bar.html`. Any optional query data - that is data that follows the first "?" character in the URL - is removed from the path and passed as `Arg#arg.querydata`.

Appmods can be used to run applications on a server. All requests to the server that has an appmod in the URL will be handled by that application. If the application decides that it want to ship a page from the disk to the client, it can return the tuple `{page, Path}`. This return value will make YAWS read the page from the disk, possibly add the page to it's cache of commonly accessed pages and ship it back to the client.

The `{page, Path}` return value is equivalent to a redirect, but it removes an extra round trip - and is thus faster.

Appmods can also be used to fake entire directory hierarchies that doesn't exists on the disk.

7.3 The opaque data

Sometimes an application needs application specific data such as the location of its data files or whatever. There exists a mechanism to pass application specific configuration data from the YAWS server to the application.

When configuring a server we have an opaque field in the configuration file that can be used for this purpose. Say that we have the following fields in the config file:

```
<server foo>
    listen = 192.168.128.44
    <opaque>
        foo = bar
        somefile = /var/myapp/db
        myname = hyber
    </opaque>
</server>
```

This will create a normal server that listens to the specified IP address. An application has access to the opaque data that was specified in that particular server through `Arg#arg.opaque`

If we have the opaque data specified above, the Arg opaque field will have the value:

```
[{foo, "bar"},
 {somefile, "/var/myapp/db"},
 {myname, "hyber"}
]
```

7.4 Customizations

When actually deploying an application at a live site, some of the standard YAWS behaviors are not acceptable. Many sites want to customize the web server behavior when a client requests a page that doesn't exists on the web server. The standard YAWS behavior is to reply with status code 404 and a message explaining that the page doesn't exist.

Similarly, when YAWS code crashes, the Reason for the crash is displayed in the Web browser. This is very convenient while developing a sit but not acceptable in production.

7.4.1 404 File not found

We can install a special handler for 404 messages. We do that by specifying a `errormod_404` in the *yaws.conf* file.

If we have:

```
<server foo>
  ..
  ..
  ..
  errormod_404 = myapp

</server>
```

When YAWS gets a request for a file that doesn't exists on the hard disk, it invokes the errormod_404 module to generate both the status code as well as the content of the message.

`Module:out404(Arg, GC, SC)` will be invoked by YAWS . The arguments are

- Arg is a #arg record
- GC is a #gconf record (defined in yaws.hrl)
- SC is a #sconf record (defined in yaws.hrl)

The function can and must do the same things that a normal `out/1` does.

7.4.2 Crash messages

We use a similar technique for generating the crash messages, we install a module in the *yaws.conf* file and let that module generate the crash message. We have:

```
errormod_crash = Module
```

The default is to display the entire formated crash message in the browser. This is good for debugging but not in production.

The function `Module:crashmsg(Arg, SC, Str)` will be called. The Str is the real crash message formated as a string.

7.5 Stream content

If the `out/1` function returns the tuple `{content, MimeType, Content}` YAWS will ship that data to the Client. This way we can deliver dynamically generated content to the client which is of a different mime type than "text/html".

If the generated file is very large and it not possible to generate the entire file, we can return the value: `{streamcontent, MimeType, FirstChunk}` and then from a different ERLANG process deliver the remaining chunks by using the functions:

1. `yaws_api:stream_chunk_deliver(YawsPid, Data)` where the `YawsPid` is the process id of the YAWS worker process. That pid is available in `Arg#arg.pid`
2. `stream_chunk_end(YawsPid)` This function must be called to indicate the end of the stream.

7.6 All out/1 return values

- `{html, DeepList}` This assumes that DeepList is formatted HTML code. The code will be inserted in the page.
- `{ehtml, Term}` This will transform the ERLANG term Term into a stream of HTML content.
- `{content, MimeType, Content}` This function will make the web server generate different content than HTML. This return value is only allowed in a YAWS file which has only one <erl> </erl> part and no html parts at all.
- `{streamcontent, MimeType, FirstChunk}` This return value plays the same role as the con tent return value above. However it makes it possible to stream data to the client if the YAWS code doesn't have access to all the data in one go. (Typically if a file is very large or if data arrives from back end servers on the network.
- `{header, H}` Accumulates a HTTP header. Used by for example the `yaws_api:setcookie/2-6` function.
- `{allheaders, HeaderList}` Will clear all previously accumulated headers and replace them.
- `{status, Code}` Will set another HTTP status code than 200.
- `break` Will stop processing of any consecutive chunks of erl or html code in the YAWS file.
- `ok` Do nothing.
- `{redirect, Url}` Erase all previous headers and accumulate a single Location header. Set the status code.
- `{redirect_local, Path}` Does a redirect to the same Scheme://Host:Port/Path as we currently are executing in.

- `{get_more, Cont, State}` When we are receiving large POSTs we can return this value and be invoked again when more Data arrives.
- `[ListOfValues]` It is possible to return a list of the above defined return values.

Chapter 8

Debugging and Development

YAWS has excellent debugging capabilities. First and foremost we have the ability to run the web server in interactive mode by means of the command line switch `-i`

This gives us a regular ERLANG command line prompt and we can use that prompt to compile helper code or reload helper code. Furthermore all error messages are displayed there. If a .yaws page producees any regular ERLANG io, that output will be displayed at the ERLANG prompt - assuming that we are running in interactive mode.

If we give the command line switch `-d` we get some additional error messages. Also YAWS does some additional checking of user supplied data such as headers.

8.1 Logs

YAWS produces various logs. All log files are written into the YAWS logdir directory. This directory is specified in the config file.

We have the following log files:

- The access log. Access logging is turn on or off per server in the *yaws.conf* file. If access_log is turned on for a server, YAWS will produce a log in Common Access Log Format called *Host-Name:PortNumber.access*
- *report.log* This file contains all error and crash messages for all virtual servers in the same file.
- *trace.traffic* and *trace.http* The two command line flags `-t` and `-T` tells YAWS to trace all traffic or just all HTTP messages and write them to a file.

Chapter 9

Security

YAWS is of course susceptible to intrusions. YAWS has the ability to run under a different user than root - Assuming we need to listen to privileged port numbers. Running as root is generally a bad idea.

Intrusions can happen basically at all places in YAWS code where the YAWS code calls either the BIF `open_port` or when YAWS code does calls to `os:cmd/1`.

Both `open_port` and `os:cmd/1` invoke the `/bin/sh` interpreter to execute its commands. If the commands are nastily crafted bad things can easily happen.

All data that is passed to these two function must be carefully checked.

Since YAWS is written in ERLANG a large class of cracks are eliminated since it is not possible to perform any buffer overrun cracks on a YAWS server. This is very good.

Another possible point of entry to the system is by providing a URL which takes the client out from the docroot. This should not be possible - and the impossibility relies on the correctness of the URL parsing code in YAWS .

9.1 WWW Authenticate

YAWS has support for WWW authenticate protected directories. The access rights to different directories is controlled by directives in the *yaws.conf* file.

We can specify several auth groups in a server configuration. If we have the following in the *yaws.conf* file:

```
<server foo>
..
..

  <auth>
```

```
    realm = secretpage
    dir = /var/yaws/www/protected
    user klacke:gazonk
    user jonny:xyz
    user ronny:12r8uyp09jksfdge4
  </auth>
</server>
```

YAWS will protect all files in the specified directory by means of WWW-Authenticate access. If a user requests a page in the directory, and doesn't have the correct WWW-Authenticate header, YAWS will reply with a proper status code that makes the browser pop up a login window.

Chapter 10

Embedded mode

YAWS is a normal OTP application. It is possible to integrate YAWS into another - larger - application. The YAWS source tree must be integrated into the larger applications build environment. YAWS is then simply started by `application:start()` from the larger applications boot script.

By default YAWS reads its configuration data from a config file, the default is "/etc/yaws.conf". If YAWS is integrated into a larger application that application typically has its configuration data kept at some other centralized place. Sometimes we may not even have a file system to read the configuration from if we run a small embedded system.

YAWS reads its application environment. If the environment key `embedded` is set to t`true`, YAWS starts in embedded mode. Once started it must be fed a configuration, and that can be done after YAWS has started by means of the function `yaws_api:setconf/2`.

It is possible to call `setconf/2` several times to force YAWS to reread the configuration.

Chapter 11

The config file - yaws.conf

In this section we provide a complete listing of all possible configuration file options. The configuration contains two distinct parts a global part which affects all the virtual hosts and a server part where options for each virtual host is supplied.

11.1 Global Part

- `dir = Directory` - All YAWS logs will be written to files in this directory. There are several different log files written by YAWS .
  - report.log - this is a text file that contains all error logger printouts from YAWS .
  - Host.access - for each virtual host served by YAWS , a file Host.access will be written which contains an access log in Common Log Format.
  - trace.http - this file contains the HTTP trace if that is enabled
  - trace.traffic - this file contains the traffic trace if that is enabled
- `ebin_dir = Directory` - This directive adds Directory to the ERLANG search path. It is possible to have several of these command in the configuration file.
- `include_dir = Directory` - This directive adds Directory to the path of directories where the ERLANG compiler searches for include files. We need to use this if we want to include .hrl files in our YAWS ERLANG code.
- `max_num_cached_files = Integer` - YAWS will cache small files such as commonly accessed GIF images in RAM. This directive sets a maximum number on the number of cached files. The default value is 400.
- `max_num_cached_bytes = Integer` - This directive controls the total amount of RAM which can maximally be used for cached RAM files. The default value is 1000000, 1 megabyte.

- `max_size_cached_file = Integer` - This directive sets a maximum size on the files that are RAM cached by YAWS . The default value i 8000, 8 kBytes.
- `cache_refresh_secs = Integer` The RAM cache is used to serve pages that sit in the cache. An entry sits in cache at most cache_refresh_secs number of seconds. The default is 30. This means that when the content is updated under the docroot, that change doesn't show until 30 seconds have passed. While developing a YAWS site, it may be convenient to set this value to 0. If the debug flag (-d) is passed to the YAWS start script, this value is automatically set to 0.
- `trace = traffic | http` - This enables traffic or http tracing. Tracing is also possible to enable with a command line flag to YAWS .
- `username = User` - When Yaws is run as root, it can be configured to change userid once it has created the necessary listen sockets on privilged ports.

11.2 Server Part

YAWS can virthost several web servers on the same IP address as well as several web servers on different IP addresses. The on limitation here is that there can be only one server with ssl enabled per each individual IP address. Each virtual host is defined within a matching pair of `<server ServerName>` and `</server>`. The ServerName will be the name of the web server.

The following directives are allowed inside a server definition.

- `port = Port` - This makes the server listen on Port
- `listen = IpAddress` - This makes the server listen on IpAddress When virthosting several servers on the same IP/port address, if the browser doesn't send a Host: field, YAWS will pick the first server specified in the config file
- `rport = Port` This forces all local redirects issued by the server to go to Port. This is useful when YAWS listens to a port which is different from the port that the user connects to. For example, running YAWS as a non-privileged user makes it impossible to listen to port 80, since that port can only be opened by a privileged user. Instead YAWS listens to a high port number port, 8000, and iptables are used to redirect traffic to port 80 to port 8000 (most NAT:ing firewalls will also do this for you).
- `rscheme = http | https` This forces all local redirects issued by the server to use this method. This is useful when an SSL off-loader, or stunnel, is used in front of YAWS .
- `access_log = true | false` Setting this directive to false turns of traffic logging for this virtual server. The default value is true.
- `docroot = Directory` - This makes the server serve all its content from Directory
- `partial_post_size = Integer` - When a YAWS file receives large POSTs, the amount of data received in each chunk is determined by the this parameter. The default value is 10240.

- `tilde_expand = true|false` - If this value is set to false YAWS will never do tilde expansion. The default is true. tilde_expansion is the mechanism whereby a URL on the form http://www.foo.com/ username is changed into a request where the docroot for that particular request is set to the directory `~username/public_html/` The default value is true.

- `appmods = [ListOfModuleNames]` - If any the names in ListOfModuleNames appear as components in the path for a request, the path request parsing will terminate and that module will be called.

  Assume for example that we have the URL http://www.hyber.org/myapp/foo/bar/baz?user=joe while we have the module foo defined as an appmod, the function foo:out(Arg) will be invoked instead of searching the file systems below the point foo.

  The Arg argument will have the missing path part supplied in its appmoddata field.

- `errormod_404 = Module` - It is possible to set a special module that handles 404 Not Found messages.

  The function Module:out404(Arg, GC, SC) will be invoked. The arguments are

  Arg is a arg record

  GC is a gconf record (defined in yaws.hrl)

  SC is a sconf record (defined in yaws.hrl)

  The function can and must do the same things that a normal `out/1` does.

- `errormod_crash = Module` - It is possible to set a special module that handles the HTML generation of server crash messages. The default is to display the entire formated crash message in the browser. This is good for debugging but not in production.

  The function Module:crashmsg(Arg, SC, Str) will be called. The Str is the real crash message formated as a string.

- `arg_rewrite_mod = Module` - It is possible to install a module that rewrites all the Arg arg records at an early stage in the YAWS server. This can be used to do various things such as checking a cookie, rewriting paths etc.

- `<ssl> .... </ssl>` This begins and ends an SSL configuration for this server.

  - `keyfile = File` - Specifies which file contains the private key for the certificate.
  - `certfile = File` - Specifies which file contains the certificate for the server.
  - `cacertfile = File` File If the server is setup to require client certificates. This file needs to contain all the certificates of the acceptable signers for the client certs.
  - `verify = 1 | 2 | 3` Specifies the level of verification the server does on client certs. 1 means nothing , 2 means the the server will ask the client for a cert but not fail if the client doesn't supply a client cert, 3 means that the server requires the client to supply a client cert.
  - `depth = Int` Specifies the depth of certificate chains the server is prepared to follow when verifying client certs.

  - `password = String` - String If the private key is encrypted on disk, this password is the 3des key to decrypt it.
  - c`ciphers = String` This string specifies the ssl cipher string. The syntax of the ssl cipher string is a little horrible sub language of its own. It is documented in the ssl man page for "ciphers".
  - `</ssl>` Ends an SSL definition

- `<auth> ... </auth>` Defines an auth structure. The following items are allowed within a matching pair of <auth> and </auth> delimiters.

  - `dir = Dir` Makes Dir to be controlled bu WWW-authenticate headers. In order for a user to have access to WWW-Authenticate controlled directory, the user must supply a password.
  - `realm = Realm` In the directory defined here, the WWW-Authenticate Realm is set to this value.
  - `user = User:Password` Inside this directory, the user User has access if the user supplies the password Password in the pop up dialog presented by the browser. We can obviously have several of these value inside a single <auth> </auth> pair.
  - `</auth>` Ends an auth definition

11.3 Configuration Examples

The following example defines a single server on port 80.

```
logdir = /var/log/yaws
<server www.mydomain.org>
        port = 80
        listen = 192.168.128.31
        docroot = /var/yaws/www
</server>
```

And this example shows a similar setup but two web servers on the same IP address

```
logdir = /var/log/yaws
<server www.mydomain.org>
        port = 80
        listen = 192.168.128.31
        docroot = /var/yaws/www
</server>

<server www.funky.org>
```

```
        port = 80
        listen = 192.168.128.31
        docroot = /var/yaws/www_funky_org
</server>
```

An example with www-authenticate and no access logging at all.

```
logdir = /var/log/yaws
<server www.mydomain.org>
        port = 80
        listen = 192.168.128.31
        docroot = /var/yaws/www
        access_log = false
        <auth>
            dir = /var/yaws/www/secret
            realm = foobar
            user = jonny:verysecretpwd
            user = benny:thequestion
            user = ronny:havinganamethatendswithy
       </auth>

</server>
```

And finally a slightly more complex example with two servers on the same IP, and one ssl server on a different IP.

```
logdir = /var/log/yaws
max_num_cached_files = 8000
max_num_cached_bytes = 6000000

<server www.mydomain.org>
        port = 80
        listen = 192.168.128.31
        docroot = /var/yaws/www
</server>

<server www.funky.org>
        port = 80
        listen = 192.168.128.31
        docroot = /var/yaws/www_funky_org
</server>
```

```
<server www.funky.org>
        port = 443
        listen = 192.168.128.32
        docroot = /var/yaws/www_funky_org
        <ssl>
           keyfile = /etc/funky.key
           certfile = /etc/funky.cert
           password = gazonk
        </ssl>
</server>
```