Lecture6- Web Server

NET 445 – Internet Programming

Web Servers

- Web servers respond to Hypertext Transfer Protocol (HTTP) requests
  - from clients and send back a response
  - containing a status code and often content such as HTML, XML or JSON as well.
- Examples for web servers:
  - Apache and Nginx (linux web servers)
  - Internet Information Services (IIS) (for windows)
- Examples for web clients
  - Google Chrome, Firefox, and Microsoft Edge.

Why are web servers necessary?

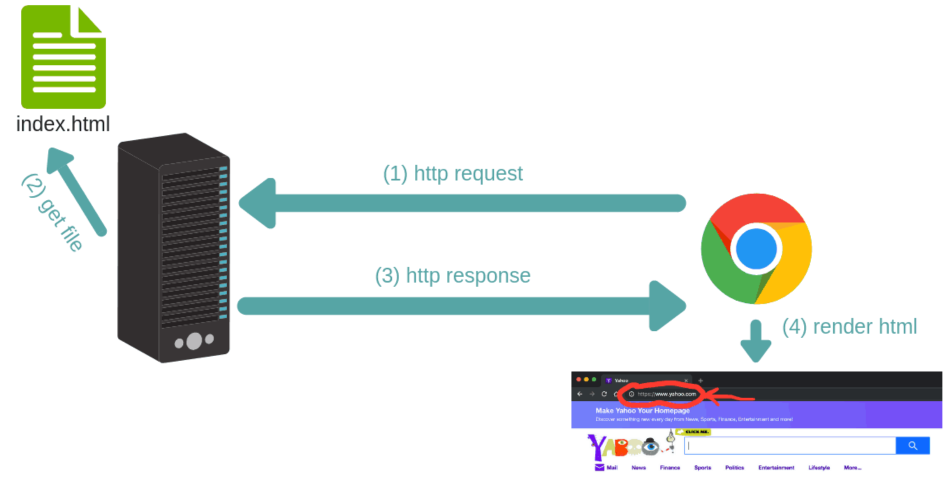
- The server and client speak the standardized language of the World Wide Web.
- This standard language is why an old Mozilla Netscape browser can still talk to a modern Apache or Nginx web server,
  - even if it cannot properly render the page design like a modern web browser can.
- The basic language of the Web with the request and response cycle from client to server then server back to client remains the same
  - as it was when the Web was invented by Tim Berners-Lee at CERN in 1989.
- Modern browsers and web servers have simply extended the language of the Web to incorporate new standards.

Web server implementations

- The conceptual web server idea can be implemented in various ways. The following web server implementations each have varying features, extensions and configurations.
  - The Apache HTTP Server has been the most commonly deployed web server on the Internet for 20+ years.
  - Nginx is the second most commonly used server for the top 100,000 websites and often serves as a reverse proxy for Python WSGI servers.
  - Caddy is a newcomer to the web server scene and is focused on serving the HTTP/2 protocol with HTTPS.

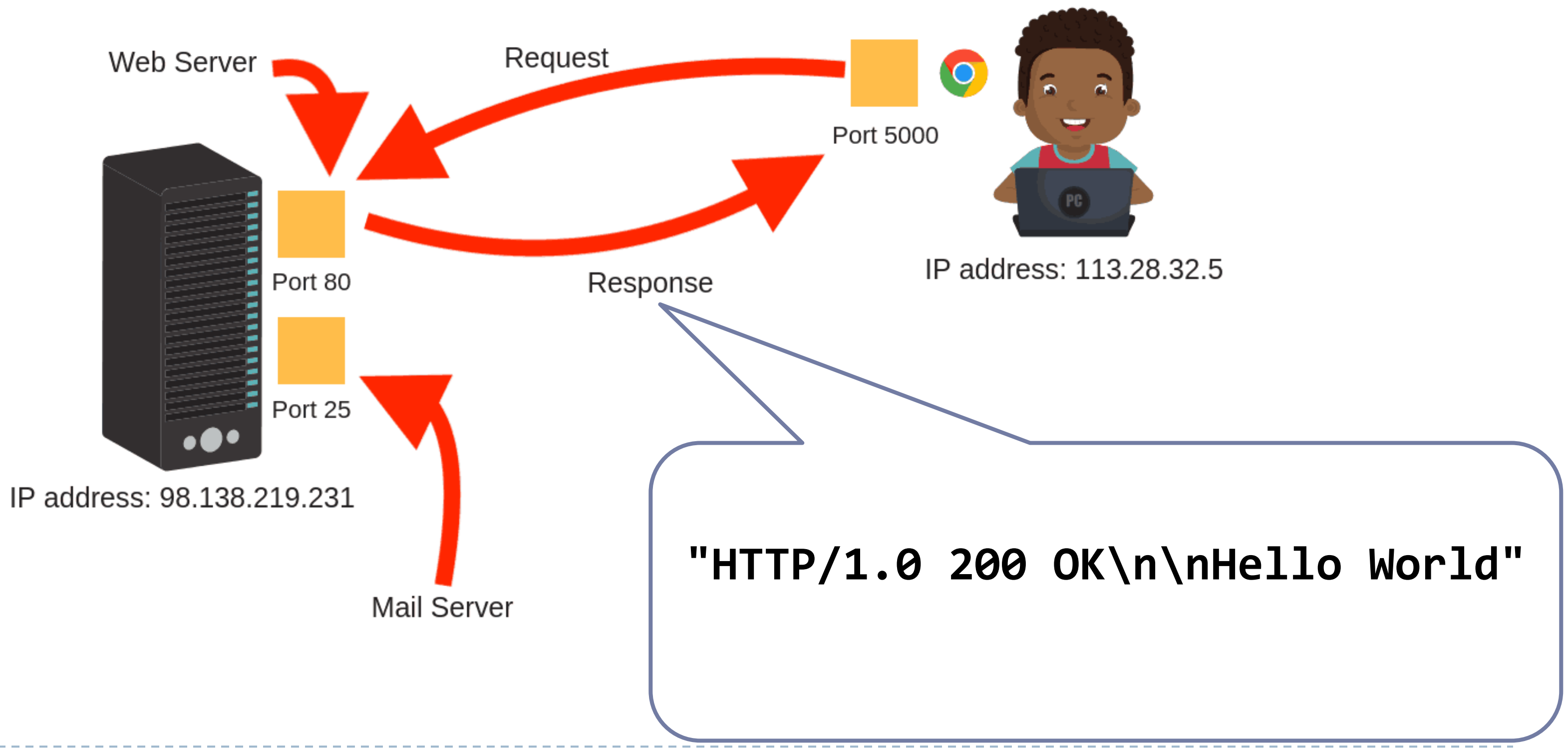
What is an HTTP Server?

- An HTTP web server is nothing but a process that is running on your machine and does exactly two things:
  - Listens for incoming http requests on a specific TCP socket address (IP address and a port number which I will talk about later)
  - Handles this request and sends a response back to the user.



Simple HTTP Server using Sockets

- Create a Simple Python script open a socket
- Send a simple request with a message "Hello World"



```
"HTTP/1.0 200 OK\n\nHello World"
```

Simple HTTP Server using Sockets

- Simple HTTP Server using Sockets

```
# Define socket host and port
SERVER_HOST = "0.0.0.0"
SERVER_PORT = 8000
# Create socket
server_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
server_socket.setsockopt(socket.SOL_SOCKET, socket.SO_REUSEADDR, 1)
server_socket.bind((SERVER_HOST, SERVER_PORT))
server_socket.listen(1)
print("Listening on port %s ..." % SERVER_PORT)

while True:
    # Wait for client connections
    client_connection, client_address = server_socket.accept()

    # Get the client request
    request = client_connection.recv(1024).decode()
    print(request)

    # Send HTTP response
    response = "HTTP/1.0 200 OK\n\nHello World"
    client_connection.sendall(response.encode())
    client_connection.close()

# Close socket
server_socket.close()
```

Simple HTTP Server using http.server

- Python standard library: http.server
- comes with a in-built webserver which can be invoked for simple web client server communication.
- The port number can be assigned programmatically and the web server is accessed through this port.
- It is not a full featured web server which can parse many kinds of file, it can parse simple static html files and serve them by responding them with required response codes.

Creating a simple HTML file to serve

- Creating a simple HTML file to serve
- Place this file in the local folder

```
<!DOCTYPE html>
<html>
<body>

<h1>This is a web page</h1>
<p>NET445 Internet Programming</p>

</body>
</html>
```

Simple HTTP Server using http.server

- Simple HTTP Server using http.server
- Place this script next to the HTML file
- Run the script and open the browser to
  - http://127.0.0.1:8000

```
import http.server
import socketserver

PORT = 8000

handler = http.server.SimpleHTTPRequestHandler

with socketserver.TCPServer(("", PORT), handler) as httpd:
    print("Server started at localhost:" + str(PORT))
    httpd.serve_forever()
```

Flask Web Framework

- What is Web Framework?
  - represents a collection of libraries and modules that enables a web application developer to write applications
  - without having to bother about low-level details such as protocols, thread management etc.
- Flask is a web application framework written in Python.
  - It is developed by **Armin Ronacher**, who leads an international group of Python enthusiasts named Pocco.
  - Flask is based on the Werkzeug WSGI toolkit and Jinja2 template engine. Both are Pocco projects.

Flask Web Framework

- WSGI
  - Web Server Gateway Interface (WSGI) has been adopted as a standard for Python web application development.
  - WSGI is a specification for a universal interface between the web server and the web applications.
- Jinja2
  - Jinja2 is a popular templating engine for Python.
  - A web templating system combines a template with a certain data source to render dynamic web pages.

Install Flask

- You can install flask using this command

```
pip3 install Flask
```

First Application in Flask

- In order to test Flask installation, type the following code in the editor as Hello.py

```
from flask import Flask
app = Flask(__name__)

@app.route("/")
def hello_world():
        return "Hello World"

if __name__ == "__main__":
        app.run()
```

Simple Application in details

- Flask constructor takes the name of current module (__name__) as argument.
- The route() function of the Flask class is a decorator, which tells the application which URL should call the associated function.
- app.route(rule, options)
- The rule parameter represents URL binding with the function.
- The options is a list of parameters to be forwarded to the underlying Rule object.
- In the above example, '/' URL is bound with hello_world() function. Hence, when the home page of web server is opened in browser, the output of this function will be rendered.
- Finally the run() method of Flask class runs the application on the local development server.

Flask – Routing

- URL '/net445' rule is bound to the hello_net445() function.
- As a result, if a user visits http://localhost:5000/net445 URL, the output of the hello_net445() function will be rendered in the browser.
- The add_url_rule() function of an application object is also available to bind a URL with a function as in the above example, route() is used.

```
from flask import Flask
app = Flask(__name__)

@app.route("/")
def hello_world():
         return "Hello World"

@app.route("/net445")
def hello_net445():
   return "hello Net445"

if __name__ == "__main__":
         app.run()
```

Flask – Variable Rules

- It is possible to build a URL dynamically, by adding variable parts to the rule parameter.
- This variable part is marked as <variable-name>.
- It is passed as a keyword argument to the function with which the rule is associated.
- In the following example, the rule parameter of route() decorator contains <name> variable part attached to URL '/hello'.

```
from flask import Flask
app = Flask(__name__)

@app.route('/hello/<name>')
def hello_name(name):
   return 'Hello %s!' % name

if __name__ == '__main__':
   app.run(debug = True)
```

Flask – Variable Rules and Conversions

- In addition to the default string variable part, rules can be constructed using the following converters –

Sr.No.	Converters & Description
1	int accepts integer
2	float For floating point value
3	path accepts slashes used as directory separator character

```
from flask import Flask
app = Flask(__name__)

@app.route('/blog/<int:postID>')
def show_blog(postID):
   return 'Blog Number %d' % postID

@app.route('/rev/<float:revNo>')
def revision(revNo):
   return 'Revision Number %f' % revNo

if __name__ == '__main__':
   app.run()
```

Flask – Templates

- Flask will try to find the HTML file in the templates folder, in the same folder in which this script is present.
- Application folder
  - Hello.py
  - templates
    - hello.html

jinja2 – Templates

- A web template contains HTML syntax interspersed placeholders for variables and expressions (in these case Python expressions) which are replaced values when the template is rendered.
- The following code is saved as **hello.html** in the templates folder.

```
<!doctype html>
<html>
   <body>

      <h1>Hello {{ name }}!</h1>

   </body>
</html>
```

Simple Template in Flask

- You can install flask using this command

```
from flask import Flask, render_template
app = Flask(__name__)

@app.route('/hello/<user>')
def hello_name(user):
   return render_template('hello.html', name = user)

if __name__ == '__main__':
   app.run(debug = True)
```

jinja2 – Templates

- The **jinja2** template engine uses the following delimiters for escaping from HTML.
- {% ... %} for Statements
- {{ ... }} for Expressions to print to the template output
- {# ... #} for Comments not included in the template output
- # ... ## for Line Statements

Advanced Template – HTML code

- named results.html

```
<!doctype html>
<html>
   <body>
      <table border = 1>
         {% for key, value in result.items() %}
            <tr>
               <th> {{ key }} </th>
               <td> {{ value }} </td>
            </tr>
         {% endfor %}
      </table>
   </body>
</html>
```

Advanced Template – Python Code

- Advanced Template – Python Code

```
from flask import Flask, render_template
app = Flask(__name__)

@app.route('/result')
def result():
   dict = {'phy':50,'che':60,'maths':70}
   return render_template('results.html', result = dict)

if __name__ == '__main__':
   app.run(debug = True)
```

References:

- Foundations of Python Network Programming Third Edition by Brandon Rhodes (2014)
- James F. Kurose, and Keith W Ross, Computer Networking: A Top-Down Approach, 6th Edition
- Python 3 documentation
- https://wiki.python.org/moin/UdpCommunication
- https://www.w3schools.com/python/
- https://www.tutorialspoint.com/python/