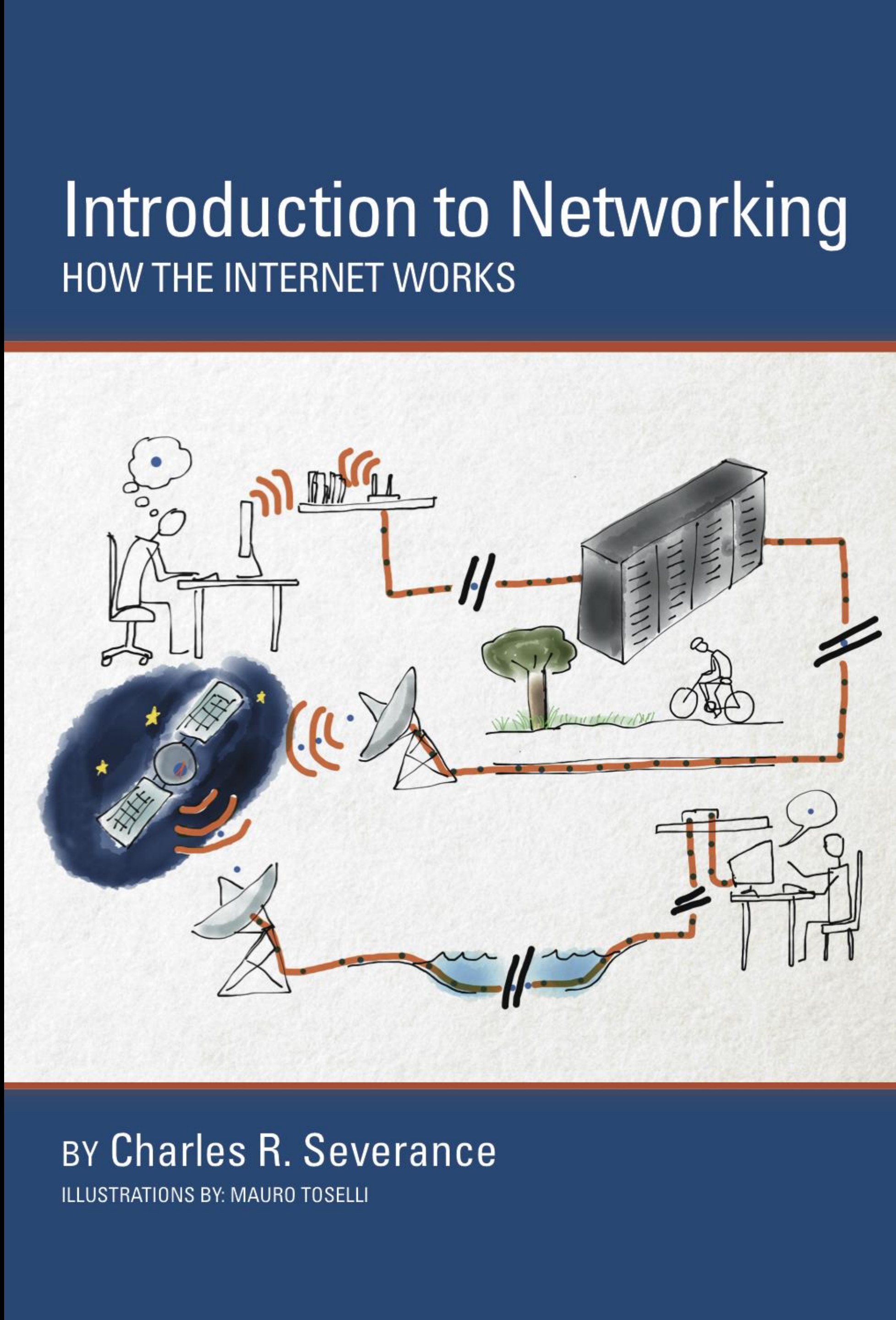
Introduction to Dynamic Web Content

Charles Severance
www.dj4e.com

A Free Book on Networking

- If you find this topic area interesting and/or need more detail
- www.net-intro.com
- https://www.coursera.org/learn/insidetheinternet



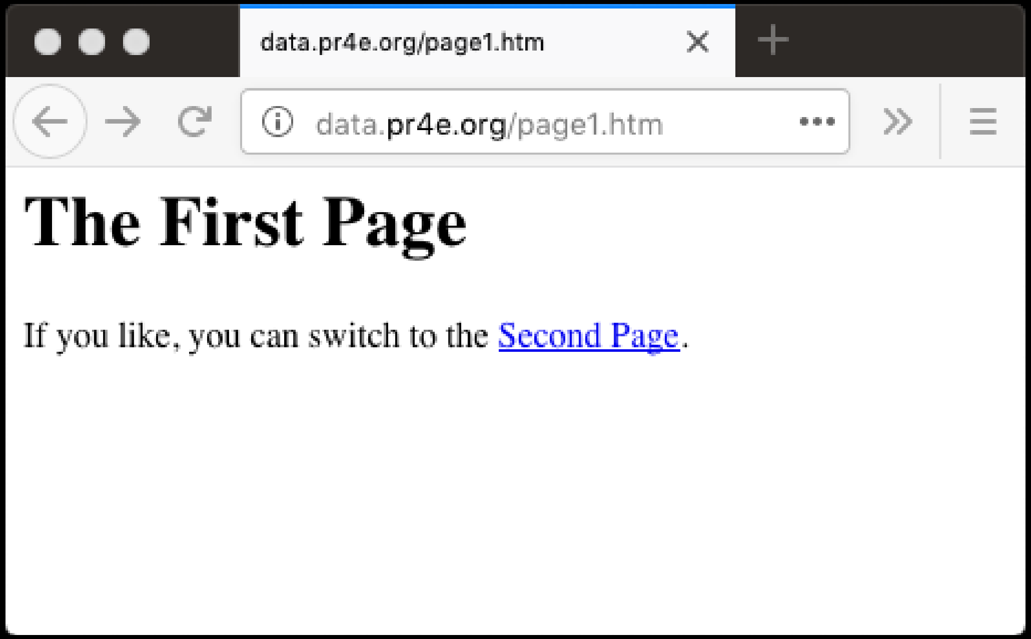
Introduction to Networking

HOW THE INTERNET WORKS

BY Charles R. Severance

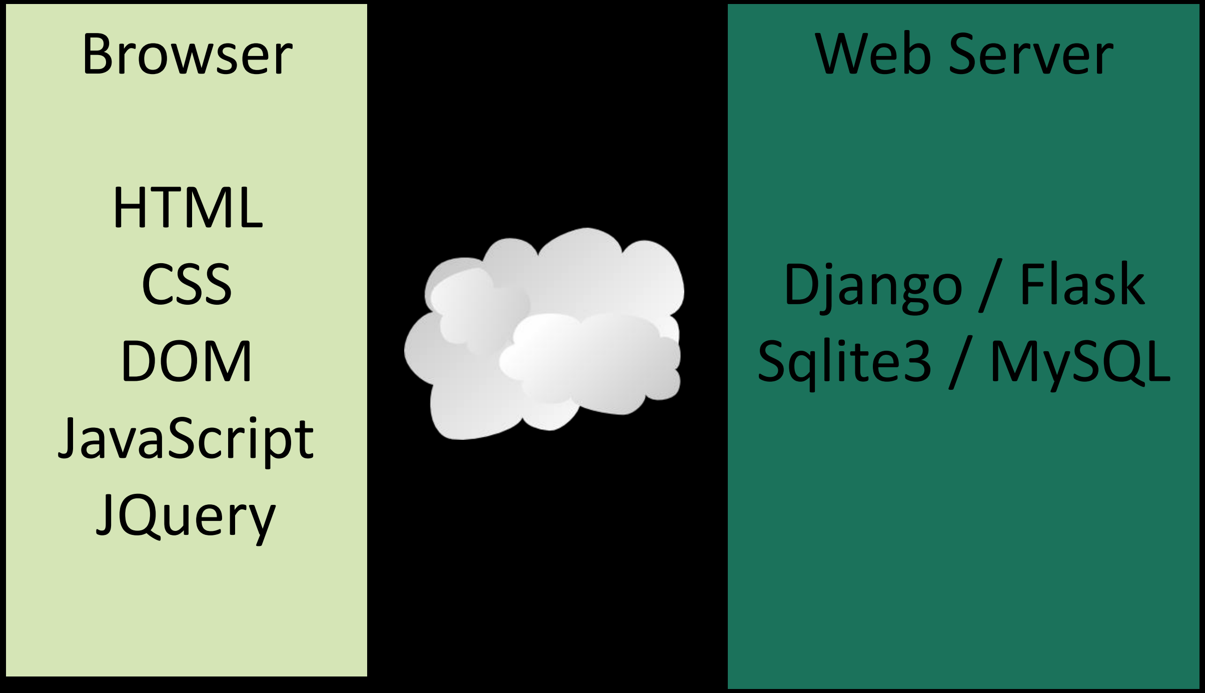
ILLUSTRATIONS BY: MAURO TOSELLI

Web Application Technologies



The First Page

If you like, you can switch to the Second Page.



Browser

HTML
CSS
DOM
JavaScript
JQuery

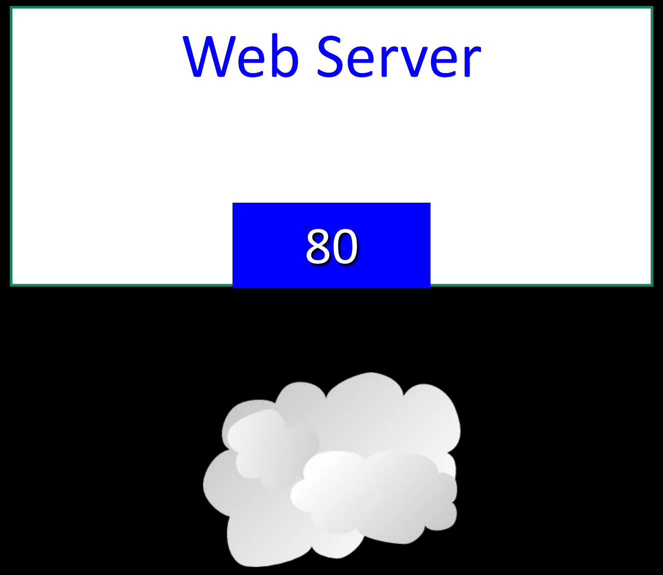
Web Server

Django / Flask
Sqlite3 / MySQL

http://data.pr4e.org/page1.htm

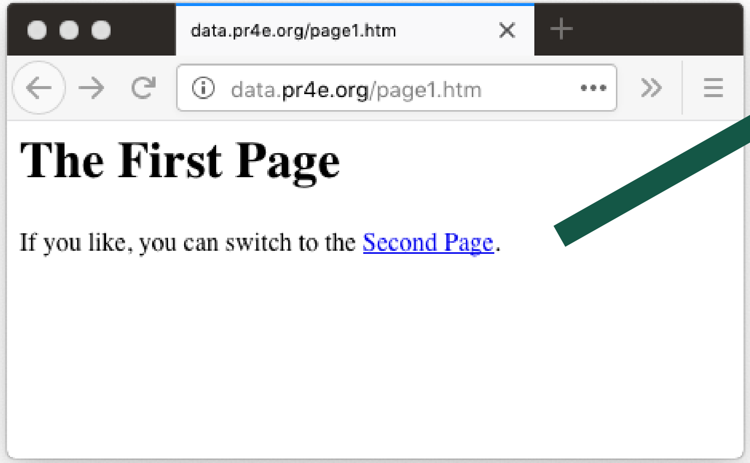
Getting Data from the Server

- Each time the user clicks on an anchor tag with an href = value to switch to a new page, the browser makes a connection to the web server and issues a “GET” request - to GET the content of the page at the specified URL.
- The server returns the HTML document to the browser, which formats and displays the document to the user.



Web Server

80



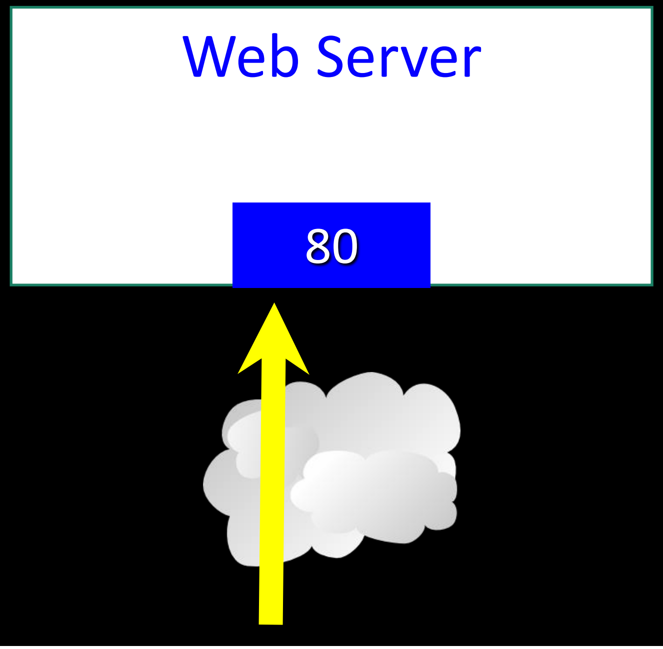
data.pr4e.org/page1.htm

The First Page

If you like, you can switch to the Second Page.

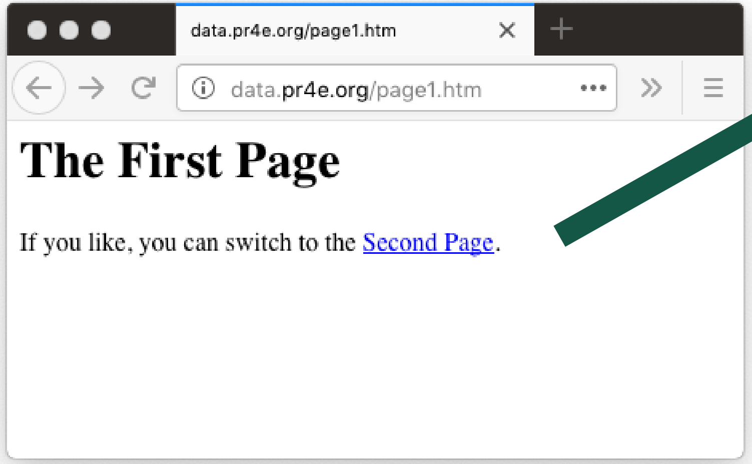
Click

Browser App



Request

GET http://data.pr4e.org/page2.htm

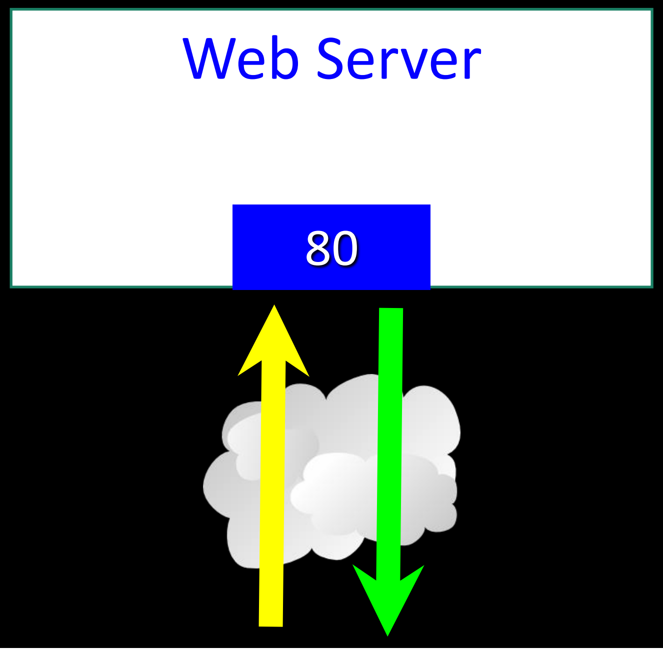


The First Page

If you like, you can switch to the [Second Page].

Click

Browser App



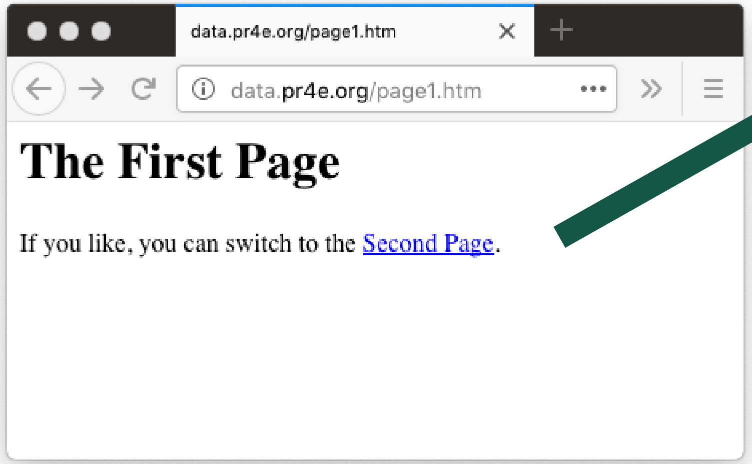
Request

GET http://data.pr4e.org/page2.htm

Response

<h1>The Second Page</h1><p>If you like, you can switch back to the <a href="page1.htm">First Page</a>.</p>

Browser App

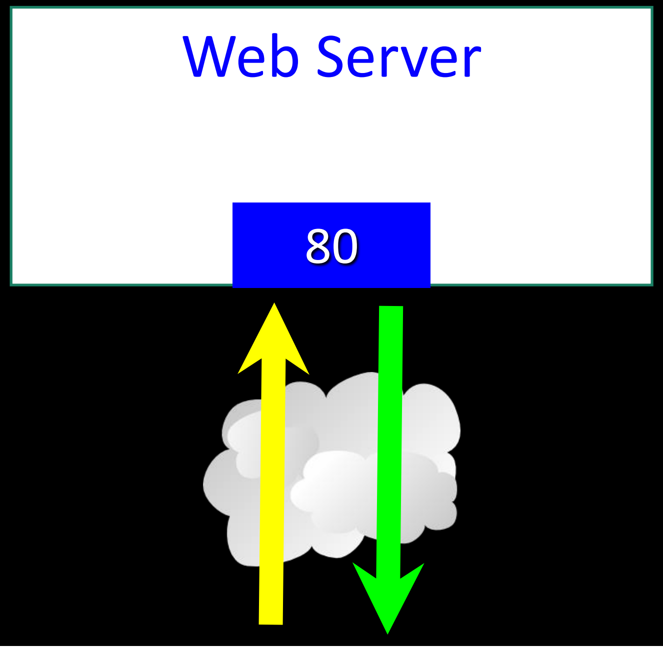


data.pr4e.org/page1.htm

The First Page

If you like, you can switch to the Second Page.

Click



Request

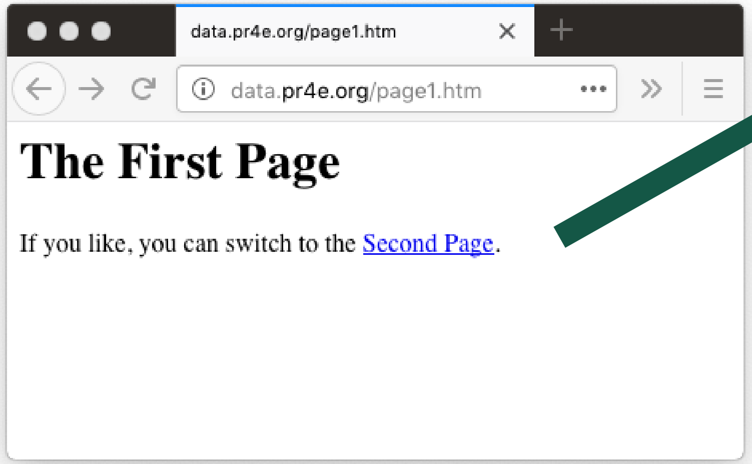
GET http://data.pr4e.org/page2.htm

Response

<h1>The Second Page</h1><p>If you like, you can switch back to the <a href="page1.htm">First Page</a>.</p>

Browser App

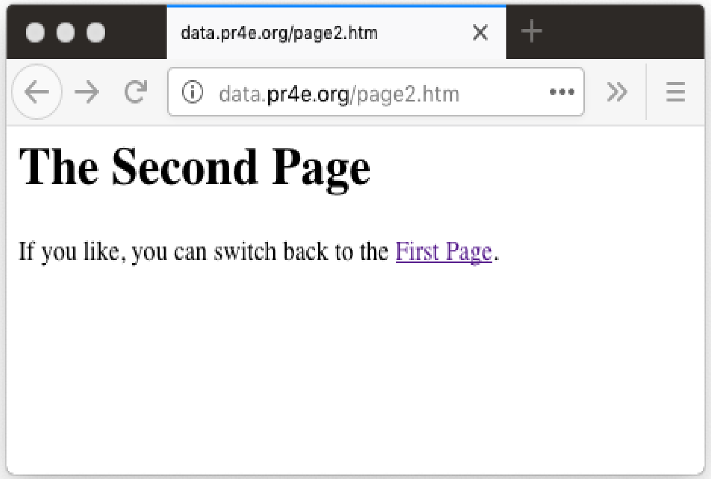
Click



The First Page

If you like, you can switch to the Second Page.

Parse/
Render



The Second Page

If you like, you can switch back to the First Page.

Network Sockets

Phone calls for pairs of applications

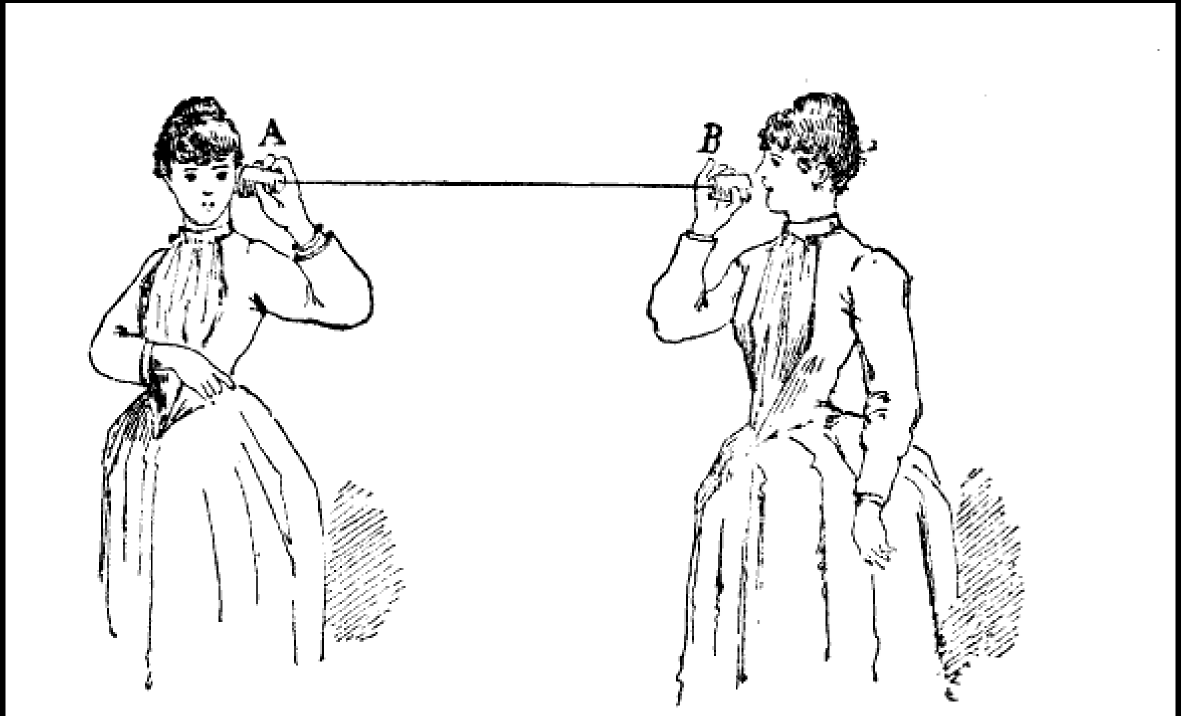


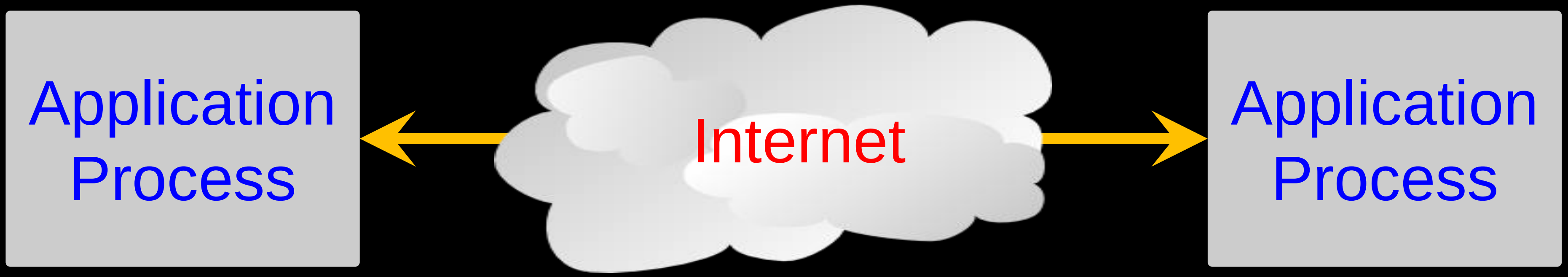
FIG. 76. Trådtelefon.

http://en.wikipedia.org/wiki/Tin_can_telephone

http://www.flickr.com/photos/kitcowan/2103850699/

TCP Connections / Sockets

"In computer networking, an Internet socket or network socket is an endpoint of a bidirectional inter-process communication flow across an Internet Protocol-based computer network, such as the Internet."

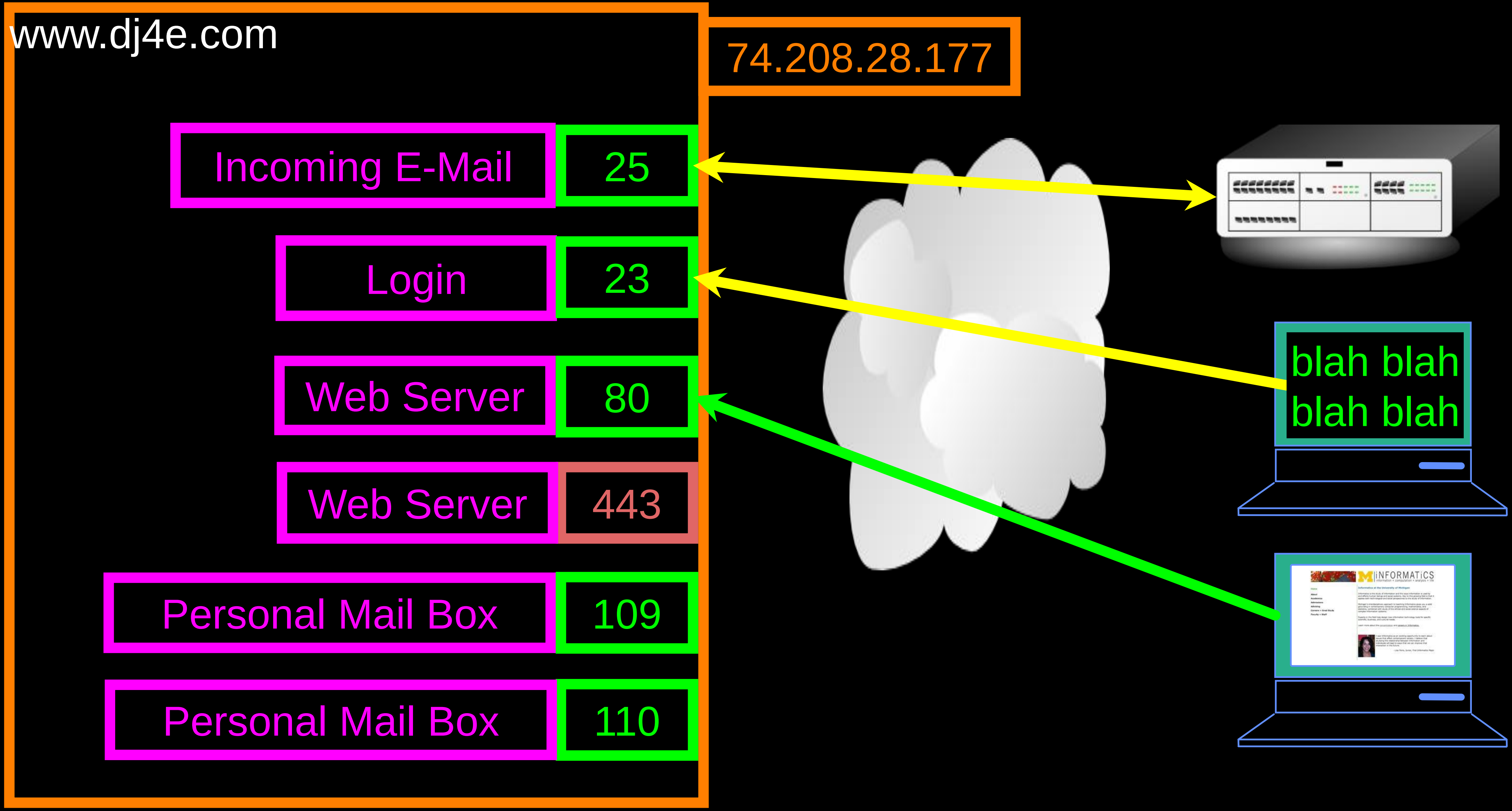


http://en.wikipedia.org/wiki/Internet_socket

TCP Port Numbers

- A port is an application-specific or process-specific software communications endpoint
- It allows multiple networked applications to coexist on the same server
- There is a list of well-known TCP port numbers

http://en.wikipedia.org/wiki/TCP_and_UDP_port



www.dj4e.com

74.208.28.177

Incoming E-Mail	25
Login	23
Web Server	80
Web Server	443
Personal Mail Box	109
Personal Mail Box	110

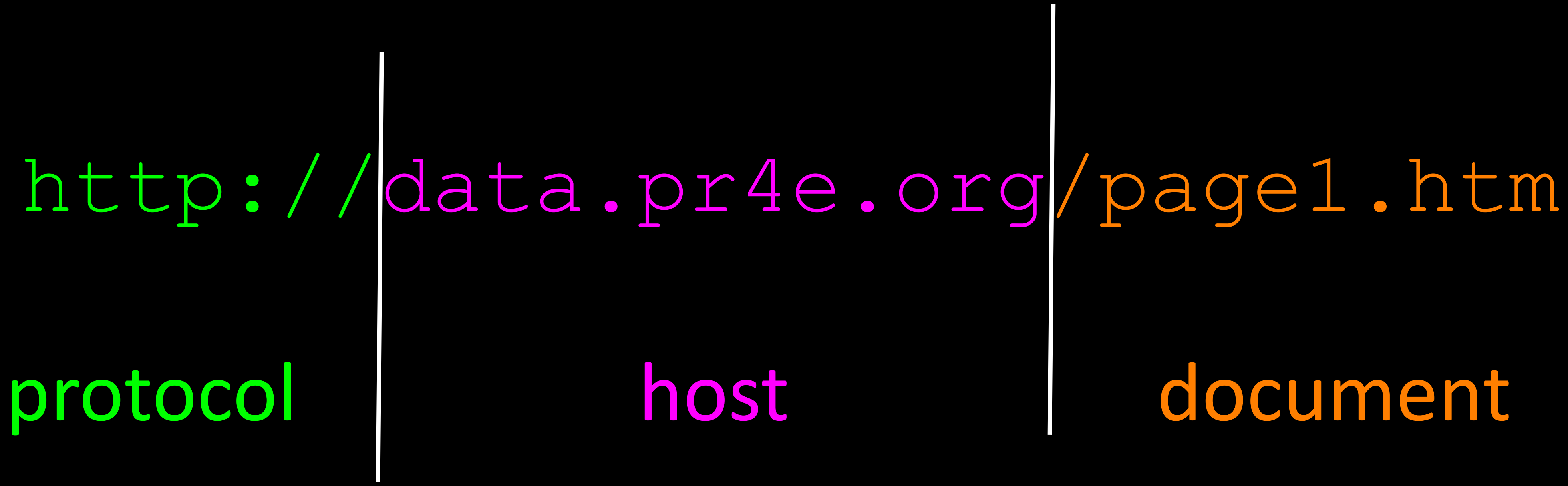
blah blah
blah blah

Clipart: http://www.clker.com/search/networksym/1

HyperText Transfer Protocol

Wandering through linked documents on the Internet

Uniform Resource Locator



`http://data.pr4e.org/page1.htm`

protocol

host

document

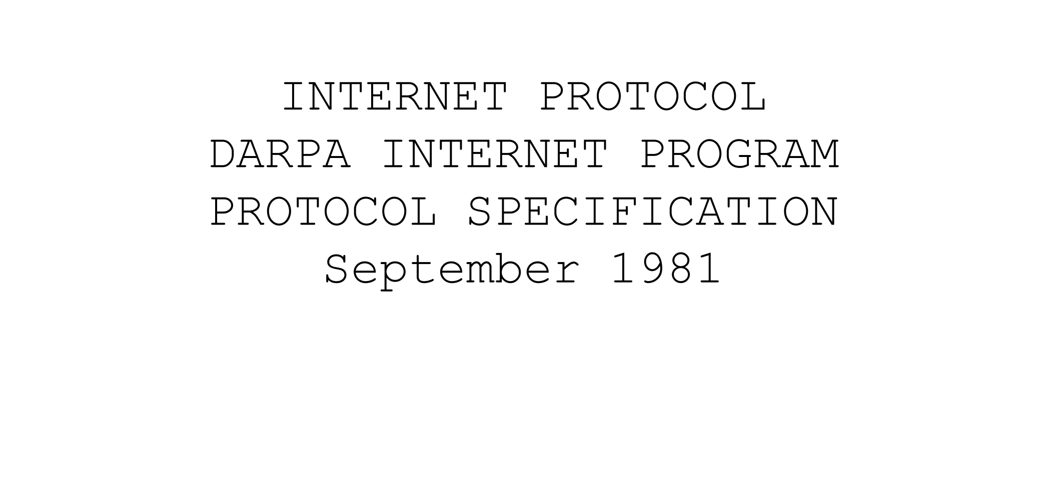
HTTP - HyperText Transfer Protocol

- The dominant Application Layer Protocol on the Internet
- Invented for the Web - to retrieve HTML, Images, Documents, etc.
- Extended to handle data in addition to documents - RSS, Web Services, etc.
- Basic Concept: Make a connection - Request a document - Retrieve the document - Close the connection

- Internet and sockets were created in the 1970's, HTTP was invented in 1990 and is an application protocol that runs atop sockets

Internet Standards

- The standards for all of the Internet protocols (inner workings) are developed by an organization
- Internet Engineering Task Force (IETF)
- www.ietf.org
- Standards are called “RFCs” - “Request for Comments”

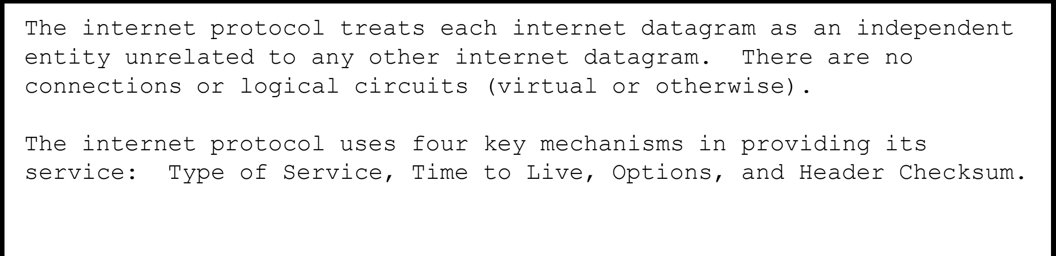


INTERNET PROTOCOL

DARPA INTERNET PROGRAM

PROTOCOL SPECIFICATION

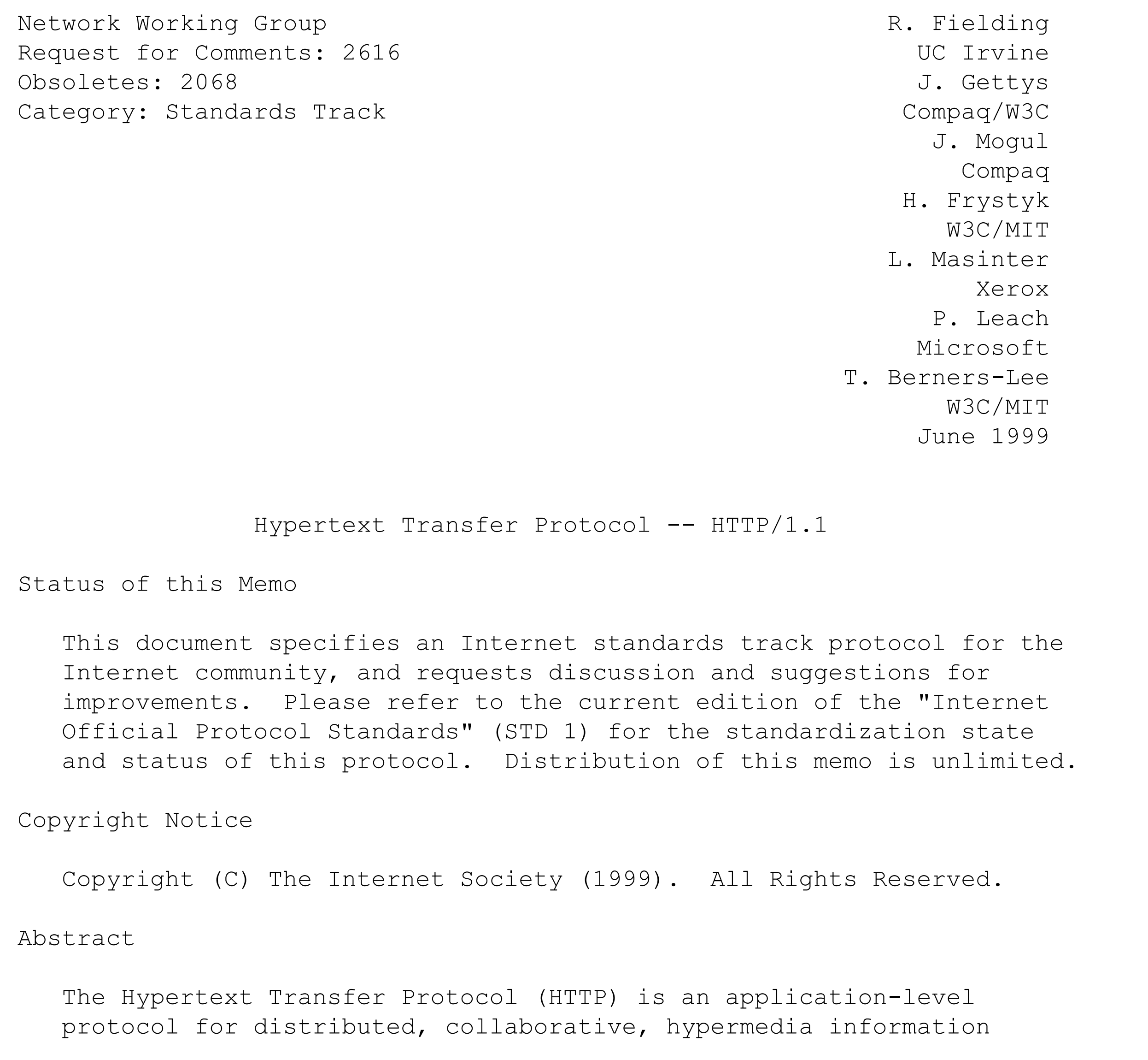
September 1981



The internet protocol treats each internet datagram as an independent entity unrelated to any other internet datagram. There are no connections or logical circuits (virtual or otherwise).

The internet protocol uses four key mechanisms in providing its service: Type of Service, Time to Live, Options, and Header Checksum.

Source: http://tools.ietf.org/html/rfc791 http://www.w3.org/Protocols/rfc2616/rfc2616.txt



Network Working Group
Request for Comments: 2616
Obsoletes: 2068
Category: Standards Track

R. Fielding
UC Irvine
J. Gettys
Compaq/W3C
J. Mogul
Compaq
H. Frystyk
W3C/MIT
L. Masinter
Xerox
P. Leach
Microsoft
T. Berners-Lee
W3C/MIT
June 1999

Hypertext Transfer Protocol -- HTTP/1.1

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Copyright Notice

Abstract

The Hypertext Transfer Protocol (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information

5 Request

A request message from a client to a server includes, within the first line of that message, the method to be applied to the resource, the identifier of the resource, and the protocol version in use.

```
     Request       = Request-Line              ; Section 5.1
                     *(( general-header        ; Section 4.5
                      | request-header         ; Section 5.3
                      | entity-header ) CRLF)  ; Section 7.1
                     CRLF
                     [ message-body ]          ; Section 4.3
```

5.1 Request-Line

The Request-Line begins with a method token, followed by the Request-URI and the protocol version, and ending with CRLF. The elements are separated by SP characters. No CR or LF is allowed except in the final CRLF sequence.

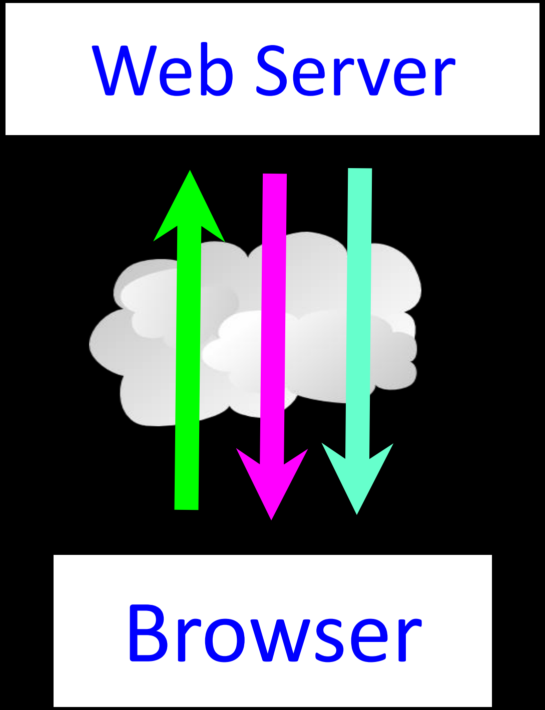
```
     Request-Line   = Method SP Request-URI SP HTTP-Version CRLF
```

Making an HTTP Request

- Connect to the server like data.pr4e.org
- - a “handshake”
- Request a document
  - GET http://data.pr4e.org/page1.htm HTTP/1.0
  - GET http://www.mlive.com/ann-arbor/ HTTP/1.0
  - GET http://www.facebook.com HTTP/1.0

Note – Telnet is not installed by default on most systems

```
$ telnet data.pr4e.org 80
Trying 74.208.28.177...
Connected to data.pr4e.org character is '^]'.
GET http://data.pr4e.org/page1.htm HTTP/1.0

HTTP/1.1 200 OK
Date: Thu, 04 Jan 2018 14:45:10 GMT
Server: Apache/2.4.7 (Ubuntu)
Last-Modified: Mon, 15 May 2017 11:11:47 GMT
Content-Type: text/html

<h1>The First Page</h1>
<p>If you like, you can switch to
the <a href="http://www.dr-chuck.com/page2.htm">Second
Page</a>.</p>
Connection closed by foreign host.
```

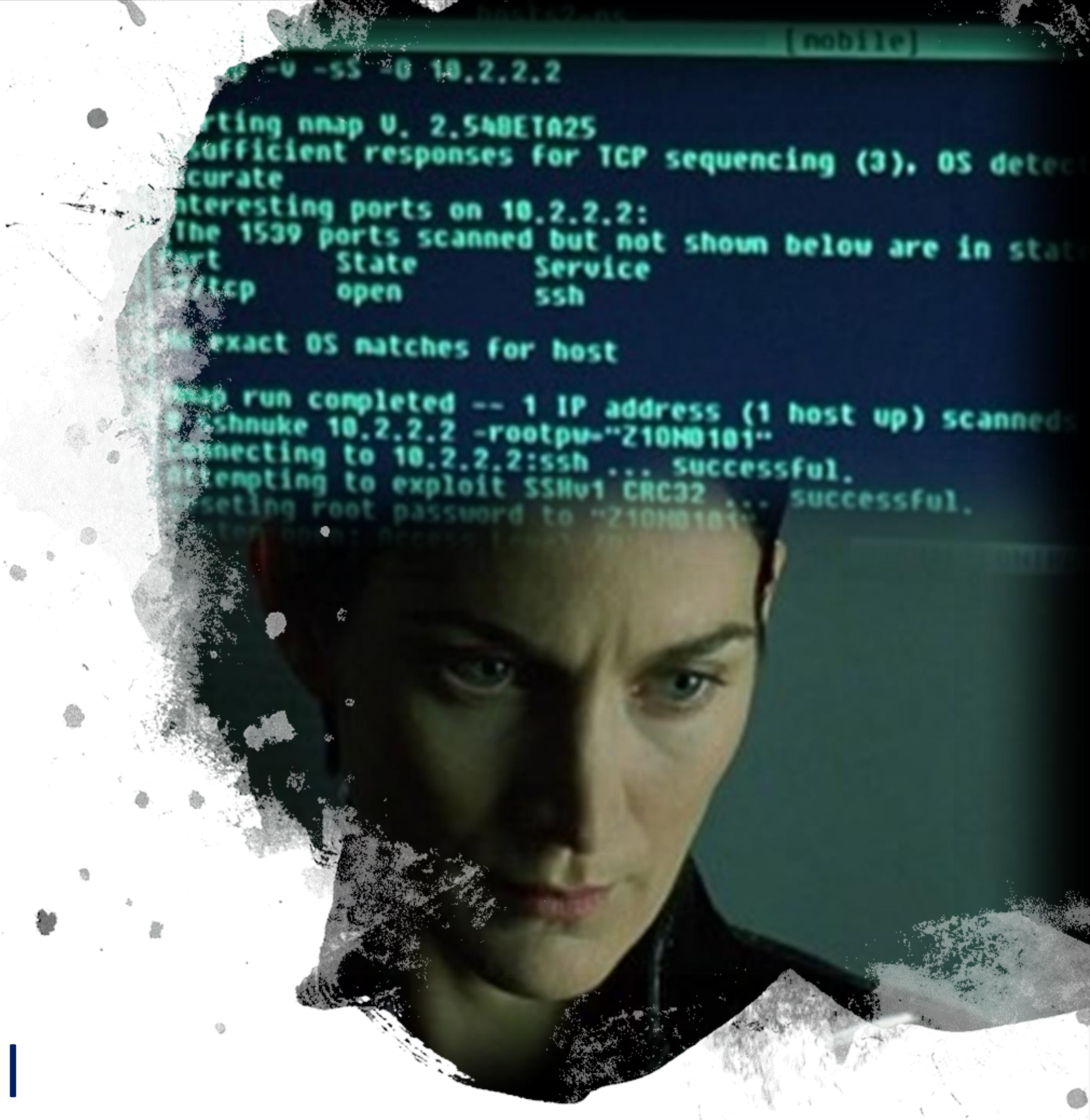


Web Server

Browser

Accurate Hacking in the Movies

- Matrix Reloaded
- Bourne Ultimatum
- Die Hard 4
- …

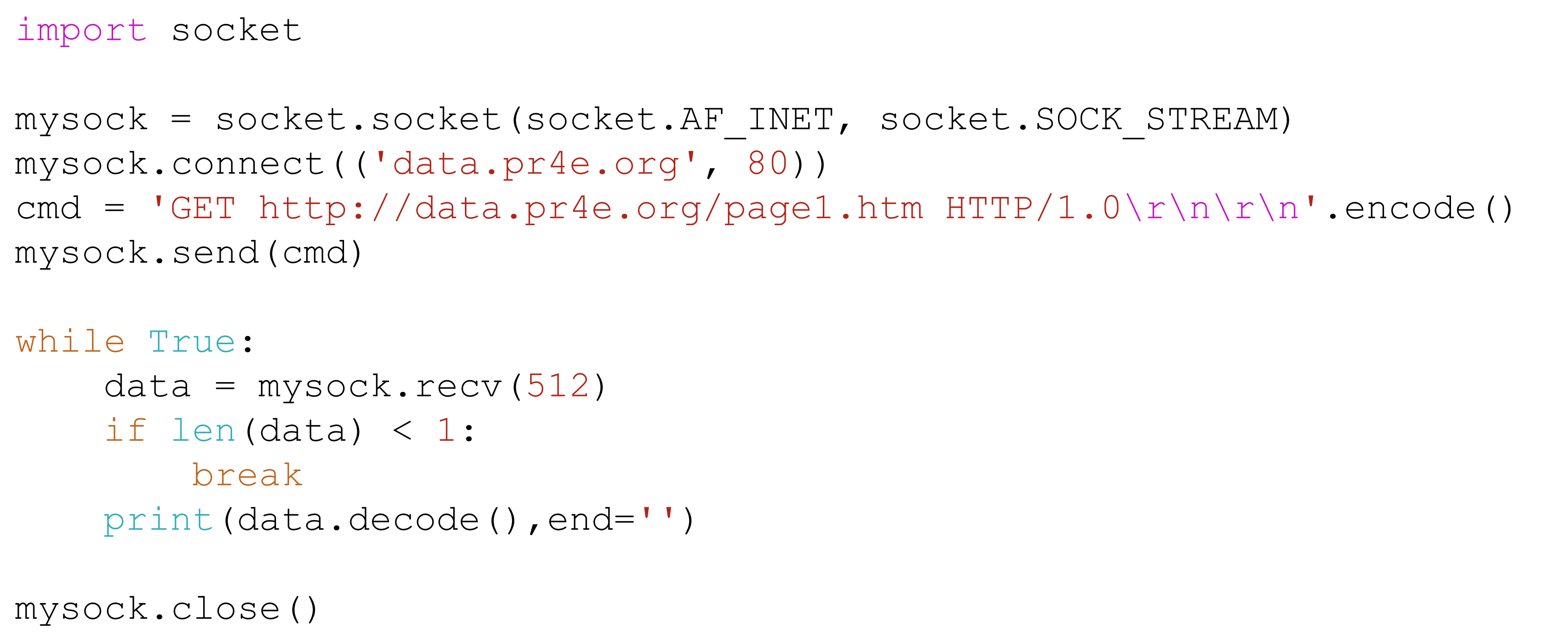


```
-v -sS -O 10.2.2.2

rting nmap V. 2.54BETA25
sufficient responses for TCP sequencing (3), OS detec
curate
nteresting ports on 10.2.2.2:
The 1539 ports scanned but not shown below are in stat
rt          State          Service
/tcp        open           ssh

exact OS matches for host

run completed -- 1 IP address (1 host up) scanned
shnuke 10.2.2.2 -rootpw="Z10N0101"
necting to 10.2.2.2:ssh ... successful.
empting to exploit SSHv1 CRC32 ... successful.
seting root password to "Z10N0101"
```

http://nmap.org/movies.html

Simple "Browser" in Python

The World's Simplest Browser



```
import socket

mysock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
mysock.connect(('data.pr4e.org', 80))
cmd = 'GET http://data.pr4e.org/page1.htm HTTP/1.0\r\n\r\n'.encode()
mysock.send(cmd)

while True:
    data = mysock.recv(512)
    if len(data) < 1:
        break
    print(data.decode(),end='')

mysock.close()
```

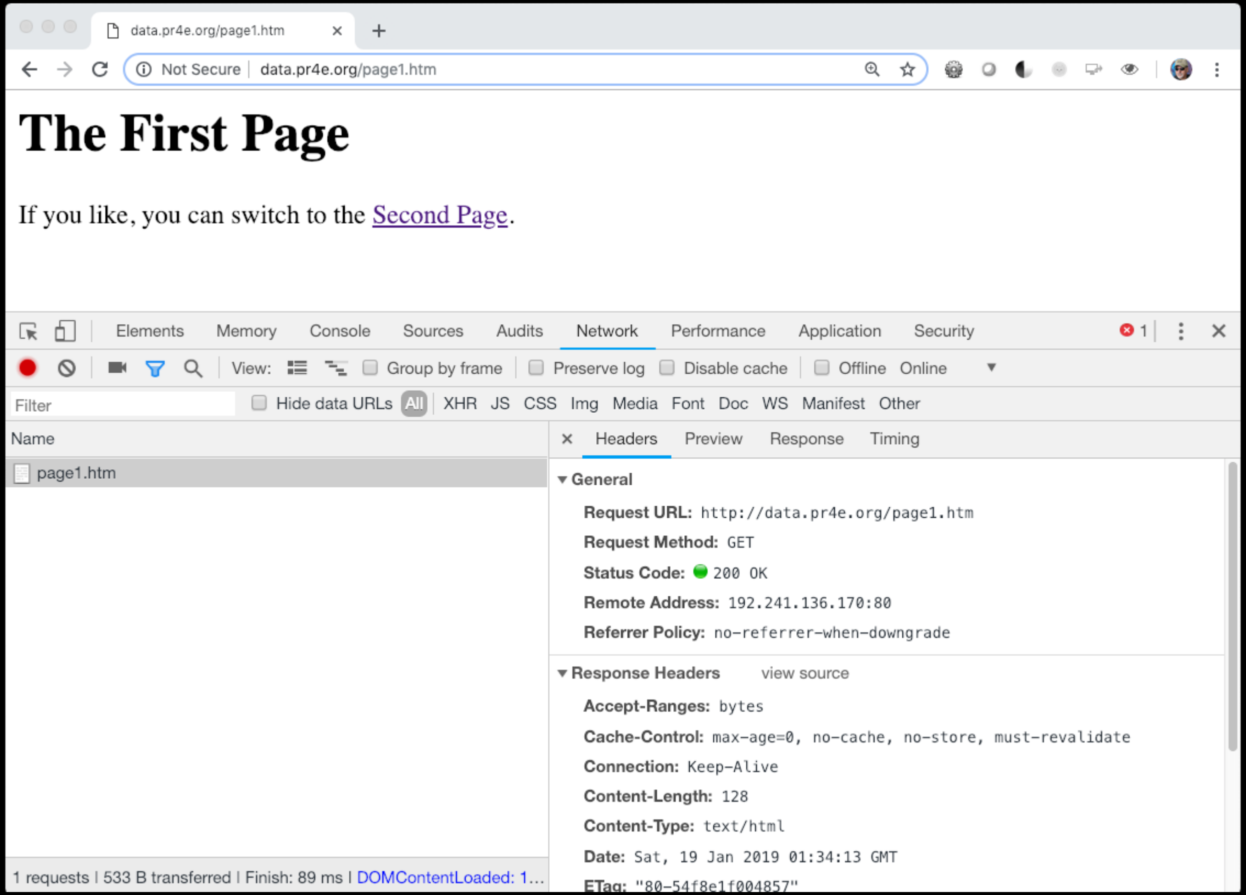
https://www.dj4e.com/code/http/socket1.py

```
$ python3 socket1.py
HTTP/1.1 200 OK
Date: Sat, 19 Jan 2019 04:23:25 GMT
Server: Apache/2.4.18 (Ubuntu)
Last-Modified: Mon, 15 May 2017 11:11:47 GMT
ETag: "80-54f8e1f004857"
Accept-Ranges: bytes
Content-Length: 128
Cache-Control: max-age=0, no-cache, no-store
Pragma: no-cache
Expires: Wed, 11 Jan 1984 05:00:00 GMT
Connection: close
Content-Type: text/html


<h1>The First Page</h1>
<p>
If you like, you can switch to the
<a href="http://data.pr4e.org/page2.htm">
Second Page</a>.
</p>
```

```
import socket

mysock = socket.socket(socket.AF_INET, sc
mysock.connect(('data.pr4e.org', 80))
cmd = 'GET http://data.pr4e.org/page1.htm
mysock.send(cmd)

while True:
    data = mysock.recv(512)
    if len(data) < 1:
        break
    print(data.decode(),end='')

mysock.close()
```

Viewing Headers – Browser Developer Mode

- Chrome: View > Developer
- FireFox: Tools -> Web Developer -> Toggle
- Safari: Preferences > Advanced > Show Develop Menu



The First Page

If you like, you can switch to the Second Page.

▾ General

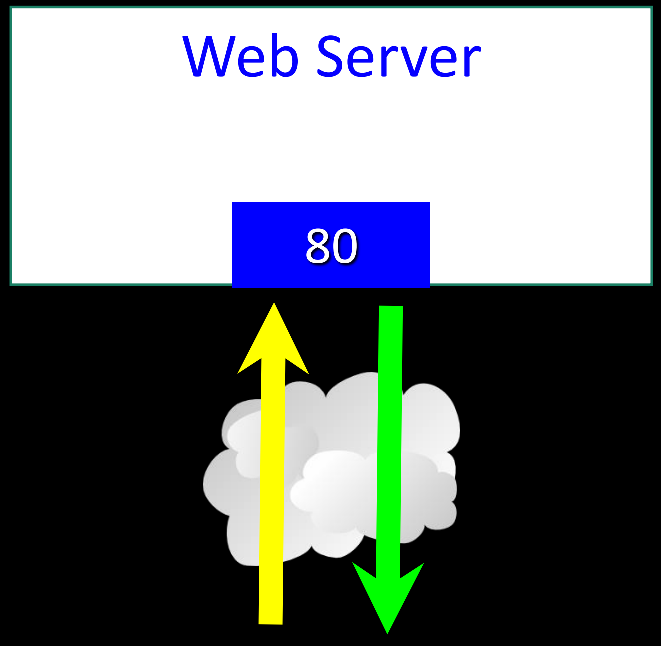
Request URL: http://data.pr4e.org/page1.htm
Request Method: GET
Status Code: ● 200 OK
Remote Address: 192.241.136.170:80
Referrer Policy: no-referrer-when-downgrade

▾ Response Headers

Accept-Ranges: bytes
Cache-Control: max-age=0, no-cache, no-store, must-revalidate
Connection: Keep-Alive
Content-Length: 128
Content-Type: text/html
Date: Sat, 19 Jan 2019 01:34:13 GMT
ETag: "80-54f8e1f004857"

In the server

… the mighty server



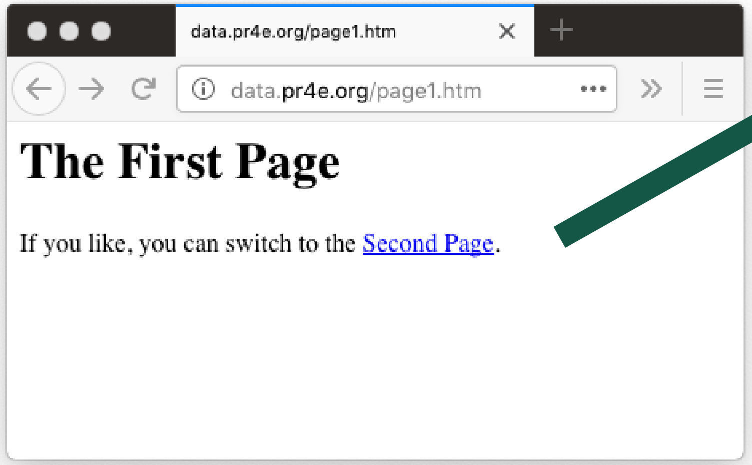
Request

GET http://data.pr4e.org/page2.htm

Response

<h1>The Second Page</h1><p>If you like, you can switch back to the <a href="page1.htm">First Page</a>.</p>

Browser App

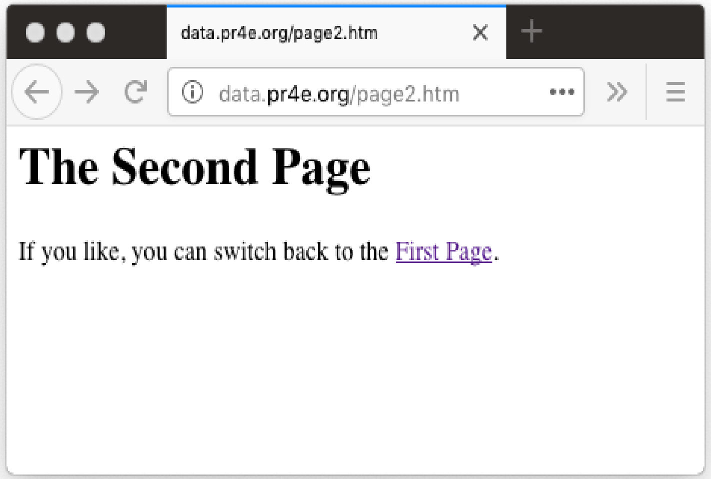


The First Page

If you like, you can switch to the Second Page.

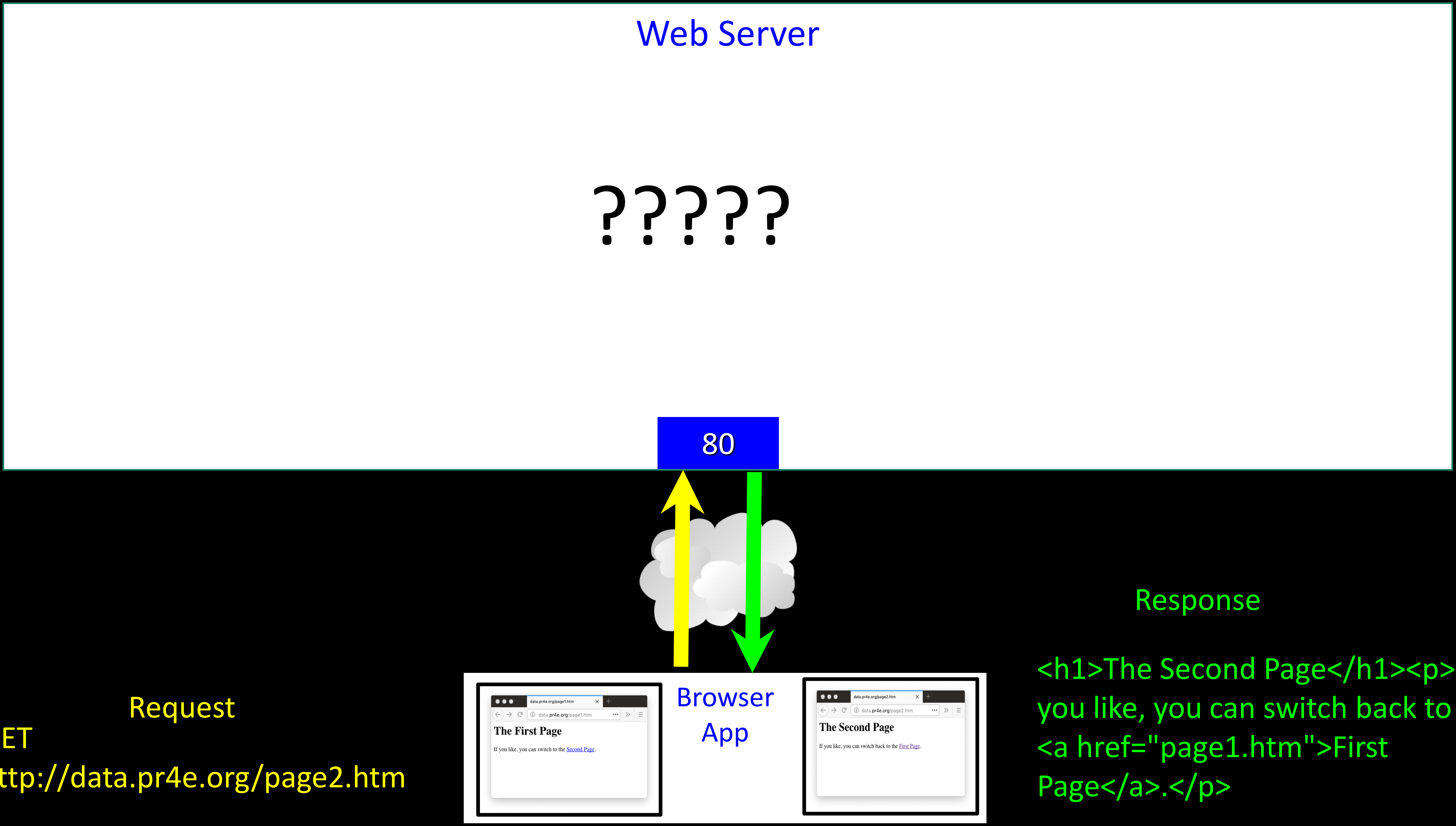
Click

Parse/ Render



The Second Page

If you like, you can switch back to the First Page.



data.pr4e.org/page1.htm

The First Page

If you like, you can switch to the Second Page.

data.pr4e.org/page2.htm

The Second Page

If you like, you can switch back to the First Page.

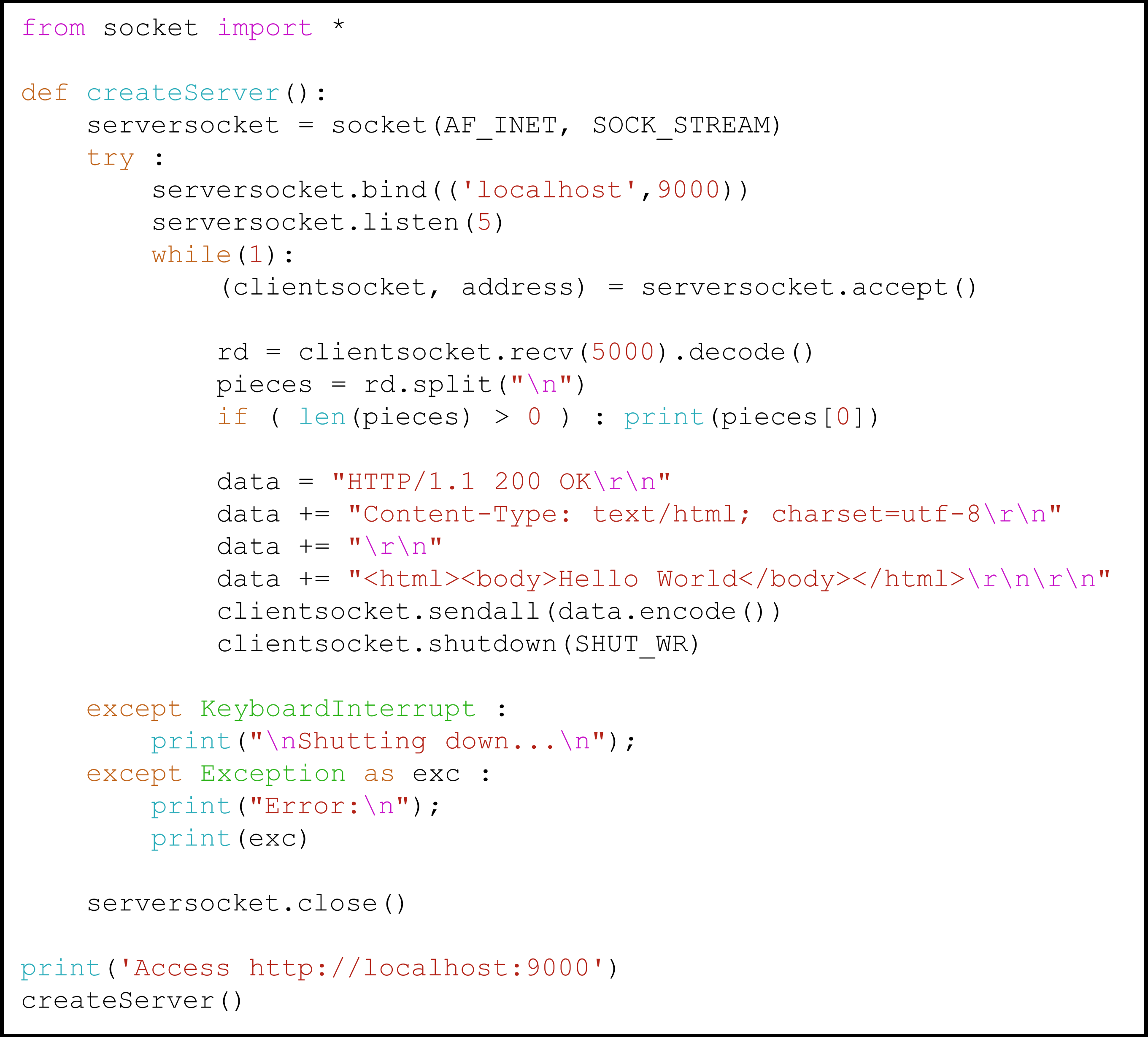
Request

GET http://data.pr4e.org/page2.htm

Response

<h1>The Second Page</h1><p>If you like, you can switch back to the <a href="page1.htm">First Page</a>.</p>

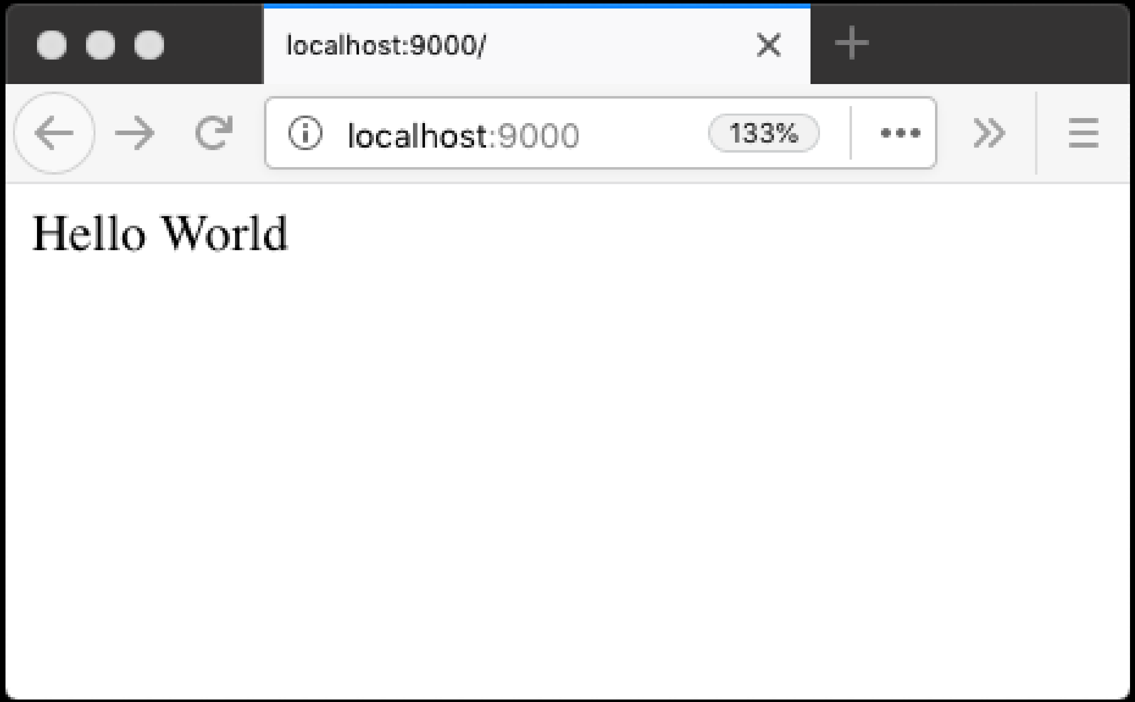
The World's Simplest Web Server



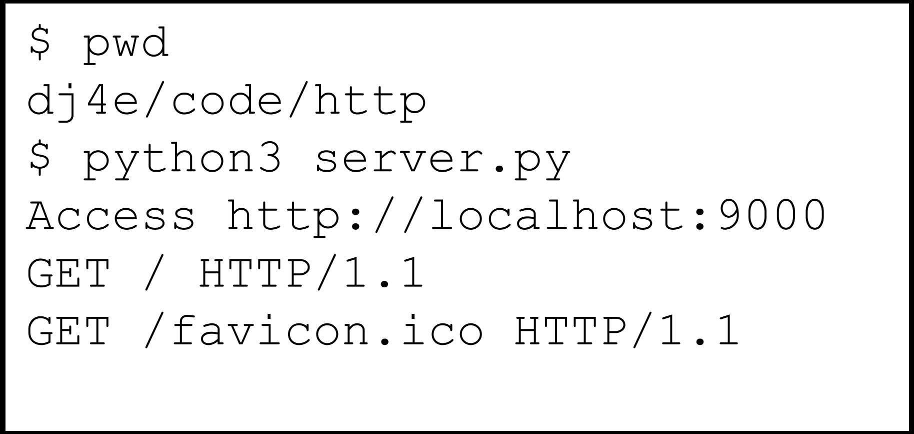
```
from socket import *

def createServer():
    serversocket = socket(AF_INET, SOCK_STREAM)
    try :
        serversocket.bind(('localhost',9000))
        serversocket.listen(5)
        while(1):
            (clientsocket, address) = serversocket.accept()

            rd = clientsocket.recv(5000).decode()
            pieces = rd.split("\n")
            if ( len(pieces) > 0 ) : print(pieces[0])

            data = "HTTP/1.1 200 OK\r\n"
            data += "Content-Type: text/html; charset=utf-8\r\n"
            data += "\r\n"
            data += "<html><body>Hello World</body></html>\r\n\r\n"
            clientsocket.sendall(data.encode())
            clientsocket.shutdown(SHUT_WR)

    except KeyboardInterrupt :
        print("\nShutting down...\n");
    except Exception as exc :
        print("Error:\n");
        print(exc)

    serversocket.close()

print('Access http://localhost:9000')
createServer()
```

https://www.dj4e.com/code/http/server.py

Browser / Server Communication



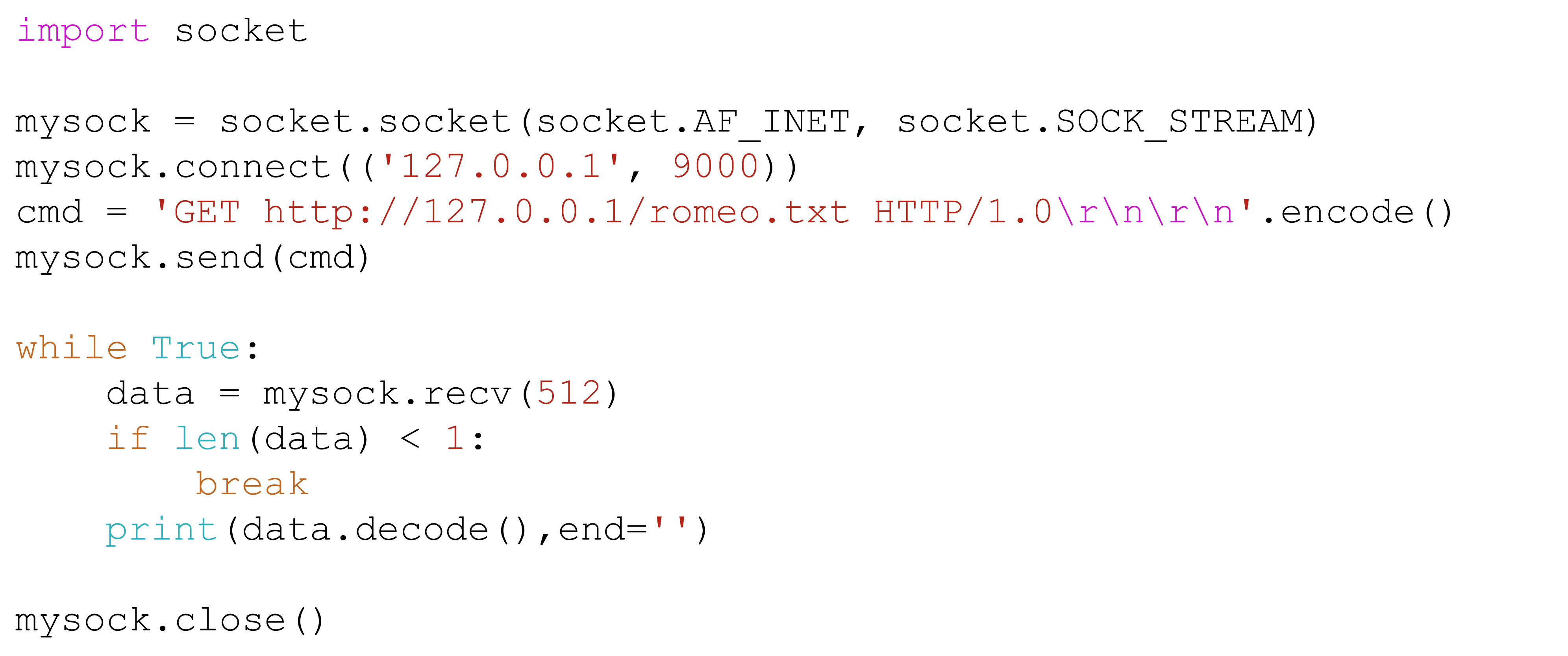
Hello World



```
$ pwd
dj4e/code/http
$ python3 server.py
Access http://localhost:9000
GET / HTTP/1.1
GET /favicon.ico HTTP/1.1
```

https://www.dj4e.com/code/http/server.py

A Very Simple Web Client



```
import socket

mysock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
mysock.connect(('127.0.0.1', 9000))
cmd = 'GET http://127.0.0.1/romeo.txt HTTP/1.0\r\n\r\n'.encode()
mysock.send(cmd)

while True:
    data = mysock.recv(512)
    if len(data) < 1:
        break
    print(data.decode(),end='')

mysock.close()
```

https://www.dj4e.com/code/http/client1.py

Client / Server Communication

```
$ pwd
dj4e/code/http
$ python3 server.py
Access http://localhost:9000
GET http://127.0.0.1/romeo.txt HTTP/1.0
```

```
$ python3 client1.py
HTTP/1.1 200 OK
Content-Type: text/html; charset=utf-8

<html><body>Hello World</body></html>

$
```

An Even Simpler Web Client

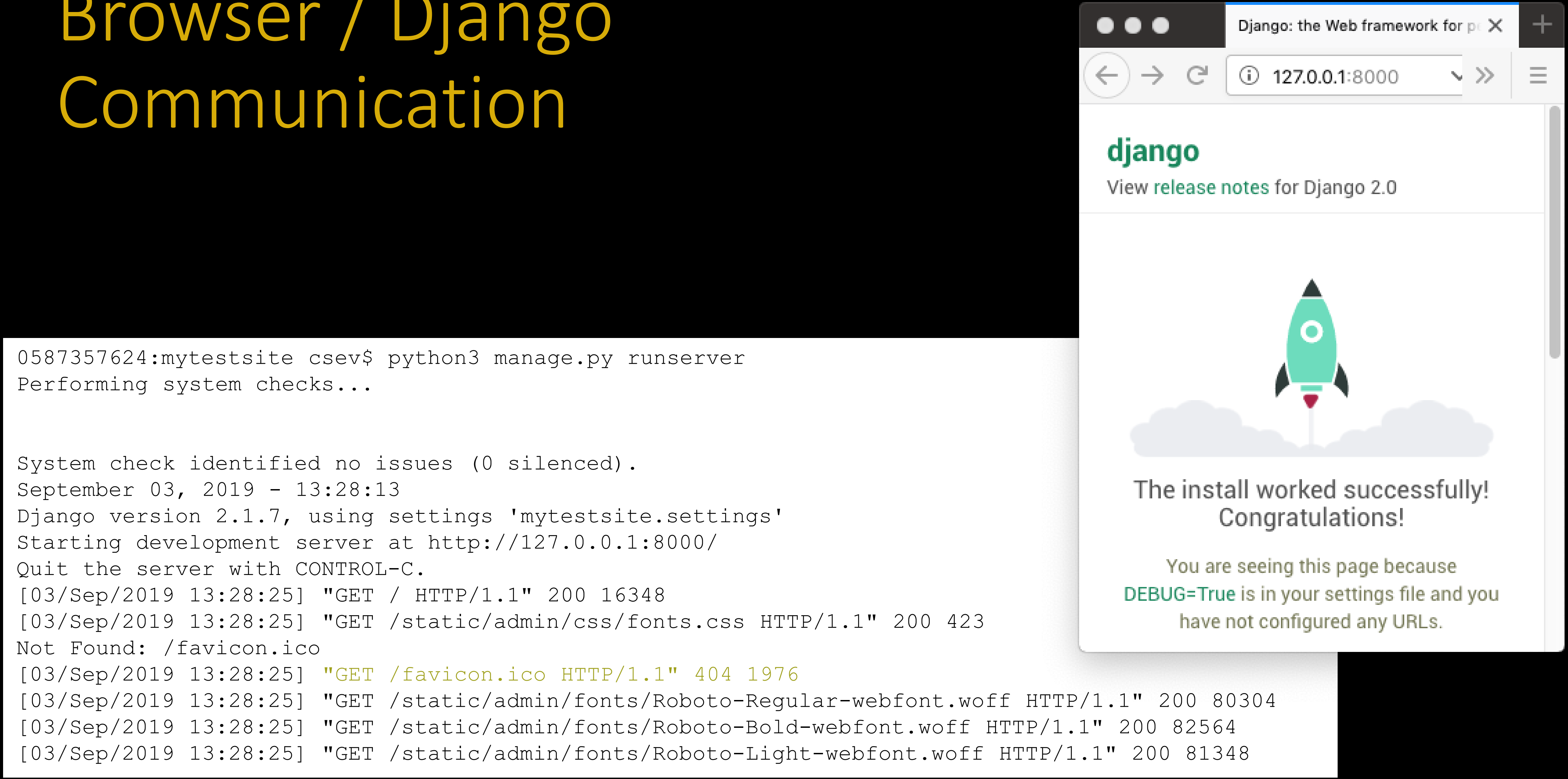
```python
import urllib.request

fhand = urllib.request.urlopen('http://127.0.0.1:9000/romeo.txt')
for line in fhand:
   print(line.decode().strip())
```

```
$ python3 server.py
Access http://localhost:9000
GET http://127.0.0.1/romeo.txt HTTP/1.0
```

```
$ python3 client2.py
<html><body>Hello World</body></html>

$
```

https://www.dj4e.com/code/http/client2.py

Browser / Django Communication



```
0587357624:mytestsite csev$ python3 manage.py runserver
Performing system checks...


System check identified no issues (0 silenced).
September 03, 2019 - 13:28:13
Django version 2.1.7, using settings 'mytestsite.settings'
Starting development server at http://127.0.0.1:8000/
Quit the server with CONTROL-C.
[03/Sep/2019 13:28:25] "GET / HTTP/1.1" 200 16348
[03/Sep/2019 13:28:25] "GET /static/admin/css/fonts.css HTTP/1.1" 200 423
Not Found: /favicon.ico
[03/Sep/2019 13:28:25] "GET /favicon.ico HTTP/1.1" 404 1976
[03/Sep/2019 13:28:25] "GET /static/admin/fonts/Roboto-Regular-webfont.woff HTTP/1.1" 200 80304
[03/Sep/2019 13:28:25] "GET /static/admin/fonts/Roboto-Bold-webfont.woff HTTP/1.1" 200 82564
[03/Sep/2019 13:28:25] "GET /static/admin/fonts/Roboto-Light-webfont.woff HTTP/1.1" 200 81348
```

django

View release notes for Django 2.0

The install worked successfully! Congratulations!

You are seeing this page because DEBUG=True is in your settings file and you have not configured any URLs.

Introduction to Dynamic Web Content

Charles Severance
www.dj4e.com

Acknowledgements / Contributions

Initial Development: Charles Severance, University of Michigan School of Information

Insert new Contributors and Translators here including names and dates

Continue new Contributors and Translators here