CSE 4344 Project 1 Webserver Project Writeup

About:

This program is written in python 3 and developed/tested in a <u>Linux Environment</u>. The web server has been tested on Firefox and Google Chrome.

To run:

There is no need to pip/install packages to run this program. It runs entirely on the default modules. Open a terminal and run the following command:

python3 start_server.py

Use ctrl+c in the terminal to stop the server.

200 Ok

To demonstrate the 200 response go start the server using the command above and go to the url in the web browser: http://localhost:1234/home.html



Home.html get request from the web browser:

```
Wireshark · Packet 39 · Loopt
  Frame 39: 596 bytes on wire (4768 bits), 596 bytes captured (4768 bits) on inte
 Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00), Dst: 00:00:00:00:00:00
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
Transmission Control Protocol, Src Port: 54756, Dst Port: 1234, Seq: 1, Ack: 1,
 Hypertext Transfer Protocol
    GET /home.html HTTP/1.1\r\n
           MOSE: IOCAINOSE:1234\f\n
          Connection: keep-alive\r\n
          Upgrade-Insecure-Requests: 1\r\n
          User-Agent: Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like
          Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,image/avif,imag
          Sec-Fetch-Site: none\r\n
          Sec-Fetch-Mode: navigate\r\n
          Sec-Fetch-User: ?1\r\n
          Sec-Fetch-Dest: document\r\n
          Accept-Encoding: gzip, deflate, br\r\n
          Accept-Language: en-US, en; q=0.9\r\n
           \r\n
           [Full request URI: http://localhost:1234/home.html]
           [HTTP request 1/1]
           [Response in frame: 41]
```

i-know-python.jpg get request from the browser:

```
Frame 46: 514 bytes on wire (4112 bits), 514 bytes captured (4112 bits) on interf
Ethernet II, Src: 00:00:00 00:00:00 (00:00:00:00:00:00), Dst: 00:00:00 00:00:00 (
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
Transmission Control Protocol, Src Port: 54760, Dst Port: 1234, Seq: 1, Ack: 1, I

    Hypertext Transfer Protocol

   GET /i-know-python.jpg HTTP/1.1\r\n
     Host: localhost:1234\r\n
     Connection: keep-alive\r\n
     User-Agent: Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Ge
     Accept: image/avif,image/webp,image/apng,image/*,*/*;q=0.8\r\n
     Sec-Fetch-Site: same-origin\r\n
     Sec-Fetch-Mode: no-cors\r\n
     Sec-Fetch-Dest: image\r\n
     Referer: http://localhost:1234/home.html\r\n
     Accept-Encoding: gzip, deflate, br\r\n
     Accept-Language: en-US, en; q=0.9\r\n
     [Full request URI: http://localhost:1234/i-know-python.jpg]
     [HTTP request 1/1]
     [Response in frame: 52]
```

Server response for home.html:

</html>

Wireshark · Packet 41 · Loopback: lo Frame 41: 549 bytes on wire (4392 bits), 549 bytes captured (4392 bits) on interface lo Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00: Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1 > Transmission Control Protocol, Src Port: 1234, Dst Port: 54756, Seq: 1, Ack: 531, Len: ▼ Hypertext Hypertext Transfer Protocol ▶ HTTP/1.1 200 OK\n ▶ HTTP/1.1 200 OK\n Date: Fri, 02 Oct 2020 20:30:00 GMT\n Server: Michaels-Python-Server (custom)\n Connection: Closed\n Content-Length: 266\n Last-Modified: Wed. 30 Sep 2020 01:01:52 GMT\n Content-Type: text/html\n [HTTP response 1/1] [Time since request: 0.000851648 seconds] [Request in frame: 39] [Request URI: http://localhost:1234/home.html] File Data: 266 bytes Line-based text data: text/html (11 lines) <!DOCTYPE html>\n <html>\n \t<link rel="icon" type="image/x-icon" href="python-icon.ico">\n <title>home</title>\n </head>\n <body>\n <h1>Home Page</h1>\n \n

Server response for i-know-python.jpg:

```
Wireshark · Packet 52 · Loopback: lo
   Frame 52: 25418 bytes on wire (203344 bits), 25418 bytes captured (203344 bits) on interface lo, id 0
▶ Ethernet II, Src: 00:00:00:00 00:00:00 (00:00:00:00:00:00), Dst: 00:00:00 00:00:00 (00:00:00:00:00:00)
▶ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
  [3 Reassembled TCP Segments (90888 bytes): #48(32768), #50(32768), #52(25352)]

Hypertext Transfer Protocol
   HTTP/1.1 200 OK\n
       Date: Fri, ⊎z Oct Z⊎z⊎ 20:30:00 GMT\n
       Server: Michaels-Python-Server (custom)\n
       Connection: Closed\n
    ▶ Content-Length: 90669\n
                                            2020 00:25:18 GMT\n
      Content-Type: image/jpg\n
       [HTTP response 1/1]
       [Time since request: 0.008381564 seconds]
       [Request URI: http://localhost:1234/i-know-python.jpg]
       File Data: 90669 bytes
  JPEG File Interchange Format
      Marker: Start or Image (0xTTO8)

Marker segment: Reserved for application segments - 0 (0xFFE0)

Marker segment: Define quantization table(s) (0xFFDB)

Marker segment: Define quantization table(s) (0xFFDB)

Start of Frame header: Start of Frame (non-differential, Huffman coding) - Baseline DCT (0xFFC0)
      Marker segment: Define Huffman table(s) (0xFFC4)
Marker segment: Define Huffman table(s) (0xFFC4)
      Marker segment: Define Huffman table(s) (0xFFC4)
Marker segment: Define Huffman table(s) (0xFFC4)
      Start of Segment header: Start of Scan (0xFFDA)
       Entropy-coded segment (dissection is not yet implemented): fc2ebe433191b90707a73d4f7fc735c3dcda980ef7c92ecc...
       Marker: End of Image (0xffd9)
```

301 Moved Permanently

To demonstrate a 301 response go to the browser and type: http://localhost:1234/index.html

This will redirect to the home.html page as shown previously. The screenshots are displayed below.

index.html get request from the web browser:

Wireshark · Packet 112 · Loopback: lo

```
▶ Frame 112: 597 bytes on wire (4776 bits), 597 bytes captured (4776 bits) on interface lo, id
▶ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:
▶ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
> Transmission Control Protocol, Src Port: 54780, Dst Port: 1234, Seq: 1, Ack: 1, Len: 531

→ Hypertext Transfer Protocol

   GET /index.html HTTP/1.1\r\n
      Host: localhost:1234\r\n
      Connection: keep-alive\r\n
      Upgrade-Insecure-Requests: 1\r\n
      User-Agent: Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/
      Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/
      Sec-Fetch-Site: none\r\n
      Sec-Fetch-Mode: navigate\r\n
      Sec-Fetch-User: ?1\r\n
      Sec-Fetch-Dest: document\r\n
            \begin{tabular}{lll} Accept-Encoding: & gzip, & deflate, & br\r\n \\ Accept-Language: & en-US, en; & q=0.9\r\n \\       \end{tabular} 
      [Full request URI: http://localhost:1234/index.html]
      [HTTP request 1/1]
      [Response in frame: 114]
```

301 response from the server:

```
Wireshark · Packet 114 · Loopback: lo
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
 Transmission Control Protocol, Src Port: 1234, Dst Port: 54780, Seq: 1, Ack: 532, Len: 401

    Hypertext Transfer Protocol

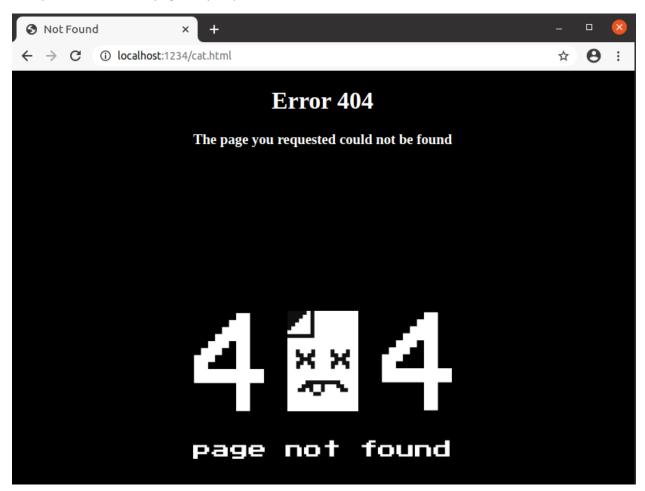
    HTTP/1.0 301 Moved Permanentlv\n
  HTTP/1.0 301 Moved Permanently\n
    Server: Michaels-Python-Server (custom)\n
    Connection: Closed\n
    Location: http://localhost:1234/home.html\n
    content-Type: text/ntmi\n
    [HTTP response 1/1]
    [Time since request: 0.001468770 seconds]
    [Request URI: http://localhost:1234/index.html]
    File Data: 15/ bytes

▼ Line-based text data: text/html (9 lines)
    <!DOCTYPE html>\n
    <html>\n
    <head>\n
    \t<title>Moved Permanently</title>\n
    </head>\n
    \t<body>\n
    \t\t<h1>The requested document has been moved permanently</h1>\n
    \t</body>\n
    </html>
```

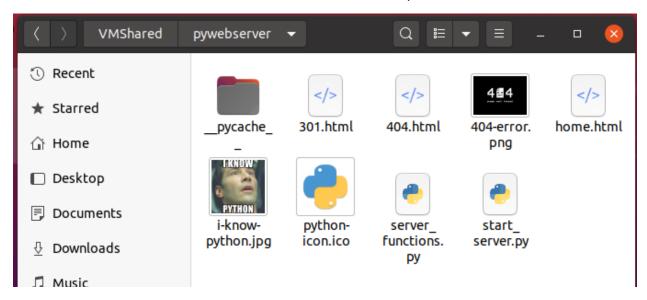
This redirects back to home.html as shown before.

404 Page Not Found

For the 404 response, I created an html file called 404.html. This file displays some text and an image to notify the user that the page they requested could not be found:



To demonstrate this, here are the current contents of the directory:



The webserver is running from this directory and I will request an html file in the browser called "cat.html". Since this file does not exists it should generate a 404 error.

cat.html get request from the web browser:

```
Wireshark · Packet 167 · Loo
  Frame 167: 595 bytes on wire (4760 bits), 595 bytes captured (4760 bits) on in
▶ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00), Dst: 00:00:00_00:00:0
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
Transmission Control Protocol, Src Port: 54792, Dst Port: 1234, Seq: 1, Ack: 1
 Hypertext Transfer Protocol
  GET /cat.html HTTP/1.1\r\n
     Host: localhost:1234\r\n
     Connection: keep-alive\r\n
     Upgrade-Insecure-Requests: 1\r\n
     User-Agent: Mozilla/5.0 (X11; Linux x86 64) AppleWebKit/537.36 (KHTML, like
     Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,im
     Sec-Fetch-Site: none\r\n
     Sec-Fetch-Mode: navigate\r\n
     Sec-Fetch-User: ?1\r\n
     Sec-Fetch-Dest: document\r\n
     Accept-Encoding: gzip, deflate, br\r\n
     Accept-Language: en-US, en; q=0.9\r\n
     \r\n
     [Full request URI: http://localhost:1234/cat.html]
     [HTTP request 1/1]
     [Response in frame: 170]
```

404 response from the server:

```
Wireshark · Packet 170 · Loopback: lo
 Frame 170: 625 bytes on wire (5000 bits), 625 bytes captured (5000 bits) on interface lo, id 0
Ethernet II, Src: 00:00:00:00:00:00:00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)
 Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
 Transmission Control Protocol, Src Port: 1234, Dst Port: 54792, Seq: 1, Ack: 530, Len: 559
 Hypertext Transfer Protocol
  HTTP/1.1 404 Not Found\n
     Date: Fri, 02 Oct 2020 21:05:26 GMT\n
     Server: Michaels-Python-Server (custom)\n
     Connection: Closed\n
    Content-Length: 373\n
     Content-Type: text/html\n
     [HTTP response 1/1]
     [Time since request: 0.019923617 seconds]
     [Request in frame: 167]
     [Request URI: http://localhost:1234/cat.html]
     <u>File Data: 373 bytes</u>
 Line-based text data: text/html (17 lines)
     <!DOCTYPE html>\n
     <hmtl>\n
         <head>\n
         \t<style type="text/css">\n
         \t\tbody {background-color: black}\n
         \t\th1, h3 {color: white}\n
         \t</style>\n
             <title>Not Found</title>\n
         </head>
                  \n
         <body>\n
         \t<center>\n
         \t\t<h1>Error 404</h1>\n
     ١t
               <h3>The page you requested could not be found</h3>\n
               <img src="./404-error.png" />\n
     ١t
         \t</center>\n
         </body>\n
     </html>
```

404-error.png get request from the web browser:

Wireshark · Packet 177 · Loopback: lo Frame 177: 509 bytes on wire (4072 bits), 509 bytes captured (4072 bits) ▶ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00 Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1 Transmission Control Protocol, Src Port: 54796, Dst Port: 1234, Seq: 1, A GET /404-error.png HTTP/1.1\r\n Host: localhost:1234\r\n Connection: keep-alive\r\n User-Agent: Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, Accept: image/avif,image/webp,image/apng,image/*,*/*;q=0.8\r\n Sec-Fetch-Site: same-origin\r\n Sec-Fetch-Mode: no-cors\r\n Sec-Fetch-Dest: image\r\n Referer: http://localhost:1234/cat.html\r\n Accept-Encoding: gzip, deflate, br\r\n Accept-Language: en-US,en;q=0.9\r\n \r\n [Full request URI: http://localhost:1234/404-error.png] [HTTP request 1/1] [Response in frame: 179]

404-error.png response from server:

```
Wireshark · Packet 179 · Loopback: lo
Frame 179: 4567 bytes on wire (36536 bits), 4567 bytes captured (36536 bits)
Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:
▶ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
> Transmission Control Protocol, Src Port: 1234, Dst Port: 54796, Seq: 1, Ack:

    Hypertext Transfer Protocol

  ► HTTP/1.1 200 OK\n
► HTTP/1.1 200 OK\n
     Date: Fri, 02 Oct 2020 21:05:26 GMT\n
     Server: Michaels-Python-Server (custom)\n
     Connection: Closed\n
   Content-Length: 4283\n
     Last-Modified: Wed, 30 Sep 2020 00:34:34 GMT\n
     Content-Type: image/png\n
     [HTTP response 1/1]
     [Time since request: 0.001129250 seconds]
      Request in frame: 1771
     [Request URI: http://localhost:1234/404-error.png]
     File Data: 4283 bytes
  Portable Network Graphic
     PNG Signature: 89504e470d0a1a0a
     Image Header (IHDR)
     Image data chunk (IDAT)
     Image Trailer (IEND)
```

Known Bugs

The program runs fine and as far as I can tell there are no know bugs that crash the server by navigating to different pages. However, for some reason, some of the threads will run into an IndexError trying to read from the tokenized list of strings that are received when the server receives a request from the browser (this list is used to obtain the file requested). The server will receive an a get request, but there will be no file requested from the browser in the response. This is a minor bug and will NOT crash the program.

References

https://realpython.com/python-sockets/

https://realpython.com/intro-to-python-threading/

https://docs.python.org/3/library/datetime.html