

NETWORK ARCHITECTURE - 1

HOME WORK - 4

FALL 2016



SUBMITTED BY:

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1. Suppose within your Web browser you click on a link to obtain a web page. The IP address for the associated URL is cached in your local host, so a DNS look-up is not necessary to obtain the IP address. Further suppose that the Web page associated with the link references ten very small objects on the same server. Let RTT_0 denote the RTTs between the local host and one of the objects. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the full web page with

a. Non-persistent HTTP?

b. Persistent HTTP?

Ans:

Web page is associated with the link references of 10 very small objects on the same server. The IP address for the associated URL is cached in the local host, so a DNS look up is not necessary to obtain the IP address. Given transmission time of the object is zero.

Number of objects = 10

RTT between the local host and one of the objects = RTT_0

Non-persistent HTTP: At most only one object can be sent over TCP connection.

Persistent HTTP: Multiple objects can be sent over a single TCP connection.

Non-persistent HTTP without parallel connections:

For each object in non-persistent HTTP, a new TCP connection has to be setup. So the total time would be twice the round trip time.

Time taken to receive the base HTML file = $2RTT_0$

Time taken to receive each object = $2RTT_0$

Number of objects = 10

Time required for 10 objects = $10 \times (2RTT_0) = 20RTT_0$

Total time = $2RTT_0 + 20RTT_0 = 22RTT_0$

Time taken by 10 objects using non-persistent HTTP without parallel connections is $22RTT_0$

Non-persistent HTTP with parallel connections:

In non-persistent HTTP with parallel connections, all the objects can be sent at the same time by establishing multiple TCP connections at the same time in a parallel manner.

Time taken to receive the base HTML file = $2RTT_0$

Time taken to receive all the 10 objects in a parallel way = $2RTT_0$

Total time = $2RTT_0 + 2RTT_0 = 4RTT_0$

Time taken by 10 objects using non-persistent HTTP with parallel connections is $4RTT_0$

Persistent HTTP without pipelining connections:

In persistent HTTP, the connection is setup and the object is sent over the same.

Time taken to receive the base HTML file = $2RTT_0$

Time taken to receive each object = RTT_0

Number of objects = 10

Time required for 10 objects = $10 \times (RTT_0) = 10RTT_0$

Total time = $2RTT_0 + 10RTT_0 = 12RTT_0$

Time taken by 10 objects using persistent HTTP without pipelining connections is $12RTT_0$

Persistent HTTP with pipelining connections:

In persistent HTTP with pipelining connections, all the objects are sent in a pipelining method on the line over which the connection is setup.

Time taken to receive the base HTML file = $2RTT_0$

Time taken to receive all the 10 objects in a pipelining way = RTT_0

Total time = $2RTT_0 + RTT_0 = 3RTT_0$

Time taken by 10 objects using persistent HTTP with pipelining connections is $3RTT_0$

2. Describe in detail i) what information should be added in which DNS servers for your own start-up company (say 'networkguru.com') that has a web server and email service to its employees. ii) What are companies you can contact for domain name registration and how much are the fees?

Ans:

(i)

A domain name is a unique name that is used for the identification of a website. Each website has a domain name that serves as an address that can be used to access the website. Domain name is the replacement of IP address which points to the IP address that is used to identify a computer.

Steps for registering for a domain name:

1. First we need to check for the availability of the domain name. This verification can be done using many web based tools.
2. After checking for the availability of the domain name, contact registrar for the registration of the domain name.
3. Registrar registers the domain name with a static IP address and names of the servers in the appropriate TLD servers.

For new start-up, **networkguru.com**

Register name **networkguru.com** at DNS registrar.

1. Provides names, IP addresses of authoritative name server (primary and secondary). Registrar inserts 2 RR's into .com TLD server.
2. For web server:

(networkguru.com, dns1.networkguru.com, NS)

(dns1.networkguru.com, 212.212.212.1, A)
3. For mail server:

(mail.networkguru.com, mail1.networkguru.com, MX)

(mail1.networkguru.com, 212.212.212.1, A)

(ii)

There are many companies that do the domain name registration. Some of them are Network Solutions, Go Daddy, Melbourne IT, etc. ICANN (The Internet Corporation for Assigned Names and Numbers) is the non-profit organization that is responsible for the accreditation of the domain name servers.

For a TLD domain, it costs around \$20 to \$30 per year whereas country specific domains cost a little more. Once the domain name is registered, it can be accessed from any part of the world.

3. What is meant by a stateful protocol? What is/are an example(s) of stateful protocol? What are the pros and cons of a stateful protocol?

Ans:

Stateful protocol: A communication protocol which requires keeping of the internal state on the server is known as a stateful protocol. It requires the server to retain session information or status about each communications partner for the duration of multiple requests. It requires dynamic allocation of storage to deal with conversations in progress. If a client session dies in mid-transaction, a part of the system needs to be responsible for cleaning up the present state of the server.

Examples of stateful protocol:

TCP (Transmission Control Protocol)

BGP (Broad Gateway Protocol)

Pros and Cons of stateful protocol:

Pros:

1. It retains session information about each communication.
2. It uses dynamic allocation of storage.
3. It keeps the internal state on the server.

Cons:

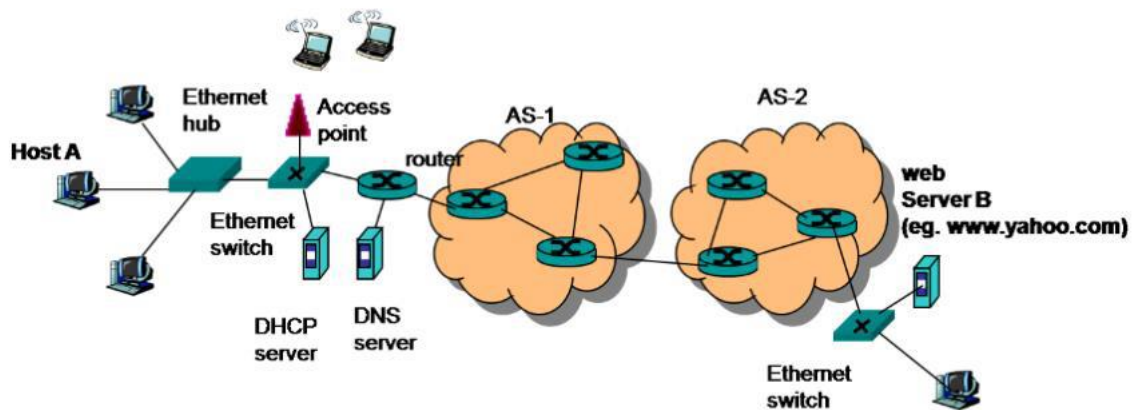
1. When the client session dies in mid-transaction, a part of the system needs to be responsible for cleaning up the present state of the server.
2. Every new request is related to the previous request.

4. Fill out the blanks below.

	Stop-n-Wait	Go-back-N	Selective Repeat
Minimum No. of Sequence number required	2	N+1	N+N
Sender's buffer size	1	N	N
Receiver's buffer size	1	1	N
No. of timers required	1	1	N

5. Consider an end-to-end communication from a host A to web server B. A user on host A clicks on the web page of web server B which is multiple AS hops away. All routers are connected with PPP (Point-to-Point Protocol) links.

Write a series of protocols used for a packet to be transferred from A to B throughout the protocol stack in data plane as well as control protocols necessary. Assume host A just gets into an Ethernet local network, thus nothing has configured initially. Host B is connected to an Ethernet LAN. Routing protocols used in each AS is not given intentionally. Assign any proper routing protocols.



Ans: The following are the protocols used for a packet to be transferred from A to B throughout the protocol stack in data plane as well as control protocols which are necessary.

- ❖ Hyper Text Transfer Protocol (HTTP) with method GET/POST
- ❖ ARP: Address Resolution Protocol,
- ❖ PPP: Point-to-Point protocol
- ❖ TCP: Application, Transport,
- ❖ IP: Network,
- ❖ MAC addresses

- ❖ Domain Name Services (DNS -resolving a host name to an IP address),
- ❖ Routing Protocol
- ❖ RIP
- ❖ OSPF
- ❖ IGRP
- ❖ iBGP/eBGP

Laboratory Homework

Part-1: Telnet Experiments

1. Try HTTP request (GET, HEAD, or POST) without using a web-browser. You can do this on command line using '> telnet webserver 80'. (for example, www.umkc.edu) Record the HTTP responses from the server – retrieve at least two different response status from the server.

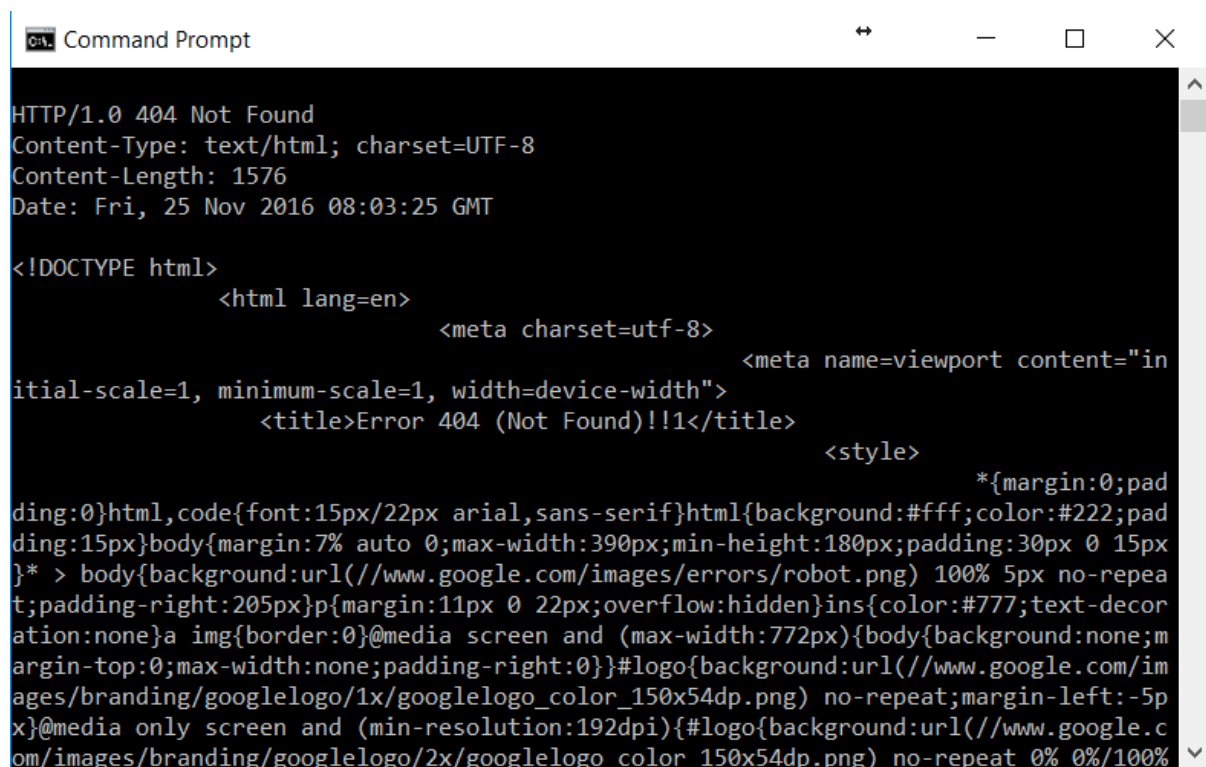
Ans:

GET Method:

telnet www.google.com 80

GET /browse/HTTP/1.1

Response 1: 404 Not Found



```

C:\> telnet www.google.com 80
HTTP/1.0 404 Not Found
Content-Type: text/html; charset=UTF-8
Content-Length: 1576
Date: Fri, 25 Nov 2016 08:03:25 GMT

<!DOCTYPE html>
    <html lang=en>
        <meta charset=utf-8>
            <meta name=viewport content="initial-scale=1, minimum-scale=1, width=device-width">
                <title>Error 404 (Not Found)!!1</title>
                    <style>
                        *{margin:0;padding:0}html,code{font:15px/22px arial,sans-serif}html{background:#fff;color:#222;padding:15px}body{margin:7% auto 0;max-width:390px;min-height:180px;padding:30px 0 15px}* > body{background:url(//www.google.com/images/errors/robot.png) 100% 5px no-repeat;padding-right:205px}p{margin:11px 0 22px;overflow:hidden}ins{color:#777;text-decoration:none}a img{border:0}@media screen and (max-width:772px){body{background:none;margin-top:0;max-width:none;padding-right:0}}#logo{background:url(//www.google.com/images/branding/googlelogo/1x/googlelogo_color_150x54dp.png) no-repeat;margin-left:-5px}@media only screen and (min-resolution:192dpi){#logo{background:url(//www.google.com/images/branding/googlelogo/2x/googlelogo_color_150x54dp.png) no-repeat 0% 0%/100%

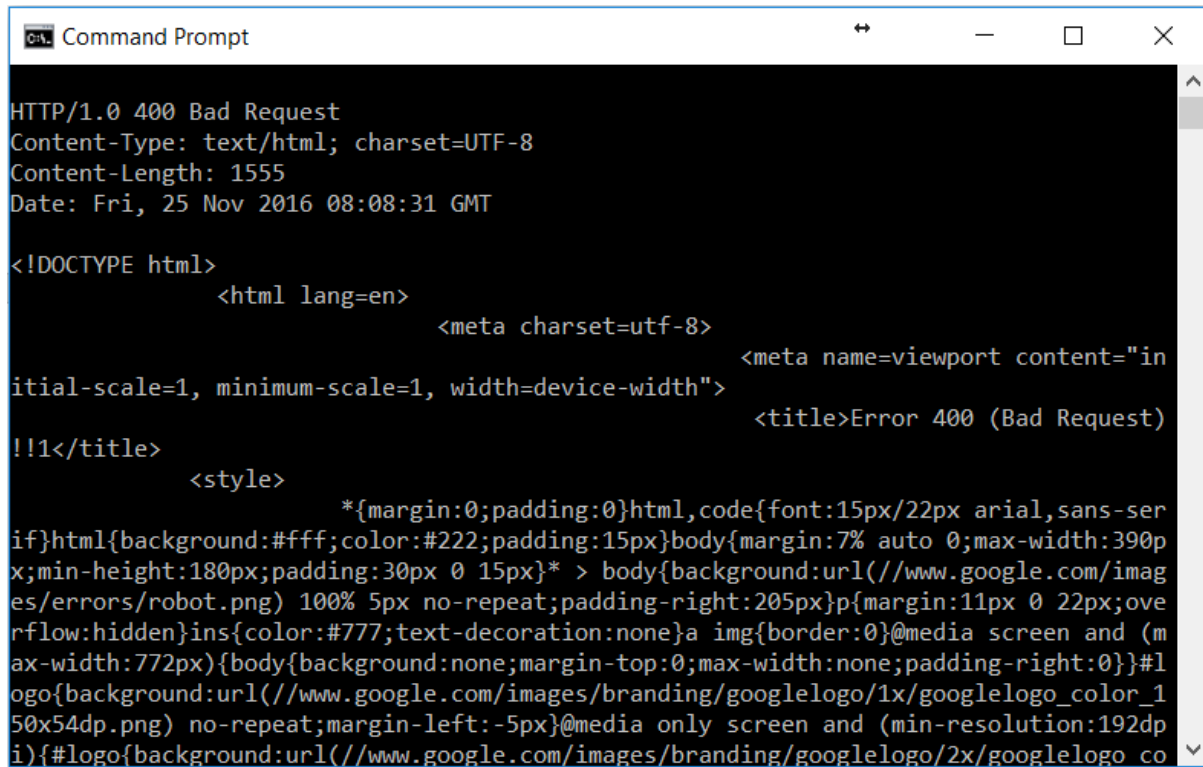
```

GET Method

telnet www.google.com 80

GET / homepage/HTTP/1.1

Response 2: 400 Bad Request



```
Command Prompt

HTTP/1.0 400 Bad Request
Content-Type: text/html; charset=UTF-8
Content-Length: 1555
Date: Fri, 25 Nov 2016 08:08:31 GMT

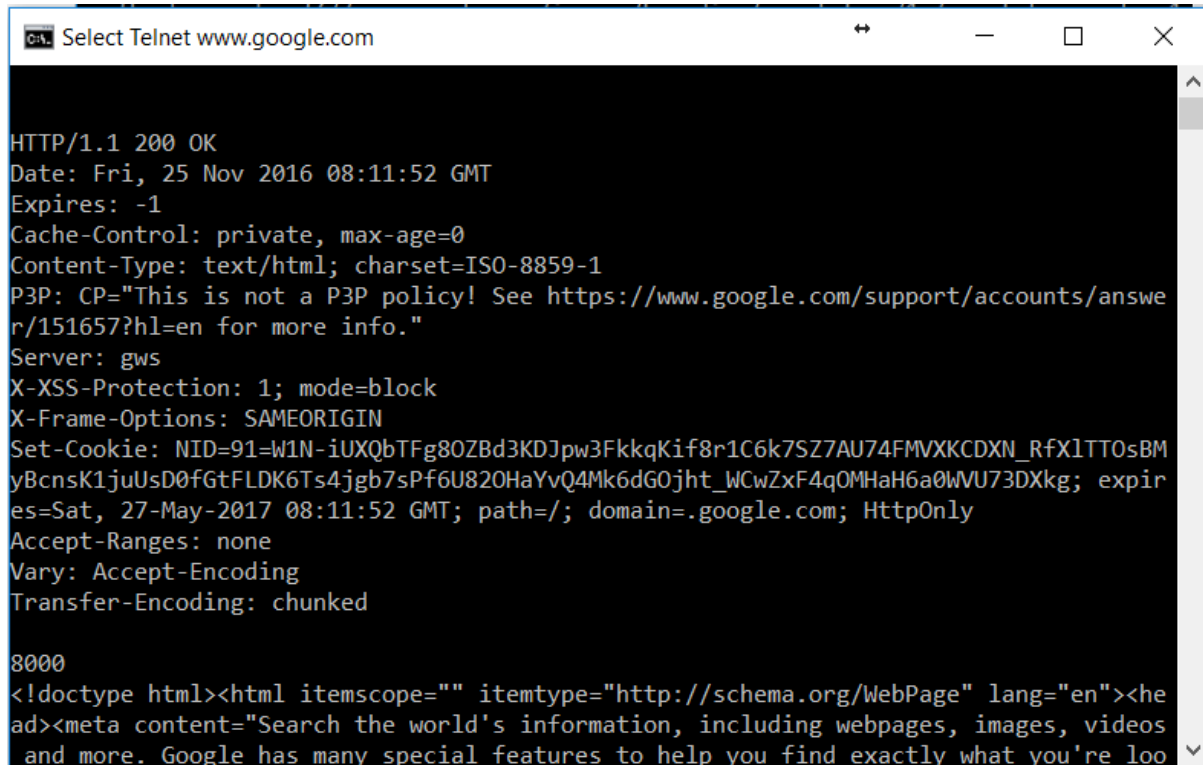
<!DOCTYPE html>
  <html lang=en>
    <meta charset=utf-8>
    <meta name=viewport content="initial-scale=1, minimum-scale=1, width=device-width">
    <title>Error 400 (Bad Request)
  !!1</title>
  <style>
    *{margin:0;padding:0}html,code{font:15px/22px arial,sans-serif}html{background:#fff;color:#222;padding:15px}body{margin:7% auto 0;max-width:390px;min-height:180px;padding:30px 0 15px}* > body{background:url(//www.google.com/images/errors/robot.png) 100% 5px no-repeat;padding-right:205px}p{margin:11px 0 22px;overflow:hidden}ins{color:#777;text-decoration:none}a img{border:0}@media screen and (max-width:772px){body{background:none;margin-top:0;max-width:none;padding-right:0}}#logo{background:url(//www.google.com/images/branding/googlelogo/1x/googlelogo_color_150x54dp.png) no-repeat;margin-left:-5px}@media only screen and (min-resolution:192dpi){#logo{background:url(//www.google.com/images/branding/googlelogo/2x/googlelogo_color_150x54dp.png) no-repeat;margin-left:-5px}}
```


GET Method

telnet www.google.com 80

GET / HTTP/1.1

Response 3: 200 OK

A screenshot of a Telnet window titled "Select Telnet www.google.com". The window shows the output of a telnet command to www.google.com on port 80. The output is an HTTP 200 OK response with various headers and the beginning of the HTML document. The text is as follows:

```
HTTP/1.1 200 OK
Date: Fri, 25 Nov 2016 08:11:52 GMT
Expires: -1
Cache-Control: private, max-age=0
Content-Type: text/html; charset=ISO-8859-1
P3P: CP="This is not a P3P policy! See https://www.google.com/support/accounts/answer/151657?hl=en for more info."
Server: gws
X-XSS-Protection: 1; mode=block
X-Frame-Options: SAMEORIGIN
Set-Cookie: NID=91=w1N-iUXQbTFg80ZBd3KDJpw3FkkqKif8r1C6k7SZ7AU74FMVXKCDXN_RfXlTTOsBM
yBcnsK1juUsD0fGtFLDK6Ts4jgb7sPf6U820HaYvQ4Mk6dG0jht_WCwZxF4q0MH6a0WVU73DXkg; expires=Sat, 27-May-2017 08:11:52 GMT; path=/; domain=.google.com; HttpOnly
Accept-Ranges: none
Vary: Accept-Encoding
Transfer-Encoding: chunked

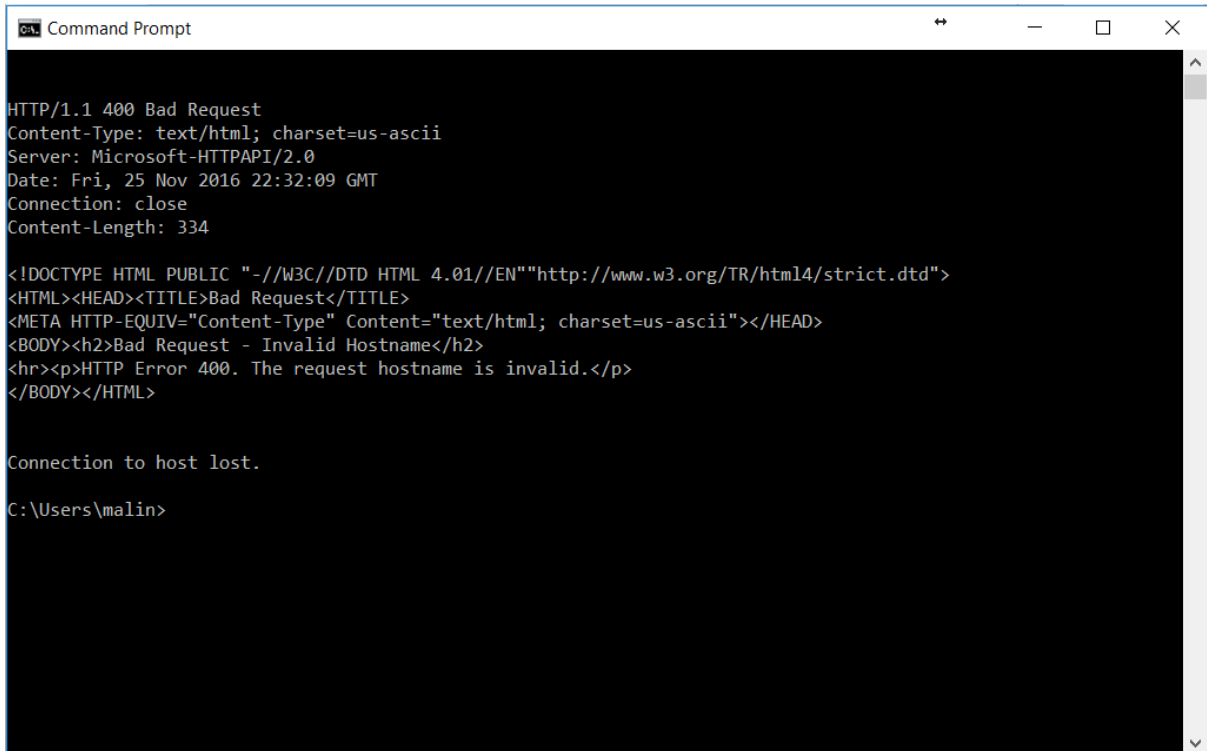
8000
<!doctype html><html itemscope="" itemtype="http://schema.org/WebPage" lang="en"><head><meta content="Search the world's information, including webpages, images, videos
and more. Google has many special features to help you find exactly what you're loo
```

HEAD Method:

telnet sce.umkc.edu 80

HEAD /research/HTTP/1.1

Response 1: 400 Bad Request



```
Command Prompt

HTTP/1.1 400 Bad Request
Content-Type: text/html; charset=us-ascii
Server: Microsoft-HTTPAPI/2.0
Date: Fri, 25 Nov 2016 22:32:09 GMT
Connection: close
Content-Length: 334

<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01//EN" "http://www.w3.org/TR/html4/strict.dtd">
<HTML><HEAD><TITLE>Bad Request</TITLE>
<META HTTP-EQUIV="Content-Type" Content="text/html; charset=us-ascii"></HEAD>
<BODY><h2>Bad Request - Invalid Hostname</h2>
<hr><p>HTTP Error 400. The request hostname is invalid.</p>
</BODY></HTML>

Connection to host lost.

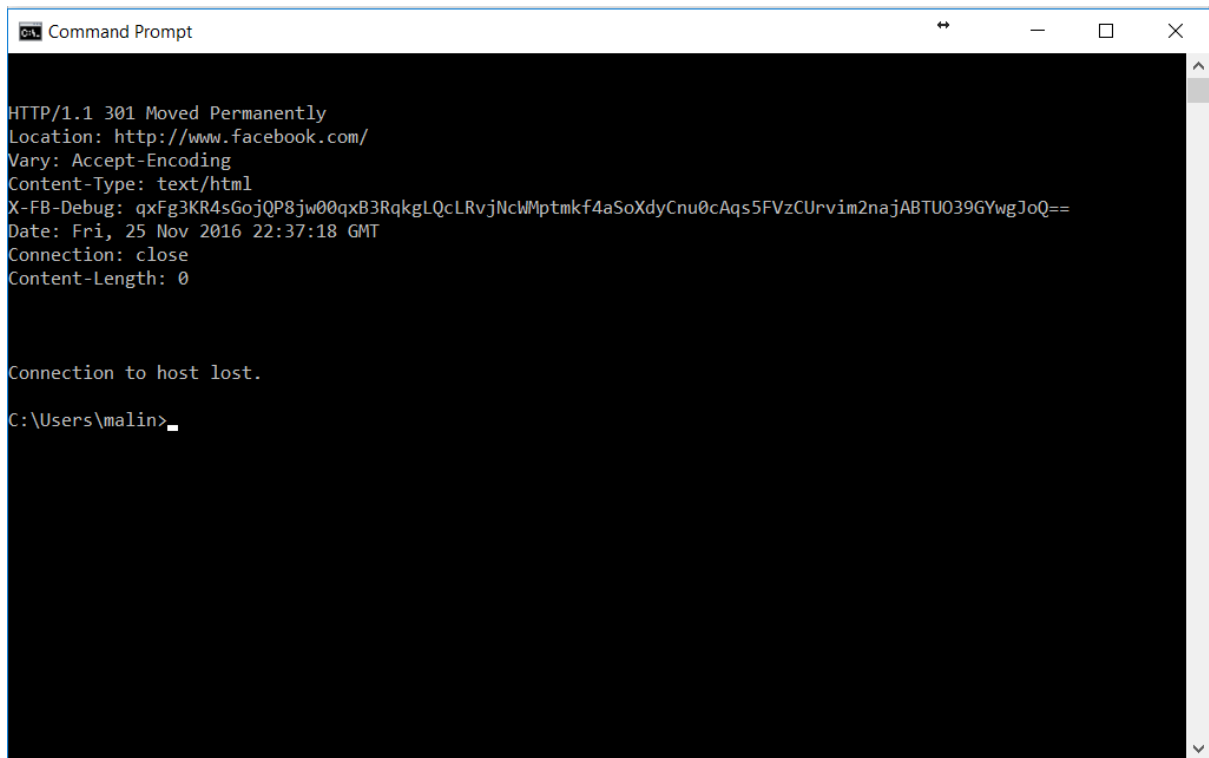
C:\Users\malin>
```

HEAD Method:

telnet www.facebook.com 80

HEAD /HTTP/1.1

Response 2: 301 Moved Permanently



```
Command Prompt

HTTP/1.1 301 Moved Permanently
Location: http://www.facebook.com/
Vary: Accept-Encoding
Content-Type: text/html
X-FB-Debug: qxfg3KR4sGojQP8jw00qx83RqkgLQcLRvjNclWptmkf4aSoXdyCnu0cAqs5FVzCURvim2najABTU039GYwgJoQ==
Date: Fri, 25 Nov 2016 22:37:18 GMT
Connection: close
Content-Length: 0

Connection to host lost.

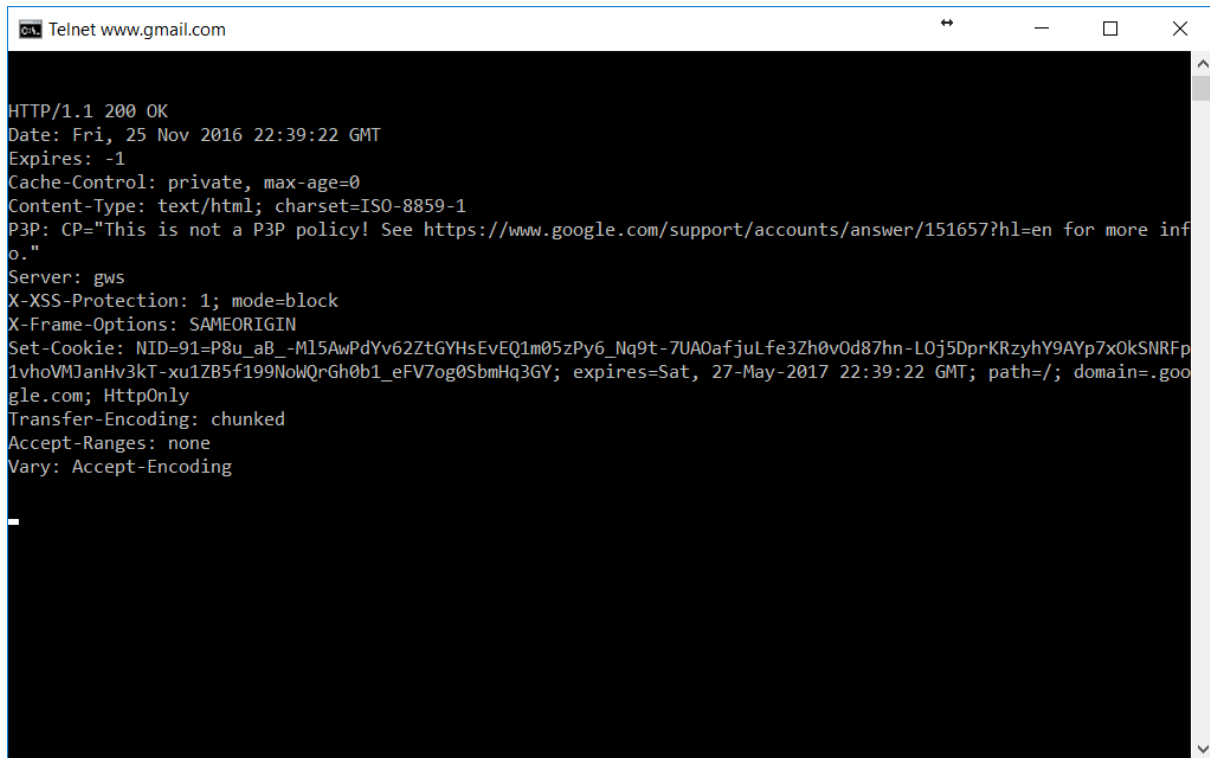
C:\Users\malin>
```

HEAD Method:

telnet www.gmail.com 80

HEAD / HTTP/1.1

Response 3: 200 OK

A screenshot of a Telnet window titled "Telnet www.gmail.com". The window shows the output of a HEAD request to www.gmail.com. The response is an HTTP 200 OK status. The headers include: Date: Fri, 25 Nov 2016 22:39:22 GMT; Expires: -1; Cache-Control: private, max-age=0; Content-Type: text/html; charset=ISO-8859-1; P3P: CP="This is not a P3P policy! See https://www.google.com/support/accounts/answer/151657?hl=en for more info."; Server: gws; X-XSS-Protection: 1; mode=block; X-Frame-Options: SAMEORIGIN; Set-Cookie: NID=91=P8u_aB_-M15AwPdYv62ZtGYHsEvEQ1m05zPy6_Nq9t-7UA0afjuLfe3Zh0v0d87hn-LOj5DprKRzyhY9AYp7x0kSNRFP1vhoVMJanHv3kT-xu1ZB5f199NoWQrGh0b1_eFV7og0SbmHq3GY; expires=Sat, 27-May-2017 22:39:22 GMT; path=/; domain=.google.com; HttpOnly; Transfer-Encoding: chunked; Accept-Ranges: none; Vary: Accept-Encoding. The body of the response is truncated with a single hyphen character.

```
Telnet www.gmail.com

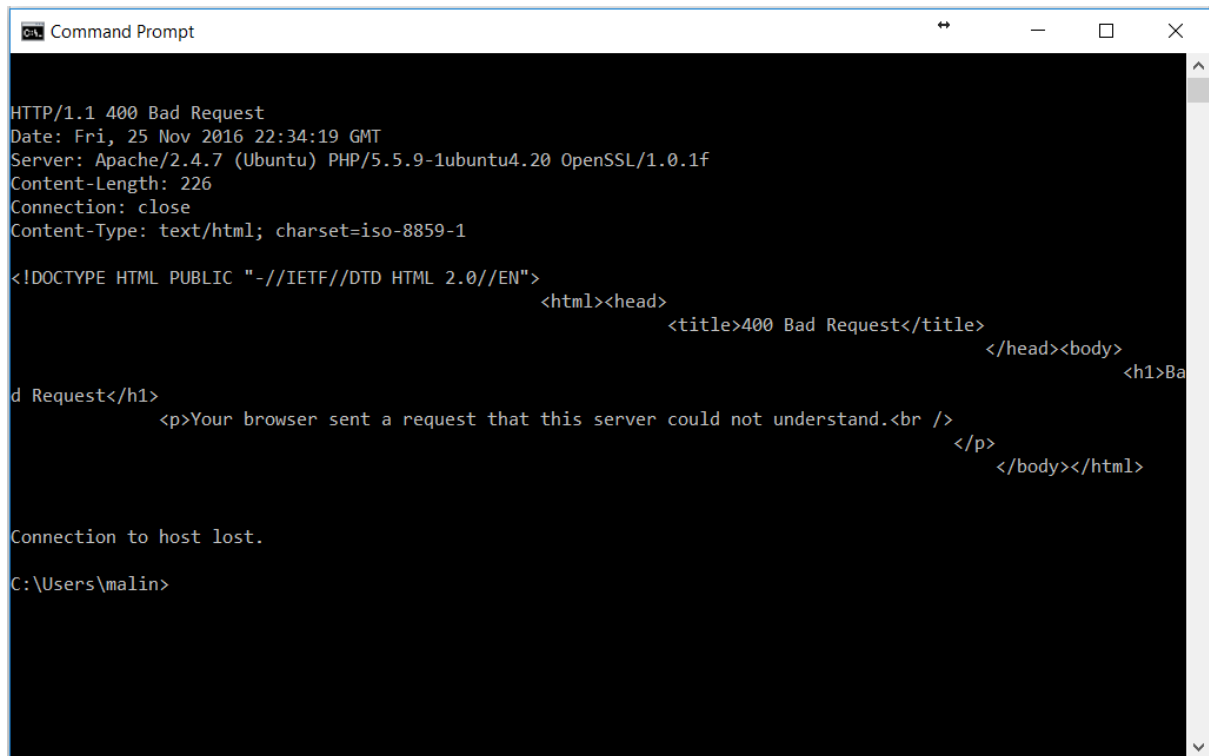
HTTP/1.1 200 OK
Date: Fri, 25 Nov 2016 22:39:22 GMT
Expires: -1
Cache-Control: private, max-age=0
Content-Type: text/html; charset=ISO-8859-1
P3P: CP="This is not a P3P policy! See https://www.google.com/support/accounts/answer/151657?hl=en for more info."
Server: gws
X-XSS-Protection: 1; mode=block
X-Frame-Options: SAMEORIGIN
Set-Cookie: NID=91=P8u_aB_-M15AwPdYv62ZtGYHsEvEQ1m05zPy6_Nq9t-7UA0afjuLfe3Zh0v0d87hn-LOj5DprKRzyhY9AYp7x0kSNRFP1vhoVMJanHv3kT-xu1ZB5f199NoWQrGh0b1_eFV7og0SbmHq3GY; expires=Sat, 27-May-2017 22:39:22 GMT; path=/; domain=.google.com; HttpOnly
Transfer-Encoding: chunked
Accept-Ranges: none
Vary: Accept-Encoding
-
```

POST Method:

telnet sce.umkc.edu 80

POST /scholarships/ HTTP/1.1

Response 1: 400 Bad Request



```
Command Prompt

HTTP/1.1 400 Bad Request
Date: Fri, 25 Nov 2016 22:34:19 GMT
Server: Apache/2.4.7 (Ubuntu) PHP/5.5.9-1ubuntu4.20 OpenSSL/1.0.1f
Content-Length: 226
Connection: close
Content-Type: text/html; charset=iso-8859-1

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
    <html><head>
        <title>400 Bad Request</title>
    </head><body>
        <h1>Bad Request</h1>
        <p>Your browser sent a request that this server could not understand.<br />
    </p>
    </body></html>

Connection to host lost.

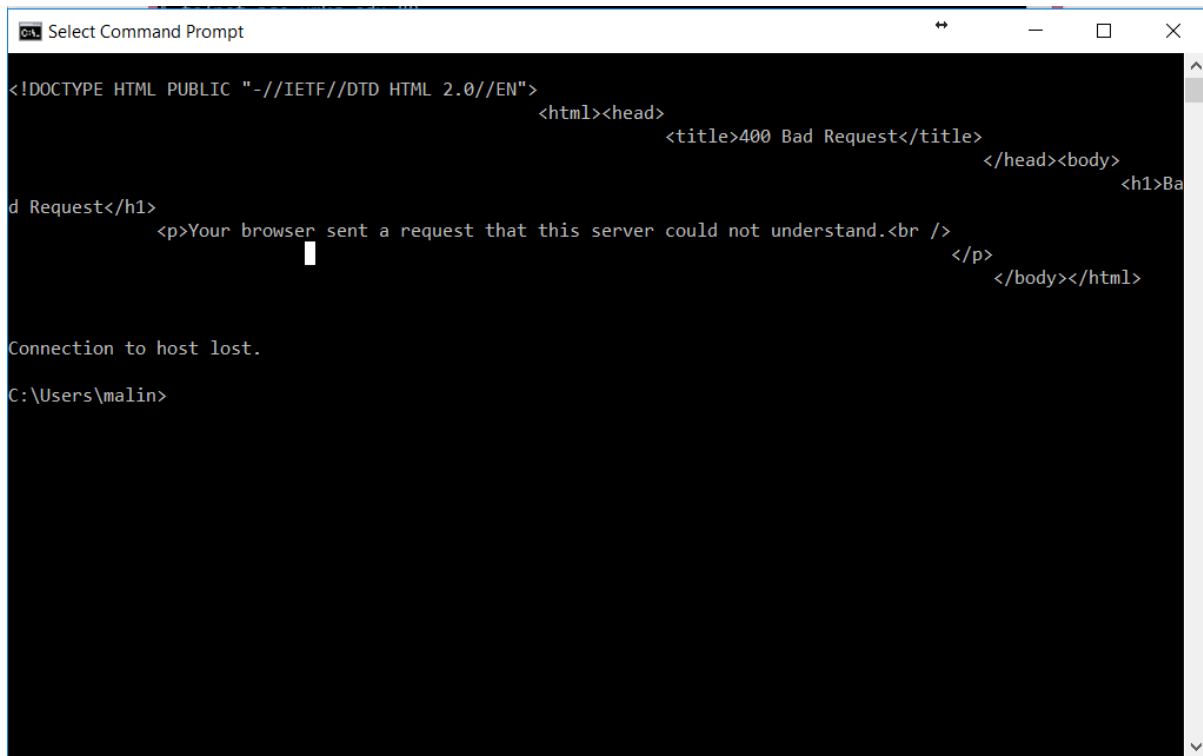
C:\Users\malin>
```

POST Method:

telnet www.umkc.edu 80

POST /scholarships/ HTTP/1.1

Response 2: 411 Length Required



```

Select Command Prompt

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
    <html><head>
        <title>400 Bad Request</title>
    </head><body>
        <h1>Bad Request</h1>
        <p>Your browser sent a request that this server could not understand.<br />
    </p>
    </body></html>

Connection to host lost.

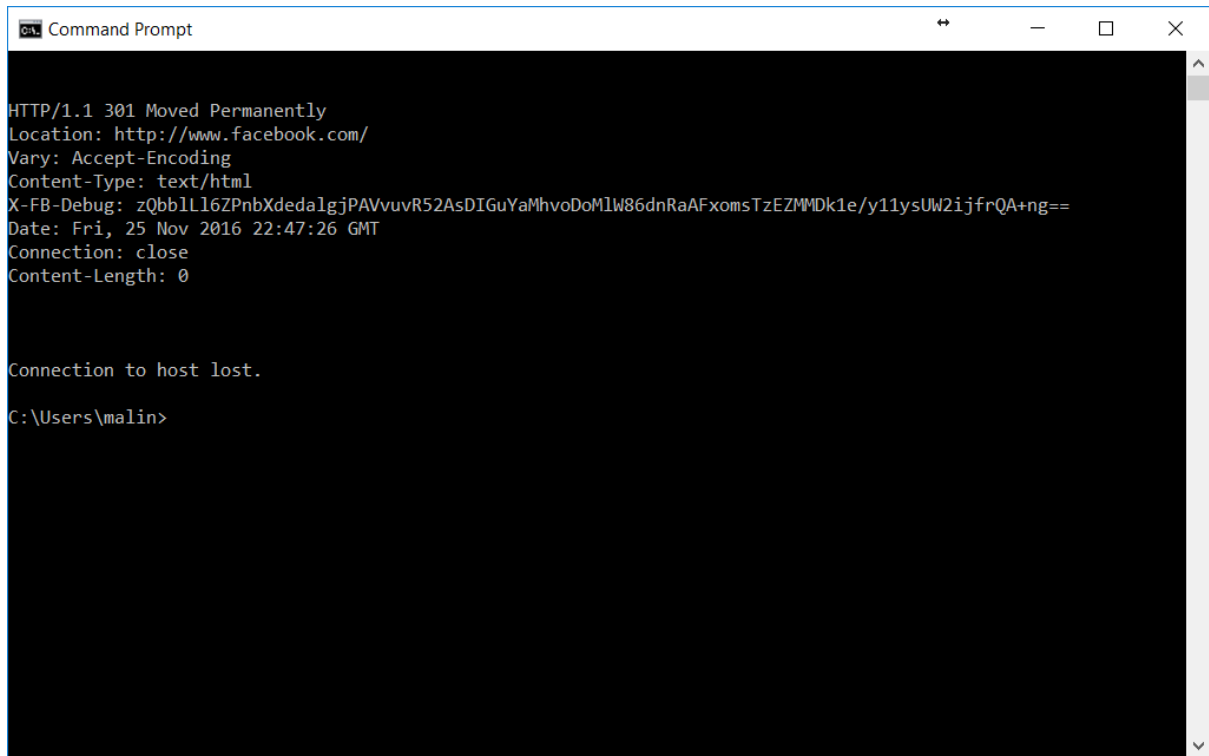
C:\Users\malin>
```

POST Method:

telnet www.facebook.com 80

POST /HTTP/1.1

Response 3: 301 Moved Permanently



```
CA Command Prompt

HTTP/1.1 301 Moved Permanently
Location: http://www.facebook.com/
Vary: Accept-Encoding
Content-Type: text/html
X-FB-Debug: zQbb1L16ZPnbXdedalgjPAVvuvR52AsDIGuYaMhvoDoM1W86dnRaAFxomsTzEZMMDk1e/y11ysUW2ijfrQA+ng==
Date: Fri, 25 Nov 2016 22:47:26 GMT
Connection: close
Content-Length: 0

Connection to host lost.

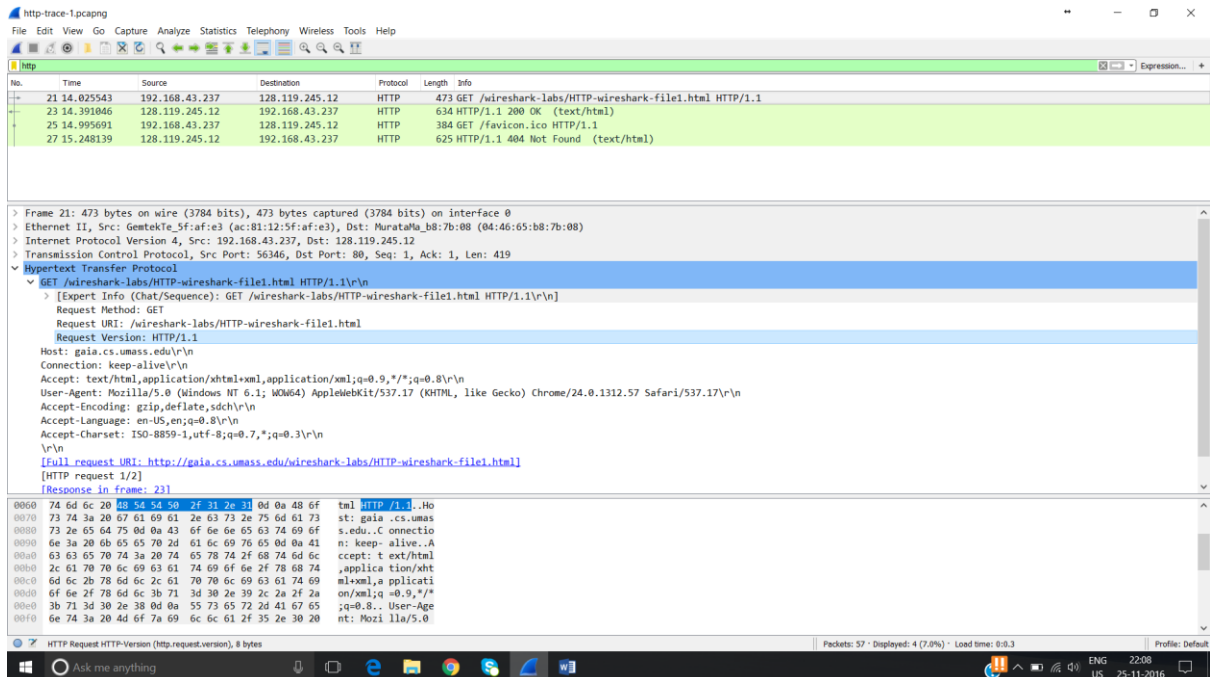
C:\Users\malin>
```

Part-2.1: The Basic HTTP GET/response interactions

1. Is your browser running HTTP version 1.0 or 1.1? What version of HTTP is the server running?

Ans:

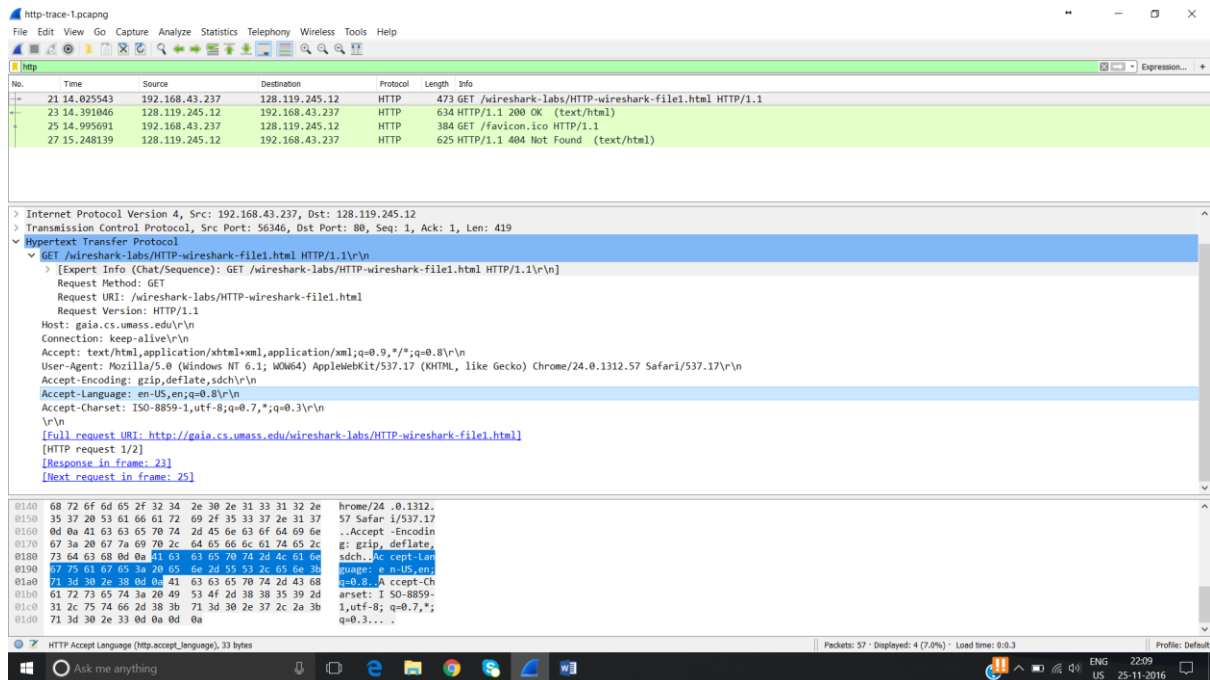
My browser and server are running on HTTP version 1.1



2. What languages (if any) does your browser indicate that it can accept to the server?

Ans:

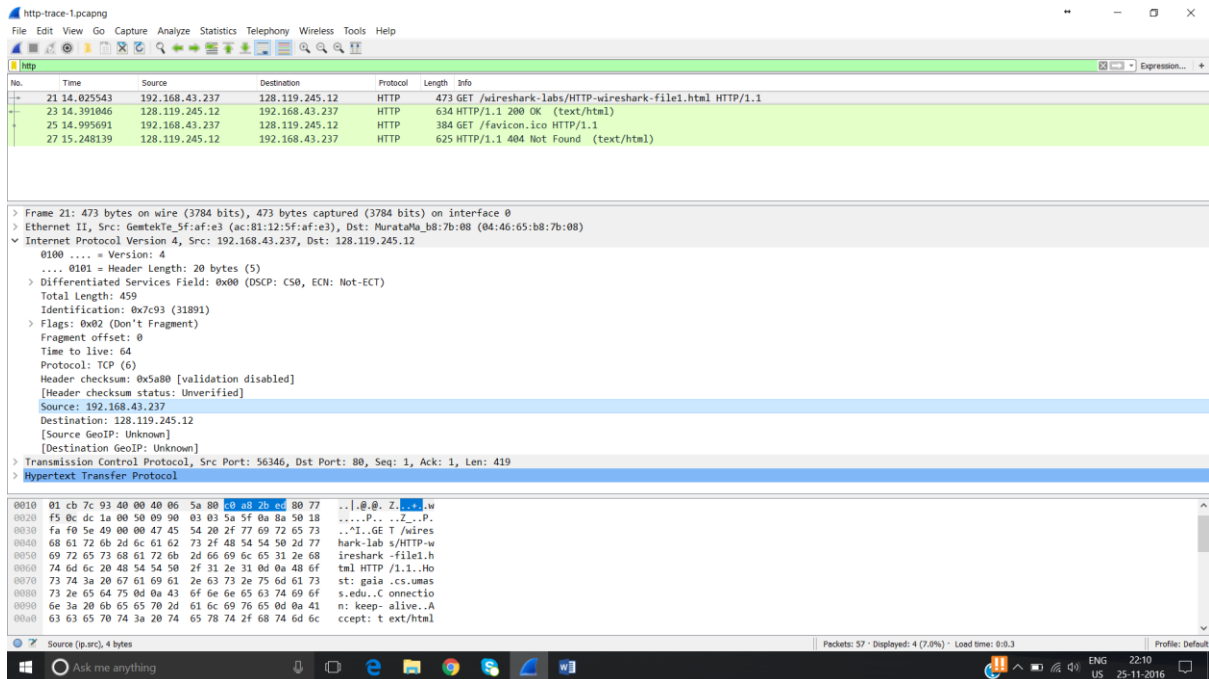
My browser accepts US English Language.



3. What is the IP address of your computer? Of the gaia.cs.umass.edu server?

Ans:

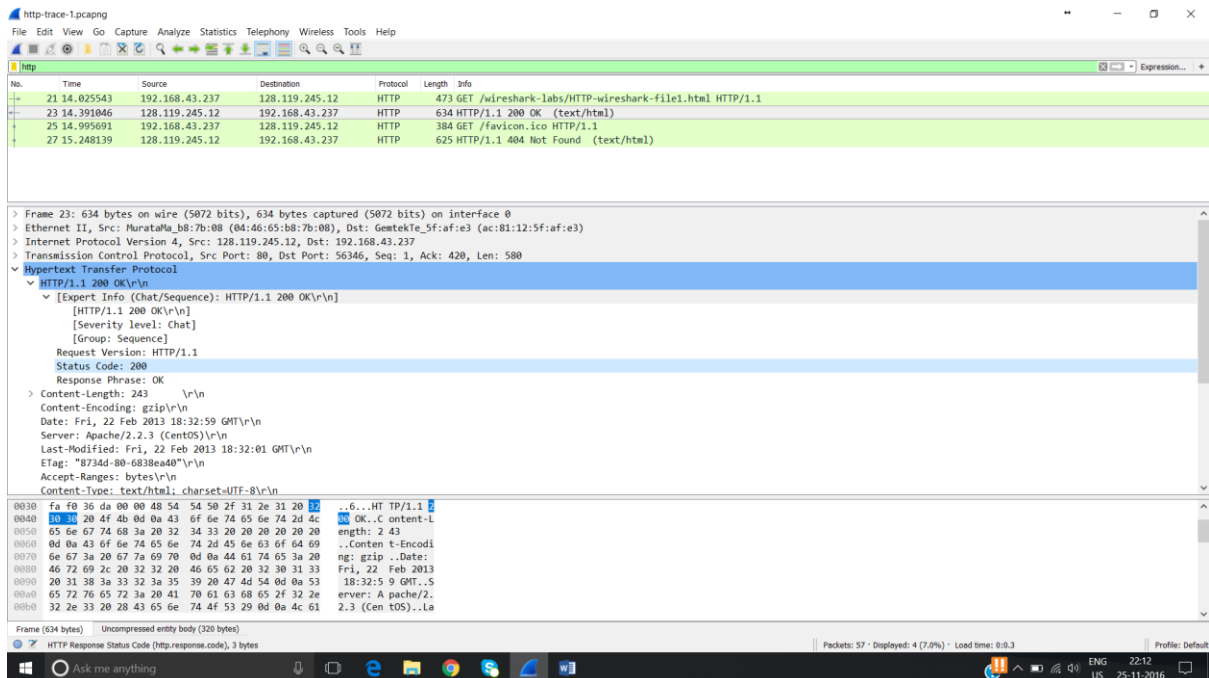
The IP address of my computer is 192.168.43.237 and that of gaia.cs.umass.edu server is 128.119.245.12



4. What is the status code returned from the server to your browser?

Ans:

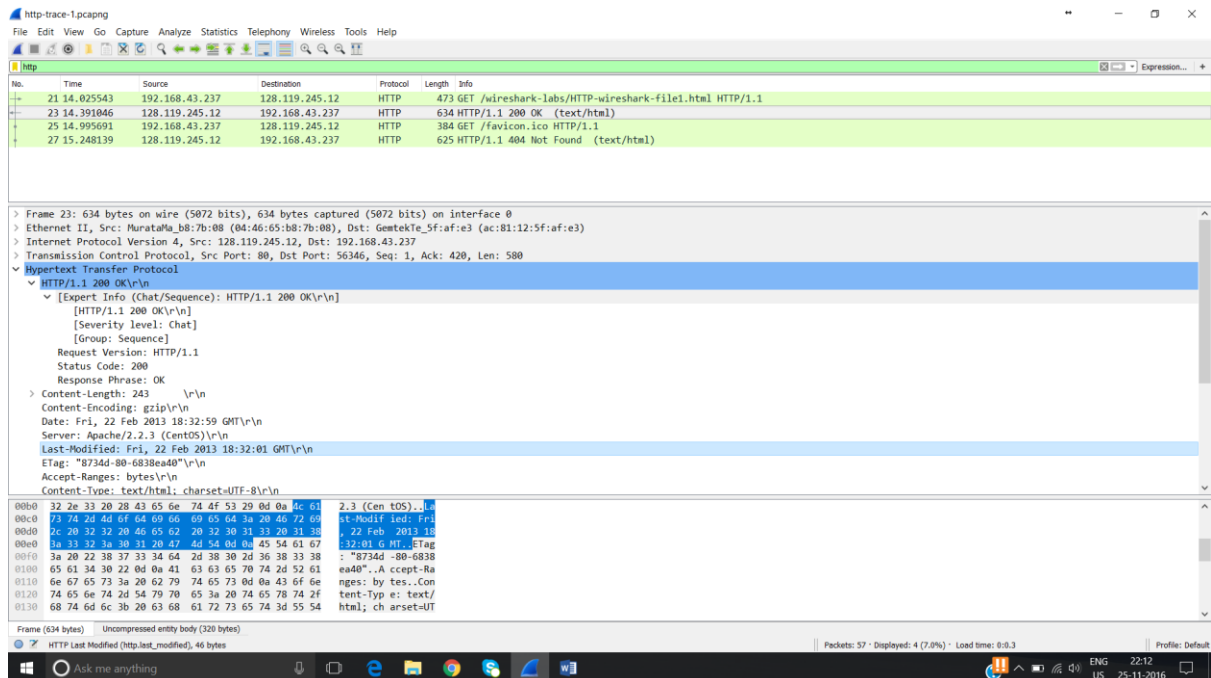
The status code is 200



5. When was the HTML file that you were retrieving last modified at the server?

Ans:

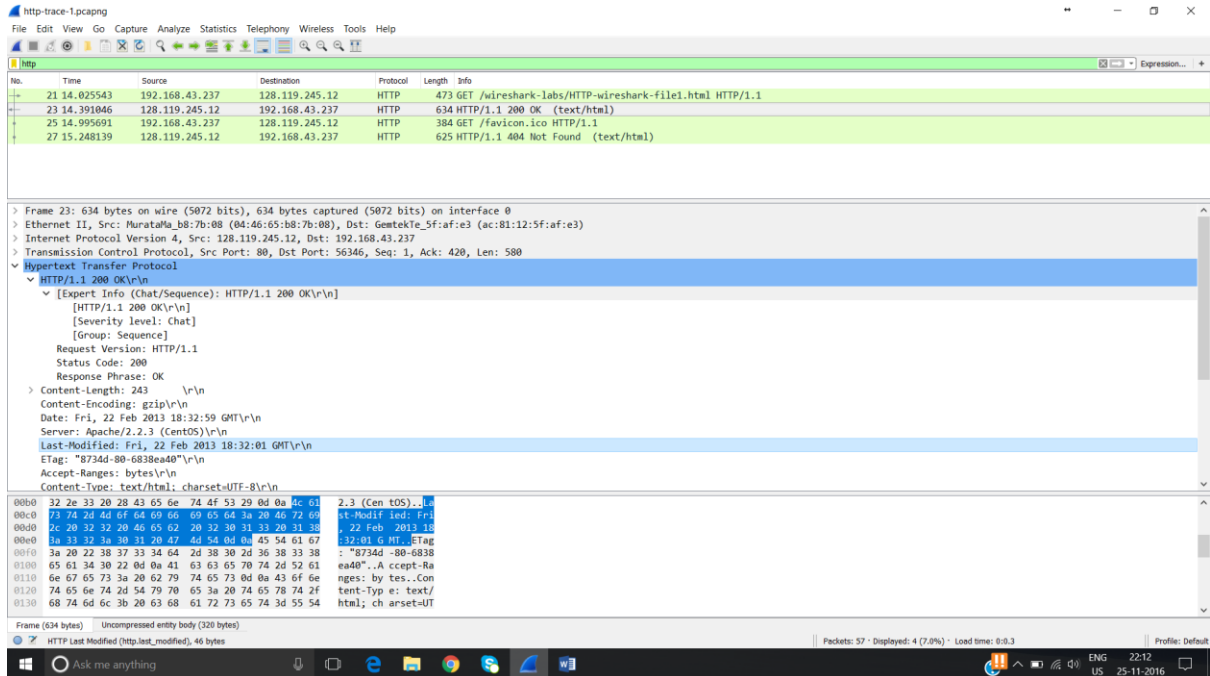
It was last modified on 22 Feb 2013, Friday at 18:32:01 GMT



6. How many bytes of content are being returned to your browser?

Ans:

The number of bytes returning to the browser is 243

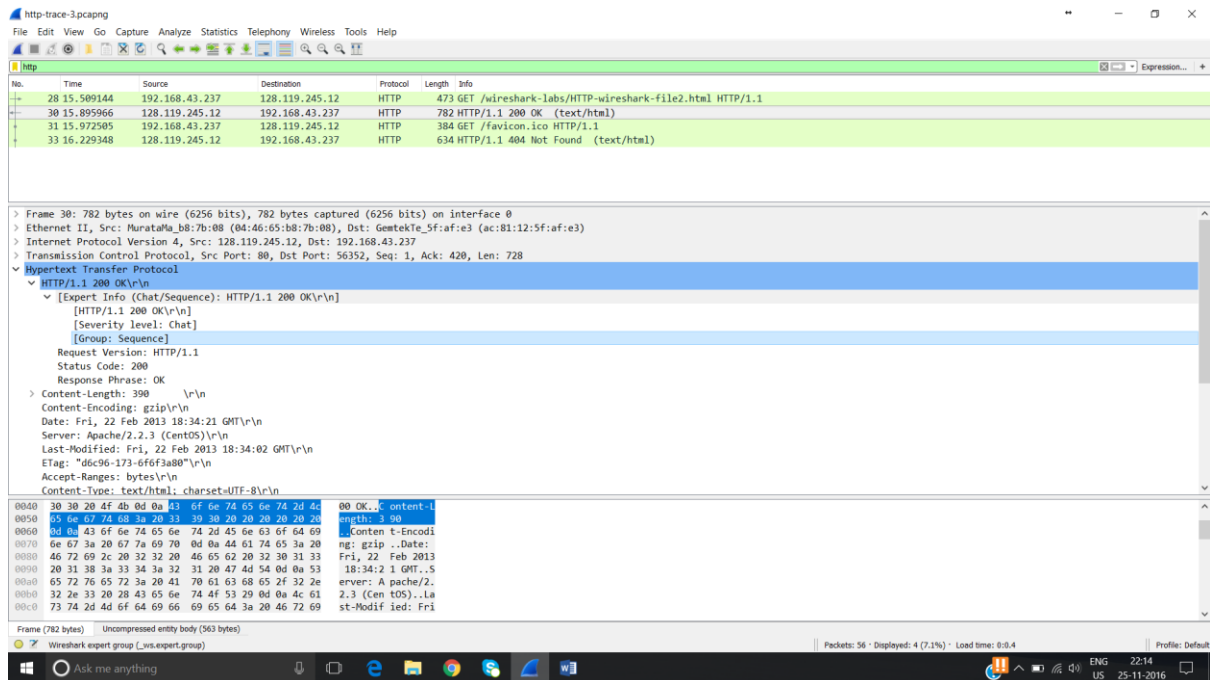


Part-2.2: Retrieving Long Documents

1. How many HTTP GET request messages were sent by your browser?

Ans:

The total number of HTTP GET request messages sent by the browser is 2



2. How many data-containing TCP segments were needed to carry the single HTTP response?

Ans:

For single HTTP response, the TCP segment length is 728 and 580

The screenshot shows a Wireshark capture of an HTTP GET request and its response. The packet list shows four packets: a GET request (728 bytes), a 200 OK response (782 bytes), a favicon request (384 bytes), and a 404 Not Found response (634 bytes). The details pane for the first packet (No. 30) shows the TCP segment length as 728 bytes. The packet bytes pane shows the raw data of the HTTP response, including the status line '200 OK (text/html)' and the 'Content-Type: text/html' header.

The screenshot shows a Wireshark capture of an HTTP GET request and its response. The packet list shows four packets: a GET request (728 bytes), a 200 OK response (782 bytes), a favicon request (384 bytes), and a 404 Not Found response (634 bytes). The details pane for the second packet (No. 31) shows the TCP segment length as 580 bytes. The packet bytes pane shows the raw data of the HTTP response, including the status line '200 OK (text/html)' and the 'Content-Type: text/html' header.

3. What is the status code and phrase associated with the response to the HTTP GET request?

Ans:

Response 1:

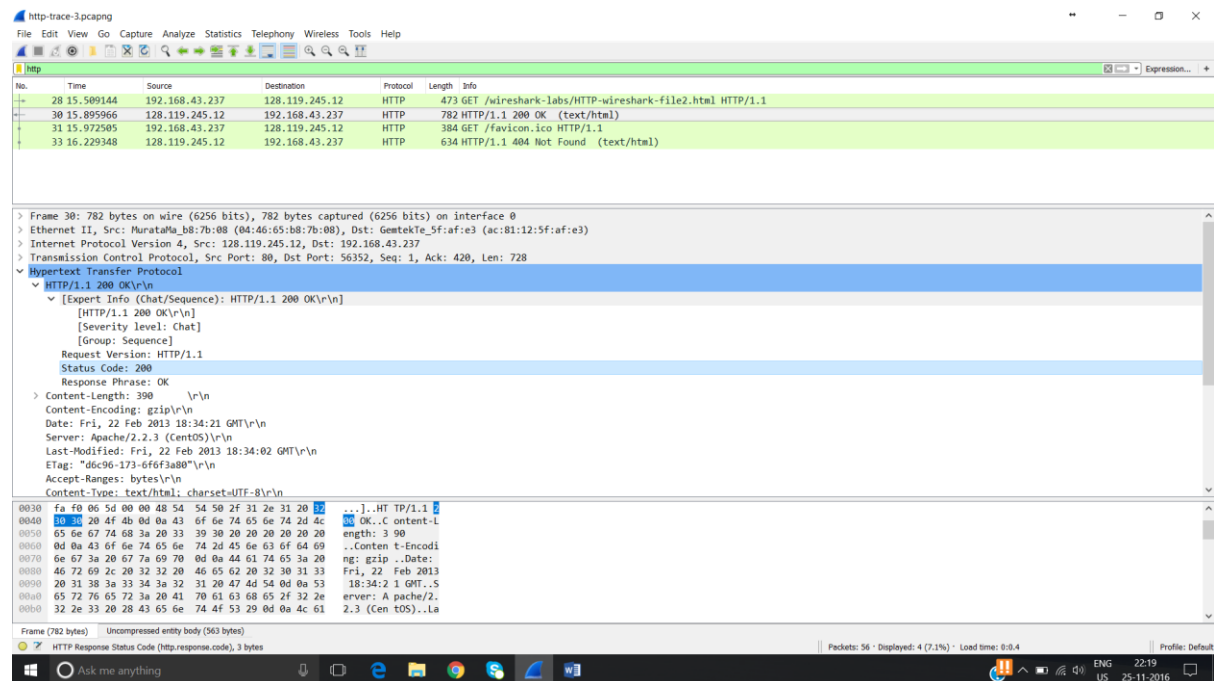
Status Code – 200

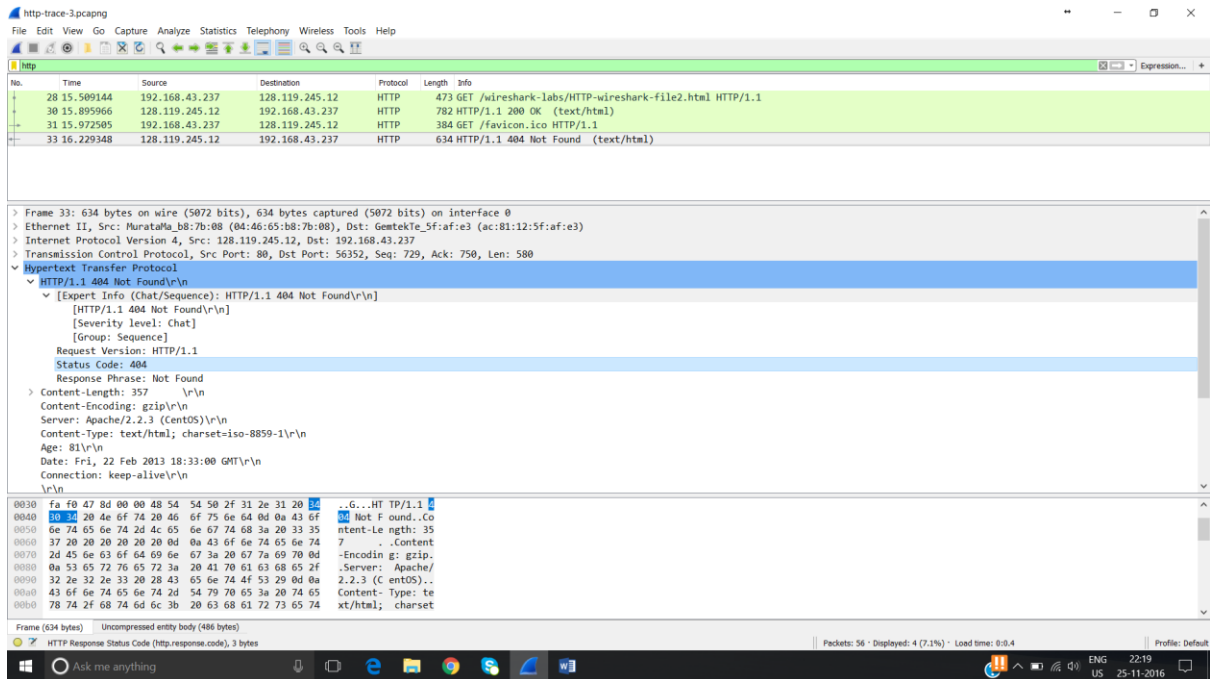
Phrase – OK

Response 2:

Status Code – 404

Phrase – Not Found





4. Are there any HTTP status lines in the transmitted data associated with a TCP induced “Continuation”?

Ans:

There are no HTTP status lines in the transmitted data associated with a TCP induced “Continuation”

