CS-335a: Computer Networking

Department of Computer Science, University of Crete
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Assignment 2 - Application Layer

At the Top!

SUBMISSION

1. Submit a single PDF file with your answers to the following questions.
2. File name should be in the form: **csdXXXX_Name_LastName_cs335_hw2.pdf**
3. Submit your assignment via email to the TA: brozi@csd.uoc.gr
   with subject: **[CS-335] Assignment 2 Submission**

   Please make sure to use the correct subject or your submission might not be graded !
4. **Deadline: 12/11/2023**

Objective: Get familiar with the HTTP protocol, Persistent vs. Non-Persistent HTTP connections and HTTP response and request messages.

HTTP

1. (20 points) Answer the following questions on WWW.

i) Is WWW a client-server or peer-to-peer application ? Why ? (3 points)

ii) Briefly describe HTTP non-persistent and HTTP persistent. What are the benefits of HTTP persistent over HTTP non-persistent ? (5 points)

iii) We said that the classical HTTP protocol is stateless, that is once you finish your HTTP session all the client-server interactions are “forgotten” and state information cannot be used in following sessions. Briefly describe how cookies can be used to preserve state across sessions. (7 points)

iv) How can web caches be used for improved user experience in remote and poorly connected areas? List one drawback of the use of Web caches. (5 points)

2. **(5 points) A.** Consider the following string of ASCII characters that were captured by Wireshark when the browser sent an HTTP GET message (i.e., this is the actual content of an HTTP GET message). The characters `<cr><lf>` are carriage return and line-feed characters.

Answer the following questions, indicating where in the HTTP GET message below you find the answer.

```
GET /cs335/index.html HTTP/1.1<cr><lf>Host:
gaia.cs.umass.edu<cr><lf>User-Agent: Mozilla/5.0 ( Windows;U;
Windows NT 5.1; en-US; rv:1.7.2) Gec ko/20040804 Netscape/7.2
(ax) <cr><lf>Accept: ext/xml, application/xml,
application/xhtml+xml, text /html;q=0.9, text/plain;q=0.8,
image/png,*/*;q=0.5 Accept-Language: en-us, en;q=0.5
<cr><lf>AcceptEncoding: zip, deflate <cr><lf>Accept-Charset:
ISO -8859-1, utf-8;q=0.7,*;q=0.7<cr><lf>Keep-Alive: 300
<cr><lf>Connection:keep-alive<cr><lf><cr><lf>
```

i) What is the URL of the document requested by the browser ? (1 point)

ii) What version of HTTP is the browser running ? (1 point)

iii) Does the browser request a non-persistent or a persistent connection ? (1 point)

iv) What is the IP address of the host on which the browser is running ? (1 point)

v) What type of browser initiates this message ? Why is the browser type needed in an HTTP request message ? (1 point)

(5 points) B. The text below shows the reply sent from the server in response to the HTTP GET message in the question above. Answer the following questions, indicating where in the message below you find the answer.

```
HTTP/1.1 200 OK<cr><lf>Date: Tue, 07 Mar 2008
12:39:45GMT<cr><lf>Server: Apache/2.0.52 (Fedora)<cr><lf>
Last-Modified: Sat, 10 Dec 2005 18:27:46 GMT<cr><lf>ETag:
”526c3-f22-a88a4c80”<cr><lf>AcceptRanges: bytes<cr><lf>
Content-Length: 3874<cr><lf>Keep-Alive: timeout=max=100
<cr><lf>Connection: Keep-Alive<cr><lf>Content-Type:
text/html; charset= ISO-8859-1<cr><lf><cr><lf><!doctype html
public ”-//w3c//dtd html 4.0 transitional//en”><lf><html><lf>
<head><lf> <meta http-equiv=”Content-Type”
content=”text/html; charset=iso-8859-1”><lf><meta
```

```
name="GENERATOR" content="Mozilla/4.79 [en] (Windows NT
5.0; U) Netscape]"><lf> <title>CMPSCI 453 / 591 /
NTU-ST550ASpring 2005 homepage</title><lf></head><lf>
<...>
```

i) Was the server able to successfully find the document or not ? What time was the document reply provided ? (1 point)

ii) When was the document last modified ? (1 point)

iii) How many bytes are there in the document being returned ? What are the first 5 bytes of the document being returned ? Explain your answer. (2 points)

iv) Did the server agree to a persistent connection ? (1 point)

3. (15 points) A browser wants to access the webpage xyz.com. Suppose the webpage is an HTML document that contains 5 JPEG images.

i) Create a sequence diagram of the communication process (request/response messages) between the client and the server.

ii) For the sake of simplicity, assume each Round-Trip Time (RTT) is 100 ms and the time to transmit each object is 10 ms. What is the total response time (i.e. the duration from the initiation of the TCP connection by the browser until it receives all requested objects) ?

Answer the above questions for each of the following cases:

A. Non-Persistent HTTP (without parallel connections) (3 + 2 points)
B. Persistent HTTP without pipelining (3 + 2 points)
C. Persistent HTTP with pipelining (3 + 2 points)

Objective: Understand the operational mechanisms of the Domain Name System (DNS) and the range of services it offers.

DNS

4. (20 points) Answer the following questions on DNS.

i) Describe 4 services/functions provided by DNS. (8 points)

ii) Could a centralized DNS server work? Indicate three possible disadvantages of such architecture in the context of DNS ? (2 points)

iii) Suppose a web browser wants to know the IP address of www.csd.uoc.gr. Describe the name resolution process assuming iterative queries are used. Which query type is considered best practice: iterative or recursive ? Explain your answer. (10 points)

5. (10 points) The `dig` (domain information groper) command is a flexible tool for interrogating DNS name servers. It performs DNS lookups and displays the answers that are returned from the queried name server(s).
Use https://networking.ringofsaturn.com/Tools/dig.php to run the following command:

```
dig chat.openai.com
```

i) What does this command do ? (2 points)

ii) What does every line (not starting with ";") of the command's output mean ? (6 points)

iii) Why in the records 'chat.openai.com.' ends with a dot ? (2 points)

Objective: Delve into the different protocols utilized in email.

EMAIL - SMTP

6. **(10 points)** Suppose Alice, with a Web-based e-mail account (like Hotmail or Gmail), sends a message to Bob, who accesses his mail from his mail server using POP3. Discuss how the message gets from Alice to Bob. Make sure to list all application layer protocols that are used to move the message between the two hosts.

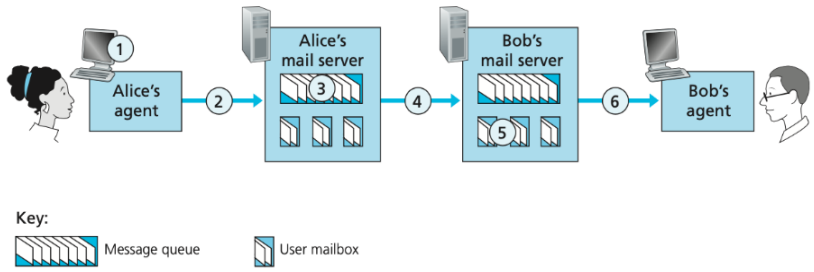

Figure 2.15 ♦ Alice sends a message to Bob

7. **(15 points)** Send an email to majordomo@csd.uoc.gr with subject "All subscribed lists" and as message the text "which". Locate the source* of both the email you sent and the response that you got from majordomo.

   * Open the email (from webmail.csd.uoc.gr) > click on the ⋮ symbol on the top right corner > click on "Show Source" from the drop down menu

   i) What exactly do we learn from the **Received** header fields of the response ? What is the difference between **Deliver-To** and **Delivered-To** headers ? (7 points)

   ii) Why are there no **Received** header fields in the sent email ? (3 points)

   iii) How is the end of the header fields encoded ? (2 points)

   iv) Estimate how long it took majordomo to compose and send its response. (3 points)

Brainstorming! (15 points– the 10 out of 15 points is bonus)

You envision an innovative adaptive video streaming system: it dynamically adjusts the streaming operation based on the ***user and network*** conditions, aiming to optimize the overall user experience. Note: the adaptation does not refer ONLY to the bitrate!

Give an overview of the architecture of your system (show in a diagram the various components) as well as the protocol at the application-layer (5 points).

Think about metrics to assess the ***perceived quality of experience*** (5 points). Argue about the advantages of your architecture and protocol (3 points).

Describe the experiments you need to run to support your claims about the attractive performance features of your system (2 points).

Feel free to target a **specialized domain** (e.g., video streaming that targets specific settings or market segment-user population or type of content or type of environment or devices);

You can assume that you can collaborate with the appropriate content provider and the availability of content is not an issue.

Extra points for innovative applications-paradigms! However you need to support your claim that your application is ***original*** (e.g., differs from existing systems/applications).