

IK2218 Protocols and Principles of the Internet  
EP2120 Internetworking

Homework 3

Solutions due: 19:00, October 6, 2023  
Review due: 19:00, October 10, 2023

## 1. Socket API (15 p)

The pseudo-code sample below (with most details omitted) describes an application that uses the socket interface (API) for communication

```
s = socket(...);
bind(s, ...);
while (true) {
    recvfrom(s, ...);
    if (fork() == 0) {
        ProcessRequest(...);
        sendto(s, ...);
        exit();
    }
}
```

- (a) Is the sample code for a client or server? Does it use TCP or UDP? Explain your answer. (5 p)
- (b) The textbook gives two examples of communication using the socket interface: 1) connection-oriented, concurrent communication, and 2) connectionless, iterative communication. Characterize the communication in the sample code using the same terminology. (5 p)
- (c) In practice, this kind of communication is not frequently used. Give an explanation why the designer of this particular application still may have decided to use it. (5 p)

## 2. Web (35 p)

Suppose that you are using your web browser and click on a link on a web page, which causes the following HTTP request to be sent:

```
GET /feathers/swordfish.html HTTP/1.1
Host: www.duck.org
Connection: keep-alive
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_8_5)
Accept-Encoding: gzip, deflate, sdch
Accept-Language: en-US,en;q=0.8
```

- (a) Which web document does the browser request? Answer by giving the URL. The answer should be a complete and correct URL. (5 p)
- (b) Describe the TCP connection policy that the client requests. (2 p)
- (c) The server gives the following response: (3 p)

```
HTTP/1.1 200 OK
Connection: Keep-Alive
Date: Sun, 20 Sep 2020 12:34:56 GMT
Server: Apache/2.2.3 (Red Hat)
Content-Length: 286
Cache-control: public, max-age=600
Keep-Alive: timeout=8, max=120
Content-Type: text/html; charset=utf-8
```

more data...

Describe the TCP connection policy with which the server responds.

- (d) Is the returned object cacheable? If so, describe how it may be cached. (5 p)

- (e) Assume that the web object that the client fetches is an HTML file that references four other web objects (which do not, in turn, use any further web objects). (15 p)

The browser can use two different strategies to speed up loading the page: 1) multiple non-persistent connections in parallel, and 2) a single persistent connection with pipelining. For each of the two cases, find the time it takes from that the user clicks on the link until the web page can be presented on the screen. That is, the total time it takes to fetch all objects that are needed for the page.

The round-trip time between client and server is RTT. Assumed that all objects are very small, and the connection is fast, so transmission time is negligible, and so is processing time on the server. Moreover, you need not consider the time it takes to close down a TCP connection (it takes place in the background).

- (f) Page load time is important on the web, but it is not the only thing that matters. (5 p)  
Not considering page load time performance, give two advantages of persistent connections over non-persistent connections.

### 3. DNS (25 p)

Use the “dig” lookup tool to get the IP address of KTH’s web server “www.kth.se”. Try different name servers, and specify the DNS server as an argument to dig (the server’s IP address prepended with ‘@’). Use the following four commands:

```
dig @193.0.14.129 www.kth.se
dig @213.108.25.4 www.kth.se
dig @130.235.20.5 www.kth.se
dig @130.237.72.200 www.kth.se
```

- (a) Explain the results: Describe the responses from the four DNS servers. What do the responses say? Note that the result may differ depending on your location. Try to run the commands on KTHs network, and outside KTH. (20 p)

We distinguish between four kinds of name servers: root, TLD, authoritative, and local. You can deduce just from studying the responses what kind of DNS server it is (the flags are useful here, among other things). For each of the four cases, describe the kind of name server that is responding to your query. Explain what the response contains. Also, for each name server, explain whether or not the answer contains the IP address you are looking for. You only need to discuss the responses at a general level – you should not discuss or describe the details of the messages, the different fields, their contents, etc. However, you probably need to study the responses carefully in order to be able to explain them.

- (b) DNS uses UDP, not TCP. Unlike TCP, UDP does not guarantee delivery of data. (5 p)  
What happens if a DNS message (query or response) is lost? Is it a problem, and if so, how is it handled?

### 4. Email (25 p)

Internet email consists of several components that have different functions. Consider the case when Alice wants to send an email to Bob. The email will be transferred in two steps, via two different mail servers, before Bob gets the mail.

- (a) What are the two mail servers? Describe their main functions. (5 p)
- (b) For each of the two transfers, explain what protocols are used, both at the application layer and at the transport layer. (5 p)
- (c) For each of the two transfers, explain what party is client and what party is server, and how the client gets the location (the domain name) of the server. Be specific when you describe how the domain names are obtained. (15 p)