University of St Andrews School of Computer Science

CS2003 — Internet and the Web — 2020/21

Tutorial 9:
Date: Week 9: 12-13 Nov 2020

This week, some of the tutorial questions are from the week 08 exercise class. This will allow you to discuss the answers in your tutorial group with your tutors.

1. HTTP operation

   Copy the shell script:

   https://studres.cs.st-andrews.ac.uk/CS2003/Examples/CS2003-Examples-wk08/curl_time.sh

   to your own filespace. Remember from the exercise class that this file can also be found on the lab machines at `/cs/studres/CS2003/Examples/CS2003-Examples-wk08/curl_time.sh`

   Run the file:

   ```
   ./curl_time.sh
   ```

   Note the two values of `real` time that are reported. Examine the contents of the shell script. Explain the difference in the two times reported.

2. IP forwarding

   You might find the `IPNetMask` program useful:

   https://studres.cs.st-andrews.ac.uk/CS2003/Examples/CS2003-Examples-wk08/IPNetMask.java

   For the forwarding table entries `A` - `D` below:

   ```
        destination     mask
   A     121.16.0.0      16
   B    121.16.20.0      24
   C    121.16.16.0      20
   D        0.0.0.0       0
   ```

   find which would be used for each of the following destination addresses:

```
121.16.20.2
121.17.20.4
121.16.6.6
121.16.17.8
121.16.21.10
120.16.20.12
```

3. IP addressing for a site

   You might find the `IPNetMask` program useful:

   https://studres.cs.st-andrews.ac.uk/CS2003/Examples/CS2003-Examples-wk08/IPNetMask.java

   You have a new office site to set up for a company with three departments, each which needs to run its own network, but the four departments should have connectivity between them.

   All departments need connectivity to the Internet.

   Each department could have up to 200 systems running (clients and internal servers).

   A set of 24 servers must be accessible directly to customers via the Internet, as well as internally to the clients in each department.

   Explain, with a diagram, how you would configure structure and addressing for this network if:

   a) you were allocated the prefix 134.24.144.0/22 for the new office site.

   b) you were allocated the prefix 134.24.144.0/27 for the new office site.

   Have your diagram ready to share with your tutor group (e.g. in the Teams chat or by sharing your screen). If you sketch your diagram on paper, take a photo of it prior to the tutorial.

4. IP subnetting in the School of CS

   The CS host servers and lab machines sit on different subnets. Using the Linux command-line tools introduced in the week 08 exercise class, try to determine the two subnets. Give the broadcast address for each subnet.

5. Implications of NAT

   We briefly discussed in lectures how NAT breaks the “end to end” nature of the Internet architecture. Remember that a simple NAT router will add an entry to its mapping table whenever an outbound packet comes from a host with a private address. Consider for instance:

- A home user, Alice, is given a single global IPv4 address 99.99.99.99 by her ISP.
- Alice decides to use the 10/8 private address space for her home network.
- Alice's son, Bob, has a laptop with the address 10.0.10.10 (allocated statically or via DHCP — this is relatively unimportant).
- Bob's laptop connects to a web server at 138.251.22.83. The laptop's operating system creates a TCP connection identified by the {src addr, src port, dest addr, dest port} four-tuple {10.0.10.10, 3888, 138.251.22.83, 80}.
- Alice's NAT router will then create an entry:

Private address, port	Public address, port
10.0.10.10, 3888	99.99.99.99, 9876

a) What will be the four-tuple of the packets that are received by the webserver (assuming no additional NAT on the webserver's network)?

b) Why might NAT make it difficult for Bob to run a server on his laptop? Drawing some diagrams might help you here.

6. Create one question on PeerWise covering the topics from week 8, and tag this question with the tag "week-8". You should also try to answer at least one question with the same tag. Your tutor will pick a question at random during the tutorial and you can go through it together as a tutorial group.