



Introducing FTP and HTTP

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A. Objectives

- How to access and FTP server
- How to upload and download files into and from and FTP server
- How to create an HTML & CSS files.
- How to upload an HTML file and view it on the server using a browser
- How FTP packet is structured
- How HTTP packet is encapsulated
- How to connect to an NTP server

B. Time of Completion

This laboratory activity is designed for students with very little knowledge of protocols and it is estimated to take about 3 hours to complete. You can use your RPi to communicate with the server

C. Requirements

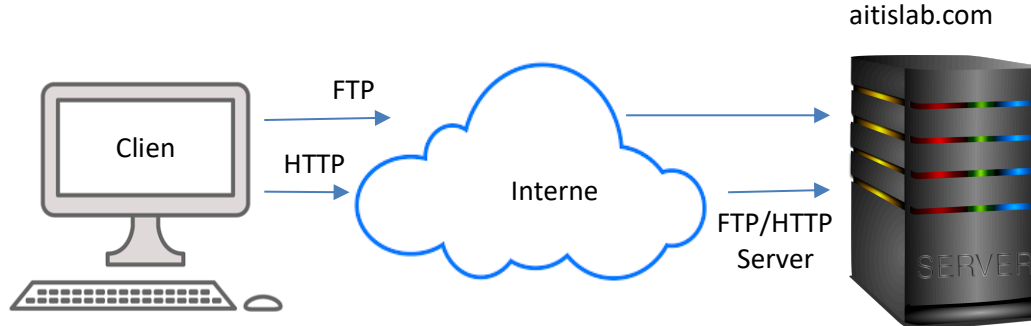
1. A Raspberry Pi 3 Model 3
2. 32 GByte MicroSD card → Give your MicroSD card to the lab instructor for a copy of Ubuntu.
3. USB adaptor to power up the Pi

D. Pre-Lab

1. Review ftp commands here: <https://www.cs.colostate.edu/helpdocs/ftp.html>
2. Learn about Wireshark.
3. Learn about PHP: <http://php.net/manual/en/function.array-keys.php>
4. Read about NTP: <https://www8.cs.umu.se/kurser/5DV020/HT07/ntp.pdf>

E. Lab

In this lab we use the following setup. The idea is to access an existing server (`aitislab.com`) from your computer (the client). You can always use your RPi as a client.



1. Access the FTP & WWW server

From a terminal window ftp into the server: `ftp aitislab.com`. Use `engineering@aitislab.com` as your username and `engineering` as your password (ask instructor for PW update). Once you see the ftp prompt (`ftp >`) type in `ls` to view existing files & directories. Continue with the following steps:

- A- Carefully review the ftp commands by reading the link in the pre-lab section.
- B- Using your first and last names create a directory called `FirstName_LastName`. See Fig. 1
- C- Inside the new directory (`FirstName_LastName`) create a file called `index.html`. Copy the html code below (Fig. 2) into the `index.html` file. Note that in order to do this you can create the index file on your client machine and then upload the html file into the proper directory. Do not use MS Word! Make sure `index.html` is NOT a directory!

```
52197-SALZ2010A:$ ftp aitislab.com
Connected to aitislab.com.
220----- Welcome to Pure-FTPd [privsep] [TLS] -----
220-You are user number 5 of 500 allowed.
220-Local time is now 07:36. Server port: 21.
220-This is a private system - No anonymous login
220 You will be disconnected after 15 minutes of inactivity.
Name (aitislab.com): engineering@aitislab.com
331 User engineering@aitislab.com OK. Password required
Password:
230-Your bandwidth usage is restricted
230-OK. Current restricted directory is /
230 0 Kbytes used (0%) - authorized: 2048000 Kb
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> ls
150 Accepted data connection
drwxr-xr-x  3 aitislab  aitislab           4096 Sep 27 18:31 .
drwxr-xr-x  3 aitislab  aitislab           4096 Sep 27 18:31 ..
-rw-----  1 aitislab  aitislab             6 Sep 27 18:31 .ftpquota
drwxr-xr-x  2 aitislab  aitislab           4096 Sep 27 18:30 farid_farahmand
-rw-r--r--  1 aitislab  aitislab            294 Sep 27 08:06 test1.html
```

Fig. 1: FTP example

```

1 <!doctype html>
2 <html>
3 <head>
4 <meta charset="UTF-8">
5 <title>Untitled Document</title>
6 </head>
7
8 <body>
9 <h1><strong>Hello! </strong></h1>
10 <p>This is my first page! </p>
11 <p><em>Thank you for visiting! </em></p>
12 <p style="font-size: medium; color: #EF1460;">My name is Farid. </p>
13 </body>
14 </html>
15

```

Fig. 2: HTML Code example

At this point you should be able to see your webpage using a browser by typing the following in the URL: <http://aitislab.com/engineering/FirstName LastName/index.html>. Change the <title> in your HTML code. What happens? In the HTML code, what does <p> represent?

It is also possible to define an inline frame with HTML tag <iframe>. The <iframe> tag can appear anywhere in your document. The <iframe> tag defines a rectangular region within the document in which the browser can display a separate document, including scrollbars and borders. An inline frame is used to embed another document within the current HTML document. Try pasting the following frame for a YouTube video in your code (you can paste it before </body> tag in Fig. 2:

```

1. <p>
2. <iframe width="560" height="315" src="https://www.youtube.com/embed/LdmH6qkTcd0" frameborder=
   "0" allow="accelerometer; autoplay; encrypted-media; gyroscope; picture-in-
   picture" allowfullscreen></iframe>
3. </p>

```

Check your web page using your smartphone. What do you see?

To learn more about creating HTML page see <https://www.tutorialspoint.com/html/index.htm>

**NOTE: YOU WILL RECEIVE A ZERO
IF FOR ANY REASON YOU VISIT ANY OTHER DIRECTORY BUT YOURS!**

2. Understanding CSS files

CSS (Cascading Style Sheets) is a plain text file format used for formatting content on web pages to help keep information in the proper display format. CSS files can help define font, size, color, spacing, border and location of HTML information on a web page, and can also be used to create a continuous look throughout multiple pages of a website. One major advantage of using CSS along with an HTML file is to design the layout of multiple web pages all at once. CSS can be added to HTML elements in THREE different ways:

- Inline - by using the style attribute in HTML elements
- Internal - by using a <style> element in the <head> section
- External - by using an external CSS file

The most common way to add CSS, is to keep the styles in **separate CSS files**. Let's look at an example. You can learn more about CSS files here: https://www.w3schools.com/html/html_css.asp

Copy/paste the following files in the same directory. Open the HTML file using your browser.

Table 1

<pre> 1. <!DOCTYPE html> 2. <html> 3. <head> 4. <title>Learn HTML</title> 5. <link rel="stylesheet" href="Example1.css"> 6. </head> 7. <body> 8. <div> 9. <h1>Learn HTML</h1> 10. <p>Let's learn some basic HTML 11.
 We are using HTML + CSS 12. </p> 13. <h2>Abbreviations</h2> 14. 15. meters, m 16. 17. distance 18. meters per second squared, m/s 19. <sup>2</sup> 20. 21. 22. <h2>Notations</h2> 23. 24. <table> 25. <tr> 26. <th>Abbreviation</th> 27. <th>Meaning</th> 28. </tr> 29. <tr> 30. <td>u 31. </td> 32. <td>Initial velocity</td> 33. </tr> 34. <tr> 35. <td>v 36. </td> 37. <td>Final velocity</td> 38. </tr> 39. <tr> 40. </tr> 41. </table> 42. </div> 43. </body> 44. </html> </pre>	<pre> 1. body { 2. background-color: #FFBDFA; /* change to 00BDFA*/ 3. font-family: Arial; 4. } 5. div { 6. background- 7. color: white; /* change to another color, say red */ 8. border-radius: 30px; 9. padding: 10px; 10. } 11. h1 { 12. text-align: center; 13. } 14. table { 15. background-color: #FF4404; /* change to 004404*/ 16. color: white; 17. border-radius: 25px; /* change to 40 */ 18. text-align: center; 19. } 20. table tr td { 21. padding: 5px; 22. } 23. table tr th { 24. padding-left: 8px; 25. } </pre>
HTML file: Example1.html	Example1.css

Note that in the HTML file we has the following tags: <html>, <head>, <title>, <body>, <div> and more.

Also, note that the way we link the CSS file to the HTML file is by using the <link> tag as shown in the following line:

```
<link rel="stylesheet" href="Example1.css">
```

In this case we are specifying that the relationship is a stylesheet. The other attribute of the <link> tag is href, which specifies the URL of the CSS file. Note that in this case we are assuming both files are located in the same directory.

In the <table> pay attention to the <tr> and <td> tags. In this case the table consists of several rows that are enclosed in a <tr>...</tr> pair of tags. Columns are enclosed in <td>...</td> pair of tags.

As we mentioned, the main purpose of adding CSS file is to add formatting. You can learn about colors here: https://www.w3schools.com/colors/colors_picker.asp. Note that in the CSS file we define the format for selected tags: <body>, <h1>, <table>. We can also define the format of nested tags inside <table> and <tr>. The formatting instructions are enclosed in a pair of curly braces: {...}. Note that each instruction for a tag is separated by a semicolon.

Finally, we end this section by noting that, as we mentioned earlier, it is possible that we use inline CSS style. Inline styles are defined within the "style" attribute of the relevant element. Here is a simple example which you can add to the above code:

```
1. <!-- This is an example of an inline CSS -->
2. <h1 style="color:blue;text-align:center;">This is a new heading</h1>
3. <p style="color:red;">This is a new paragraph.</p>
```

Once again note that comments are places between <!--this is a comment -- >

A. Answer the following questions:

A.0 – Answer the following questions:

- What is tag used for?
- What is <sup> tag used for?
- What is tag used for?
- In the CSS file, change background-color: to 00BDFE. What happens?
- In the CSS file, change background-color: to something else. What happens?
- In the CSS file, change border-radius to a different size. What happens?
- In the CSS file, change padding to a larger number. What happens?
- What can you do to change the BOX containing Abbreviation & Meaning rectangular and get rid of the rounded edges?
- What can you do to change the BOX containing Abbreviation & Meaning circular?

A.1 – You should now change your HTML code to add the following text on your web page exactly as it appears (**keep the format exactly the same**). **You need to use a CSS file to control your HTML page.**

Welcome to my

Networking Course Webpage.

To get more information please refer to [EE 465](#).

I live on the 2nd floor

<!-- Add a video frame here! This is just a comment -->

Note that when EE 465 is clicked the user must be directed to the course page. **Show a snapshot of your code.**

A.2 – What is the IP address of the server (aitislab.com)? What is the Linux command you used to find out? Where is the server located at?¹

A.3 – Can you use `ftp <IP_ADDRESS>` instead of using `ftp aitislab.com`?

A.4 – Open your *Wireshark* on your client machine and while it is running and capturing, perform an ftp on the aitislab server. Make sure you have been logged in. Stop the *Wireshark* and save the packets into a file. **Filter** all the ftp packets. Answer the following questions:

- What is the IP address of the aitislab.com server?
- Looking at the captured FTP packets, is it possible to see your password? What does it tell you?
- Click on one of the captured FTP packets. **Draw** the encapsulated packet and show all the overheads. Must be done by computer.
- In Wireshark go to Analyze → Follow → TCP stream. What do you see? Show a snapshot.

A.5 – Open your *Wireshark* on your client machine and while it is running and capturing in your browser type your webpage's address. Once you see the page stop the *Wireshark* and save the packets into a file. **Filter** all the **http** packet. Answer the following:

- What is the IP address of the web server? Is the address different from the FTP server? What does it tell you?
- When you requested for the web page how many HTTP messages were exchanged? **Show** the snapshot.
- Looking at the captured HTTP packets, is it possible to see the content of the web page? How? Explain.
- Click on one of the captured HTTP packets. **Draw** the encapsulated packet and show all the overheads.
- In Wireshark go to Analyze → Follow → HTTP stream. What do you see? **Show** a snapshot. What are different colors for?
- What version of HTTP the server is using?
- Looking at Analyze → Follow → HTTP stream, what type of OS the server is using?
- When the server receives your request, is it possible for the server to tell what type of OS the client is using?
- When the server receives your request, is it possible for the server to tell what type of browser you are using?
- How can you use command `curl` to view your web page? Does it work? What is the command?

A.6 – Using `nslookup aitislab.com` what is the address of your DNS server that resolves aitislab.com? What port is used on the DNS server to receive the name resolution request?

```
#!/bin/sh
HOST='aitislab.com'
USER='engineering@aitislab.com'
PASSWD='engineering'
FILE='test2_junk'

ftp -n $HOST <<END_SCRIPT
quote USER $USER
quote PASS $PASSWD
cd /farid_farahmand
put $FILE
pwd
ls
quit
END_SCRIPT
exit 0
```

¹ You can use the following: <https://www.whatismyip.com/ip-address-lookup/>

A.7 - Is it possible to do SSH into the aitislab.com server? How?

3. Access the FTP server using a Shell script

It is possible to use a shell script to upload your `index.html` file into your directory. Use the following script to automate uploading the `index.html` file. Show a snapshot of your code.

4. Access the PHP server

Review the PHP code below. Note that this code checks the URL and searches for KEYS. Each key has a variable. For example, consider the following URL:

http://aitislab.com/phpf/first_php.php?name=farid&age=23&Last=Farahmand

In this case we have three KEYS: name, age and Last. The keys are separated by `&`. Each KEY's value is identified by `"=`".

Copy the following PHP code and upload it into your directory in aitis.com server. Call it `myFirstPHPCode.php`.

B. Answer the following questions:

B.1 – Change the code below, such that if the age (x) is more than 30 the web page says: Your age is x; you are too old! Other, the text says you are very young! Take a snapshot of your php page and the URL you used to access it. Submit the snapshot.

```
<?php
/* Parameter Reader Language: PHP */
// print beginning of an HTML page:
echo "<html><head></head><body>\n";
// Print out all the variables
foreach ($_REQUEST as $key => $value)
{
    echo "$key: $value<br>\n";
}
// finish the HTML
echo "</body></html>\n";
?>
```

Note: at this point you must have the following files in your directory called
 FirstName_LastName: index.html and myFirstPHPCode.php. Do not remove them!

5. Access the NTP Server

Network Time Protocol (NTP) is an application protocol used for clock synchronization between computer systems over packet-switched, variable-latency data networks. In operation since before 1985, NTP is one of the oldest Internet protocols in current use. So, we can think of an NTP server as really just a time server that utilizes Network Time Protocol (NTP). Whilst other time protocols do exist, NTP is by far the most commonly used and is utilized in over ninety percent of time servers².

NTP server and time server are therefore interchangeable terms but describe the same thing: a device used to receive and distribute a timing signal. The timing signal is received by the NTP server (or time server) via a number of ways; the Internet, national time and frequency transmission (long wave) or the GPS (global positioning system) network. Once received the time server (NTP server) checks the authenticity of this signal (except from Internet sources where authentication is not possible), evaluates its accuracy then distributes it amongst the network.

The figure below shows the interaction between the client and the NTP server.

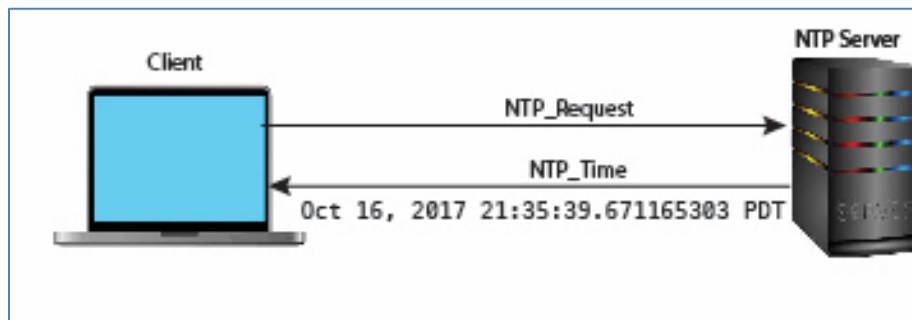


Fig. 3: NTP Client-Server Interaction.

² Read more here: <https://ntpserver.wordpress.com/2008/09/24/what-is-a-ntp-server/>

The `ntpq` is a utility to check the status of the NTP server. By default, when `ntpd` is installed, it is configured to start at every system start, so your RPi is probably already running `ntpq`. To check this, you can run the following command to receive the clock:

```
ntpq -c 'rv 0 clock' localhost
→ clock=dd90cd05.ee28ccfb Tue, Oct 17 2017 11:40:05.930
```

Also try:

```
ntpq -c "rv 0 stratum" europe.pool.ntp.org
```

If the command timed out try again after a little while. If NTP command does not work, install it first:

```
sudo apt-get install ntp
```

Try: `ntpq -q`. Note that you can see the source of your system clock and which NTP server you are connected to.

remote	refid	st	t	when	poll	reach	delay	offset	jitter
*ussjc2-ntp-001.	.GPSs.	1	u	128	256	277	15.111	60.249	5.619

Please report if any of the commands does not work properly.

It is possible to write a simple Python code to access an NTP server. See Appendix A and follow the steps in the provided sample code.

C. Answer the following questions:

- 1- Open Wireshark and enter `ntp` in the filter. Wait for a while (maybe 5 min). Do you see any NTP packets? If so, which timing source is your machine trying to synchronize with?
- 2- Using the provided code in Appendix A access `193.79.237.14`. Open Wireshark and capture the NTP packets. Answer the following:
 - How is the NTP application encapsulated (in terms of layers)? Name all the layers.
 - What is the Port address for NTP application?
 - Is it possible to know the name of the machine with IP address `193.79.237.14`? How?
 - Which NTP application version are you using?
 - Looking at the payload of the NTP packet, what is UTC referred to?

6. Using PHP to plot data (optional)

Read about available libraries for PHP visualization:

<https://www.codediesel.com/php/6-excellent-charting-libraries-for-php/> .

Assume you have a CSV file which contains the following data. Write a PHP code such that it plots the data from the CSV file. The PHP code should be accessible from your web page via the client. Leave a copy of the file in your directory. Note that you MUST read the data from the CSV file so if the values change, your graph should change.

CSV File Example

1	54
2	65
3	76
4	24
4	98
5	56

E. Submissions

Submit your answers to part A and B. Graduate students must also show the code for part 4 and explain what libraries have been installed.

F. Credits

Special thanks to online resources and all SSU students who assisted putting together this lab.

G. References

[1] Creating a shell script: <http://www.stratigery.com/scripting.ftp.html>

Appendix A

```
#!/usr/bin/env python

# Make sure you install ntplib:
# 1- Download the ntplib zip (https://pypi.python.org/pypi/ntplib/) file
#    and place it in the library
# 2- At this point you should have a directory called ntp_server.py
# 3- In the ntp_server.py directory, from your terminal, type: python setup.py install
# 4- Copy the code below in a file called ntp_server.py
# 5- Run the ntp_server.py file.

import ntplib
from time import ctime

def print_time():    # We define a function called print_time()
    my_ntp_server = 'europe.pool.ntp.org'
    ntp_client = ntplib.NTPClient()
    response = ntp_client.request(my_ntp_server, version=3)
    print response.tx_time
    print response.offset
    print response.version
    print ctime(response.tx_time)

if __name__ == "__main__":
    print_time()
```

Python program listing to perform NTP request from an NTP Server (europe.pool.ntp.org). Follow the commented instructions to run the code.