v4

Penetration Testing Student

Preliminary Skills

Section 01 | Module 01

Table of Contents

Module 01 | Preliminary Skills

Learning Objectives

By the end of this module, you should have a better understanding of:

- The Infosec Culture
- Basics of Cryptography
- Wireshark Usage
- Numeric Systems

1.1

Welcome

1.1 Welcome

Welcome to this eLearnSecurity course, *Penetration Testing Student version 4.*

With this course, you are starting your journey in IT security and penetration testing!

1.1 Welcome

This module will give you the basic skills to get started, as well as:

- Some information about the IT security field: culture, career opportunities, and jargon.
- Basic understanding of the difference between a clear-text protocol and an encrypted protocol.
- **Your first laboratory**: intercepting network traffic!

1.1.1 Course Structure

Let’s start by introducing the course material. The *Penetration Testing Student version 4* course comes in different plans. According to your plan you get different training material:

- The **Barebone** plan includes training slides only.
- The **Full** and the **Elite** plans come with training slides, video lessons, and practical hands-on labs in the Hera Lab environment plus the opportunity to become certified!

Now, let’s see how to best use the training material!

1.1.2 Slides

The course is divided into three main sections:

Preliminary Skills: Prerequisites

Preliminary Skills: Programming

Penetration Testing

Every section is made up of several **modules**.

The content of every module is made up of slides, like the ones you are reading right now.

1.1.2 Slides

In the **slides**, you will also find directions on how to access the videos, as well as how to access the labs where you will put into **practice** the theoretical skills acquired.

Every module contains an index at the beginning, in addition to external references at the end along with a full list of videos and labs available for the module you are reading.

1.1.2 Slides

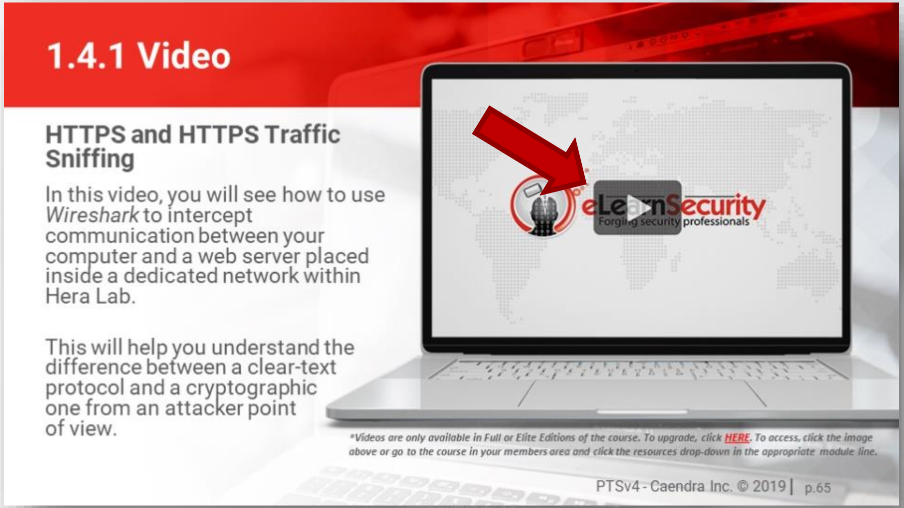
You can immediately access different places in the slides by using the right navigation menu. For instance, clicking on the **Map** icon (🌐) will take you to the Table of Contents where you can select to review a topic of your choosing, while the **References** folder (🗀) , **Video** icon (🎬) , or **Lab** icon (⚗) buttons will take you to the end of the slides to show you the full list of references, videos or labs respectively; this feature comes in very handy throughout your learning journey when you need to rapidly find a link, a video, or practice a topic a little more.

1.1.3 Videos

Videos are a great way to see information presented in the course put into action; this allows you to deepen your knowledge on specific topics.

Throughout the course, you will encounter some special slides containing a link to a video.

You can start the video by clicking on the video image.



1.4.1 Video

HTTPS and HTTPS Traffic Sniffing

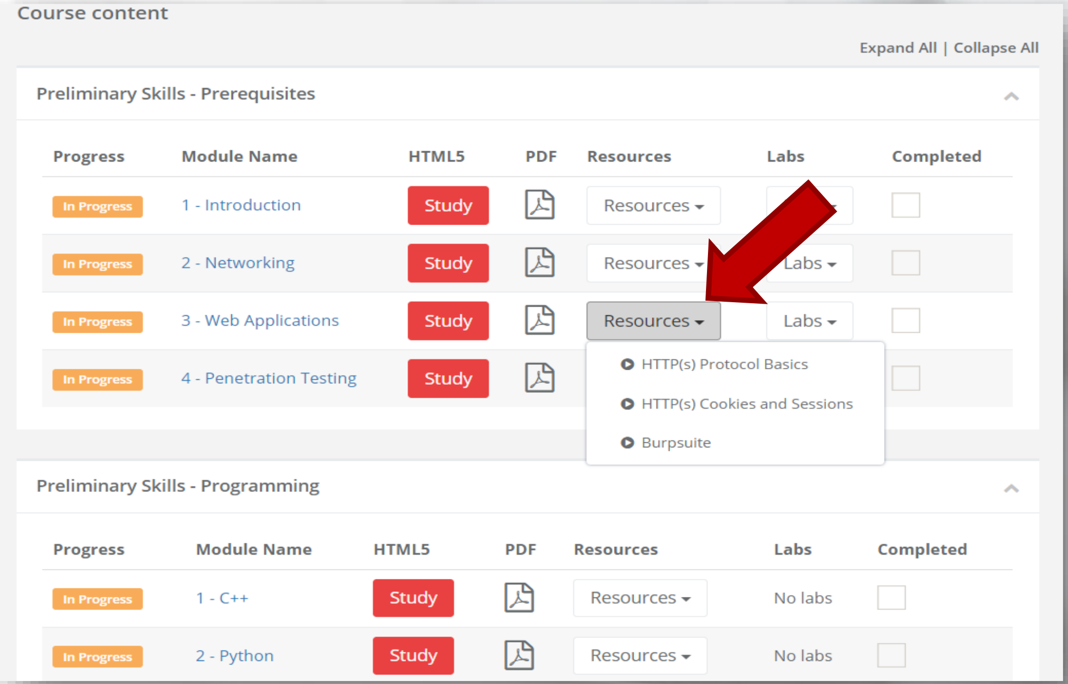
In this video, you will see how to use *Wireshark* to intercept communication between your computer and a web server placed inside a dedicated network within Hera Lab.

This will help you understand the difference between a clear-text protocol and a cryptographic one from an attacker point of view.

**Videos are only available in Full or Elite Editions of the course. To upgrade, click HERE. To access, click the image above or go to the course in your members area and click the resources drop-down in the appropriate module line.*

1.1.3 Videos

Additionally, you can access videos from your member's area by going to the appropriate module line and clicking the resources drop-down menu.



Course content

Expand All | Collapse All

Preliminary Skills - Prerequisites

Progress	Module Name	HTML5	PDF	Resources	Labs	Completed
In Progress	1 - Introduction	Study		Resources ▾		☐
In Progress	2 - Networking	Study		Resources ▾	Labs ▾	☐
In Progress	3 - Web Applications	Study		Resources ▾	Labs ▾	☐
In Progress	4 - Penetration Testing	Study				☐

- HTTP(s) Protocol Basics
- HTTP(s) Cookies and Sessions
- Burpsuite

Preliminary Skills - Programming

Progress	Module Name	HTML5	PDF	Resources	Labs	Completed
In Progress	1 - C++	Study		Resources ▾	No labs	☐
In Progress	2 - Python	Study		Resources ▾	No labs	☐

1.1.3 Videos

Practice makes perfect! Try to apply what you see in the videos as much as you can.

As a reminder, videos are available in the **Full** and **Elite** plans only.

1.1.4 Virtual Labs

Hera Virtual labs, the most sophisticated labs on IT Security, differentiate eLearnSecurity courses from all the others.

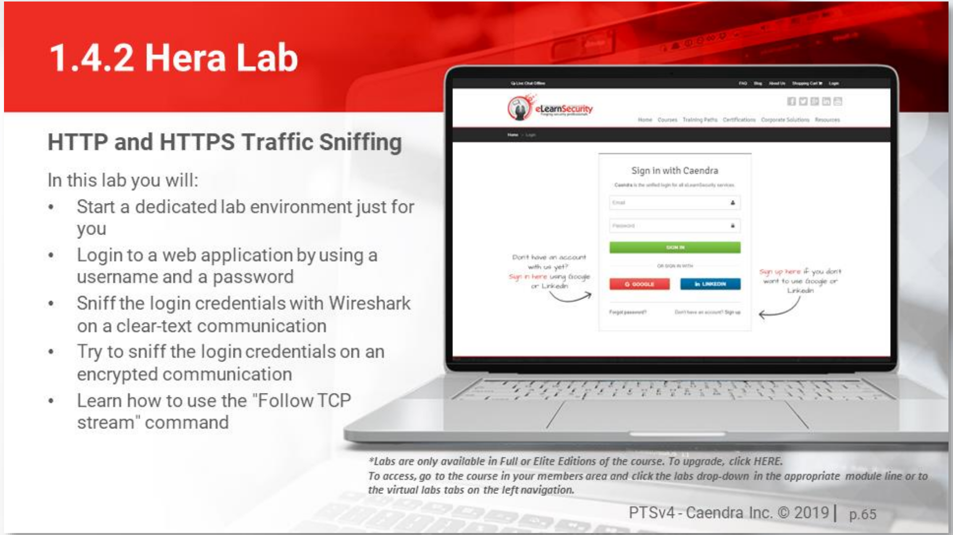
Each virtual lab scenario included in this course consists of **isolated** computer network environments, which means that every lab is **dedicated** to the student and other students **will not be able to interfere with your environment**.

It would be a shame if you were successfully attacking a machine while another student made it crash! Right?

1.1.4 Virtual Labs

Throughout the course, you will find special slides telling you that you are ready to put into practice what you have just learned.

Those slides contain instructions regarding the lab learning objectives.



1.4.2 Hera Lab

HTTP and HTTPS Traffic Sniffing

In this lab you will:

- Start a dedicated lab environment just for you
- Login to a web application by using a username and a password
- Sniff the login credentials with Wireshark on a clear-text communication
- Try to sniff the login credentials on an encrypted communication
- Learn how to use the "Follow TCP stream" command

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Home Courses Training Paths Certifications Corporate Solutions Resources
FAQ Blog About Us Shopping Cart Login
Sign in with Caendra
Caendra is the unified login for all eLearnSecurity services
Email
Password
SIGN IN
OR SIGN IN WITH
GOOGLE
LINKEDIN
Forgot password?
Don't have an account? Sign up
Don't have an account with us yet? Sign in here using Google or LinkedIn
Sign up here if you don't want to use Google or LinkedIn

**Labs are only available in Full or Elite Editions of the course. To upgrade, click HERE.*
To access, go to the course in your members area and click the labs drop-down in the appropriate module line or to the virtual labs tabs on the left navigation.

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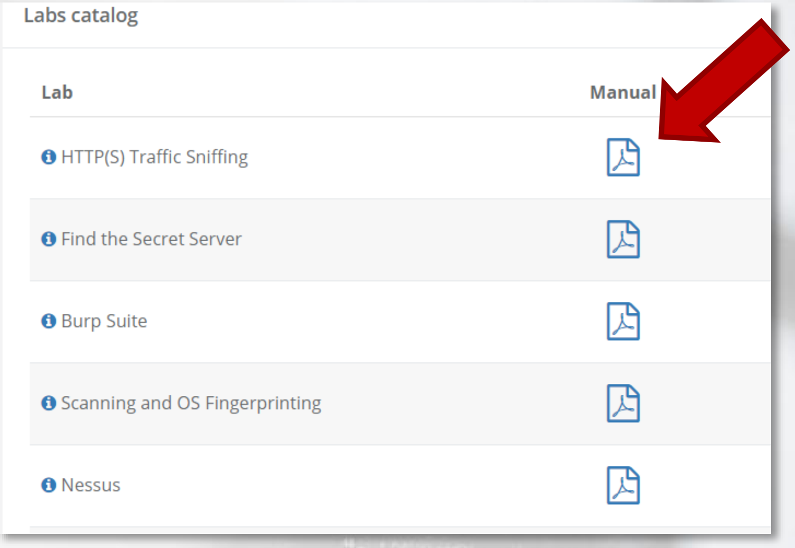
1.1.4 Virtual Labs

If you get stuck while doing the labs, don't worry!

You can find the solutions to each lab in the related PDF Lab Manual.



Labs catalog

Lab	Manual
ℹ HTTP(S) Traffic Sniffing	📄
ℹ Find the Secret Server	📄
ℹ Burp Suite	📄
ℹ Scanning and OS Fingerprinting	📄
ℹ Nessus	📄

1.1.4 Virtual Labs

To best use a lab, a great idea is to first focus on achieving the lab goals and then use it for the extra-mile: to **test other tools and techniques** to reach the same goals or even attempt **other attacks**.

Since every lab in Hera is made up of networks of real computers and servers, there are many (unexpected) things you can do!

Please note that the labs are available in the **Full** and **Elite** plans only!

1.1.5 Good Luck!

Are you ready to enter the fantastic and challenging world of **information security**?

Good luck and enjoy studying the course, as much as we enjoyed writing it!

1.2

The Information Security Field

1.2 The Information Security Field

How does this support my pentesting career?

- Knowing the information security field
- Career opportunities
- Talking with colleagues

1.2.1 Infosec Culture

Information Security has deep roots in the **underground hacking scene**, which still looks at computer systems with curiosity, trying to figure out new ways to use and break them!

1.2.1 Infosec Culture

The term *hacker* was born in the sixties in the MIT community.

It refers to people who prefer to understand how a system works rather than just using it. These people are **curious, highly intelligent and strongly motivated to pursue knowledge!**

1.2.1 Infosec Culture

Approaching systems with curiosity lets hackers and infosec professionals find new ways to use computer systems, bypassing the restrictions imposed by software vendors or programmers and deeply understanding any security pitfall of any kind of implementation.

Being able to perform an attack also means being able to deeply understand the technology and the functioning of the target system.

1.2.1 Infosec Culture

Being a hacker means being pushed by curiosity and having a hunger for knowledge. Hackers explore and improve their skills daily.

This aspect is still valid in the modern information security field; **there is always something new** to learn, something interesting to try or something exciting to study!

1.2.1 Infosec Culture

The history of hacking could easily be an entire book or a course by itself. If you do a quick Internet search on hacking, you will find that it is not necessarily related to computers only.

Hacking is more of an approach, or a lifestyle, applied to telephone lines, people and software development.

https://en.wikipedia.org/wiki/John_Draper
https://www.mitnicksecurity.com/about/kevin-mitnick-worlds-most-famous-hacker-biography
https://stallman.org/

1.2.1 Infosec Culture

The Conscience of a Hacker, also known as *The Hacker's Manifesto* written by *The Mentor,* is a document that gives an idea about the ideals of the underground hacking community.

Being an information security professional means pursuing knowledge, being honest with yourself and never stop challenging yourself and your colleagues.

http://phrack.org/issues/7/3.html

1.2.2 Career Opportunities

Nowadays, companies of all sizes, as well as government bodies are using advanced technologies to store and process a great deal of confidential data on computers and mobile devices.

Data is not only stored but also transmitted across private and public networks to other computers. Therefore, it is a **must** to protect sensitive information. Companies pay a premium to safeguard their data and ensure that their systems are protected. Or, at least they should.

1.2.2 Career Opportunities

An even more important sector is national security. Recently, governments have to face a broad range of cyber-threats: global cyber syndicates, hackers for hire, hacktivists, terrorists and state-sponsored hackers.

With critical infrastructure like power plants, trains or dams being controlled by computers, using hacking skills for good has become critical for the safety of nations.

1.2.2 Career Opportunities

Companies and governments need to implement hardware and software defensive systems to protect their digital assets.

Additionally, they also need to train their entire organization to make sure:

- Secure applications are developed,
- Proper defensive measures are taken, and
- That proper use of the company's data is in place.

IT Security is a very difficult game! A way to ensure that a system is secure from cyber-attacks is by **hiring a penetration tester**.

1.2.2 Career Opportunities

Penetration testers (also called pentesters) are professionals who are hired to simulate a hacking attack against a network, a computer system, a web application or the entire organization.

They master the same tools and techniques that malicious hackers use to discover any (and all) vulnerability in the systems they test.

1.2.2 Career Opportunities

These highly skilled professionals often work:

- As freelancers
- In an IT Security services company
- As in-house employees

1.2.2 Career Opportunities

Moreover, as IT is a broad knowledge domain, they can specialize in specific infosec sectors such as:

- Systems attacks
- Web applications
- Malware analysis
- Reverse engineering
- Mobile applications
- Other

1.2.2 Career Opportunities

The demand for penetration testers is on a steady growth.

Being passionate, skilled and hungry for knowledge are fundamental characteristics for a successful pentesting career.

By starting this course, you have made a big step in the right direction! We'll now introduce some of the jargon used by information security professionals.

1.2.3 Information Security Terms

Speaking the **domain language** is **fundamental** in any field. It helps you to better understand the industry and better communicate with your colleagues.

We will now review a list of important terms to know. Keep this chapter as a reference while studying.

1.2.3.1 White Hat Hacker

A **white hat hacker** is a professional penetration tester or ethical hacker who performs authorized attacks against a system helping the client solve their security issues.

White hat hackers do not perform illegal actions.

1.2.3.2 Black Hat Hacker

A **black hat hacker** is a hacker who performs unauthorized attacks against a system with the purpose of causing damage or gaining profit.

There is also a category of black hat hackers called **crackers**.

1.2.3.3 Users and Malicious Users

A **user** is a computer system user. It can be an employee of your client or an external user.

A **malicious user** is a user who misuses or attacks computer systems and applications.

1.2.3.4 Root or Administrator

The **root** or **administrator** users are the users who manage IT networks or single systems.

They have the maximum privileges over a system.

1.2.3.5 Privileges

In a computer system, **privileges** identify the action that a user is allowed to do.

The higher the privileges, the more the control over a system a user has.

1.2.3.6 Security Through Obscurity

Security through obscurity is the use of secrecy of design, implementation or configuration in order to provide security.

In this course, you will learn that security through obscurity cannot stop a skilled and motivated attacker.

1.2.3.7 Attack

An **attack** is any kind of action aimed at misusing or taking control over a computer system or application. Some examples of attacks are:

- Getting unauthorized access to an administration area
- Stealing a user's password
- Causing denial of service
- Eavesdropping on communications

1.2.3.8 Privilege Escalation

Privilege escalation is an attack where a malicious user gains elevated privileges over a system.

1.2.3.9 Denial of Service

With a **denial of service (DoS)** attack, a malicious user makes a system or a service unavailable.

The attack could be carried out by making the service crash or by saturating the service resources, thus making it unresponsive for legitimate users.

1.2.3.10 Remote Code Execution

During a **remote code execution** attack, a malicious user manages to execute some attacker-controlled code on a victim remote machine.

Remote code execution vulnerabilities are very dangerous because they can be exploited over the network by a remote attacker.

1.2.3.11 Shell Code

A **shellcode** is a piece of custom code which provides the attacker a shell on the victim machine.

Shellcodes are generally used during remote code execution attacks.

1.2.3.11 Shell Code

Now that you know a little more about the information security field, it is time to start learning some technical skills!

1.3

Cryptography and VPNs

1.3 Cryptography and VPNs

How does this support my pentesting career?

- Understanding how information is transmitted over computer networks
- Choosing the right protocol for the job
- Knowing how to protect your traffic

1.3 Cryptography and VPNs

Why do we introduce Cryptography here?

The main goal of this chapter is to introduce you to concepts that will be useful throughout the course; for instance, accessing our virtual labs.

1.3 Cryptography and VPNs

We will now explain the main difference between clear-text and cryptographic protocols.

Additionally, you will learn what a VPN (Virtual Private Network) is and how it works. All our virtual labs use VPN so knowing what it is will help you get most of out this course!

1.3.1 Clear-text Protocols

Clear-text protocols transmit data over the network without any kind of transformation (encryption).

This lets an attacker **eavesdrop** on the communication, as well as perform other malicious actions.

Hi server,
this is Alice.
Hi server,
this is Alice.

1.3.1 Clear-text Protocols

Because of their nature, clear-text protocols are **easy to intercept, eavesdrop and mangle**. They should not be used to transmit critical or private information.

If there is **absolutely no alternative** to a clear-text protocol, you should use it **only on trusted networks**.

1.3.2 Cryptographic Protocols

On the other hand, **cryptographic** protocols transform (encrypt) the information transmitted to protect the communication.

Cryptographic protocols have many different goals. One of them is to **prevent eavesdropping.**

1.3.2 Cryptographic Protocols

If an attacker intercepts the traffic, they will not be able to understand it.

???
Hi server, this is Alice.

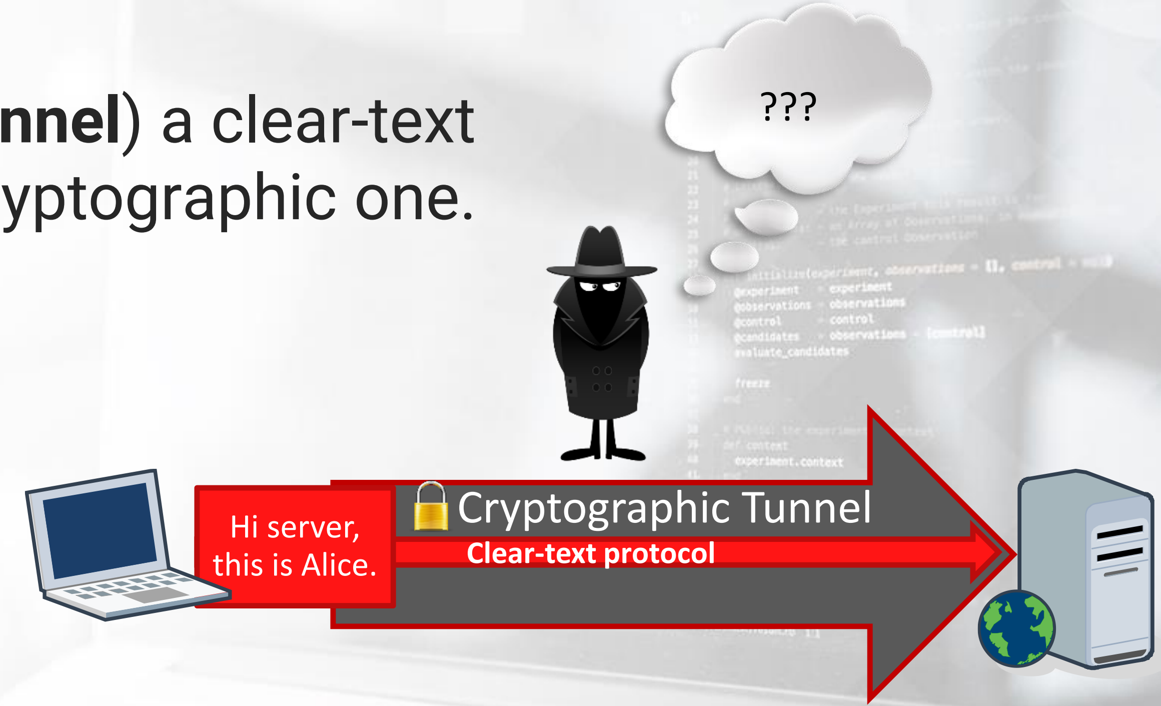
1.3.2 Cryptographic Protocols

If you need to transmit private information, for example - a username and a password, you should always **use a cryptographic protocol** to protect the communication over the network.

What if you need to run a clear-text protocol on an untrusted network?

1.3.2 Cryptographic Protocols

You can wrap (**tunnel**) a clear-text protocol into a cryptographic one.



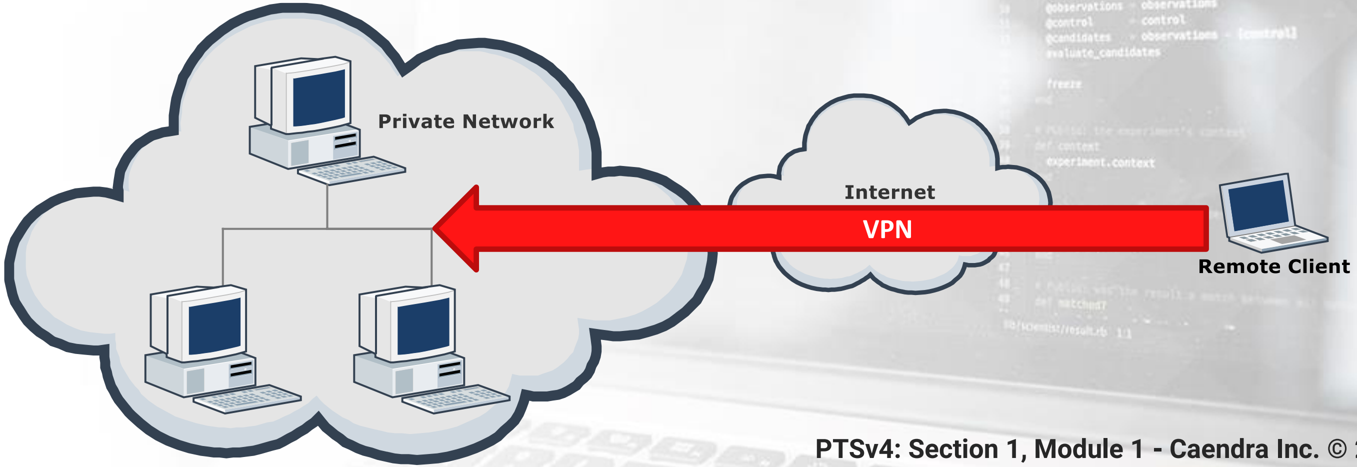
1.3.2 Cryptographic Protocols

A great example of protocol tunneling is a **VPN**.

1.3.3 Virtual Private Networks

A **Virtual Private Network** (VPN) uses cryptography to extend a private network over a public one, like the Internet.

The extension is made by performing a protected connection to a private network (*such as your office or home network*).



1.3.3 Virtual Private Networks

From the client point of view, being in the VPN **is the same as being directly connected** to the private network.

For example, when you launch a *Hera Lab* scenario from your member's area, a VPN tunnel is created, letting you connect directly to the lab network.

1.3.3 Virtual Private Networks

When you are connected via VPN, you are actually running the very same protocols of the private network.

This lets you perform even low-level network operations. For example, you can use a packet sniffer like **Wireshark**.

1.4

Wireshark Introduction

1.4 Wireshark Introduction

Wireshark is a network sniffer tool. A sniffer allows you to see the data transmitted over the network to and from your computer.

Wireshark will be discussed in depth in the next modules. For now, we are going to see its basic usage just to understand the difference between clear-text and cryptographic protocols.

1.4.1 Video – HTTP and HTTPS Traffic Sniffing

In the following video, you will see how to use *Wireshark* to intercept communication between your computer and a web server placed inside a dedicated network within Hera Lab.

This will help you understand the difference between a clear-text protocol and a cryptographic one from an attacker point of view.

1.4.1 Video

HTTPS and HTTPS Traffic Sniffing

In this video, you will see how to use *Wireshark* to intercept communication between your computer and a web server placed inside a dedicated network within Hera Lab.

This will help you understand the difference between a clear-text protocol and a cryptographic one from an attacker point of view.

**Videos are only available in Full or Elite Editions of the course. To upgrade, click HERE. To access, go to the course in your members area and click the resources drop-down in the appropriate module line.*

1.4.2 Hera Lab – HTTP and HTTPS Traffic Sniffing

Now it’s time to practice what you have just learned in a hands-on lab!

This lab is the only one that follows the same steps of a video or a lesson. We created it so you can become familiar with the Hera Lab environment.

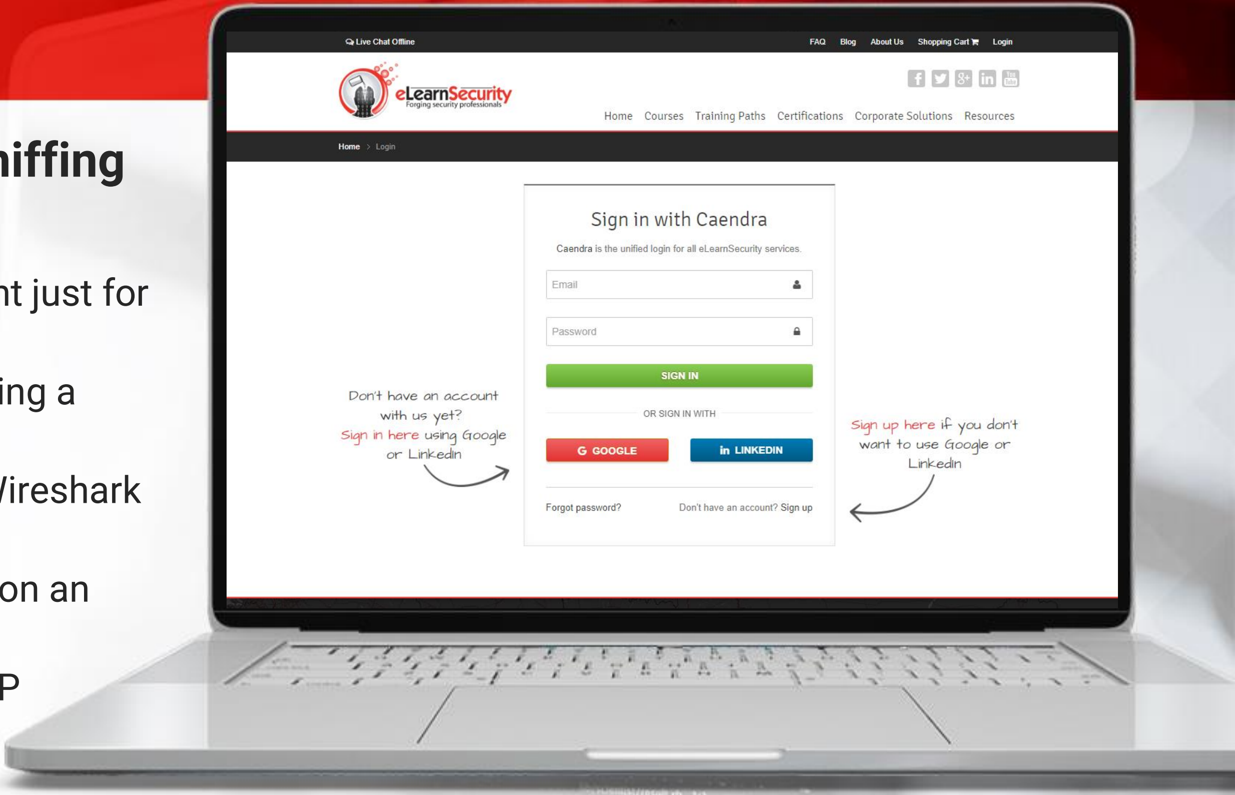
You will find additional information and instructions on the next slide.

1.4.2 Hera Lab

HTTP and HTTPS Traffic Sniffing

In this lab you will:

- Start a dedicated lab environment just for you
- Login to a web application by using a username and a password
- Sniff the login credentials with Wireshark on a clear-text communication
- Try to sniff the login credentials on an encrypted communication
- Learn how to use the "Follow TCP stream" command



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Sign up here if you don't want to use Google or LinkedIn

Labs are only available in Full or Elite Editions of the course. To upgrade, click HERE. To access, go to the course in your members area and click the labs drop-down in the appropriate module line or to the virtual labs tabs on the left navigation.

1.5

Binary Arithmetic Basics

1.5 Binary Arithmetic Basics

How does this support my pentesting career?

- Computers represent data in binary format
- Network addressing
- Computer logic operation

1.5 Binary Arithmetic Basics

Computers represent any kind of data with just two symbols:

0 (zero)

1 (one)

In this section, you will see what a **binary number** is and how to convert a decimal number into binary format.

1.5.1 Decimal and Binary Bases

Decimal notation uses ten symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) to represent numbers while **binary** notation uses only two symbols (0, 1).

Q

How can you represent "big" numbers by using just two symbols?

A

*You can do so by using the same method that you use with base-ten. The only difference is the **number of symbols** at your disposal.*

1.5.1 Decimal and Binary Bases

When you count in decimal, you **start from zero** and increment the number until you reach nine.

Nine is the **last symbol** in decimal.

When you reach it, you have to increment the digit to the left of it and start back from zero.

1.5.1 Decimal and Binary Bases

You can use the same method in binary:

- You start counting from 0, the first symbol.
- When you reach 1, which is the last symbol, you increment the digit to the left of it.

EXAMPLE

1.5.1 Decimal and Binary Bases

1 + 1 = 10

- You have to increment 1, so you "add" a digit on the left and start back from 0

111 + 1 = 1000

- Here you increment the rightmost digit, then you have to increment the next and so on.

1.5.1 Decimal and Binary Bases

Counting	
Decimal	Binary
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010

Last symbol

Last symbol

1.5.2 Converting from and to Binary

How do you convert **from binary to decimal format**?

You can use the **position** of the digits.

- $293_{10} = 3*10^0 + 9*10^1 + 2*10^2$

#	10^0	10^1	10^2
293	3	9	2

1.5.2 Converting from and to Binary

You can use the same method in binary, the only difference is the base.

- $1101^2 = 1*2^0 + 0*2^1 + 1*2^2 + 1*2^3 = 13_{10}$

#	2^0	2^1	2^2	2^3
1101	1	0	1	1

1.5.2 Converting from and to Binary

To convert a decimal number into binary format, you have to:

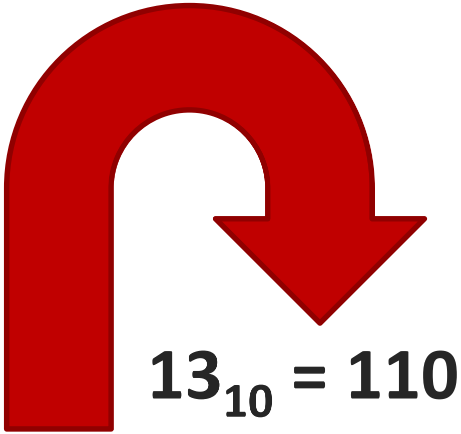
- Divide it by 2 and keep a note of the remainder.
- Then, you do it again dividing the result of the previous step by 2. Keep a note of the remainder (0 or 1).
- Iterate the same operation until the dividend is zero.

EXAMPLE

1.5.2.1 Converting from Binary Example

$13_{10} = ???_2$

- $13 / 2 = 6$ remainder: 1
- $6 / 2 = 3$ remainder: 0
- $3 / 2 = 1$ remainder: 1
- $1 / 2 = 0$ remainder: 1



$13_{10} = 1101_2$

1.5.3 Bitwise operations

Now that you know how binary representation works let’s look at some basic low-level operations.

1.5.3 Bitwise operations

A computer can directly manipulate bits by performing **bitwise operations**, which are used a lot in network programming and assembly programming.

EXAMPLE

1.5.3.1 NOT

NOT is a simple operation that flips the bits; zeroes become ones and ones become zeroes.

NOT works on a single number.

```
NOT 1101 = 0010
```

EXAMPLE

1.5.3.2 AND

AND performs a **Logical *AND*** between the bits of its operands.

If both bits in the comparing position are ones, the result is one; otherwise, it is zero.

```
1001 AND 1100 = 1000
```

EXAMPLE

1.5.3.3 OR

OR performs a **Logical *OR*** between the bits of its operands.

If **at least** one of the bits in the comparing position is one, the result is one.

```
1001 OR 1100 = 1101
```

EXAMPLE

1.5.3.4 XOR

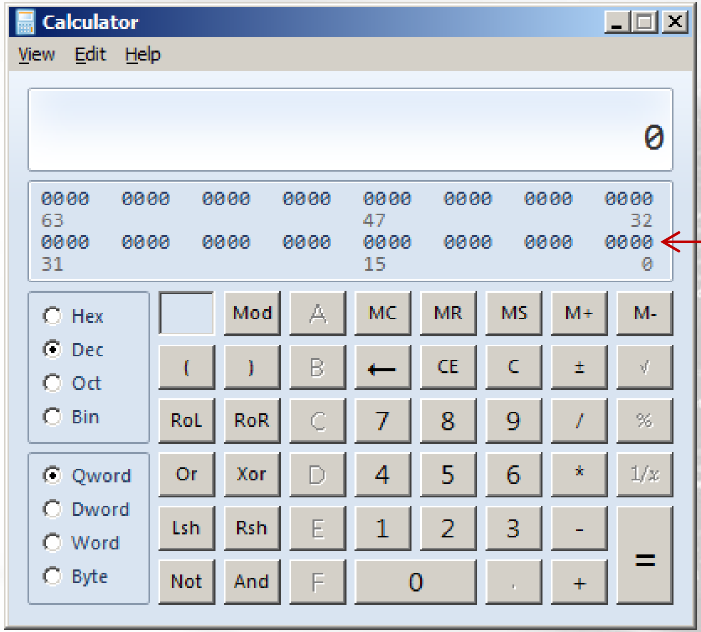
XOR performs a **Logical Exclusive *OR*** between the bits of its operands.

If **just one** of the bits in the comparing position is one, the result is one; otherwise, it is zero.

```
1001 XOR 1100 = 0101
```

1.5.4 Calculator

You can use a common calculator application and set the mode to "Programmer" to work in binary mode.



```
                                                      0
0000    0000    0000    0000    0000    0000    0000    0000
63                              47                        32
0000    0000    0000    0000    0000    0000    0000    0000
31                              15                         0
```

○ Hex
● Dec
○ Oct
○ Bin

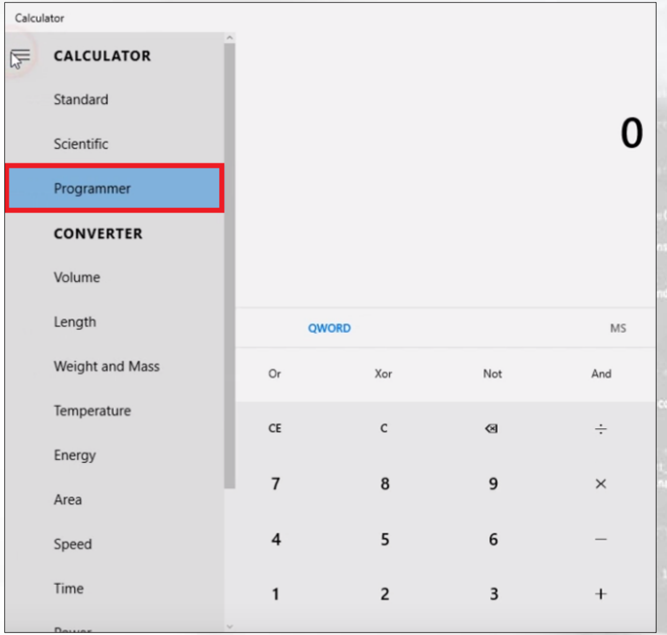
● Qword
○ Dword
○ Word
○ Byte

Click on a bit to flip it.

From 0 to 1 and vice-versa.

1.5.4 Calculator

The same on Windows 10…



1.5.4 Calculator

You can also use your fingers to count and perform operations in binary mode.

Check out this tutorial!

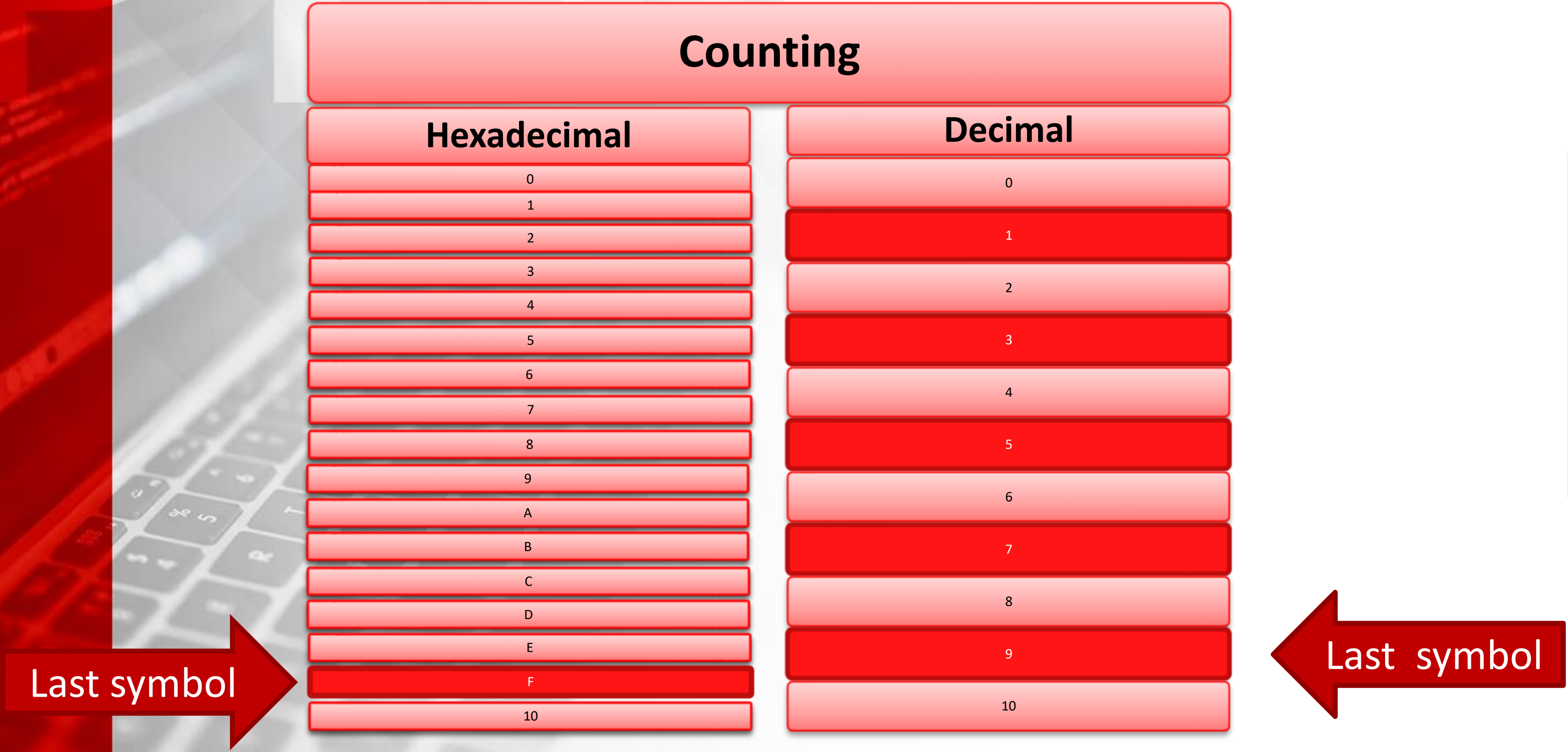
http://www.mathsisfun.com/numbers/binary-count-fingers.html

1.5.5 Hexadecimal arithmetic

Numbers can also be presented in a format other than decimal or binary system. Another system that is widely used in computer science is the **hexadecimal system**.

This system works the same way as the binary or decimal system. Let’s take a look at the diagram on the next slide.

1.5.5 Decimal and Hexadecimal Bases



Counting

Hexadecimal

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
10

Decimal

0
1
2
3
4
5
6
7
8
9
10

Last symbol

Last symbol

1.5.5 Hexadecimal arithmetic

Remember the last symbol? For a binary system, it is 1, while in decimal, it is 9. If we follow this format, then in hexadecimal, the maximal symbol is 15.

Since higher numbers are always built out of multiple digits, to avoid confusion, all double-digit numbers were switched to letters. Thus, we count 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

1.5.5 Hexadecimal arithmetic

In this case, the maximal digit is „F” (15 in decimal).

You probably noticed that not all hexadecimal numbers contain letters, so in order to distinguish them from decimal, we add „0x” at the beginning or „h” at the end.

Exemplary numbers may then look similar to those: 0x10 or 44h.

1.5.5 Hexadecimal arithmetic

You can convert hexadecimal to decimal and reverse in a similar manner as you did with binary.

Let’s now see how it’s possible to convert a hexadecimal number to decimal one. The following slides will guide you through the process.

1.5.5.1 Converting hexadecimal to decimal

We will be working with the exemplary number 0x3a1, which can also be written as 3a1h.

Basically, to inform that the given number is hexadecimal, we use „0x" at the beginning or „h" at the end.

First, we need to understand the target number's decimal representation; so, we can write 3a1h as (3 10 1)h since „A" is „10" in decimal. This format will be helpful in further calculations.

1.5.5.1 Converting hexadecimal to decimal

How do you convert **from hexadecimal to decimal format**?

You can use the **position** of the digits.

- 0x3a1 = 0x(3 10 1)
- 0x3a1 = $1*16^0 + 10*16^1 + 3*16^2 = 929_{10}$

#	16^0	16^1	16^2
3a1	1	a (10)	3

1.5.5.2 Converting decimal to hexadecimal

In order to convert a decimal number to a hexadecimal one, we will perform subsequent divisions by 16 (system base) and note down the remainders, as per below picture:

number	div by	result	hexadecimal
1019	16	63.6875	0.6875*16 = 11 (B)
63	16	3.9375	0.9375*16 = 15 (F)
3	16	0.1875	0.1875*16 = 3
0	Can’t divide 0	-	Result is 0x3FB

1.5.5.2 Converting decimal to hexadecimal

First, we take 1019 and divide by 16 (system base), and we receive **63,6875**.

We note down 63 for further calculation, and use **0.6875** to calculate the last digit of result hexadecimal number.

Let's multiply **0.6875** by the system base (16), and the result is 11 **(B in HEX)**.

B is then the **last digit of result hexadecimal number**.

1.5.5.2 Converting decimal to hexadecimal

Like in the previous slides, we'll do similarly with the noted 63. Let's start by dividing it by 16 to receive 3,**9375**.

Let's note down 3 for further calculations and use **0.9375** to get the second digit of result for our hexadecimal number.

Let's multiply **0.9375** by the base (16), and we receive 15 **(F in HEX)**.

F will then be the next digit. **So far we have the following results for the last digits of our hexadecimal number – „FB"**.

1.5.5.2 Converting decimal to hexadecimal

Let’s now turn our attention to the number we just noted down, 3. When we divide it by 16, we receive **0.1875**.

By proceeding in the same way as we have previously, we should note down zero for further division, but since it is not possible to divide 0, we know that we are currently calculating the last digit for the resultof our hexadecimal number.

0.1875 will let us know the last digit of result if we again follow previous instruction.

Multiplying the above value by 16 allows to obtain last digit: **3**.

1.5.5.2 Converting decimal to hexadecimal

Looking at the calculations, now we know result number: **0x3FB** which is hexadecimal form of decimal 1019.

1.5.5.3 Automated converting

You now know how to recognise hexadecimal numbers, and how to convert them to decimal form, in addition to converting decimal numbers to its hexadecimal form.

But during penetration testing work, you might want to speed things up. If so, then it's best to use converters like online resources. For example, you can check following websites:

- https://www.binaryhexconverter.com/decimal-to-hex-converter
- https://www.binaryhexconverter.com/hex-to-decimal-converter

Conclusion

Congratulations!

You have just finished your first module of the **Penetration Testing Student** course.

In the next modules, you are going to deepen your knowledge of cryptography, protocols, computer networks, penetration testing and much more!

References

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Videos

HTTP(s) Traffic Sniffing & Wireshark Introduction

In this video, you will see how to use *Wireshark* to intercept communication between your computer and a web server placed inside a dedicated network within Hera Lab.

This will help you understand the difference between a clear-text protocol and a cryptographic one from an attacker point of view.

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Labs

HTTP(S) Traffic Sniffing

Intercept traffic with Wireshark. Learn how to “Follow TCP Stream”.

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