

Software Security

exercises

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August 29, 2019



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Preface

This material is prepared for use in *Software Security* course and was prepared by Henrik Lund Kramshøj, <http://www.zencurity.com> . It describes the networking setup and applications for trainings and courses where hands-on exercises are needed.

Further a presentation is used which is available as PDF from kramse@Github
Look for software-security-exercises in the repo security-courses.

These exercises are expected to be performed in a training setting with network connected systems. The exercises use a number of tools which can be copied and reused after training. A lot is described about setting up your workstation in the repo

<https://github.com/kramse/kramse-labs>

Prerequisites

This material expect that participants have a working knowledge of TCP/IP from a user perspective. Basic concepts such as web site addresses and email should be known as well as IP-addresses and common protocols like DHCP.

Have fun and learn

Exercise content

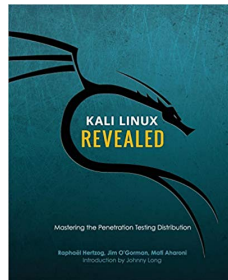
Most exercises follow the same procedure and has the following content:

- **Objective:** What is the exercise about, the objective
- **Purpose:** What is to be the expected outcome and goal of doing this exercise
- **Suggested method:** suggest a way to get started
- **Hints:** one or more hints and tips or even description how to do the actual exercises
- **Solution:** one possible solution is specified
- **Discussion:** Further things to note about the exercises, things to remember and discuss

Please note that the method and contents are similar to real life scenarios and does not detail every step of doing the exercises. Entering commands directly from a book only teaches typing, while the exercises are designed to help you become able to learn and actually research solutions.

Exercise 1

Download Kali Linux Revealed (KLR) Book 10 min



Kali Linux Revealed Mastering the Penetration Testing Distribution

Objective:

We need a Kali Linux for running tools during the course. This is open source, and the developers have released a whole book about running Kali Linux.

This is named Kali Linux Revealed (KLR)

Purpose:

We need to install Kali Linux in a few moments, so better have the instructions ready.

Suggested method:

Create folders for educational materials. Go to <https://www.kali.org/download-kali-linux-revealed-book/> Read and follow the instructions for downloading the book.

Solution:

When you have a directory structure for download for this course, and the book KLR in PDF you are done.

Discussion:

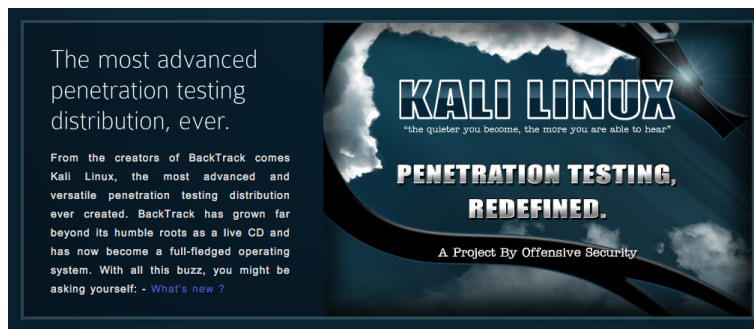
Linux is free and everywhere. The tools we will run in this course are made for Unix, so they run great on Linux.

Kali Linux is a free pentesting platform, and probably worth more than \$10.000

The book KLR is free, but you can buy/donate, and I recommend it.

Exercise 2

Check your Kali VM, run Kali Linux 30 min



Objective:

Make sure your virtual machine is in working order.

We need a Kali Linux for running tools during the course.

Purpose:

If your VM is not installed and updated we will run into trouble later.

Suggested method:

Go to <https://github.com/kramse/kramse-labs/>

Read the instructions for the setup of a Kali VM.

Hints:

If you allocate enough memory and disk you won't have problems.

Solution:

When you have a updated virtualisation software and Kali Linux, then we are good.

Discussion:

Linux is free and everywhere. The tools we will run in this course are made for Unix, so they run great on Linux.

Kali Linux includes many hacker tools and should be known by anyone working in infosec.

Exercise 3

Check your Debian VM 10 min



Objective:

Make sure your virtual Debian 9 machine is in working order.

We need a Debian 9 Linux for running a few extra tools during the course.

This is a bonus exercise - only one Debian is needed per team.

Purpose:

If your VM is not installed and updated we will run into trouble later.

Suggested method:

Go to <https://github.com/kramse/kramse-labs/>

Read the instructions for the setup of a Kali VM.

Hints:

Solution:

When you have a updated virtualisation software and Kali Linux, then we are good.

Discussion:

Linux is free and everywhere. The tools we will run in this course are made for Unix, so they run great on Linux.

Exercise 4

Investigate /etc 10 min

Objective:

We will investigate the /etc directory on Linux. We need a Debian 9 Linux and a Kali Linux, to compare

Purpose:

Start seeing example configuration files, including:

- User database /etc/passwd and /etc/group
- The password database /etc/shadow

Suggested method:

Boot your Linux VMs, log in

Investigate permissions for the user database files passwd and shadow

Hints:

Linux has many tools for viewing files, the most efficient would be less.

```
hlk@debian:~$ cd /etc
hlk@debian:/etc$ ls -l shadow passwd
-rw-r--r-- 1 root root  2203 Mar 26 17:27 passwd
-rw-r----- 1 root shadow 1250 Mar 26 17:27 shadow
hlk@debian:/etc$ ls
... all files and directories shown, investigate more if you like
```

Showing a single file: less /etc/passwd and press q to quit

Showing multiple files: less /etc/* then :n for next and q for quit

Trying reading the shadow file as your regular user:

```
user@debian-9-lab:/etc$ cat /etc/shadow
cat: /etc/shadow: Permission denied
```

Why is that? Try switching to root, using su or sudo, and redo the command.

Solution:

When you have seen the most basic files you are done.

Discussion:

Linux is free and everywhere. The tools we will run in this course are made for Unix, so they run great on Linux.

Sudo is a tool often used for allowing users to perform certain tasks as the super user. The tool is named from superuser do! <https://en.wikipedia.org/wiki/Sudo>

Exercise 5

Run OWASP Juice Shop 45 min

**Objective:**

Lets try starting the OWASP Juice Shop

Purpose:

We will be doing some web hacking where you will be the hacker. There will be an application we try to hack, designed to optimise your learning.

It is named JuiceShop which is written in JavaScript

Suggested method:

Go to <https://github.com/bkimminich/juice-shop>

Read the instructions for running juice-shop - docker is a simple way.

What you need

You need to have browsers and a proxy, plus a basic knowledge of HTTP.

If you could install Firefox it would be great, and we will use the free version of Burp Suite, so please make sure you can run Java and download the free version from Portswigger from:

<https://portswigger.net/burp/communitydownload>

Hints:

The application is very modern, very similar to real applications.

The Burp proxy is an advanced tool! Dont be scared, we will use small parts at different times.

Solution:

When you have a running Juice Shop web application in your team, then we are good.

Discussion:

It has lots of security problems which can be used for learning hacking, and thereby how to secure your applications. It is related to the OWASP.org Open Web Application Security Project which also has a lot of resources.

Sources:

<https://github.com/bkimminich/juice-shop>

https://www.owasp.org/index.php/Category:OWASP_WebGoat_Project

It is recommended to buy the *Pwning OWASP Juice Shop Official companion guide to the OWASP Juice Shop* from <https://leanpub.com/juice-shop> - suggested price USD 5.99

Exercise 6

Setup JuiceShop environment, app and proxy - up to 60min

Objective:

Run JuiceShop with Burp proxy.

Start JuiceShop and make sure it works, visit using browser.

Then add a web proxy in-between. We will use Burp suite which is a commercial product, in the community edition.

Purpose:

We will learn more about web applications as they are a huge part of the applications used in enterprises and on the internet. Most mobile apps are also web applications in disguise.

By inserting a web proxy we can inspect the data being sent between browsers and the application.

Suggested method:

You need to have browsers and a proxy, plus a basic knowledge of HTTP.

If you could install Firefox it would be great, and we will use the free version of Burp Suite, so please make sure you can run Java and download the free version plain JAR file from Portswigger from:

<https://portswigger.net/burp/communitydownload>

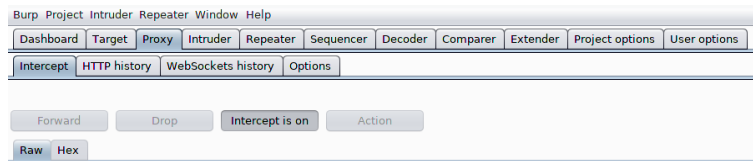
follow the Getting Started instructions at:

<https://support.portswigger.net/customer/portal/articles/1816883-getting-started-with-burp-suite>

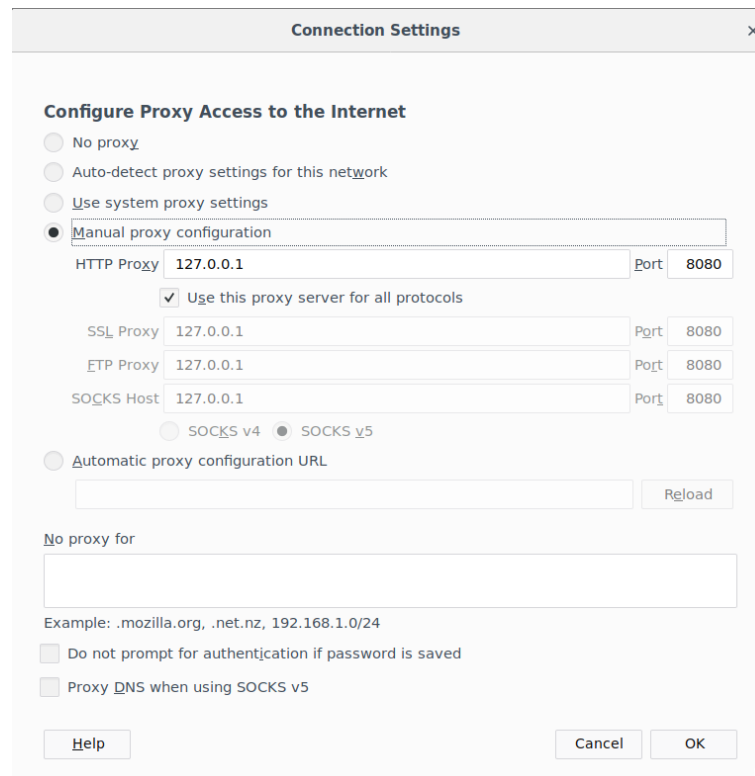
Hints:

Recommend running Burp on the default address and port 127.0.0.1 port 8080.

Note: Burp by default has `intercept is on` in the Proxy tab, press the button to allow data to flow.



Then setting it as proxy in Firefox:



Solution:

When web sites and servers start popping up in the Target tab, showing the requests and responses - you are done.

Your browser will alert you when visiting TLS enabled sites, HTTPS certificates do not match, as Burp is doing a person-in-the-middle. You need to select advanced and allow this to continue.

Discussion:

Since Burp is often updated I use a small script for starting Burp which I save in `~/bin/burp` - dont forget to add to PATH and `chmod x bin/burp`.

```
#!/bin/sh
DIRNAME=`dirname $0`
BURP=`ls -ltra $DIRNAME/burp*.jar | tail -1`
java -jar -Xmx6g $BURP &
```

Exercise 7

Run small programs: Python, Shell script 20min

Objective:

Be able to create small scripts using Python and Unix shell.

Purpose:

Often it is needed to automate some task. Using scripting languages allows one to quickly automate.

Python is a very popular programming language. The Python language is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991.

You can read more about Python at:

<https://www.python.org/about/gettingstarted/> and

[https://en.wikipedia.org/wiki/Python_\(programming_language\)](https://en.wikipedia.org/wiki/Python_(programming_language))

Shell scripting is another method for automating things on Unix. There are a number of built-in shell programs available.

You should aim at using basic shell scripts, to be used with `/bin/sh` - as this is the most portable Bourne shell.

Suggested method:

Both shell and Python is often part of Linux installations.

Use and editor, leafpad, atom, VI/VIM, joe, EMACS, Nano ...

Create two files, I named them `python-example.py` and `shell-example.sh`:

```
#!/usr/bin/env python3
# Function for nth Fibonacci number

def Fibonacci(n):
    if n<0:
        print("Incorrect input")
    # First Fibonacci number is 0
    elif n==1:
        return 0
    # Second Fibonacci number is 1
    elif n==2:
        return 1
    else:
        return Fibonacci(n-1)+Fibonacci(n-2)

# Driver Program
print(Fibonacci(9))
```

```
#This code is contributed by Saket Modi
# https://www.geeksforgeeks.org/python-program-for-program-for-fibonacci-numbers-2/
```

```
#!/bin/sh
# The ! and # tell which interpreter to use
# Comments are easy

DATE=`date +%Y-%m-%d`
USERCOUNT=$(wc -l /etc/passwd)
echo "Todays date in ISO format is: $DATE"

echo "This system has $USERCOUNT users"
```

Unix does not require the file type .py or .sh, but it is often recommended to use it. To be able to run these programs you need to make them executable. Use the commands to set execute bit and run them:

Note: Python is available in two versions, version 2 and version 3. You should aim at running only version 3, as the older one is deprecated.

Hints:

```
$ chmod +x python-example.py shell-example.sh
```

```
$ ./python-example.py
21
```

```
$ ./shell-example.sh
Todays date in ISO format is: 2019-08-29
This system has 32 /etc/passwd users
```

Solution:

When you have tried making both a shell script and a python program, you are done.

Discussion:

If you want to learn better shell scripting there is an older but very recommended book,

Classic Shell Scripting Hidden Commands that Unlock the Power of Unix By Arnold Robbins, Nelson Beebe. Publisher: O'Reilly Media Release Date: December 2008
<http://shop.oreilly.com/product/9780596005955.do>

Exercise 8

Run parts of a Django tutorial 30min

Objective:

Talk about web applications, how they are made.

Purpose:

Know how you can get started using a framework, like Django
<https://www.djangoproject.com/>

Suggested method:

We will visit a Django tutorial and talk about the benefits from using existing frameworks.

Hints:

Input validation is a problem most applications face. Using Django a lot of functionality is available for input validation.

Take a look at Form and field validation:

<https://docs.djangoproject.com/en/2.2/ref/forms/validation/>

You can also write your own validators, and should centralize validation in your own applications.

```
from django.core.exceptions import ValidationError
from django.utils.translation import gettext_lazy as _

def validate_even(value):
    if value % 2 != 0:
        raise ValidationError(
            _('%(value)s is not an even number'),
            params={'value': value},
        )
```

Example from: <https://docs.djangoproject.com/en/2.2/ref/validators/>

Solution:

When we have covered basics of what Django is, what frameworks provide and seen examples, we are done.

Discussion:

Django is only an example, other languages and projects exist.