

Welcome to

0. Introduction

KEA Kompetence Computer Systems Security 2024

Henrik Kramselund he/him han/ham xhek@kea.dk @kramse

Slides are available as PDF, kramse@Github 

0-Introduction-system-security.tex in the repo security-courses

Contact information



- Henrik Kramselund, he/him internet samurai mostly networks and infosec
- Network and security consultant Zencurity, teach at KEA and activist
- Master from the Computer Science Department at the University of Copenhagen (DIKU)
- Email: xhek@kea.dk Mobile: +45 2026 6000

You are welcome to drop me an email

Goals for part I



- Welcome, course goals and expectations, get to know eachother
- Create a good starting point for learning
- Learn to find resources, files and programs/libraries
- Concrete Expectations
- Prepare tools for the exercises, Prepare Virtual Machines

Photo by Thomas Galler on Unsplash

Plan for part I

- Introduce lecturer and students
- Expectations for this course
- Literature list walkthrough
- Prepare tools for the exercises
- Kali and Debian Linux introduction

Exercises

- Kali Linux installation
- Debian Linux installation

Linux is a toolbox we will use and participants will use virtual machines

Time schedule

- 10:00 Welcome – Get started, begin part 1
- 10:45 break
- 11:00 Part 1 continued
- 12:30 Lunch
- 13:00 Part 2 Lecture and exercises
- 16:30 Summary of the day, key points, conclusions
- 17:00 End of day
- We aim at maximum of 45min of lecture without breaks.
- There may be times where 45min lecture is followed by exercises. You can get started immediately or take a break.

This will be the basic plan for each day

Course Materials

This material is in multiple parts:

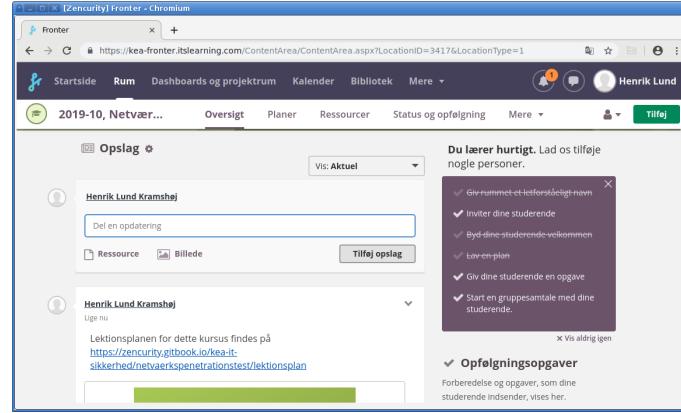
- Slide shows - presentation - this file
- Exercises - PDF which is updated along the way

Books listed in the lecture plan Additional resources from the internet

Note: the presentation slides are not a substitute for reading the books, papers and doing exercises, many details are not shown

A special thanks to William D. (Bill) Young Associate Professor of Instruction and Research Scientist, The University of Texas at Austin

When asked if I could borrow parts from his CS361 *Introduction to Computer Security* he graciously wrote:
"You are welcome to use them freely. You can credit me at the beginning."



We will use fronter a lot, both for sharing educational materials and news during the course.

You will also be asked to turn in deliverables through fronter

<https://kea-fronter.itslearning.com/>

If you haven't received login yet, let us know

Overview Diploma in IT-security

Afgangsprojektet (15 ECTS)	
Der udvikles løbende nye valgfag til Diplom i it-sikkerhed. Disse vil løbende blive beskrevet i en allonge (bilag 2) til studieordningen.	
Sikkerhed i it-governance (it-sikkerhedsledelse) (5 ECTS)	Systemsikkerhed (10 ECTS)
Videregående sikkerhed i it-governance (Videregående sikkerhedsledelse) (5 ECTS)	
Softwaresikkerhed (10 ECTS)	
Netværks- og kommunikationssikkerhed (10 ECTS)	



Course: VF 3 Computer Systems Security (10 ECTS)

Teaching dates: mondays 10:00 - 17:00
8/1, 15/1, 22/1, 29/1, 26/2, 4/3, 11/3 2024

Exam: 25/3 2024

Photo by Paweł Janiak on Unsplash

Deliverables and Exam

- Exam
- Individual: Oral based on curriculum
- Graded (7 scale)
- Draw a question with no preparation. Question covers a topic
- Try to discuss the topic, and use practical examples
- Exam is 30 minutes in total, including pulling the question and grading
- Count on being able to present talk for about 10 minutes
- Prepare material (keywords, examples, exercises, wireshark captures) for different topics so that you can use it to help you at the exam
- Deliverables:
- 2 Mandatory assignments
- Both mandatory assignments are required in order to be entitled to the exam.

Course Description

From: STUDIEORDNING Diplomuddannelse i it-sikkerhed Marts 2022

Indhold: Den studerende kan udføre, udvælge, anvende, og implementere praktiske tiltag til sikring af firmaets udstyr og har viden og færdigheder der supportere dette.

Viden

Den studerende har viden om:

- Generelle governance principper / sikkerhedsprocedurer
- Væsentlige forensic processer
- Relevante it-trusler
- Relevante sikkerhedsprincipper til systemsikkerhed
- OS roller ift. sikkerhedsovervejelser
- Sikkerhedsadministration i DBMS.

Færdigheder

Den studerende kan:

- Udnutte modforanstaltninger til sikring af systemer
- Følge et benchmark til at sikre opsætning af enhederne
- Implementere systematisk logning og monitering af enheder
- Analysere logs for incidents og følge et revisionsspor
- Kan genoprette systemer efter en hændelse.

Kompetencer

Den studerende kan:

- håndtere enheder på command line-niveau
- håndtere værktøjer til at identificere og fjerne/afbøde forskellige typer af endpoint trusler
- håndtere udvælgelse, anvendelse og implementering af praktiske mekanismer til at forhindre, detektere og reagere over for specifikke it-sikkerhedsmæssige hændelser
- håndtere relevante krypteringstiltag

Final word is the Studieordning which can be downloaded from

https://kompetence.kea.dk/studieordninger/Studieordning_Diplom_IT-sikkerhed_2022_03.pdf

Expectations alignment



Form groups of 2-3 students

In groups of 2 students, brainstorm for 5 minutes on what topics you would like to have in this course

Use 5 minutes more on Agreeing on 5 topics and prioritize these 5 topics

PS We will from time to time have exercises, groups dont need to be the same each time.

Prerequisites

This course includes exercises and getting the most of the course requires the participants to carry out these practical exercises

We will use Linux for some exercises but previous Linux and Unix knowledge is not needed

It is recommended to use virtual machines for the exercises

Security and most internet related security work has the following requirements:

- Network experience
- Server experience
- TCP/IP principles - often in more detail than a common user
- Programming is an advantage, for automating things
- Some Linux and Unix knowledge is in my opinion a **necessary skill**
 - too many new tools to ignore, and lots found at sites like Github and Open Source written for Linux

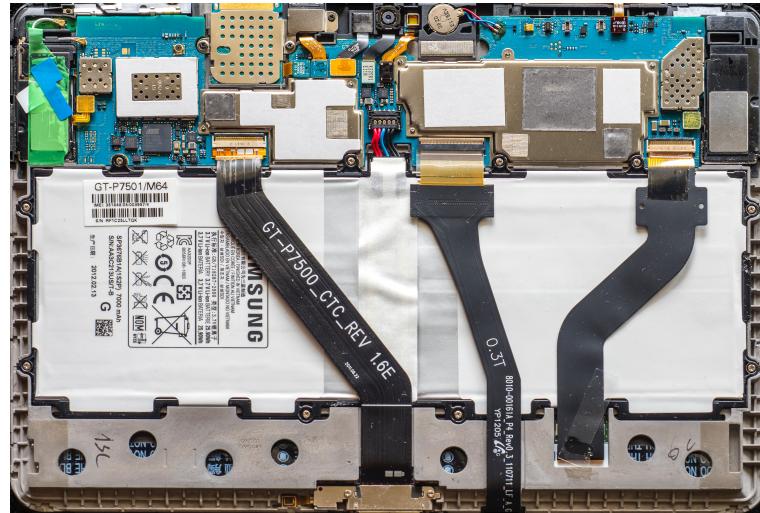
Goals and plans

“A goal without a plan is just a wish.”
Antoine de Saint-Exupéry

I want this course to

- Include everything required by studieordningen
- Be practical – you can do something useful
- Kickstart your journey into System Security
Getting the best books and papers
- Present a lot of useful sources, tools
- Prepare you for production use of the knowledge

What is Infrastructure



- Enterprises today have a lot of computing systems supporting the business needs
- These are very diverse and often discrete systems

Photo by Alexander Schimmeck on Unsplash

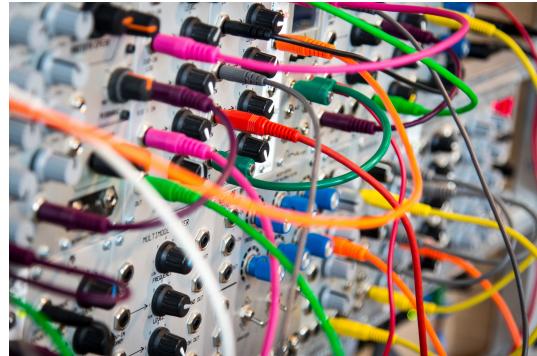
Business Challenges



- Accumulation of software
- Legacy systems
- Partners
- Various types of data
- Employee churn, replacement

Photo by Adam Bignell on Unsplash

Software Challenges



- Complexity
- Various languages
- Various programming paradigms, client server, monolith, Model View Controller
- Conflicting data types and available structures
- Steam train vs electric train

Photo by John Barkiple on Unsplash

Developers Challenges



- Work in teams across organisation - and partners, vendors, sub-contractors
- Work with legacy systems, old technology
- Learn new Technologies

Photo by Kelly Sikkema on Unsplash

Integration Challenges



- Enable communication between components
- Need mediator, interpreter, translator
- Recognize standard patterns

Photo by Thomas Drouault on Unsplash

Course overview

We will now go through a little from the Table of Contents in the books.

and the *Lektionsplan*

<https://zencurity.gitbook.io/kea-it-sikkerhed/systemsikkerhed/lektionsplan>

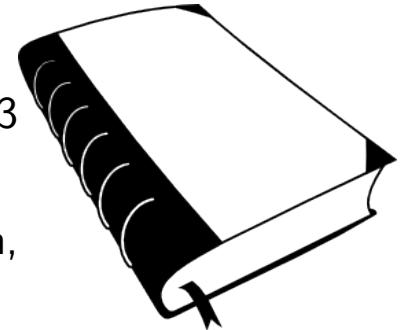
Primary literature

Primary literature - not all chapters are part of the curriculum:

- *Mastering Linux Security and Hardening* (MLSH) - Third Edition, Donald A. Tevault, 2023
ISBN: 9781837630516
- *Defensive Security Handbook: Best Practices for Securing Infrastructure* (DSH), Lee Brotherton, Amanda Berlin ISBN: 978-1-491-96038-7
- *Forensics Discovery* (FD), Dan Farmer, Wietse Venema 2004, Addison-Wesley
ISBN: 9780201634976

This book is currently available for "free":

<http://fish2.com/security/> – also uploaded to Fronter



Free graphics by Lumen Design Studio

Other papers and resources will also be part of the curriculum!

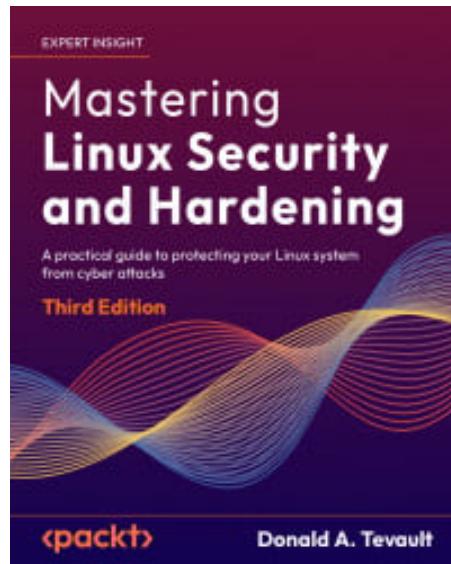
Course overview

We will now go through a little from the Table of Contents in the books.

and the lecture plan in Fronter (Source is also in Git

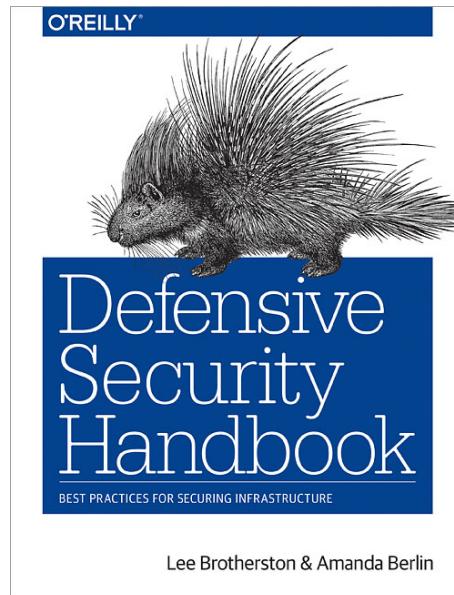
<https://github.com/kramse/kea-it-sikkerhed/blob/master/system-security/lektionsplan.md>)

Book: Mastering Linux Security and Hardening (MLSH)



Mastering Linux Security and Hardening (MLSH), third edition, Donald A. Tevault, 2023 ISBN: 9781837630516
<https://www.packtpub.com/product/mastering-linux-security-and-hardening-third-edition/9781837630516>

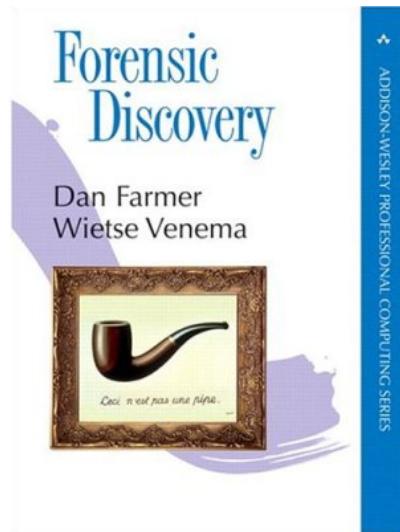
Book: Defensive Security Handbook (DSH)



Defensive Security Handbook: Best Practices for Securing Infrastructure, Lee Brotherston, Amanda Berlin ISBN: 978-1-491-96038-7 – Note: 2nd edition scheduled for this year

<https://www.oreilly.com/library/view/defensive-security-handbook/9781491960370/>

Book: Forensics Discovery (FD)



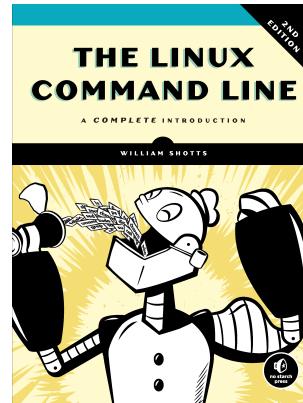
Forensics Discovery, Dan Farmer, Wietse Venema 2004, Addison-Wesley.

Can be found at <http://www.porcupine.org/forensics/forensic-discovery/>

Supporting literature books

- *The Linux Command Line: A Complete Introduction*, 2nd Edition
by William Shotts
- *Linux Basics for Hackers Getting Started with Networking, Scripting, and Security in Kali*
OccupyTheWeb, December 2018, 248 pp. ISBN-13: 978-1-59327-855-7 - shortened LBfH
- *The Debian Administrator's Handbook*, Raphaël Hertzog and Roland Mas
<https://debian-handbook.info/> - shortened DEB
- *Kali Linux Revealed Mastering the Penetration Testing Distribution*
Raphaël Hertzog, Jim O'Gorman - shortened KLR

Book: The Linux Command Line



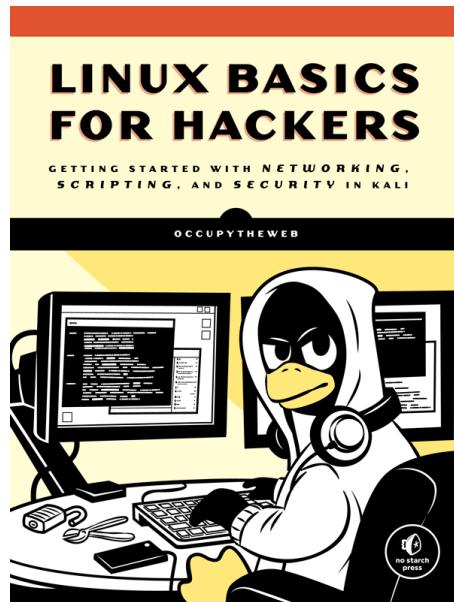
The Linux Command Line: A Complete Introduction, 2nd Edition by William Shotts

Print: <https://nostarch.com/tlcl2>

Download – internet edition <https://sourceforge.net/projects/linuxcommand>

Not curriculum but explains how to use Linux

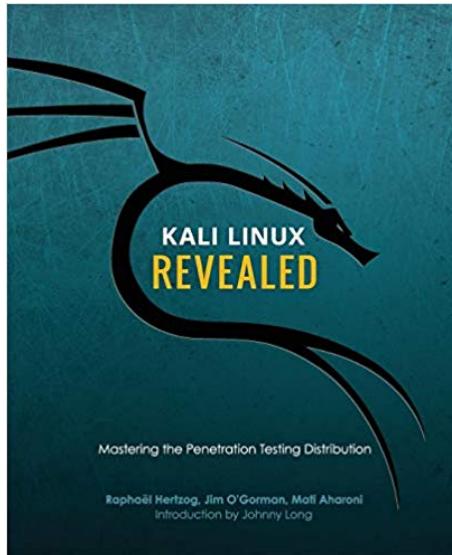
Book: Linux Basics for Hackers (LBfH)



Linux Basics for Hackers Getting Started with Networking, Scripting, and Security in Kali by OccupyTheWeb December 2018, 248 pp. ISBN-13: 9781593278557

<https://nostarch.com/linuxbasicsforhackers> Not curriculum but explains how to use Linux

Book: Kali Linux Revealed (KLR)



Kali Linux Revealed Mastering the Penetration Testing Distribution

<https://www.kali.org/download-kali-linux-revealed-book/>

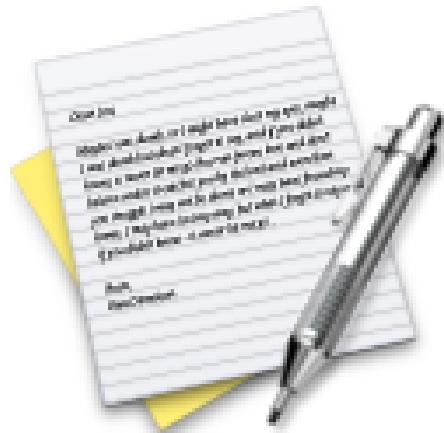
Not curriculum but explains how to install Kali Linux

The Debian Administrator's Handbook (DEB)



The Debian Administrator's Handbook, Raphaël Hertzog and Roland Mas
<https://debian-handbook.info/> - shortened DEB

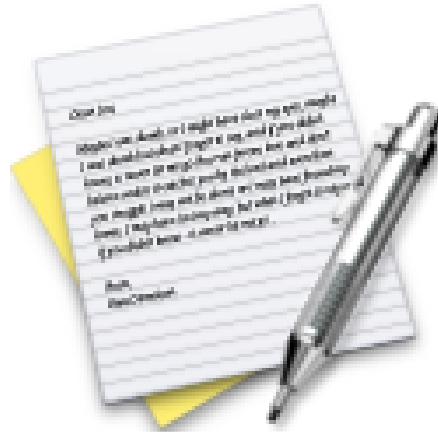
Not curriculum but explains how to use Debian Linux



Now lets do the exercise

⚠ Download Kali Linux Revealed (KLR) Book 10min

which is number **1** in the exercise PDF.



Now lets do the exercise

⚠ Download Debian Administrator's Handbook (DEB) Book 10min

which is number **2** in the exercise PDF.

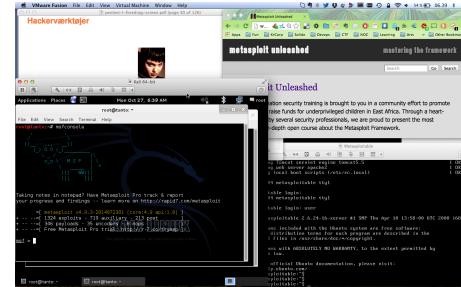
Technologies used in this course

The following tools and environments are examples that may be introduced in this course:

- Programming languages and frameworks Java, Python, regular expressions
- Development environments – choose your own IDE / Editor – I use **Atom**
- Networking and network protocols: TCP/IP, HTTP, DNS, Netflow
- Web technologies and services: REST, API, HTML5, CSS, JavaScript
- Tools like cURL, Zeek, Git and Github
- Aggregated example platforms: Elastic stack, logstash, elasticsearch, kibana, grafana, Filebeat

This list is not complete or a promise

Hackerlab Setup



- Hardware: modern laptop CPU with virtualisation
Dont forget to enable hardware virtualisation in the BIOS
- Virtualisation software: VMware, Virtual box, HyperV pick your poison
- Hackersoftware: Kali Virtual Machine amd64 64-bit <https://www.kali.org/>
- Linux server system: Debian 12 Bookworm amd64 64-bit <https://www.debian.org/>
- Setup instructions can be found at <https://github.com/kramse/kramse-labs>

It is enough if these VMs are pr team

Mixed exercises

Then we will do a mixed bag of exercises to introduce technologies, find your current knowledge level with regards to:

- Linux as an operating system – user database in /etc/
- Linux command line
- Demo: Ansible
- Git, Python, scripting
- Demo: Elasticsearch – how to run a *service*

Note: today we will consider all these optional, we won't be able to do them all

Later we will return to them!

Straffelovens paragraf 263 Stk. 2. Med bøde eller fængsel indtil 6 måneder straffes den, som ubrettiget skaffer sig adgang til en andens oplysninger eller programmer, der er bestemt til at bruges i et anlæg til elektronisk databehandling.

Hacking kan betyde:

- At man skal betale erstatning til personer eller virksomheder
- At man får konfiskeret sit udstyr af politiet
- At man, hvis man er over 15 år og bliver dømt for hacking, kan få en bøde - eller fængselsstraf i alvorlige tilfælde
- At man, hvis man er over 15 år og bliver dømt for hacking, får en plettet straffeattest. Det kan give problemer, hvis man skal finde et job eller hvis man skal rejse til visse lande, fx USA og Australien
- Frit efter: <http://www.stophacking.dk> lavet af Det Kriminalpræventive Råd
- Frygten for terror har forstærket ovenstående - så lad være!

Exercise CHAOS: Don't Panic – have fun learning



“It is said that despite its many glaring (and occasionally fatal) inaccuracies, the Hitchhiker’s Guide to the Galaxy itself has outsold the Encyclopedia Galactica because it is slightly cheaper, and because it has the words ‘DON’T PANIC’ in large, friendly letters on the cover.”

Hitchhiker’s Guide to the Galaxy, Douglas Adams

Your lab setup

- Go to GitHub, Find user Kramse, click through kramse-labs
- Look into the instructions for the Virtual Machine – Debian and Kali only
- Get the lab instructions, from

<https://github.com/kramse/kramse-labs/tree/master/suricatazeek>

Yes, reusing instruction for the Suricata Zeek workshop - tested and working!

Command prompts in Unix

Shells :

- sh - Bourne Shell
- bash - Bourne Again Shell, often the default in Linux
- ksh - Korn shell, original by David Korn, but often the public domain version used
- csh - C shell, syntax similar to C language
- Multiple others available, zsh is very popular

Windows have command.com, cmd.exe but PowerShell is more similar to the Unix shells

Used for scripting, automation and programs

Command prompts

```
[hlk@fischer hlk]$ id  
uid=6000(hlk) gid=20(staff) groups=20(staff),  
0(wheel), 80(admin), 160(cvs)  
[hlk@fischer hlk]$ sudo -s  
[root@fischer hlk]#  
[root@fischer hlk]# id  
uid=0(root) gid=0(wheel) groups=0(wheel), 1(daemon),  
20(staff), 80(admin)  
[root@fischer hlk]#
```

Note the difference between running as root and normal user. Usually books and instructions will use a prompt of hash mark # when the root user is assumed and dollar sign \$ when a normal user prompt.

Command syntax

```
echo [-n] [string ...]
```

Commands are written like this:

- Always begin with the command to execute, like echo above
- Options typically short form with single dash -n
- or long options --version
- Some commands allow grouping options, tar -c -v -f becomes tar -cvf
NOTE: some options require parameters, so tar -c -f filename.tar not equal to tar -fc filename.tar
- Optional options are in brackets []
- Output can be saved using redirection, into new file/overwrite echo hello > file.txt or append echo hello >> file.txt
- Read from files wc -l file.txt or pipe output into input cat file.txt | wc -l
wc is word count, and option l is count lines

Unix Manual system

```
kommando [options] [argumenter]  
$ cal -j 2005
```

It is a book about a Spanish guy called Manual. You should read it. – Dilbert

Manual system in Unix is always there!

Key word search `man -k` see also `apropos`

Different sections, can be chosen

See `man crontab` the command vs the file format in section 5 `man 5 crontab`

A manual page

NAME

cal - displays a calendar

SYNOPSIS

cal [-jy] [[month] year]

DESCRIPTION

cal displays a simple calendar. If arguments are not specified, the current month is displayed. The options are as follows:

- j Display julian dates (days one-based, numbered from January 1).
- y Display a calendar for the current year.

The Gregorian Reformation is assumed to have occurred in 1752 on the 3rd of September. By this time, most countries had recognized the reformation (although a few did not recognize it until the early 1900's.) Ten days following that date were eliminated by the reformation, so the calendar for that month is a bit unusual.

The year 1752

```
user@Projects:$ cal 1752
```

...

April

May

June

Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	
1	2	3	4				1	2						1	2	3	4	5	6		
5	6	7	8	9	10	11	3	4	5	6	7	8	9	7	8	9	10	11	12	13	
12	13	14	15	16	17	18	10	11	12	13	14	15	16	14	15	16	17	18	19	20	
19	20	21	22	23	24	25	17	18	19	20	21	22	23	21	22	23	24	25	26	27	
26	27	28	29	30			24	25	26	27	28	29	30	28	29	30					
														31							

July

August

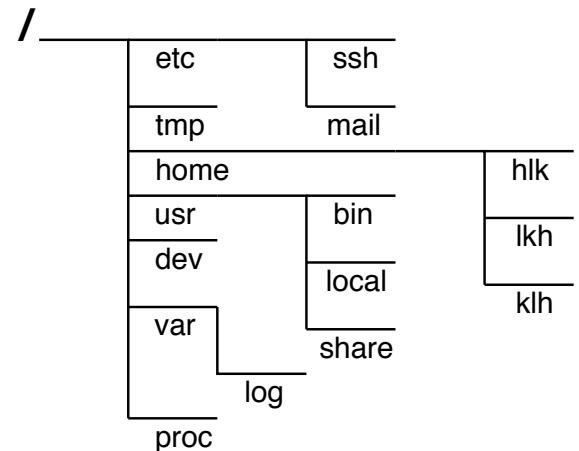
September

Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa
														1						
1	2	3	4											1	2	14	15	16		
5	6	7	8	9	10	11	2	3	4	5	6	7	8	17	18	19	20	21	22	23
12	13	14	15	16	17	18	9	10	11	12	13	14	15	24	25	26	27	28	29	30
19	20	21	22	23	24	25	16	17	18	19	20	21	22							
26	27	28	29	30	31		23	24	25	26	27	28	29	30	31					

...

Linux configuration in /etc

- Command line is a requirement in the *studieordningen* ☺
- Linux and Unix uses a single virtual file system
https://en.wikipedia.org/wiki/Unix_filesystem
- No drive letters like the ones in MS-DOS and Microsoft Windows
- Everything starts at the root of the file system tree / - NOTE: *forward slash*
- One special directory is /etc/ and sub directories which usually contain a lot of configuration files



Installing software in Debian – apt

DESCRIPTION

apt provides a high-level commandline interface for the package management system. It is intended as an end user interface and enables some options better suited for interactive usage by default compared to more specialized APT tools like apt-get(8) and apt-cache(8).

update (apt-get(8))

update is used to download package information from all configured sources. Other commands operate on this data to e.g. perform package upgrades or search in and display details about all packages available for installation.

upgrade (apt-get(8))

upgrade is used to install available upgrades of all packages currently installed on the system from the sources configured via sources.list(5). New packages will be installed if required to satisfy dependencies, but existing packages will never be removed. If an upgrade for a package requires the removal of an installed package the upgrade for this package isn't performed.

full-upgrade (apt-get(8))

full-upgrade performs the function of upgrade but will remove currently installed packages if this is needed to upgrade the system as a whole.

- Install a program using apt, for example apt install nmap



From my course materials:

Ansible is great for automating stuff, so by running the playbooks we can get a whole lot of programs installed, files modified - avoiding the Vi editor.

- Easy to read, even if you don't know much about YAML
- <https://www.ansible.com/> and [https://en.wikipedia.org/wiki/Ansible_\(software\)](https://en.wikipedia.org/wiki/Ansible_(software))
- Great documentation
https://docs.ansible.com/ansible/latest/collections/ansible/builtin/apt_module.html

Ansible Dependencies



- Ansible based on Python, only need Python installed
<https://www.python.org/>
- Often you use Secure Shell for connecting to servers
<https://www.openssh.com/>
- Easy to configure SSH keys, for secure connections

Ansible playbooks

Example playbook content, installing software using APT:

```
apt:  
  name: "{{ packages }}"  
vars:  
  packages:  
    - nmap  
    - curl  
    - iperf  
    ...
```

Running it:

```
cd kramse-labs/suricatazeek  
ansible-playbook -v 1-dependencies.yml 2-suricatazeek.yml 3-elasticstack.yml 4-configuration.yml
```

"YAML (a recursive acronym for "YAML Ain't Markup Language") is a human-readable data-serialization language."
<https://en.wikipedia.org/wiki/YAML>



- We need to store configurations
- Run playbooks
- Problem: Remember what we did, when, how
- Solution: use git for the playbooks
- Not the only version control system, but my preferred one

Alternative

Download and install the public signing key:

```
wget -qO - https://artifacts.elastic.co/GPG-KEY-elasticsearch | sudo apt-k
```

Installing from the APT repository



You may need to install the `apt-transport-https` package on Debian before proceeding:

```
sudo apt-get install apt-transport-https
```

Save the repository definition to `/etc/apt/sources.list.d/elastic-7.x.list`:

```
echo "deb https://artifacts.elastic.co/packages/7.x/apt stable main" | su
```

My playbooks allow installation of a whole Elastic stack in less than 10 minutes,

compare to:

Getting started with the Elastic Stack

<https://www.elastic.co/guide/en/elastic-stack-get-started/current/get-started-elastic-stack.html>

Git getting started

Hints:

Browse the Git tutorials on <https://git-scm.com/docs/gittutorial>
and <https://guides.github.com/activities/hello-world/>

- What is git
- Terminology

Note: you don't need an account on Github to download/clone repositories, but having an account allows you to save repositories yourself and is recommended.

Demo: Ansible, Python, Git!

Running Git will allow you to clone repositories from others easily. This is a great way to get new software packages, and share your own.

Git is the name of the tool, and Github is a popular site for hosting git repositories.

- Go to <https://github.com/kramse/kramse-labs>
- Lets explore while we talk

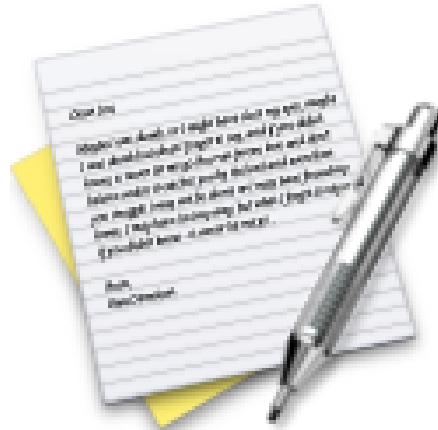
Demo: output from running a git clone

```
user@Projects:tt$ git clone https://github.com/kramse/kramse-labs.git
Cloning into 'kramse-labs'...
remote: Enumerating objects: 283, done.
remote: Total 283 (delta 0), reused 0 (delta 0), pack-reused 283
Receiving objects: 100% (283/283), 215.04 KiB | 898.00 KiB/s, done.
Resolving deltas: 100% (145/145), done.
```

```
user@Projects:tt$ cd kramse-labs/
```

```
user@Projects:kramse-labs$ ls
LICENSE README.md core-net-lab lab-network suricatazeek work-station
user@Projects:kramse-labs$ git pull
Already up to date.
```

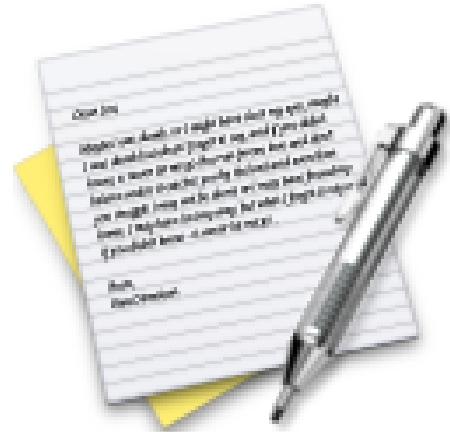
for reference at home later



Now lets do the exercise

⚠ Check your Kali VM, run Kali Linux 30 min

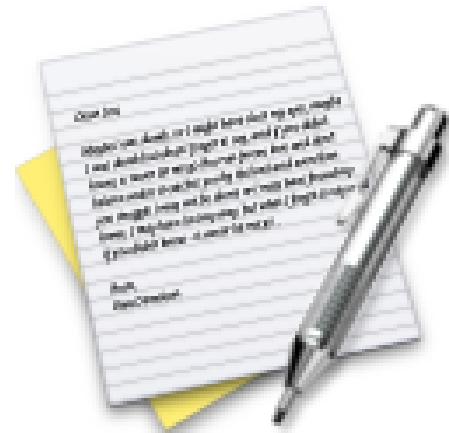
which is number **3** in the exercise PDF.



Now lets do the exercise

⚠ Check your Debian VM 10min

which is number **4** in the exercise PDF.

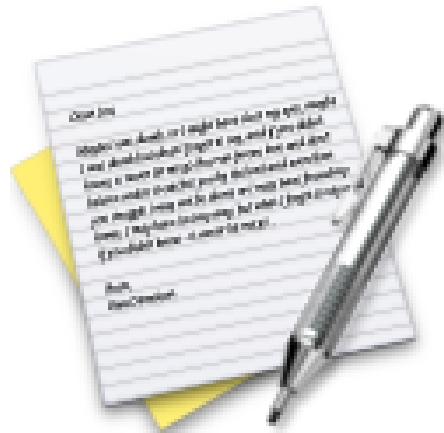


Now lets do the exercise

⚠ Investigate /etc 10min

which is number **5** in the exercise PDF.

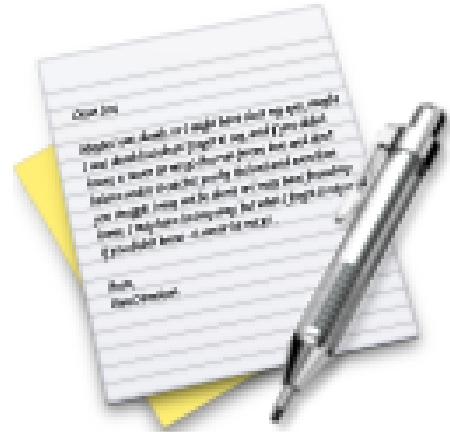
Exercise



Now lets do the exercise

⚠ Enable UFW firewall - 10min

which is number **6** in the exercise PDF.

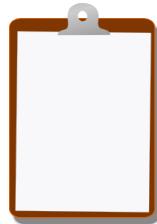


Now lets do the exercise

i Git tutorials - 15min

which is number **7** in the exercise PDF.

For Next Time



Think about the subjects from this time, write down questions

Check the plan for chapters to read in the books

Visit web sites and download papers if needed

Retry the exercises to get more confident using the tools

Buy the books!