Welcome to

1. Overview, Programming Knowledge and Lab Setup

KEA Kompetence OB2 Software Security

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Slides are available as PDF, kramse@Github

1-programming-and-lab-setup.tex in the repo security-courses

Plan for today

Initial Overview of Software Security

- Introduction to Methods
- Strategies for Security Testing

Get lab environment ready

- Linux introduction and familiarisation
- Run programs, servers and applications, how to
- Find the level of programming in the group

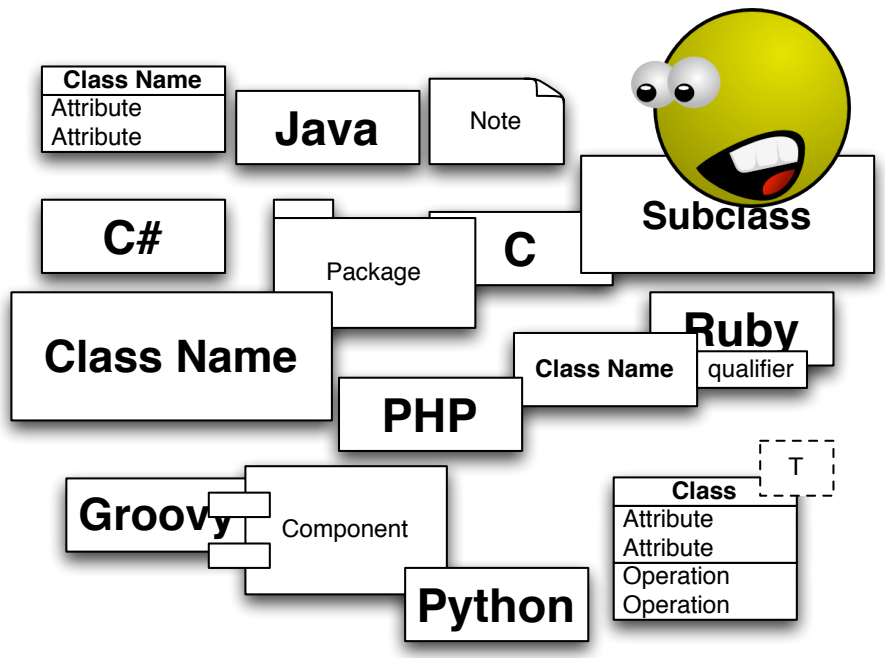
Exercises

- Setup JuiceShop environment, app and proxy
- Run small programs: Python, Shell script
- Run parts of a Django tutorial

Reading Summary

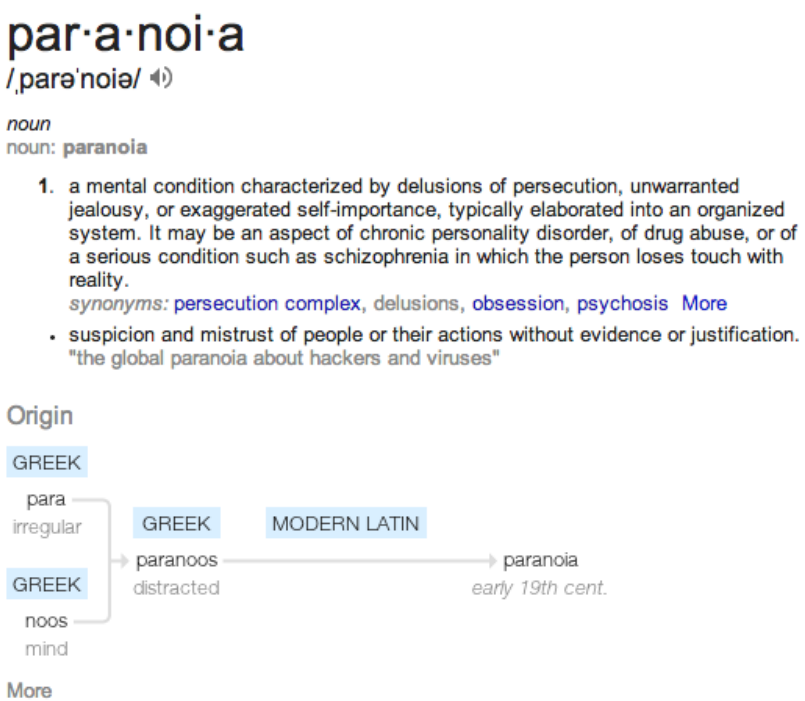
AoST chapter 1: Case Your Own Joint: A Paradigm Shift from Traditional Software Testing

Goals:



Software security - because software is everywhere

Paranoia defined



par·a·noi·a

/ˌparəˈnoiə/

noun

noun: **paranoia**

1. a mental condition characterized by delusions of persecution, unwarranted jealousy, or exaggerated self-importance, typically elaborated into an organized system. It may be an aspect of chronic personality disorder, of drug abuse, or of a serious condition such as schizophrenia in which the person loses touch with reality.
   synonyms: persecution complex, delusions, obsession, psychosis More
2. suspicion and mistrust of people or their actions without evidence or justification.
   "the global paranoia about hackers and viruses"

Origin

GREEK para irregular + GREEK noos mind → GREEK paranoos distracted → MODERN LATIN paranoia *early 19th cent.*

More

Source: google paranoia definition

Face reality

From the definition:

> suspicion and mistrust of people or their actions **without evidence or justification**. **the global paranoia about hackers and viruses**

It is not paranoia when:

- Criminals sell your credit card information and identity theft
- Trade infected computers like a commodity
- Governments write laws that allows them to introduce back-doors - and use these
- Governments do blanket surveillance of their population, implement censorship, threaten citizens and journalist

You are not paranoid when there are people actively attacking you!

I recommend we have appropriate paranoia (DK: passende paranoia)

Overlapping Security Incidents

New data breaches nearly every week, these from danish news site version2.dk

Problem, we need to receive data from others

Data from others may contain malware

Have a job posting, yes
- then HR will be expecting CVs sent as .doc files

or the other way

Attackers used a LinkedIn job ad and Skype call to breach bank's defences

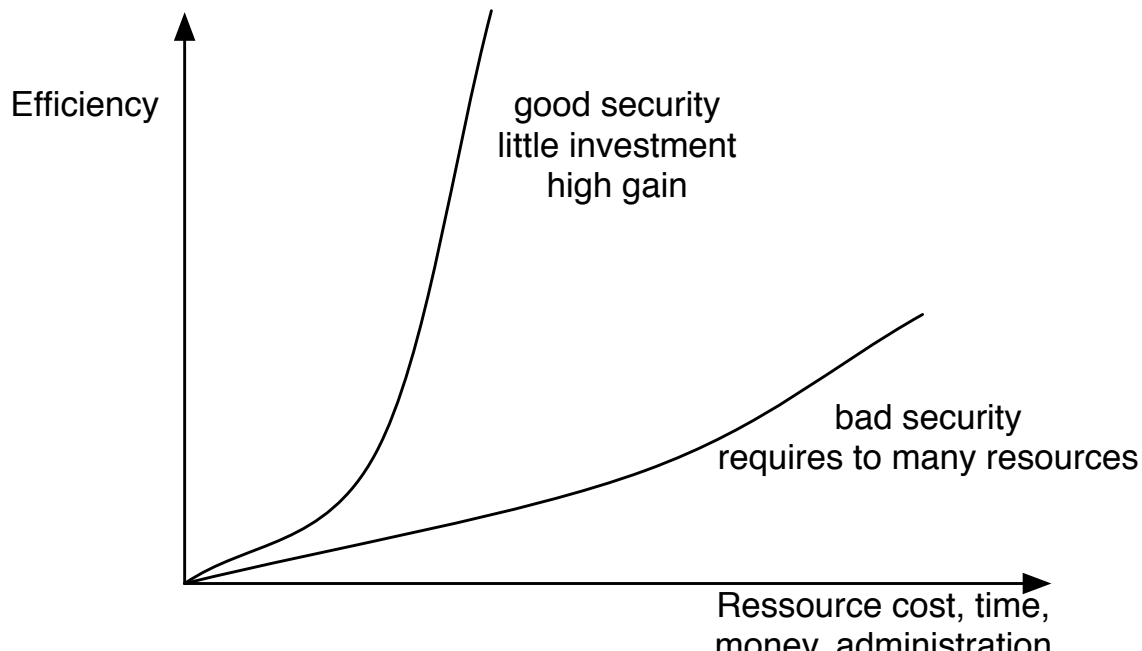
The attack

One of these is the Chilean news site's claim that the attack started with a LinkedIn advert offering a developer role to which a Redbanc employee replied.

The attackers set up a Skype call to conduct an interview during which the individual was tricked into downloading a file called ApplicationPDF.exe, sent via a weblink, which subsequently infected the employee's computer.

https://nakedsecurity.sophos.com/2019/01/21/attackers-used-a-linkedin-job-ad-and-skype-call-to-breach-banks-defences/

Good security



You always have limited resources for protection - use them as best as possible

Recommendations

Keep updated!

- read web sites, books, articles, mailing lists, Twitter, ...

Always have a chapter on security evaluation

- any process must have security, like RFC Request for Comments have

Incident Response

- you WILL have security incidents, be prepared

Write down security policy

- including software and e-mail policies

Advice

Use technology

Learn the technology - read the freaking manual

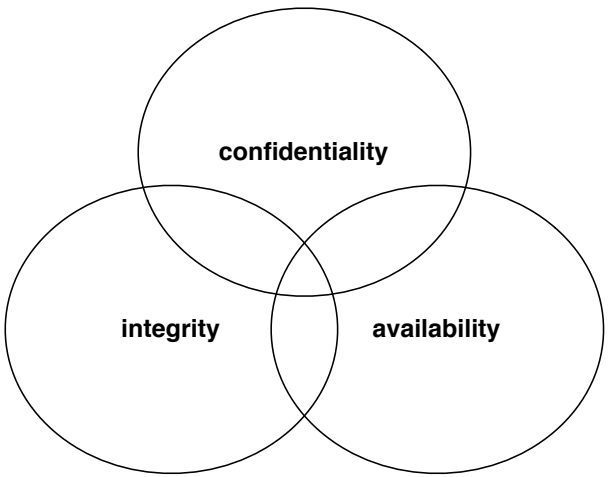
Think about the data you have, upload, facebook license?! WTF!

Think about the data you create - nude pictures taken, where will they show up?

- Turn off features you don't use
- Turn off network connections when not in use
- Update software and applications
- Turn on encryption: IMAP**S**, POP3**S**, HTTP**S** also for data at rest, full disk encryption, tablet encryption
- Lock devices automatically when not used for 10 minutes
- Dont trust fancy logins like fingerprint scanner or face recognition on cheap devices

But which features to disable? Let the security principles guide you

Confidentiality, Integrity and Availability



We want to protect something

Confidentiality - data kept a secret

Integrity - data is not subjected to unauthorized changes

Availability - data and systems are available when needed

What is data?

Personal data you dont want to loose:

- Wedding pictures
- Pictures of your children
- Sextapes
- Personal finances

Source: picture of my son less than 24 hours old - precious!

Security is a process

Remember:

- what is information and security?
- Data kept electronically
- Data kept in physical form
- Dont forget the human element of security

Incident Response and Computer Forensics reaction to incidents

Good security is the result of planning and long-term work

Security is a process, not a product, Bruce Schneier

Source for quote: https://www.schneier.com/essays/archives/2000/04/the_process_of_secur.html

Work together

Team up!

We need to share security information freely

We often face the same threats, so we can work on solving these together

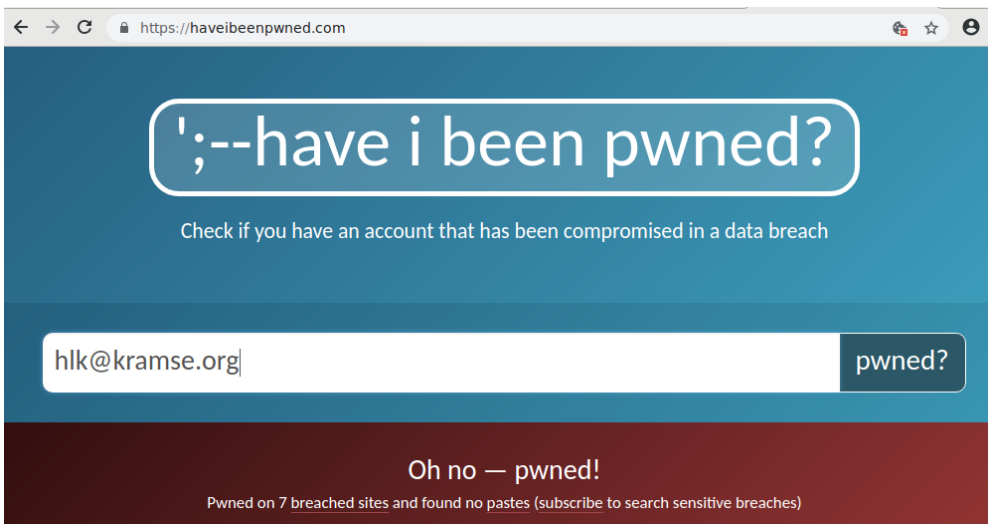
Goals of Security

Prevention - means that an attack will fail

Detection - determine if attack is underway, or has occured - report it

Recovery - stop attack, assess damage, repair damage

Your data has already have been owned by criminals



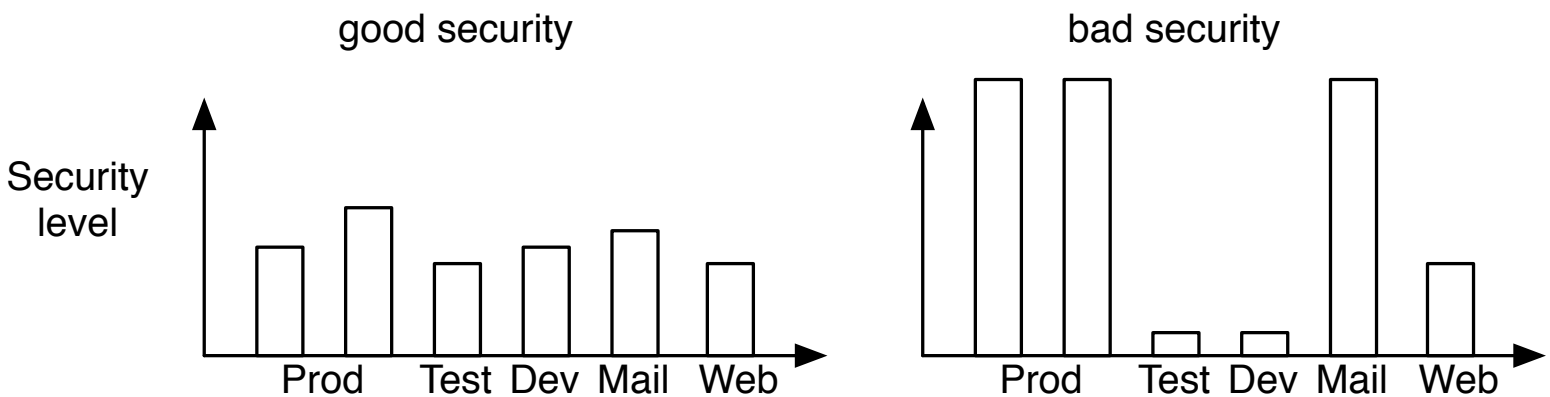
Your data is already being sold, and resold on the Internet

Stop reusing passwords, use a password safe to generate and remember

Check you own email addresses on https://haveibeenpwned.com/

Go ahead try the web site - hold up your hand if you are in those dumps

Balanced security



Better to have the same level of security

If you have bad security in some part - guess where attackers will end up

Hackers are not required to take the hardest path into the network

Realize there is no such thing as 100% security

Cost-Benefit Analysis

Benefits of computer security must be weighed against value of assets

Often more expensive to add security mechanisms to a system, than designing them in

Initial Overview of Software Security

- Security Testing Versus Traditional Software Testing
- Functional testing does not prevent security issues!
- SQL Injection example, injecting commands into database
- Attackers try to break the application, server, operating system, etc.
- Use methods like user input, memory corruption / buffer overflow, poor exception handling, broken authentication, ...

Where to start?

OWASP top ten

> The OWASP Top Ten provides a minimum standard for web application security. The OWASP Top Ten represents a broad consensus about what the most critical web application security flaws are.

The Open Web Application Security Project (OWASP)

OWASP produces lists of the most common types of errors in web applications

http://www.owasp.org

Create Secure Software Development Lifecycle

Vulnerabilities - CVE

Common Vulnerabilities and Exposures (CVE):

- classification
- identification

When discovered each vuln gets a CVE ID

CVE maintained by MITRE - not-for-profit org for research and development in the USA.

National Vulnerability Database search for CVE.

Sources: http://cve.mitre.org/ og http://nvd.nist.gov

also checkout OWASP Top-10 http://www.owasp.org/

Sample vulnerabilities

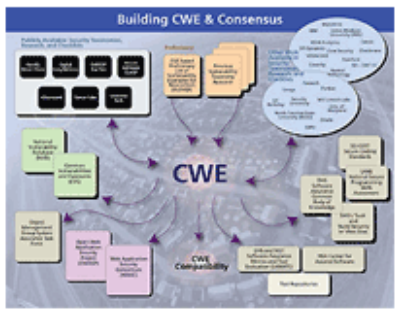
CVE-2000-0884
IIS 4.0 and 5.0 allows remote attackers to read documents outside of the web root, and possibly execute arbitrary commands, via malformed URLs that contain UNICODE encoded characters, aka the "Web Server Folder Traversal"vulnerability.

CVE-2002-1182
IIS 5.0 and 5.1 allows remote attackers to cause a denial of service (crash) via malformed WebDAV requests that cause a large amount of memory to be assigned.

Source:
http://cve.mitre.org/-CVE

And updates from vendors reference these too! A closed loop

CWE Common Weakness Enumeration



Enlarge

CWE™ International in scope and free for public use, CWE provides a unified, measurable set of software weaknesses that is enabling more effective discussion, description, selection, and use of software security tools and services that can find these weaknesses in source code and operational systems as well as better understanding and management of software weaknesses related to architecture and design.

CWE in the Enterprise

- Software Assurance
- Application Security
- Supply Chain Risk Management
- System Assessment
- Training
- Code Analysis
- Remediation & Mitigation
- NVD (National Vulnerability Database)
- *Recommendation ITU-T X.1524 CWE,* ITU-T CYBEX Series

http://cwe.mitre.org/

CWE/SANS Monster mitigations

Monster Mitigations

These mitigations will be effective in eliminating or reducing the severity of the Top 25. These mitigations will also address many weaknesses that are not even on the Top 25. If you adopt these mitigations, you are well on your way to making more secure software.

A Monster Mitigation Matrix is also available to show how these mitigations apply to weaknesses in the Top 25.

ID	Description
M1	Establish and maintain control over all of your inputs.
M2	Establish and maintain control over all of your outputs.
M3	Lock down your environment.
M4	Assume that external components can be subverted, and your code can be read by anyone.
M5	Use industry-accepted security features instead of inventing your own.
GP1	(general) Use libraries and frameworks that make it easier to avoid introducing weaknesses.
GP2	(general) Integrate security into the entire software development lifecycle.
GP3	(general) Use a broad mix of methods to comprehensively find and prevent weaknesses.
GP4	(general) Allow locked-down clients to interact with your software.

See the Monster Mitigation Matrix that maps these mitigations to Top 25 weaknesses.

Source: http://cwe.mitre.org/top25/index.html

Hacker tools

Improving the Security of Your Site by Breaking Into it
by Dan Farmer and Wietse Venema in 1993

Later in 1995 release the software SATAN
Security Administrator Tool for Analyzing Networks

Caused some commotion, panic and discussions, every script kiddie can hack, the internet will melt down!

> We realize that SATAN is a two-edged sword – like many tools, it can be used for good and for evil purposes. We also realize that intruders (including wannabees) have much more capable (read intrusive) tools than offered with SATAN.

label Source: http://www.fish2.com/security/admin-guide-to-cracking.html

Use hacker tools!

Port scan can reveal holes in your defense

Web testing tools can crawl through your site and find problems

Pentesting is a verification and proactively finding problems

Its not a silverbullet and mostly find known problems in existing systems

Combined with honeypots they may allow better security

Local vs. remote exploits

Local vs. remote angiver om et exploit er rettet mod en sårbarhed lokalt på maskinen, eksempelvis opnå højere privilegier, eller beregnet til at udnytter sårbarheder over netværk

Remote root exploit - den type man frygter mest, idet det er et exploit program der når det afvikles giver angriberen fuld kontrol, root user er administrator på Unix, over netværket.

Zero-day exploits dem som ikke offentliggøres – dem som hackere holder for sig selv. Dag 0 henviser til at ingen kender til dem før de offentliggøres og ofte er der umiddelbart ingen rettelser til de sårbarheder

Computer worms

Definition 23-14 A *computer worm* is a program that copies itself from one computer to another.
Definition from Computer Security: Art and Science, Matt Bishop ISBN: 9780321712332

Computer worms has existed since research began mid-1970s

Morris Worm from November 2, 1988 was a famous example

Virus, trojan or worm?
Unless you work specifically in the computer virus industry, call it all malware

The Internet Worm 2. nov 1988

Exploited the following vulnerabilities

- buffer overflow in fingerd - VAX code
- Sendmail - DEBUG functionality
- Trust between systems: rsh, rexec, ...
- Bad passwords

Contained camouflage!

- Program name set to 'sh'
- Used fork() to switch PID regularly
- Password cracking using intern list of 432 words and /usr/dict/words
- Found systems to infect in /etc/hosts.equiv, .rhosts, .forward, netstat ...

Made byRobert T. Morris, Jr.

Stuxnet

Worm in 2010 intended to infect Iran nuclear program

Target was the uranium enrichment process

Infected other industrial sites

SCADA, and Industrial Control Systems (ICS) are becoming very important for whole countries

A small *community* of consultants work in these *isolated* networks, but can be used as infection vector - they visit multiple sites

More can be found in https://en.wikipedia.org/wiki/Stuxnet

Bots and botnets

Definition 23-15 A *bot* is malware that carries out some action in coordination with other bots. The attacker, called a *botmaster*, controls the bots from one or more systems called *command and control (C&C) servers* or *motherships*. They communicate over paths called *C&C channels*. A collection of bots is a *botnet*.
Definition from Computer Security: Art and Science, Matt Bishop ISBN: 9780321712332

Internet Relay Chat has been popular for control channel to botnets

Botnets are popular for spamming campaigns or Distributed Denial of Service (DDoS) attacks

The site https://malware.lu/ has interesting reads about botnets, and taking over the botnet infrastructures

Introduction to Methods

- Following slides list some of the methods for eliminating security issues
- Sometimes when eliminating is not possible the runtime environment can be improved
- Other times the strategy involves the systems used for development - like alleviating the version control systems to enforce policies and restrict developers from doing bad things

Low hanging fruits - easy

Higher quality software is often more secure

Coding standards - style

This file specifies the preferred style for kernel source files in the OpenBSD source tree. It is also a guide for preferred user land code style. These guidelines should be followed for all new code. In general, code can be considered “new code” when it makes up about 50more of the file(s) involved. ...
Use queue(3) macros rather than rolling your own lists, whenever possible. Thus, the previous example would be better written:

```
#include <sys/queue.h>
struct  foo {
LIST_ENTRY(foo) link;  /* Queue macro glue for foo lists */
            struct  mumble amumble; /* Comment for mumble */
            int     bar;
};
LIST_HEAD(, foo) foohead;      /* Head of global foo list */
```

OpenBSD style(9)

Coding standards functions

The following copies as many characters from input to buf as will fit and NUL terminates the result. Because strncpy() does not guarantee to NUL terminate the string itself, it must be done by hand.

```
char buf[BUFSIZ];

(void)strncpy(buf, input, sizeof(buf) - 1);
buf[sizeof(buf) - 1] = '\0';
```

Note that `strlcpy(3)` is a better choice for this kind of operation. The equivalent using `strlcpy(3)` is simply:

```
(void)strlcpy(buf, input, sizeof(buf));
```

OpenBSD strcpy(9)

Compiler warnings - gcc -Wall

```
# gcc -o demo demo.c
demo.c: In function main:
demo.c:4: warning: incompatible implicit declaration of built-in
function strcpy
```

```
# gcc -Wall -o demo demo.c
demo.c:2: warning: return type defaults to int
demo.c: In function main:
demo.c:4: warning: implicit declaration of function strcpy
demo.c:4: warning: incompatible implicit declaration of built-in
function strcpy
demo.c:5: warning: control reaches end of non-void function
```

Easy to do!

No warnings = no errors?

```
# cat demo2.c
#include <strings.h>
int main(int argc, char **argv)
{
    char buf[200];
    strcpy(buf, argv[1]);
    return 0;
}
# gcc -Wall -o demo2 demo2.c
```

This is an insecure program, but no warnings!

(cheating, some compilers actually warn today)

Version control sample hooks scripts

Before checking in code in version control, pre-commit - check

- case-insensitive.py
- check-mime-type.pl
- commit-access-control.pl
- commit-block-joke.py
- detect-merge-conflicts.sh
- enforcer
- log-police.py
- pre-commit-check.py
- verify-po.py

http://subversion.tigris.org/tools_contrib.html

http://svn.collab.net/repos/svn/trunk/contrib/hook-scripts/

This references Subversion, which is not used much anymore. Just to show the concept is NOT new. Use hooks!

Example Enforcer

In a Java project I work on, we use log4j extensively. Use of System.out.println() bypasses the control that we get from log4j, so we would like to discourage the addition of println calls in our code.

We want to deny any commits that add a println into the code. The world being full of exceptions, we do need a way to allow some uses of println, so we will allow it if the line of code that calls println ends in a comment that says it is ok:

```
System.out.println("No log4j here"); // (authorized)
```

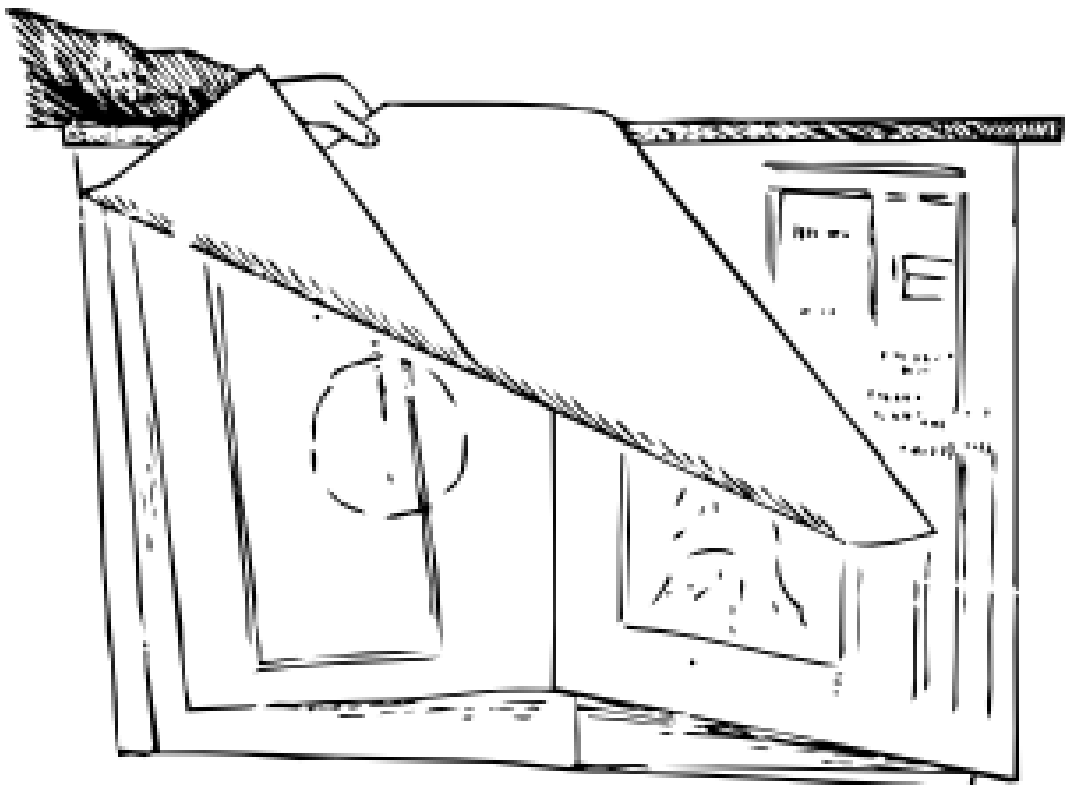
http://svn.collab.net/repos/svn/trunk/contrib/hook-scripts/enforcer/enforcer

Example verify-po.py

```
#!/usr/bin/env python
"""This is a pre-commit hook that checks whether the contents
of PO files committed to the repository are encoded in UTF-8.
"""
```

http://svn.collab.net/repos/svn/trunk/tools/hook-scripts/verify-po.py

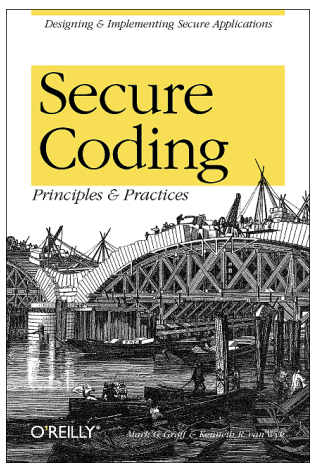
Design for security - more work



Security is cheapest and most effective when done during design phase.

Secure Coding starts with the design

Secure Coding: Principles and Practices af Mark G. Graff, Kenneth R. Van Wyk 2003



Architecture/design – while you are thinking about the application

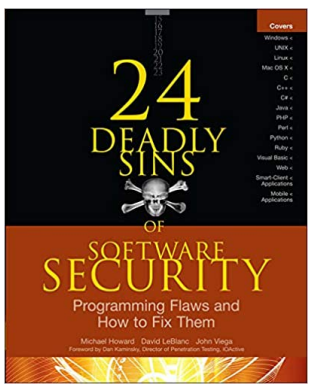
Implementation – while you are writing the application

Operations – After the application is in production

Ca. 200 pages, very dense.

Sins in Software Security

24 Deadly Sins of Software Security af Michael Howard, David Leblanc, John Viega 2010



Should be mandatory reading for all developers

Authors have written other great books

This book is very precise and gives a good overview

Deadly Sins 1/2

Part I Web Application Sins 1-4

1) SQL Injection 2) Web Server-Related Vulnerabilities 3) Web Client-Related Vulnerabilities (XSS) 4) Use of Magic URLs, Predictable Cookies, and Hidden Form Fields

Part II Implementation Sins 5-18

5) Buffer Overruns, 6) Format String, 7) Integer Overflows, 8) C++ Catastrophes, 9) Catching Exceptions, 10) Command Injection 11) Failure to Handle Errors Correctly 12) Information Leakage 13) Race Conditions 14) Poor Usability 15) Not Updating Easily 16) Executing Code with Too Much Privilege 17) Failure to Protect Stored Data 18) The Sins of Mobile Code

Deadly Sins 2/2

Part III Cryptographic Sins 19-21

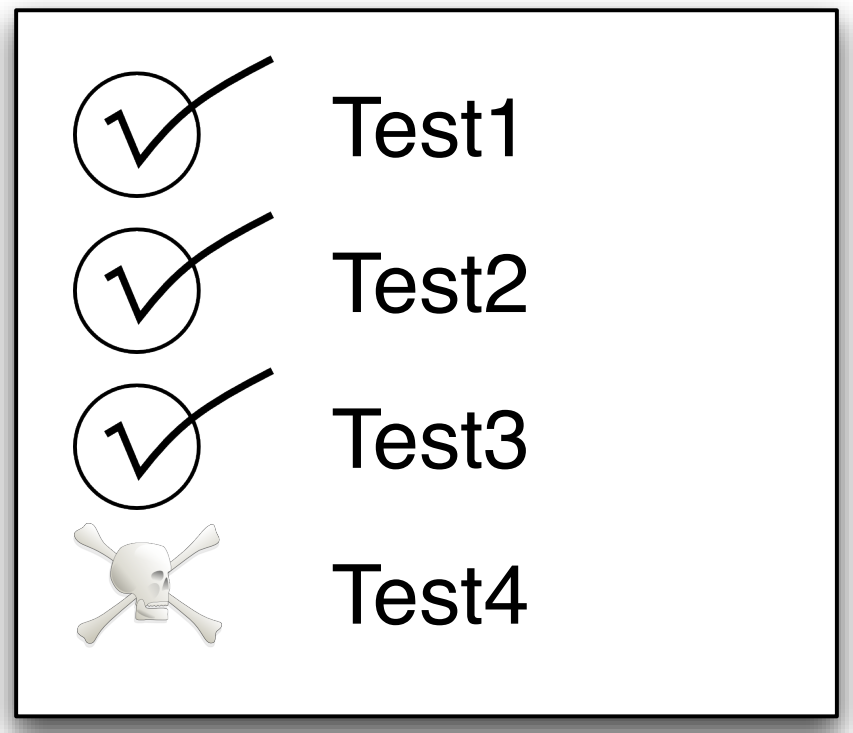
19) Use of Weak Password-Based System 20) Weak Random Numbers 21) Using Cryptography Incorrectly

Part IV Networking Sins 22-24

22) Failing to Protect Network Traffic, 23) Improper use of PKI, Especially SSL, 24) Trusting Network Name Resolution

Still want to program in C?

Testing - more work now, less work in the long run



Unit testing - low level / functions

```
public class TestAdder {
    public void testSum() {
        Adder adder = new AdderImpl();
        assert(adder.add(1, 1) == 2);
        assert(adder.add(1, 2) == 3);
        assert(adder.add(2, 2) == 4);
        assert(adder.add(0, 0) == 0);
        assert(adder.add(-1, -2) == -3);
        assert(adder.add(-1, 1) == 0);
        assert(adder.add(1234, 988) == 2222);
    }
}
```

Test individual functions

Example from http://en.wikipedia.org/wiki/Unit_testing

Avoid regressions, old errors reappearing

Analysis

Use tools for analysing code and applications

Typer af analyse

statisk analyse

finder fejl uden at køre programmet

typisk findes konstruktioner som indeholder fejl, brug af forkerte funktioner m.v.

dynamisk analyse

findes ved at køre programmet, typisk i et specielt miljø

Statiske analyseværktøjer

Flawfinder http://www.dwheeler.com/flawfinder/

RATS Rough Auditing Tool for Security, C, C++, Perl, PHP and Python

PMD static ruleset based Java

http://en.wikipedia.org/wiki/List_of_tools_for_static_code_analysis

A Fool with a Tool is still a Fool

1. Run tool
2. Fix problems
3. Rinse repeat

Fixing problems?

```
char tmp[256]; /* Flawfinder: ignore */
strcpy(tmp, pScreenSize); /* Flawfinder: ignore */
```

Eksempel fra http://www.dwheeler.com/flawfinder/

Pseudo Random Number Generator

Debian OpenSSL [edit]

In May 2008, security researcher Luciano Bello revealed his discovery that changes made in 2006 to the random number generator in the version of the OpenSSL package distributed with Debian GNU/Linux and other Debian-based distributions, such as Ubuntu, dramatically reduced the entropy of generated values and made a variety of security keys vulnerable to attack.[10][11] The security weakness was caused by changes made to the openssl code by a Debian developer in response to compiler warnings of apparently redundant code.[12] This caused a massive worldwide regeneration of keys, and despite all attention the issue got, it could be assumed many of these old keys are still in use. Key types affected include SSH keys, OpenVPN keys, DNSSEC keys, key material for use in X.509 certificates and session keys used in SSL/TLS connections. Keys generated with GnuPG or GNUTLS are not affected as these programs used different methods to generate random numbers. Non-Debian-based Linux distributions are also unaffected. This security vulnerability was promptly patched after it was reported.

https://en.wikipedia.org/wiki/Random_number_generator_attack#Debian_OpenSSL

The random number generator is VITAL for crypto security

Hard to do - manual analysis

Hvorfor ikke bare programmere sikkert?

Der er mange ressourcer tilgængelige:

Websites: *Secure Programming for Linux and Unix HOWTO*
http://www.dwheeler.com/secure-programs/

Bøger: *24 Deadly Sins of Software Security: Programming Flaws and How to Fix Them* Michael Howard, David LeBlanc, John Viega + deres andre bøger

Det er for svært, dyrt, tager for lang tid!?

Dynamic analysis

compile time vs. at run time nogle fejl kan ikke findes på compile-time

Er du doven så oversæt og kør programmet på OpenBSD ;-)

Break it

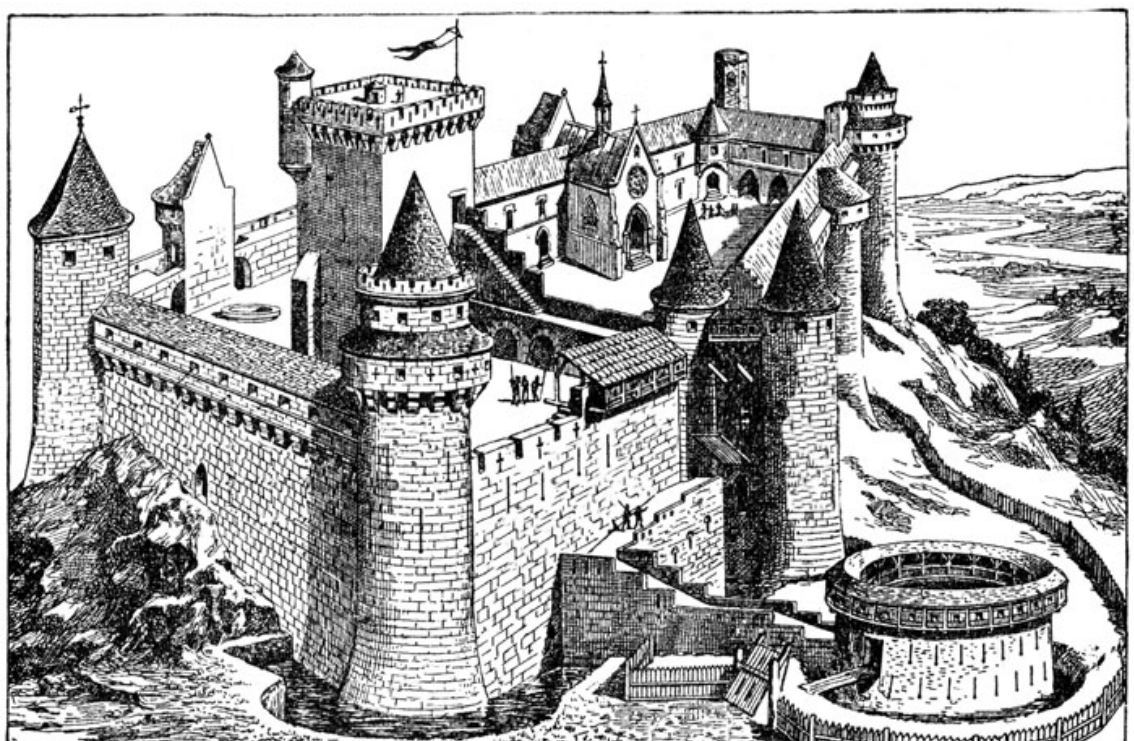
Use fuzzers, hackertools, improve security by breaking it

Simple fuzzer

```
$ for i in 10 20 30 40 50
>> do
>> ./demo `perl -e "print 'A'x$i"`
>> done
AAAAAAAAAA
AAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAA
Memory fault
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
Memory fault
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
Memory fault
```

Memory fault/segmentation fault - juicy!

Enhance and secure runtime environment



Sidste chance er på afviklingstidspunktet

Chroot, Jails and

Der findes mange typer *jails* på Unix

Ideer fra Unix chroot som ikke er en egentlig sikkerhedsfeature

- Unix chroot - bruges stadig, ofte i daemoner som OpenSSH
- FreeBSD Jails
- SELinux
- Solaris Containers og Zones - *jails på steroider*
- VMware virtuelle maskiner, er det et jail?

Hertil kommer et antal andre måder at adskille processer - sandkasser

Husk også de simple, database som `_postgresql`, Tomcat som `tomcat`, Postfix postsystem som `_postfix`, SSHD som `sshd` osv. - simple brugere, få rettigheder

JVM security policies

```
// ========== WEB APPLICATION PERMISSIONS ====================================
// These permissions are granted by default to all web applications
// In addition, a web application will be given a read FilePermission
// and JndiPermission for all files and directories in its document root.
grant {
    // Required for JNDI lookup of named JDBC DataSource's and
    // javamail named MimePart DataSource used to send mail
    permission java.util.PropertyPermission "java.home", "read";
    permission java.util.PropertyPermission "java.naming.*", "read";
    permission java.util.PropertyPermission "javax.sql.*", "read";
...
};
// The permission granted to your JDBC driver
// grant codeBase "jar:file:${catalina.home}/webapps/examples/WEB-INF/lib/driver.jar!/-" \{
//      permission java.net.SocketPermission "dbhost.mycompany.com:5432", "connect";
// \};
```

Eksempel fra apache-tomcat-6.0.18/conf/catalina.policy

Apple sandbox named generic rules

```
;; named - sandbox profile
;; Copyright (c) 2006-2007 Apple Inc.  All Rights reserved.
;;
;; WARNING: The sandbox rules in this file currently constitute
;; Apple System Private Interface and are subject to change at any time and
;; without notice. The contents of this file are also auto-generated and not
;; user editable; it may be overwritten at any time.
;;
(version 1)
(debug deny)

(import "bsd.sb")

(deny default)
(allow process*)
(deny signal)
(allow sysctl-read)
(allow network*)
```

Apple sandbox named specific rules

```
;; Allow named-specific files
(allow file-write* file-read-data file-read-metadata
  (regex "^(/private)?/var/run/named\\pid$"
         "^/Library/Logs/named\\.log$"))

(allow file-read-data file-read-metadata
  (regex "^(/private)?/etc/rndc\\.key$"
         "^(/private)?/etc/resolv\\.conf$"
         "^(/private)?/etc/named\\.conf$"
         "^(/private)?/var/named/"))
```

Eksempel fra `/usr/share/sandbox` på Mac OS X

Produktionsmodning af miljøer

Tænk på det miljø som servere og services skal udsættes for

Sørg for hærdning og tænk generel sikring:

- Opdateret software - ingen kendte sikkerhedshuller eller sårbarheder
- Fjern **single points of failure** - redundant strøm, ekstra enheder, to DNS servere fremfor en
- Adskilte servere - interne og eksterne til forskellige formål
- Lav filtre på netværket, eller på data - firewalls og proxy funktioner
- Begræns adgangen til at læse information
- Begræns adgangen til at skrive information - eksempelvis databaser
- Brug **least privileges** - sørg for at programmer og brugere kun har de nødvendige rettigheder til at kunne udføre opgaver
- Følg med på områderne der har relevans for virksomheden og *jeres* installation

Meld jer på security mailinglister for de produkter I benytter, også open source

Change management

Er der tilstrækkeligt med fokus på software i produktion

Kan en vilkårlig server nemt reetableres

Foretages rettelser direkte på produktionssystemer

Er der fall-back plan

Burde være god systemadministrator praksis

Fundamentet skal være iorden

Sørg for at den infrastruktur som I bygger på er sikker:

- redundans
- opdateret
- dokumenteret
- nem at vedligeholde

Husk tilgængelighed er også en sikkerhedsparameter

Fokus Always

- Brugerstyring
- Asset management
- Laptop sikkerhed
- VPN alle steder
- Penetration testing
- Firewalls og segmentering
- TLS og VPN indstillinger
- DNS og email
- Syslog og monitorering
- Incident Response og reaktion

Check eventuelt IT sikkerhedsupdate 2019 præsentationen:

https://github.com/kramse/security-courses/tree/master/presentations/misc/it-sikkerhedsupdate-2019

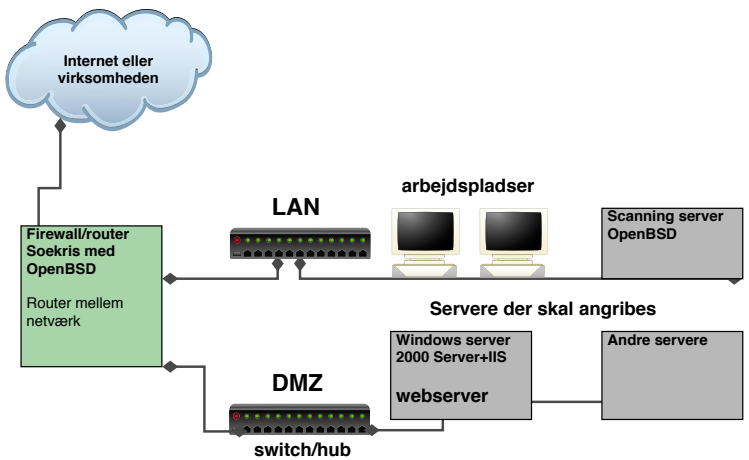
Design a robust network Isolation and segmentation

Hvad kan man gøre for at få bedre netværkssikkerhed?

- Bruge switche - der skal ARP spoofes og bedre performance
- Opdele med firewall til flere DMZ zoner for at holde udsatte servere adskilt fra hinanden, det interne netværk og Internet
- Overvåge, læse logs og reagere på hændelser

Husk du skal også kunne opdatere dine servere

Basic Network Security Pattern Isolate in VLANs



Du bør opdele dit netværk i segmenter efter trafik

Du bør altid holde interne og eksterne systemer adskilt!

Du bør isolere farlige services i jails og chroots

Brug port security til at sikre basale services DHCP, Spanning Tree osv.

Building Secure Infrastructures

A real-life setup of an infrastructure from scratch can be daunting!

You need:

- Policies
- Procedures
- Incident Response

Running systems which require

- Configurations
- Settings
- Supporting infrastructure – networks
- Supporting infrastructure – logging, dashboarding, monitoring

Building something *secure* is **hard work!**

Existing infrastructures

or even worse you inherited an infrastructure

Multiple networks, with different vendors, rules

Multiple generations of services, applications, technologies

Built over decades

Varying to no documentation

Organizational challenges

Ingrained culture – frozen in time

How do you get started improving security?

Integrate or develop?

Dont:

- Reinvent the wheel - too many times, unless you can maintain it afterwards
- Never invent cryptography yourself
- No copy paste of functionality, harder to maintain in the future

Do:

- Integrate with existing solutions
- Use existing well-tested code: cryptography, authentication, hashing
- Centralize security in your code and organization

Center for Internet Security CIS Controls

The CIS ControlsTM are a prioritized set of actions that collectively form a defense-in-depth set of best practices that mitigate the most common attacks against systems and networks. The CIS Controls are developed by a community of IT experts who apply their first-hand experience as cyber defenders to create these globally accepted security best practices. The experts who develop the CIS Controls come from a wide range of sectors including retail, manufacturing, healthcare, education, government, defense, and others.

Source: https://www.cisecurity.org/ CIS-Controls-Version-7-1.pdf

Center for Internet Security CIS Controls 7.1

- **Offense informs defense:** Use knowledge of actual attacks that have compromised systems to provide the foundation to continually learn from these events to build effective, practical defenses. Include only those controls that can be shown to stop known real-world attacks.
- **Prioritization:** Invest first in Controls that will provide the greatest risk reduction and protection against the most dangerous threat actors and that can be feasibly implemented in your computing environment. The CIS Implementation Groups discussed below are a great place for organizations to start identifying relevant Sub-Controls.
- **Measurements and Metrics:** Establish common metrics to provide a shared language for executives, IT specialists, auditors, and security officials to measure the effectiveness of security measures within an organization so that required adjustments can be identified and implemented quickly.
- **Continuous diagnostics and mitigation:** Carry out continuous measurement to test and validate the effectiveness of current security measures and to help drive the priority of next steps.
- **Automation:** Automate defenses so that organizations can achieve reliable, scalable, and continuous measurements of their adherence to the Controls and related metrics. Source: CIS-Controls-Version-7-1.pdf

Inventory and Control of Hardware Assets

CIS controls 1-6 are Basic, everyone must do them.

CIS Control 1:
Inventory and Control of Hardware Assets
Actively manage (inventory, track, and correct) all hardware devices on the network so that only authorized devices are given access, and unauthorized and unm anaged devices are found and prevented from gaining access.

What is connected to our networks?

What firmware do we need to install on hardware?

Where IS the hardware we own?

What hardware is still supported by vendor?

Source: Center for Internet Security CIS Controls 7.1 CIS-Controls-Version-7-1.pdf

Inventory and Control of Software Assets

CIS Control 2:
Inventory and Control of Software Assets
Actively manage (inventory, track, and correct) all software on the network so that only authorized software is installed and can execute, and that all unauthorized and unmanaged software is found and prevented from installation or execution.

What licenses do we have? Paying too much?

What versions of software do we depend on?

What software needs to be phased out, upgraded?

What software do our employees need to support?

Source: Center for Internet Security CIS Controls 7.1 CIS-Controls-Version-7-1.pdf

Continuous Vulnerability Management

CIS Control 3:
Continuous Vulnerability Management
Continuously acquire, assess, and take action on new information in order to identify vulnerabilities, remediate, and minimize the window of opportunity for attackers.

Source: Center for Internet Security CIS Controls 7.1 CIS-Controls-Version-7-1.pdf

Controlled Use of Administrative Privileges

CIS Control 4:
Controlled Use of Administrative Privileges
The processes and tools used to track/control/prevent/correct the use, assignment, and configuration of administrative privileges on computers, networks, and applications.

Source: Center for Internet Security CIS Controls 7.1 CIS-Controls-Version-7-1.pdf

Secure Configuration for Hardware and Software

CIS Control 5:
Secure Configuration for Hardware and Software on Mobile Devices, Laptops, Workstations and Servers
Establish, implement, and actively manage (track, report on, correct) the security configuration of mobile devices, laptops, servers, and workstations using a rigorous configuration management and change control process in order to prevent attackers from exploiting vulnerable services and settings.

Source: Center for Internet Security CIS Controls 7.1 CIS-Controls-Version-7-1.pdf

Maintenance, Monitoring and Analysis of Audit Logs

CIS Control 6:
Maintenance, Monitoring and Analysis of Audit Logs
Collect, manage, and analyze audit logs of events that could help detect, understand, or recover from an attack.

... and present it, use it daily, report it to management!

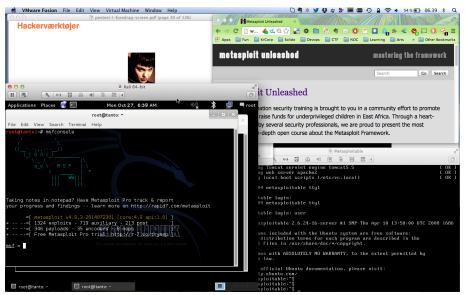
Source: Center for Internet Security CIS Controls 7.1 CIS-Controls-Version-7-1.pdf

Application Software Security

CIS Control 18:
Application Software Security
Manage the security life cycle of all in-house developed and acquired software in order to prevent, detect, and correct security weaknesses.

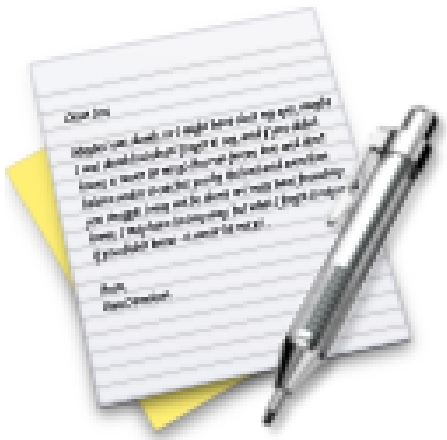
Source: Center for Internet Security CIS Controls 7.1 CIS-Controls-Version-7-1.pdf

Our labs and training environment



- This course will use Linux
- We already created virtual machines
- Linux is free, and not as resource hungry
- We can have a hacker lab with multiple machines, on a single laptop
- Lots of free and open source tools run on Linux, save money!

Exercise

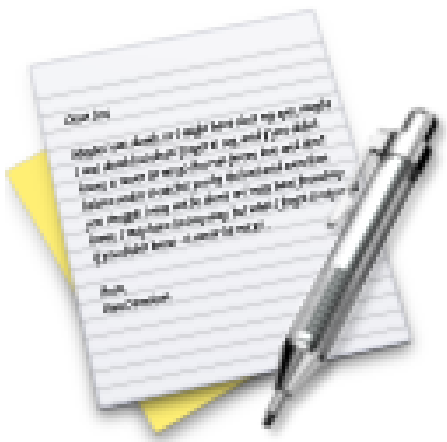


Now lets do the exercise

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

which is number **9** in the exercise PDF.

Exercise

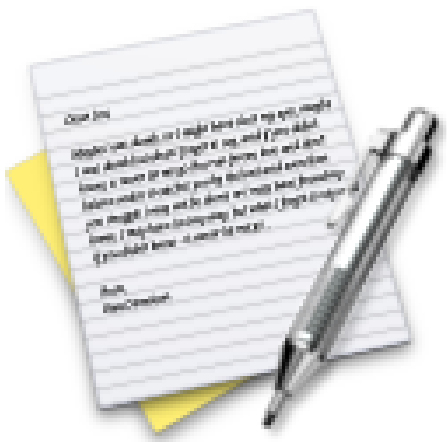


Now lets do the exercise

⚠ Run small programs: Python, Shell script 20min

which is number **10** in the exercise PDF.

Exercise

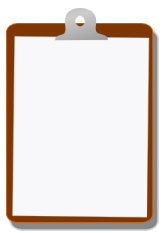


Now lets do the exercise

❶ Run parts of a Django tutorial 30min

which is number **11** 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