COPENHAGEN BUSINESS ACADEMY

DevOps part 4/4: Security

Jens Egholm Pedersen
<jeep@cphbusiness.dk>

Learning how to learn

- Meta-cognition
  - Dunning-Kruger effect
- Use what we have prepared for you
- Continuous feedback

- We gave you feedback on your assignments!
  - Any questions?

See also: Dunning-Kruger effect, Metacognition improves your grade!

Recap

- Service-level agreement (SLA)
- Monitoring
- Logging
- Post-mortem analysis
- Load balancing
- Scaling
  - Monitoring of scaling

Goals of LSD

- Train the student to develop large-scale IT systems, where scalability is a key characteristic
- The student must have knowledge of concepts, techniques and technologies for the continuous integration and delivery of software-based systems
- The student must be able to design, implement, and maintain large distributed systems in distributed development teams

See also: Your curriculum 2017 (pdf)

Goals of the DevOps part

- Give you theoretical and practical knowledge on maintening and operating large systems

1) Monitoring	2. November
2) Logging	9. November
3) Scaling	16. November
4) Security	23. November

- Essentially everything that happens *around* the code

See also: Your curriculum 2017 (pdf)

Goals for today

- Understand Docker Swarm is and why we need it
- Understand what a critical system is
- Understand and apply threat modeling
- Understand and apply risk matrices
- Gain practical knowledge on finding and mitigating breaches
- Gain practical knowledge on intrusion detection

Literature: DevOps introduction

Docker swarm recap

- Docker swarm: container orchestration
  - Container ids (+versions)
  - Container names
  - Container networks
    - Overlay
    - Ingest (load balancing)
- Requirement: Docker hub / registry

Service discovery

- Automatically discover machines providing the same service
- DNS A record with multiple entries:
  1) Request: 0.0.0.1
  2) Request: 0.0.0.2
  3) Request: 0.0.0.3…

See also: DNS-SD on Wikipedia, RFC2782

Service discovery in docker

- Overlay networks
  - manage communications among the Docker daemons participating in the swarm

```
docker network create
       --driver overlay monitoring
```

```
nslookup tasks.docker-exporter
```

See also: Docker swarm networking

Monitoring via docker-machine

- Docker-machine experimental feature
  - Inbuilt prometheus monitoring

-
  ```
  docker-machine create
        --driver virtualbox
        --engine-opt experimental
        --engine-opt metrics-addr=0.0.0.0:4999 mybox
  ```

See also: Docker metrics in Prometheus

Monitoring via docker-machine

- Docker-machine experimental feature
  - Inbuilt prometheus monitoring
- One small problem… We have to expose it on a specific docker network

```
docker
  service create
  --mode global
  --name docker-exporter
  --network monitoring
  --publish 4999
  -e IN=172.18.0.1:4999
  basi/socat:v0.1.0
```

See also: Docker metrics in Prometheus

A note on configuration

- No longer a common file system
- How to hangle configuration?

```
docker config create prometheus-config prometheus.yml
```

```
docker service create --name prometheus
    --config=prometheus-config,target=/etc/prometheus/prometheus.yml
```

See also: Docker metrics in Prometheus

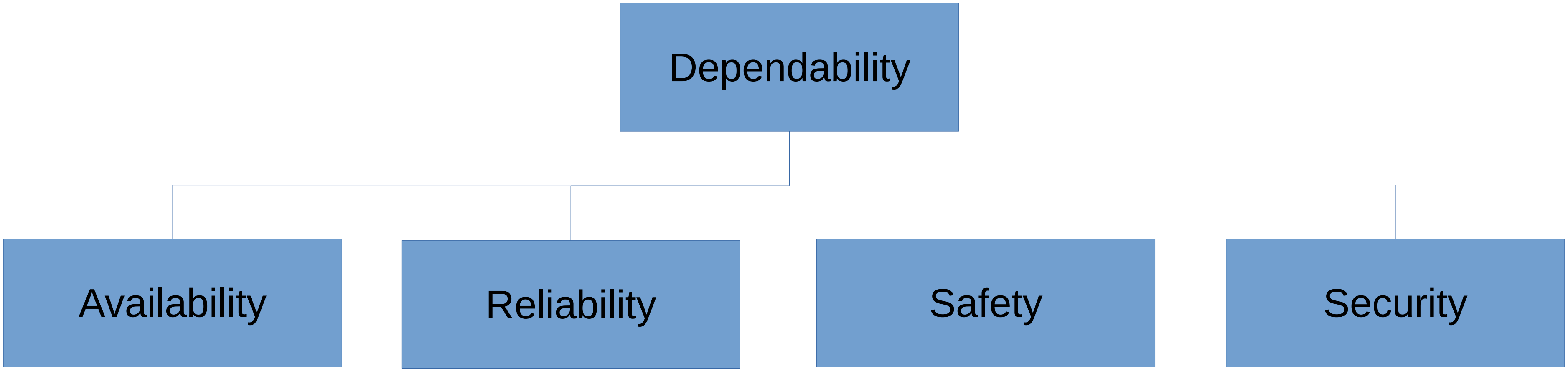
Monitoring via docker-machine

- Putting it all together
- We have docker-exporters and a prometheus configuration file to listen for the dns service discovery

```
docker service create
    --name prometheus -p 9090:9090
    --config src=prometheus,
        target=/etc/prometheus/prometheus.yml
    --network monitoring prom/prometheus
```

See also: Docker metrics in Prometheus

Dependability



See also: Ian Sommerville: Software Engineering

Laws and regulations

- Regulation (EC) No 45/2001 on the protection of individuals with regard to the processing of personal data
- Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data
- Commission Decision 2001/497/EC of 15 June 2001 on standard contractual clauses for the transfer of personal data to third countries
- International Safe Harbor Privacy Principles
- Directive 2002/58/EC of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector
- Directive 2006/24/EC of 15 March 2006 on the retention of data generated or processed in connection with the provision of publicly available electronic communications services or of public communications networks
- Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures
- Council Framework Decision 2005/222/JHA of 24 February 2005 on attacks against information systems.

See also: EU legislation on IT risks

Attacker types

- Script kiddies
  - Low threat, low profile
- Black hat groups
  - Hight threat, high profile
- Government groups
  - Hight threat, political profile
- White hats
  - Low threat, political profile

See also: Tony UcedaVelez on threat models

Security

- Secure from what?
  - The who/where
- What are you protecting?
  - The what
- When are you secure?
  - The how

Threats

- A threat is a combination of
  - Intent
  - Capability
  - Opportunity

- Intent
  - Hard to do anything about, but don’t be idiots
- Capability
  - Impossible to change
- Opportunity
  - This is our focus

See also: Tony UcedaVelez on threat models

Intelligence

(Not the “I’m smart” intelligence)

- Knowledge of attackers to protect from
  - Actionable
  - On a strategic, operational, tactical level

See also: Military intelligence

Intelligence

- Knowledge of attackers to protect from
  - Actionable
  - On a strategic, operational, tactical level

- Strategical level
  - Broad issues of business values, economy, political
- Operational level
  - Design of practical countermeasures and policies
- Tactical
  - Practical level: information about current threats and priorities

See also: Military intelligence

Intelligence tasking

- Knowledge of attackers to protect from
  - Actionable
  - On a strategic, operational, tactical level

- Tasking
  1) Collect
  2) Analyse
  3) Process
  4) Disseminate

See also: Military intelligence

Intelligence tasking

1) Collect
   - Gather information
   - What are your assets? What is worth protecting?
2) Analyse
   - Analyse adversary and opportunities
   - What are the threats and vulnerabilities?
3) Process
   - Process the information so far
   - What are the risks? Which risks are worth protecting from?
4) Disseminate
   - Decide and implement mitigations

See also: Military intelligence

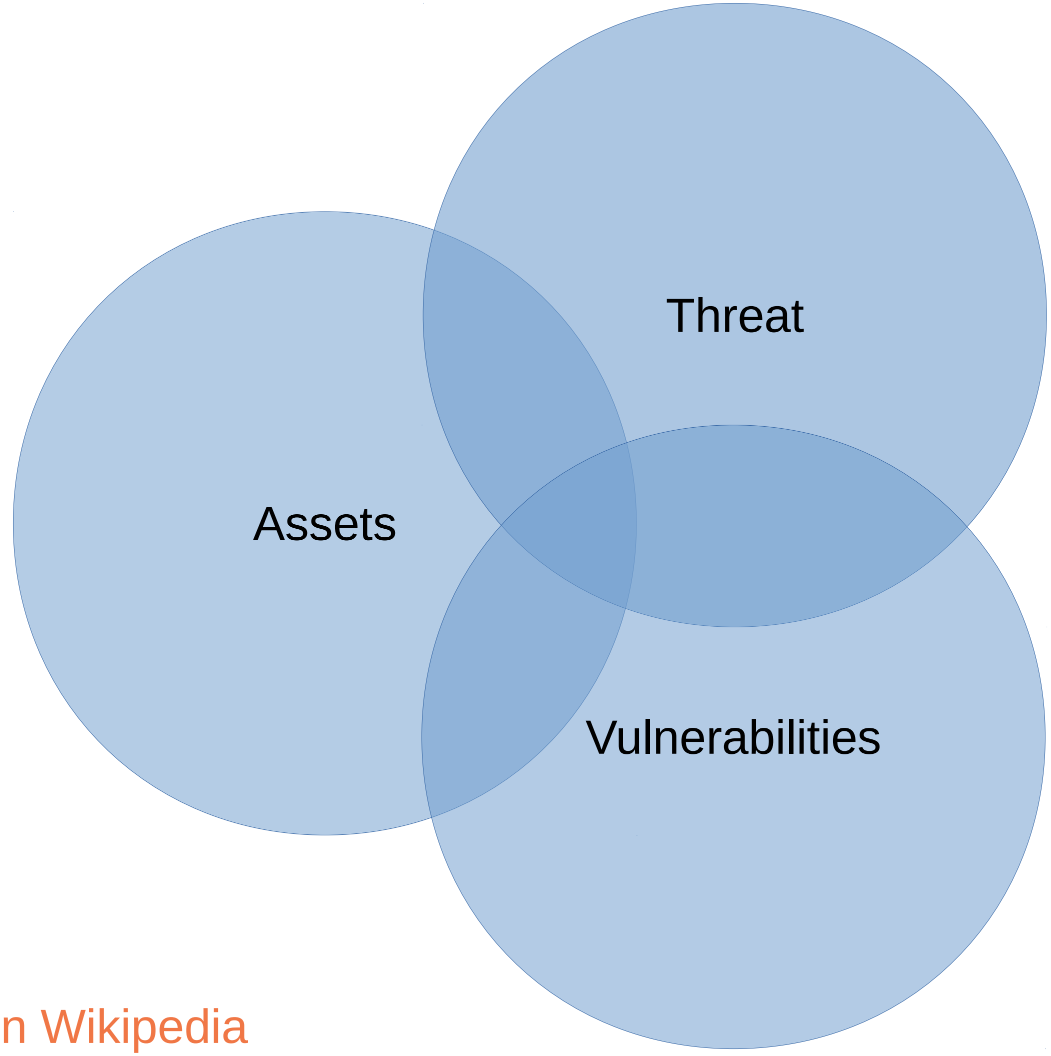
Threat modelling

- Threats
  - The who
  - Who/what is the threat and what can they do?
- Assets
  - The what
  - What are you trying to protect?
- Vulnerabilities
  - The how
  - Where are you vulnerable?
  - Attack vectors

See also: Tony UcedaVelez on threat models

Threat modelling

- Threats
- Assets
- Vulnerabilities



See also: Threat modelling on Wikipedia

Intelligence tasking

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See also: Military intelligence

Critical systems

- “a system which must be highly reliable to avoid incurring prohibitive costs” - Wikipedia

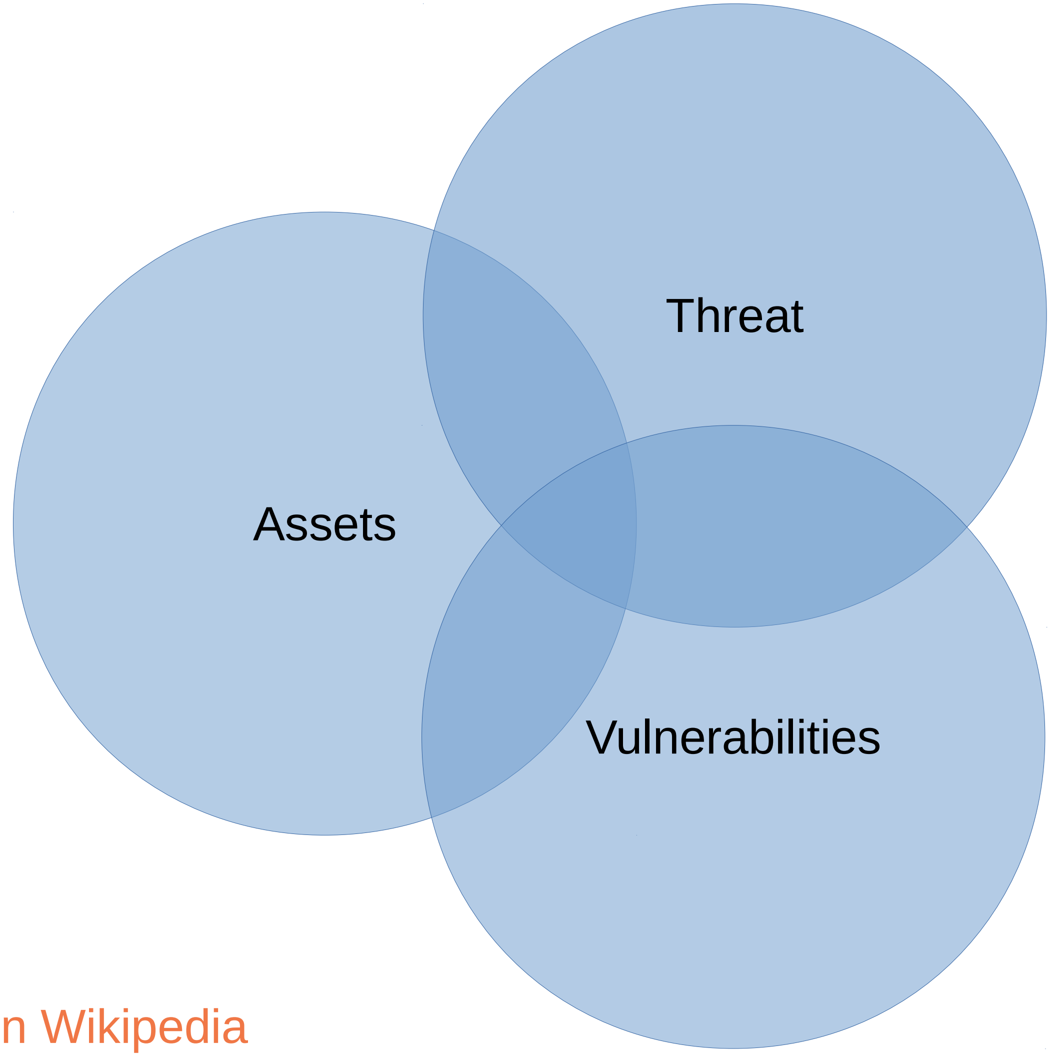
- Safety critical
  - Failure leads to death
- Mission critical
  - Failure may lead to death
- Business critical
  - Failure leads to economic loss
- Security critical
  - Failure leads to data loss

See also: Critical system on Wikipedia

Threat modelling

- Threats
- Assets
- Vulnerabilities

- Safety critical
- Mission critical
- Business critical
- Security critical



See also: Threat modelling on Wikipedia

Recap

- Understand Docker Swarm is and why we need it
- Understand what a critical system is
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- Understand and apply risk matrices
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Literature: DevOps introduction

Risk matrices

- All this is about risk
  - How do we assess risks?

- Severity
  - Catastrophic – Multiple Deaths
  - Critical – One Death or Multiple Severe Injuries
  - Marginal – One Severe Injury or Multiple Minor Injuries
  - Negligible – One Minor Injury

See also: Risk matrix on Wikipedia

Risk matrices

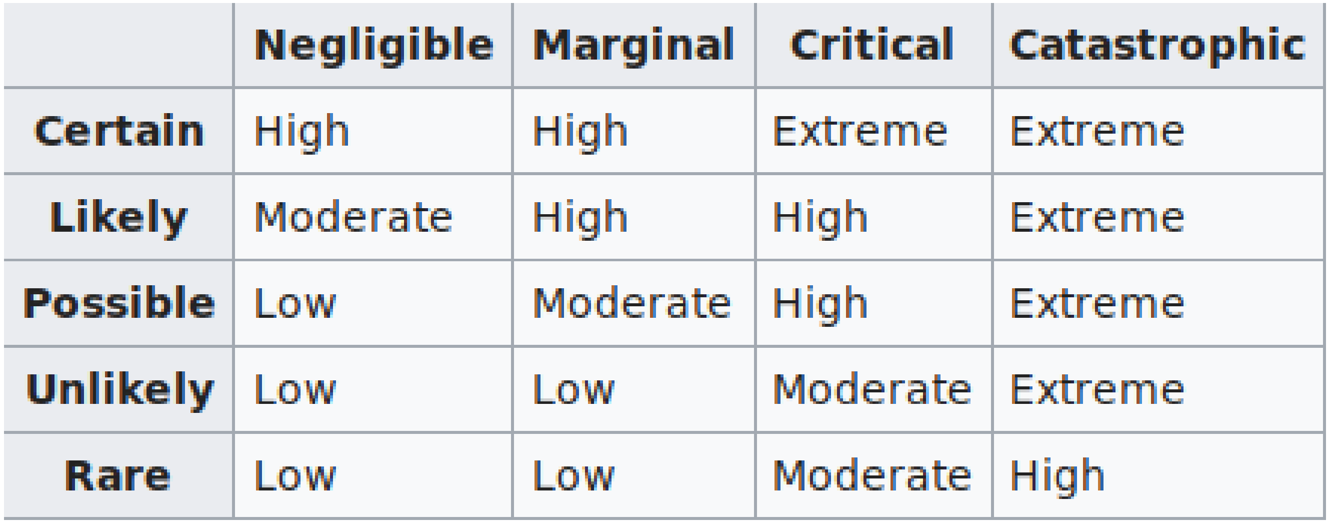
- All this is about risk
  - How do we assess risks?

- Likelihood
  - Certain
  - Likely
  - Possible
  - Unlikely
  - Rare

See also: Risk matrix on Wikipedia

Risk matrices

- All this is about risk
  - How do we assess risks?



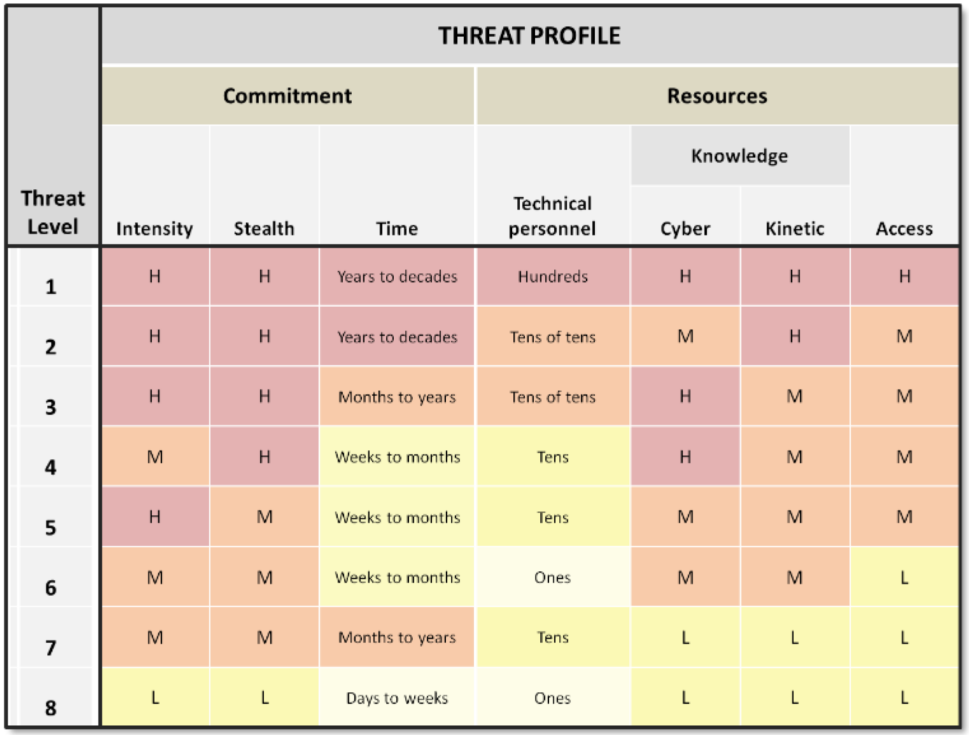
	Negligible	Marginal	Critical	Catastrophic
Certain	High	High	Extreme	Extreme
Likely	Moderate	High	High	Extreme
Possible	Low	Moderate	High	Extreme
Unlikely	Low	Low	Moderate	Extreme
Rare	Low	Low	Moderate	High

See also: Risk matrix on Wikipedia

Cyber threat matrix

- Variant of the risk matrix

Table 1. Generic threat matrix



	THREAT PROFILE						
	Commitment			Resources			
					Knowledge		
Threat Level	Intensity	Stealth	Time	Technical personnel	Cyber	Kinetic	Access
1	H	H	Years to decades	Hundreds	H	H	H
2	H	H	Years to decades	Tens of tens	M	H	M
3	H	H	Months to years	Tens of tens	H	M	M
4	M	H	Weeks to months	Tens	H	M	M
5	H	M	Weeks to months	Tens	M	M	M
6	M	M	Weeks to months	Ones	M	M	L
7	M	M	Months to years	Tens	L	L	L
8	L	L	Days to weeks	Ones	L	L	L

Reproduced from Duggan et al. [8].

See also: NSA on CTM

Intelligence tasking

1) Collect
   - Gather information
   - What are your assets? What is worth protecting?
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   - Analyse adversary and opportunities
   - What are the threats and vulnerabilities?
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   - Process the information so far
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   - Decide and implement mitigations

See also: Military intelligence

The pyramid of pain

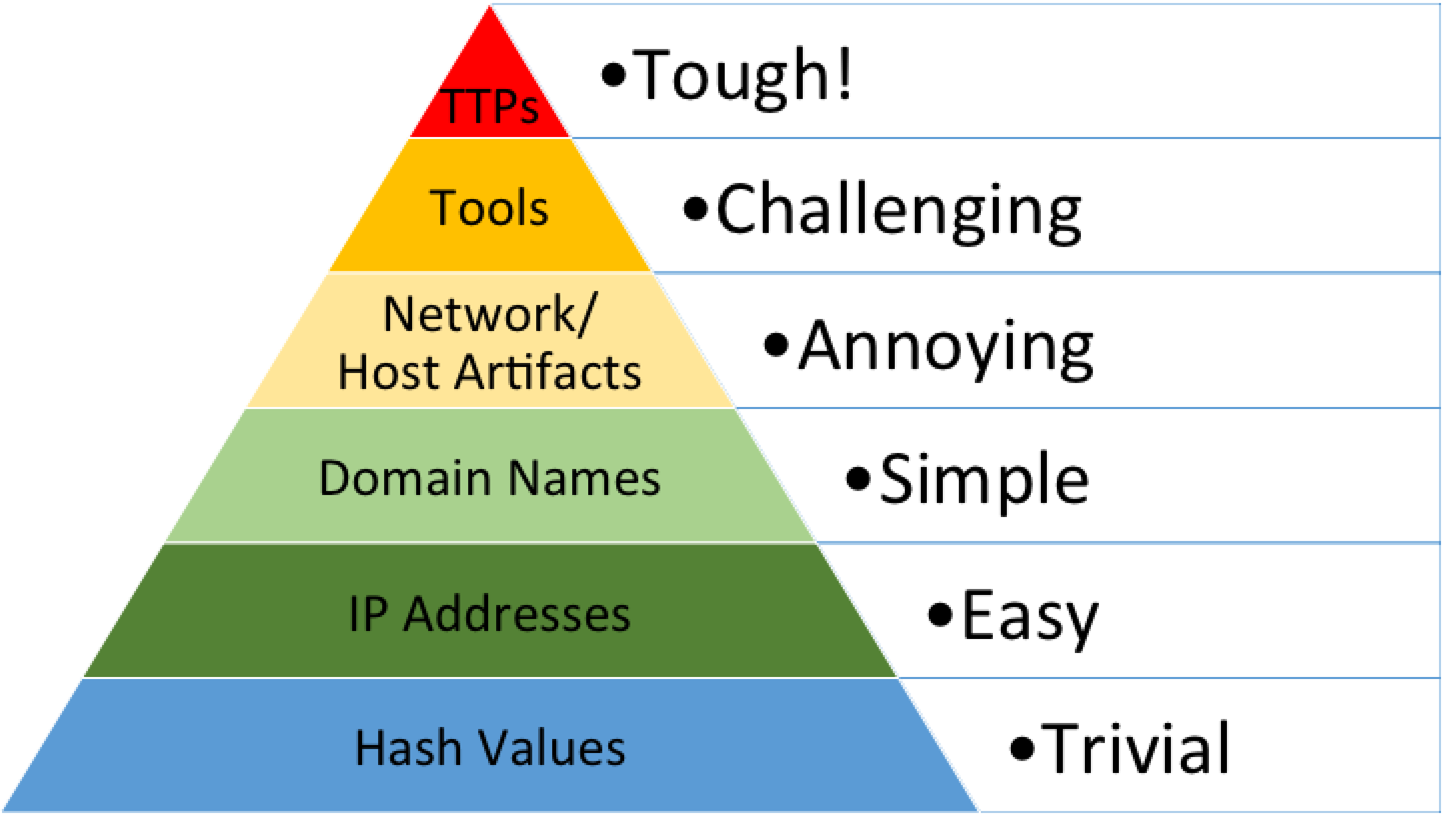
- How can you actually detect intrusions?

- Hash values
- IP addresses
- Domains
- Network/host artifcats
- Tools
- Tactics, Techniques and Procedures

See also: NSA on CTM

The pyramid of pain

- How can you actually detect intrusions?



See also: David Bianco on the pyramid of pain

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Penetration testing

- Open Web Testing Framework
- Automates part of pentesting
- https://owtf.github.io/

OWASP

- Open Web Application Security Project

- Very very cool project with tons of resources
  - Join their meetup here in Copenhagen!

- OWASP top 10 security flaws

- OWASP top 10 cheat sheet
  - https://www.owasp.org/index.php/OWASP_Top_Ten_Cheat_Sheet

- How to guides
  - https://www.owasp.org/index.php/Category:How_To

See also: OWASP.org, OWASP top 10

Intrusion kill chain

- Another military term
  - Identify, dispatch, decide, attack and resolve

- Detect: determine whether an attacker is poking around
- Deny: prevent information disclosure and unauthorized access
- Disrupt: stop or change outbound traffic (to attacker)
- Degrade: counter-attack command and control
- Deceive: interfere with command and control
- Contain: network segmentation changes

See also: Kill chain on Wikipedia

Intrusion detection

- Finding out that you are actually under attack!
  - It's hard. Sorry!

1) Develop a baseline for "normal"
   - Traffic, logins, elevation etc.
2) Stop intruders from taking information *out*
   - Firewalls, traffic filtering, white/black listing
3) Train personnel

See also: 3 steps for intrusion detection

Penetration testing (pentesting)

- Just like with software you can test security
- Simulated attacks on your systems
- Requires you to know potential vulnerabilities

See also: Penetration testing on Wikipedia, Kali linux

OWTF

- Open Web Testing Framework
- Automates part of pentesting
- https://owtf.github.io/

Recap

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Next hand-in

Deadline: **28th of November 23:59:55**

1) Define your assets
2) Create a risk matrix of your project
3) As operators:
   - Try to find at least one vulnerability in the project you are operating
   - Run OWTF or take one of the OWASP top 10
   - Try to find the attack in the logs

Hand-in: Report containing the above