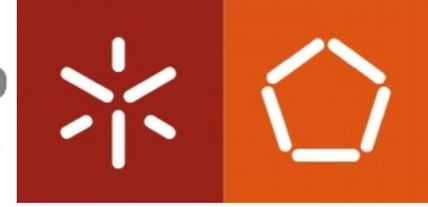
Universidade do Minho
Departamento de Informática



Tecnologias de Segurança

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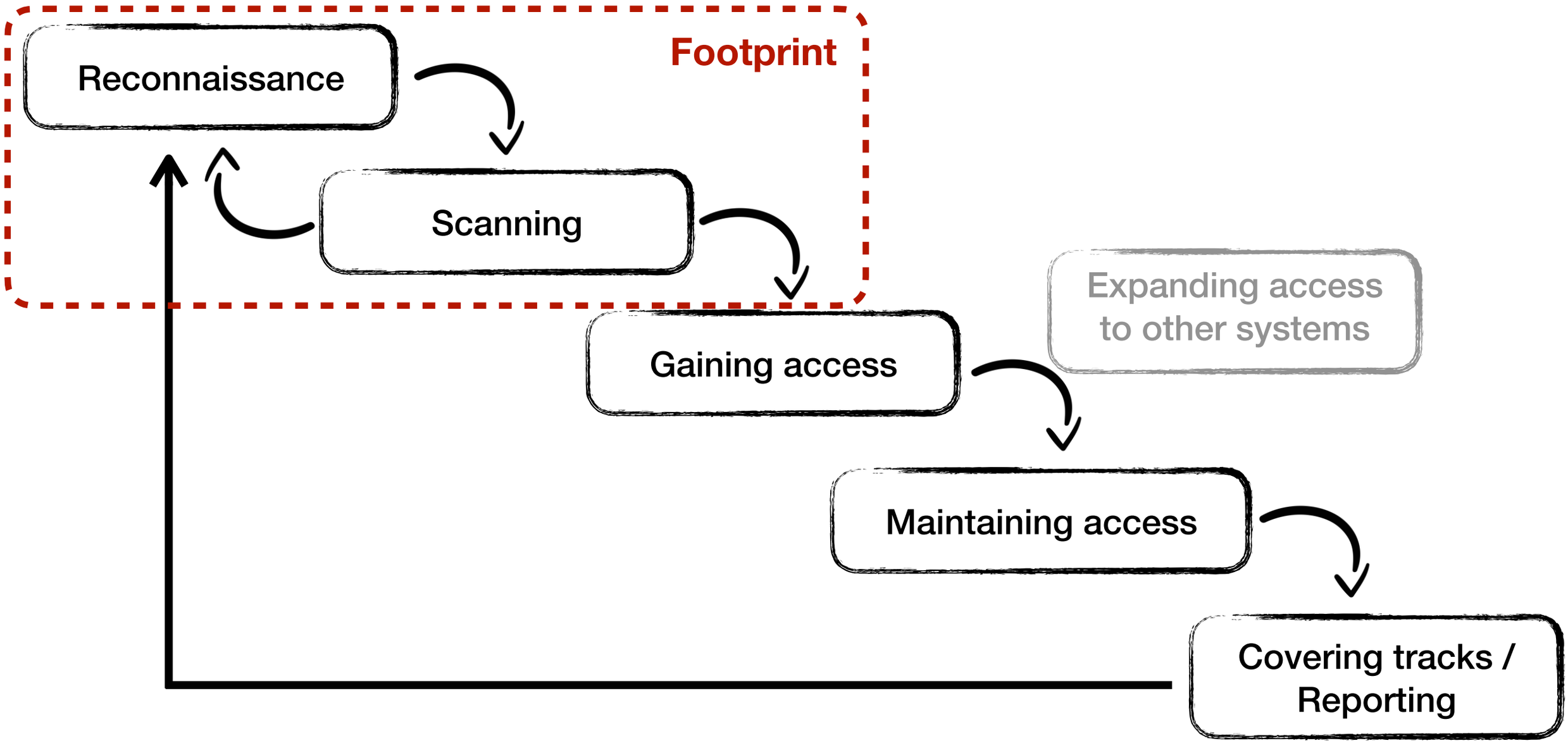
Penetration Testing - *Pentest*

- Authorised attempt to gain system access in an effort to identify and recommend resolutions for vulnerabilities in those systems

- “Ethical hacking”

Penetration Testing - *Pentest*

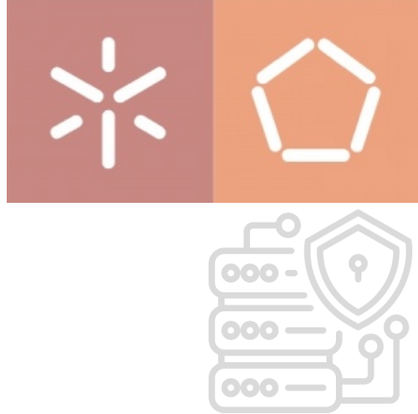
- Cyclical 5 stages process



Penetration Testing

- Footprinting
  - passive (reconnaissance) or active (scanning) information gathering about some target
  - enable an attacker to create a near complete profile of an organisation’s security posture

Pentest - Reconnaissance



- Internal source
  - DNS information
  - private websites
  - dumpster diving
  - shoulder surfing
  - eavesdropping

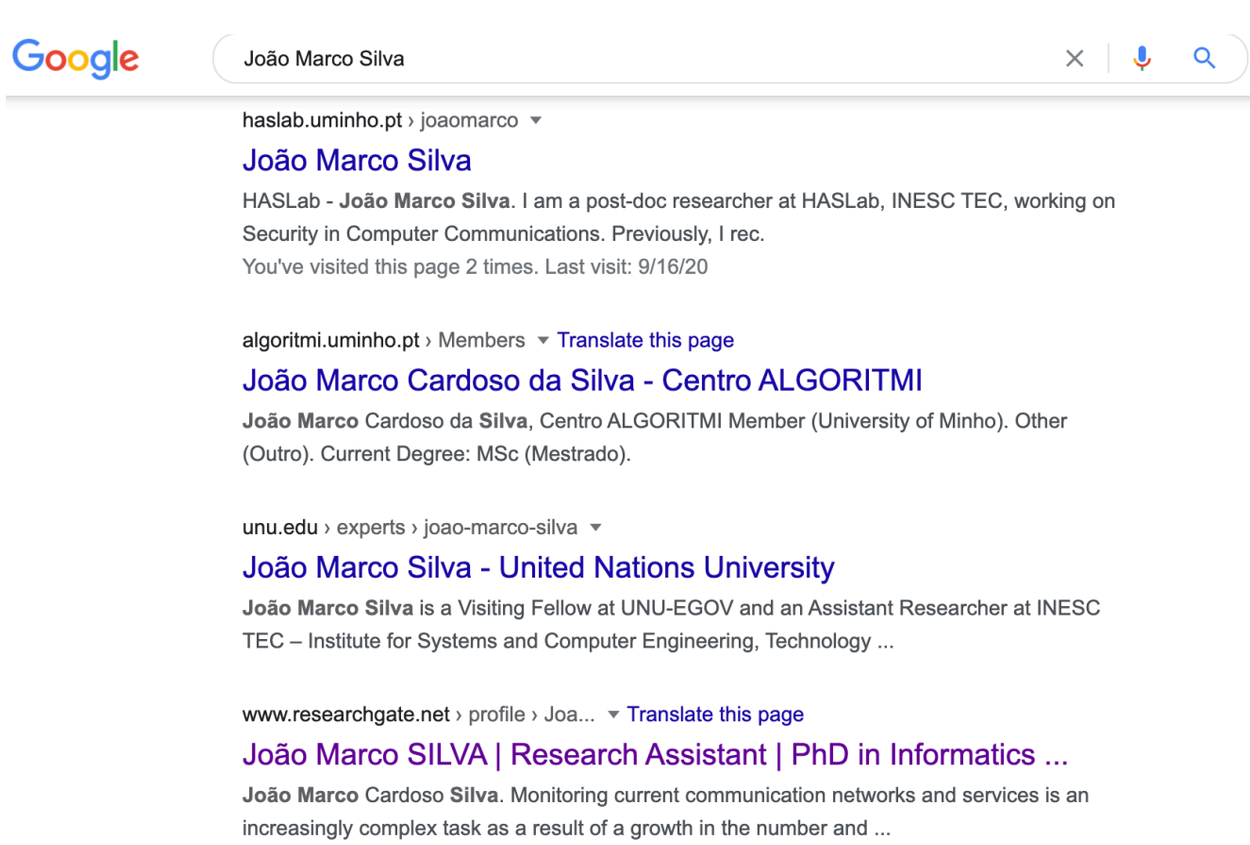
Pentest - Reconnaissance

- External source
  - Services
    - Web site
    - social media
    - whois (https://lookup.icann.org/)
    - DNS
    - Archive sites archive.org (WayBackMachine)
    - URL analysis
    - Source code
    - Search engine
    - Job vacancy

Pentest - Reconnaissance

- Example - Website

- Typically exposed data
  - Board members
  - Technical teams
  - Addresses
  - Business partners



Pentest - Reconnaissance

- Example - Whois DB

```
jotamarco@macbookpro ~ % whois scanme.nmap.org
% IANA WHOIS server
% for more information on IANA, visit http://www.iana.org
% This query returned 1 object

refer:        whois.pir.org

domain:       ORG

organisation: Public Interest Registry (PIR)
address:      11911 Freedom Drive 10th Floor,
address:      Suite 1000
address:      Reston, VA 20190
address:      United States

contact:      administrative
name:         Director of Operations, Compliance and Customer Support
organisation: Public Interest Registry (PIR)
address:      11911 Freedom Drive 10th Floor,
address:      Suite 1000
address:      Reston, VA 20190
address:      United States
phone:        +1 703 889 5778
fax-no:       +1 703 889 5779
e-mail:       ops@pir.org

contact:      technical
name:         Senior Director, DNS Infrastructure Group
organisation: Afilias
address:      Building 3, Suite 105
address:      300 Welsh Road
address:      Horsham, Pennsylvania 19044
address:      United States
phone:        +1 215.706.5700
fax-no:       +1 215.706.5701
e-mail:       tld-tech-poc@afilias.info
```

whois.domaintools.com [redacted]

DOMAINTOOLS PROFILE CONNECT MONITOR SUPPORT Whois Lookup

Website

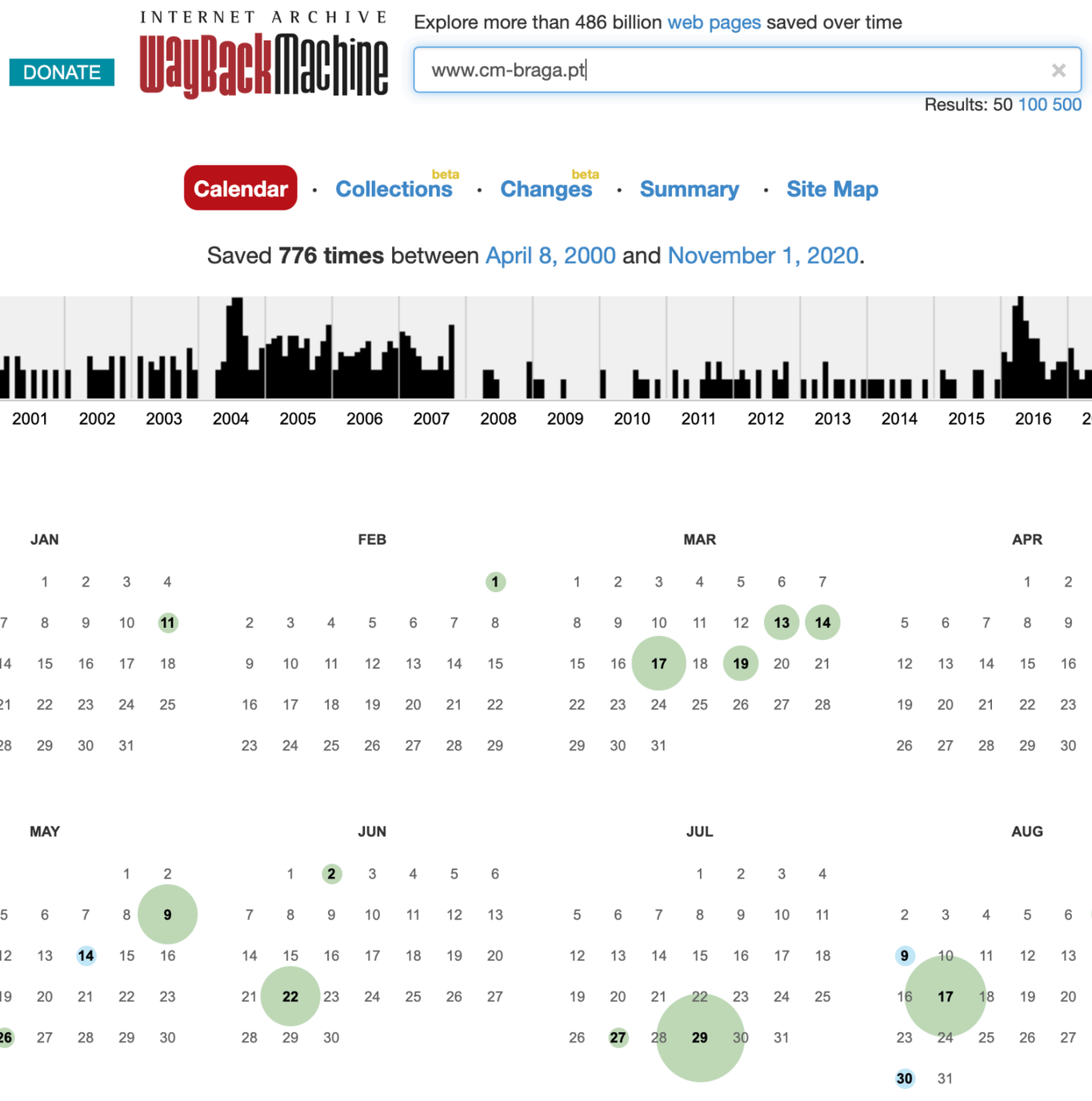
Website Title	Account Suspended
Server Type	Apache/2.4.46 (cPanel) OpenSSL/1.1.1h mod_bwlimited/1.4
Response Code	200
Terms	14 (Unique: 12, Linked: 0)
Images	0 (Alt tags missing: 0)
Links	0 (Internal: 0, Outbound: 0)

Whois Record (last updated on 2020-11-19)

```
domain:       [redacted]
owner:        [redacted]
owner-c:      JMS770
tech-c:       BRCTA23
nserver:      dns1.ma9.com.br
nsstat:       20201119 AA
nslastaa:     20201119
nserver:      dns2.ma9.com.br
nsstat:       20201119 AA
nslastaa:     20201119
created:      20041217 #1917879
changed:      20191218
expires:      20211217
status:       published

nic-hdl-br:   JMS770
person:       Joao Marco Cardoso da Silva
created:      20051028
changed:      20190319

nic-hdl-br:   BRCTA23
person:       [redacted]
created:      20150930
changed:      20190514
```

Pentest - Reconnaissance

- Example - archive.org



Pentest - Reconnaissance

- Example - Job vacancy

Windows Administrator (.Net/Java)

Apply Now Save

Job Company

Must Have:

- Minimum of 5 years of confirmed expertise and working experience in:
  - Windows Server 2008 / 2012r2 / 2016 administration in large infrastructures o Very good knowledge of server hardware layers, especially HP, and the surrounding environment (LAN, SAN, etc ...) o Ability to design and develop IT solutions (VB script, Windows Shell, Power Shell).
  - Ability to automate and script in order to keep all administration actions simple and standard o Microsoft Windows Active Directory administration (infra, GPO), DNS, DHCP, IIS, cluster, middleware (Dotnet, Java), WSUS.
  - Microsoft Windows Platforms (SCOM, SharePoint, IIS, .NET, ...) o PowerShell scripting and other languages o Configuration and managing of remote servers Nice to Have:
- Knowledge of Puppet would be a plus
- Knowledge in Symantec AV and TSM Backup · ServiceNow · IPC knowledge

Senior Vmware Administrator

Apply Now Save

Job Company Rating Salary Benefits

Required qualifications to be successful in this role

Must Have minimum of 3 years of confirmed expertise and working experience in:
• Virtualization expert for ESX and Vmware environment (versions: 6 / 6.5 / 6.7)
• Good knowledge of Vrealize (Vrops) tools
• Proven experience in IT production environment (incident, 24H/7 on duty, early morning organization) , with DRP architecture.
• A good experience on Vmware migration & upgrade.
• Hyperconvergent solution skills is appreciated : Nutanix, VSAN, VRA, ..
• Audit and security skills.
• Scripting skills and automation.
• Strong general knowledge in IT and Datacenter infrastructure architectures

Pentest - Reconnaissance

- Example - DNS

Using OS resolver

```
jotamarco@macbookpro ~ % host www.uminho.pt
www.uminho.pt has address 193.137.9.114
jotamarco@macbookpro ~ % dig www.uminho.pt

; <<>> DiG 9.10.6 <<>> www.uminho.pt
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 4776
;; flags: qr rd ra ad; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 512
;; QUESTION SECTION:
;www.uminho.pt.                 IN      A

;; ANSWER SECTION:
www.uminho.pt.          14062   IN      A       193.137.9.114

;; Query time: 65 msec
;; SERVER: 192.168.86.1#53(192.168.86.1)
;; WHEN: Thu Nov 19 11:58:19 WET 2020
;; MSG SIZE  rcvd: 58
```

nslookup with local DNS server

```
jotamarco@macbookpro ~ % nslookup www.totalsem.com
Server:         192.168.86.1
Address:        192.168.86.1#53

Non-authoritative answer:
Name:   www.totalsem.com
Address: 34.200.194.131

jotamarco@macbookpro ~ % nslookup server1.totalsem.com
Server:         192.168.86.1
Address:        192.168.86.1#53

** server can't find server1.totalsem.com: NXDOMAIN
```

Check if an IP address is a functioning DNS

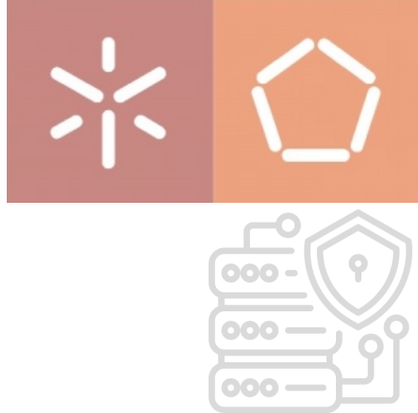
```
jotamarco@macbookpro ~ % nslookup
> server 177.70.15.142
Default server: 177.70.15.142
Address: 177.70.15.142#53
> www.uminho.pt
Server:         177.70.15.142
Address:        177.70.15.142#53

** server can't find www.uminho.pt: REFUSED
> server 8.8.8.8
Default server: 8.8.8.8
Address: 8.8.8.8#53
> www.uminho.pt
Server:         8.8.8.8
Address:        8.8.8.8#53

Non-authoritative answer:
Name:   www.uminho.pt
Address: 193.137.9.114
```

Pentest - Scanning

We will use the information acquired during the reconnaissance stage to shape probes and communicate directly with targets with the intent of identifying potential threats and vulnerabilities

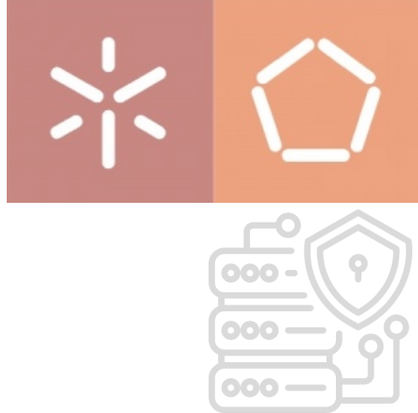
- To do so, it is required to know
  - specifics about the Operating System (OS)
  - what services are available on the server
  - application version information
  - …

Pentest - Scanning



- Passive vs Active scanning
  - a tradeoff between detectability and depth of information
- Use public vulnerability databases to determine if the target system might be vulnerable to attack
- In this phase, there is no exploiting activities
  - it is an auditing process aiming to identify which risks might exist - not to prove their existence

Pentest - Scanning

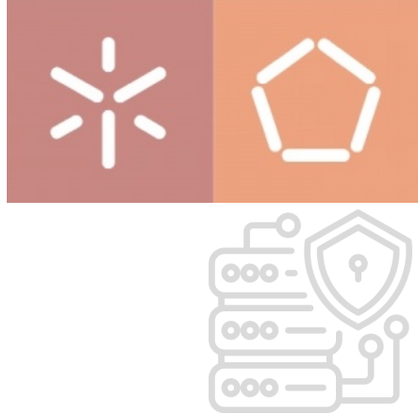


- Activity examples
  - check for live systems
  - check for open ports
  - scan beyond the IDS/Firewalls
  - banner grabbing
  - scan for vulnerabilities

Pentest - Scanning

- Tools
  - Nmap Security Scanner
    - Source https://nmap.org/
      - documentation https://nmap.org/book/man.html
  - vulnerability scanner
    - OpenVAS - http://www.openvas.org/
    - Nessus - https://www.tenable.com/downloads/nessus
  - Other tools might be used
    - https://sectools.org/tag/app-scanners/
    - https://sectools.org/tag/web-scanners/

Pentest - Scanning



- Port Scanning
  - verifying the existence of the target system
  - obtaining a list of communication channels (ports) that accept connections
  - identify what applications are on the communication channels

Pentest - Scanning

- Port scanning with nmap
  - checking for live systems
    - ICMP - Internet Control Message Protocol (using ping)
    - ICMP might be disabled (use nmap with -sn flag)
      - -sn -> nmap ping scan (-sP in older versions)

Pentest - Scanning

- Port scanning with nmap
  - Most of the interesting applications from a PenTest perspective use TCP to communicate
    - Web servers
    - file transfer applications
    - databases
- Tools use the TCP three-way handshake to identify open ports

 # nmap -sS target

```
jotamarco@macbookpro ~ % sudo nmap -sS 192.168.86.200
Password:
Starting Nmap 7.80 ( https://nmap.org ) at 2020-11-22 17:33 WET
Nmap scan report for 192.168.86.200
Host is up (0.0044s latency).
Not shown: 989 closed ports
PORT      STATE SERVICE
22/tcp    open  ssh
80/tcp    open  http
139/tcp   open  netbios-ssn
443/tcp   open  https
445/tcp   open  microsoft-ds
873/tcp   open  rsync
3261/tcp  open  winshadow
5000/tcp  open  upnp
5001/tcp  open  commplex-link
50001/tcp open  unknown
50002/tcp open  iiimsf
```

Pentest - Scanning

- Different types of scan are supported aiming to avoid being identified by a firewall
  - ACK scan (-sA)
  - FIN scan (-sF)
  - Null scan (-sN)
  - Xmas Tree scan (-sX)

Pentest - Scanning

- System identification
  - most application exploits are written for specific OS, so finding out the running OS is essential to identify possible vulnerabilities on the target

    # **nmap -O target**

- Passive OS fingerprinting
  - capturing TCP packets and analysing TTL information in order to identify manually the OS
- Application banner also might provide such information

Pentest - Scanning

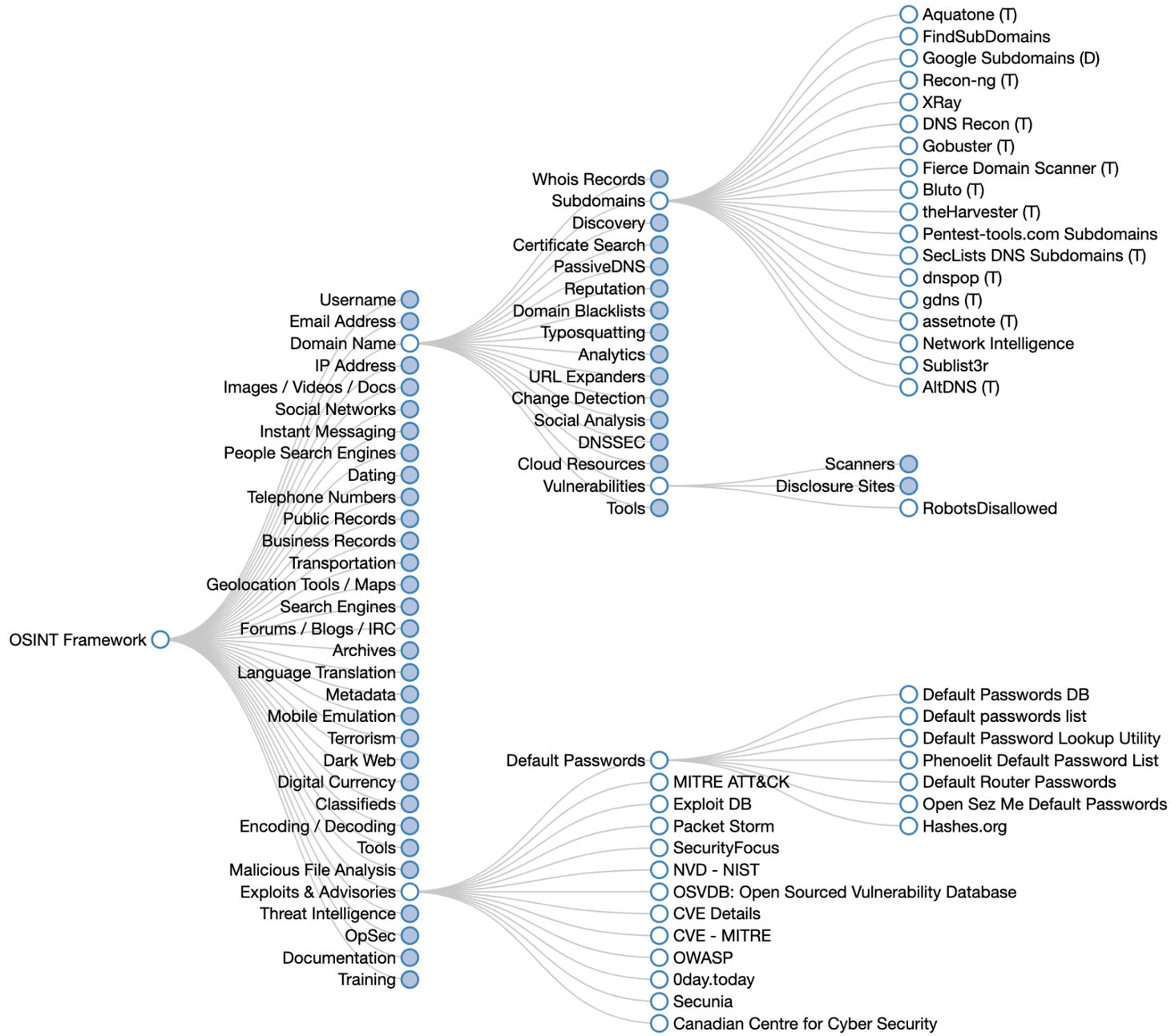
- Services identification
  - Banner
    - connecting to an unknown service on a port and checking if that port provides information about the service itself
      - with nmap, use the -sV flag

```
Starting Nmap 7.80 ( https://nmap.org ) at 2020-11-22 17:35 WET
Nmap scan report for 192.168.86.200
Host is up (0.0038s latency).
Not shown: 989 closed ports
PORT      STATE SERVICE     VERSION
22/tcp    open  ssh         OpenSSH 7.4 (protocol 2.0)
80/tcp    open  http        nginx
139/tcp   open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: BACKUPS)
443/tcp   open  ssl/http    nginx
445/tcp   open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: BACKUPS)
873/tcp   open  rsync
3261/tcp  open  iscsi       Synology DSM Snapshot Replication iSCSI LUN
5000/tcp  open  http        nginx
5001/tcp  open  ssl/http    nginx
50001/tcp open  upnp        Portable SDK for UPnP devices 1.6.21 (Linux 4.4.59+; UPnP 1.0)
50002/tcp open  http        lighttpd 1.4.43
```

- Packet analysis
  - analysing TCP/IP stack from captured packets and matching the data to known services

Pentest - Footprinting

- OSINT: Open-source intelligence framework



Pentest - Footprinting

- OSINT resources in cybersecurity