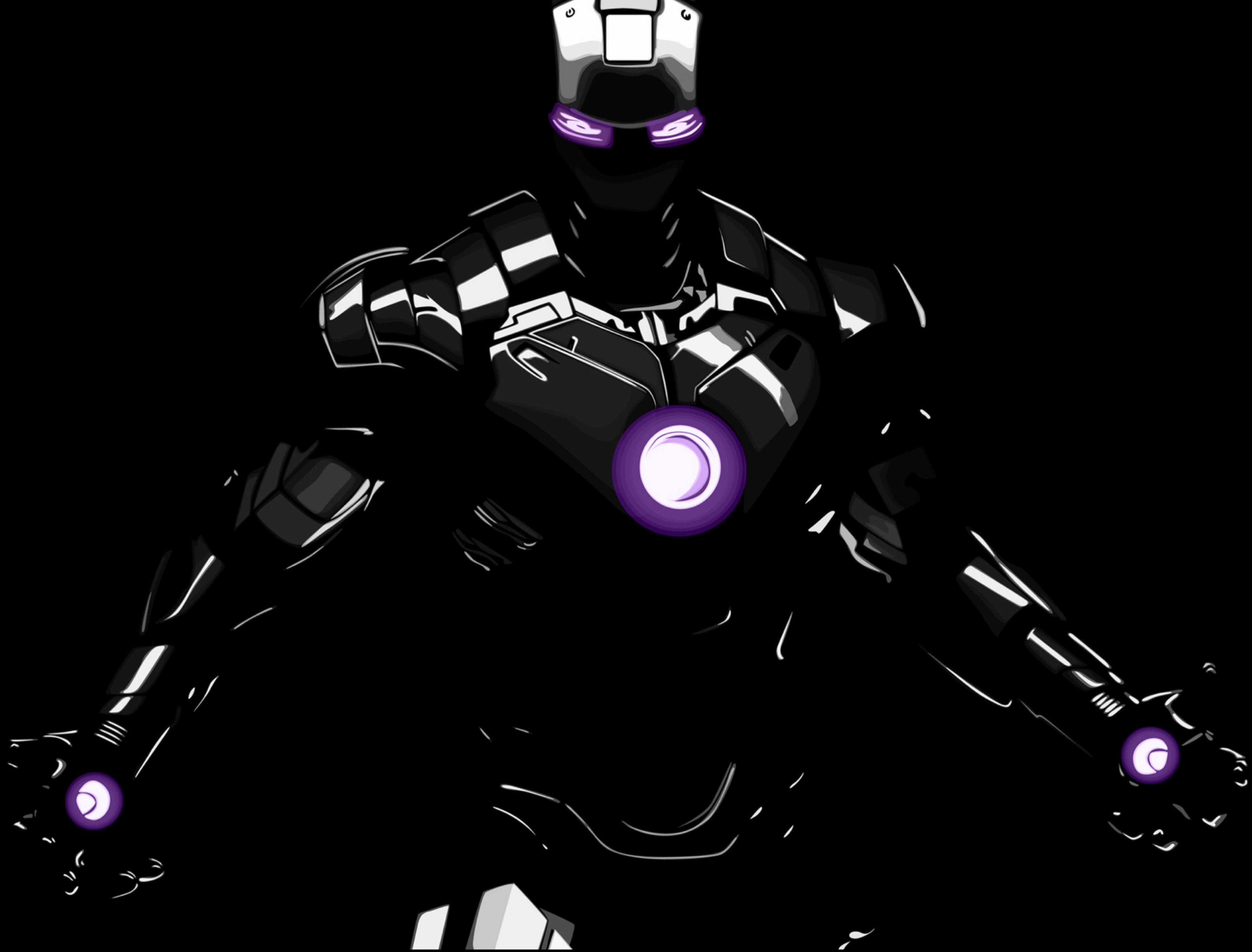
BISHOPFOX

POSE A THREAT

HOW PERCEPTUAL ANALYSIS HELPS BUG HUNTERS

PRESENTED BY ROB RAGAN AND OSCAR SALAZAR



TURNING **CHAOS**

afug.wls.wsat.oordinator....f283.png
aevb.status.010f0f0...3dd.png
aewe.status.0e0e0c...3be.png
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afll.web.console.727303...c64.png
afon.wls.wsat.oordinator....b64.png
adwd.sitecore.login.07331...c9f.png
abav.docker.variables.env....ffcd.png
accd.env.4c4c5c...0a8.png
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aexx.status.424c5c...2e5.png
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aaoj.ckeditor.ckfin
aazb.docker.varia
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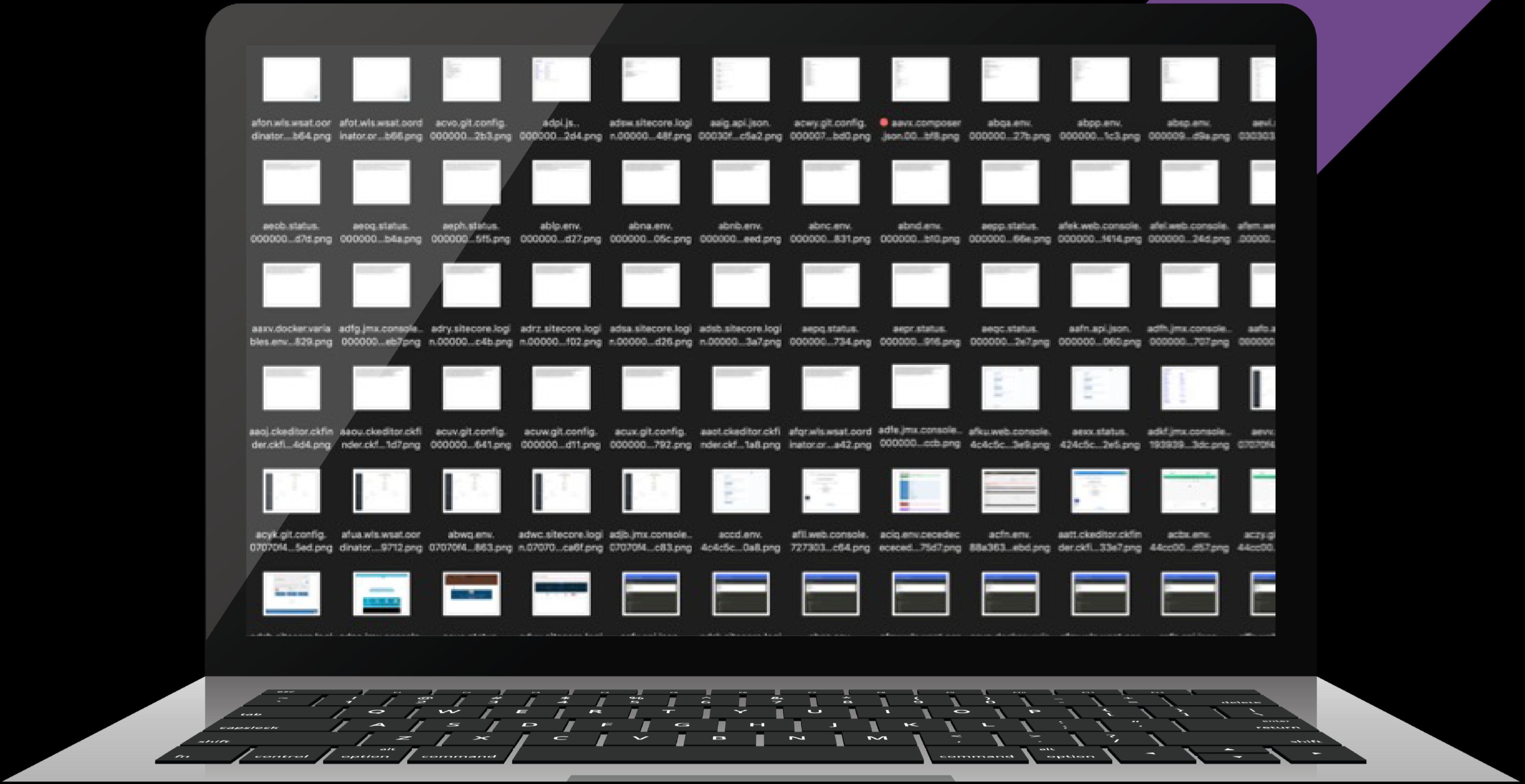
abwq.env.
adne.jmx.console.
aevv.status.
aaza.docker.varia

INTO **ORDER**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adrz.sitecore.login.00000...f02.png
adsa.sitecore.login.00000...d26.png
adsb.sitecore.login.00000...3a7.png
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aepr.status.000000...916.png
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adfh.jmx.console..000000...707.png
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aaou.ckeditor.ckfinder.ckf...1d7.png
acuv.git.config.000000...641.png
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acfn.env.88a363...ebd.png
aatt.ckeditor.ckfinder.ckfi...33e7.png
acbx.env.44cc00...d57.png

LET’S SEE SOME HANDS

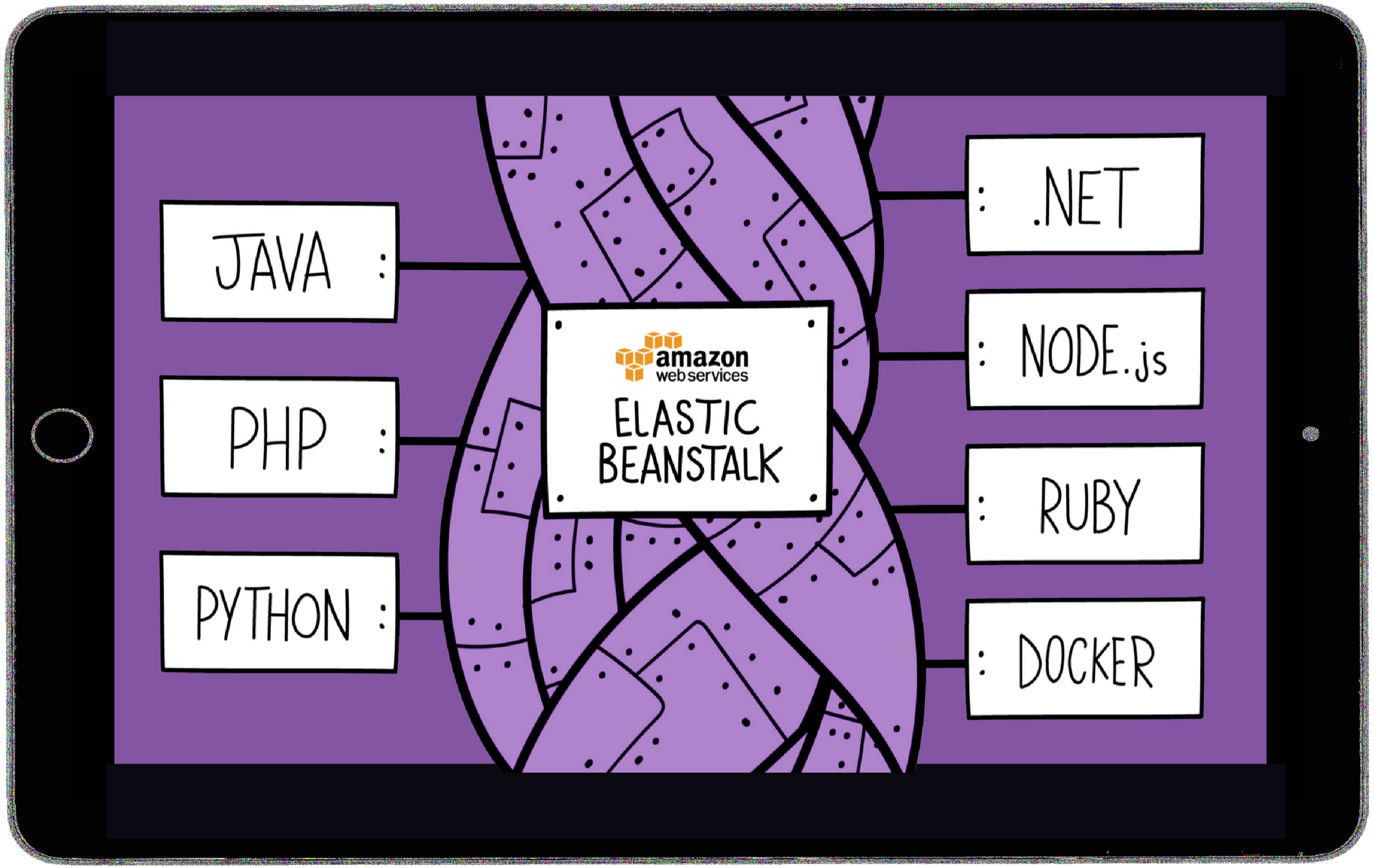
WHO HERE IS A PENTESTER?

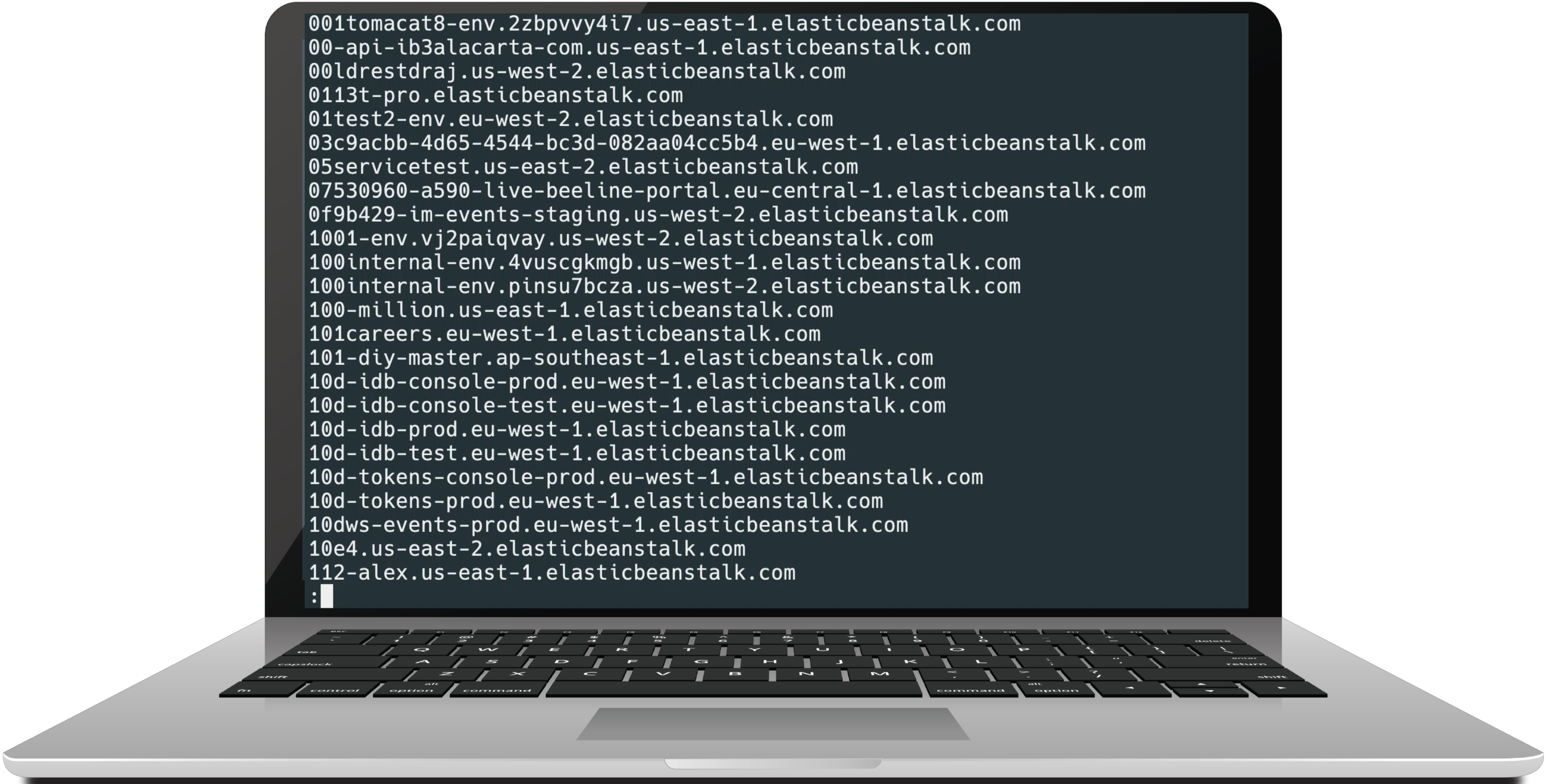
QUESTION

WHO HAS HAD THEIR AWS

CREDENTIALS STOLEN?

WHAT IS **ELASTICBEANSTALK**





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001tomacat8-env.2zbpvvy4i7.us-east-1.elasticbeanstalk.com
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101careers.eu-west-1.elasticbeanstalk.com
101-diy-master.ap-southeast-1.elasticbeanstalk.com
10d-idb-console-prod.eu-west-1.elasticbeanstalk.com
10d-idb-console-test.eu-west-1.elasticbeanstalk.com
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10d-idb-test.eu-west-1.elasticbeanstalk.com
10d-tokens-console-prod.eu-west-1.elasticbeanstalk.com
10d-tokens-prod.eu-west-1.elasticbeanstalk.com
10dws-events-prod.eu-west-1.elasticbeanstalk.com
10e4.us-east-2.elasticbeanstalk.com
112-alex.us-east-1.elasticbeanstalk.com
:
```

5 AVENUES OF ATTACK

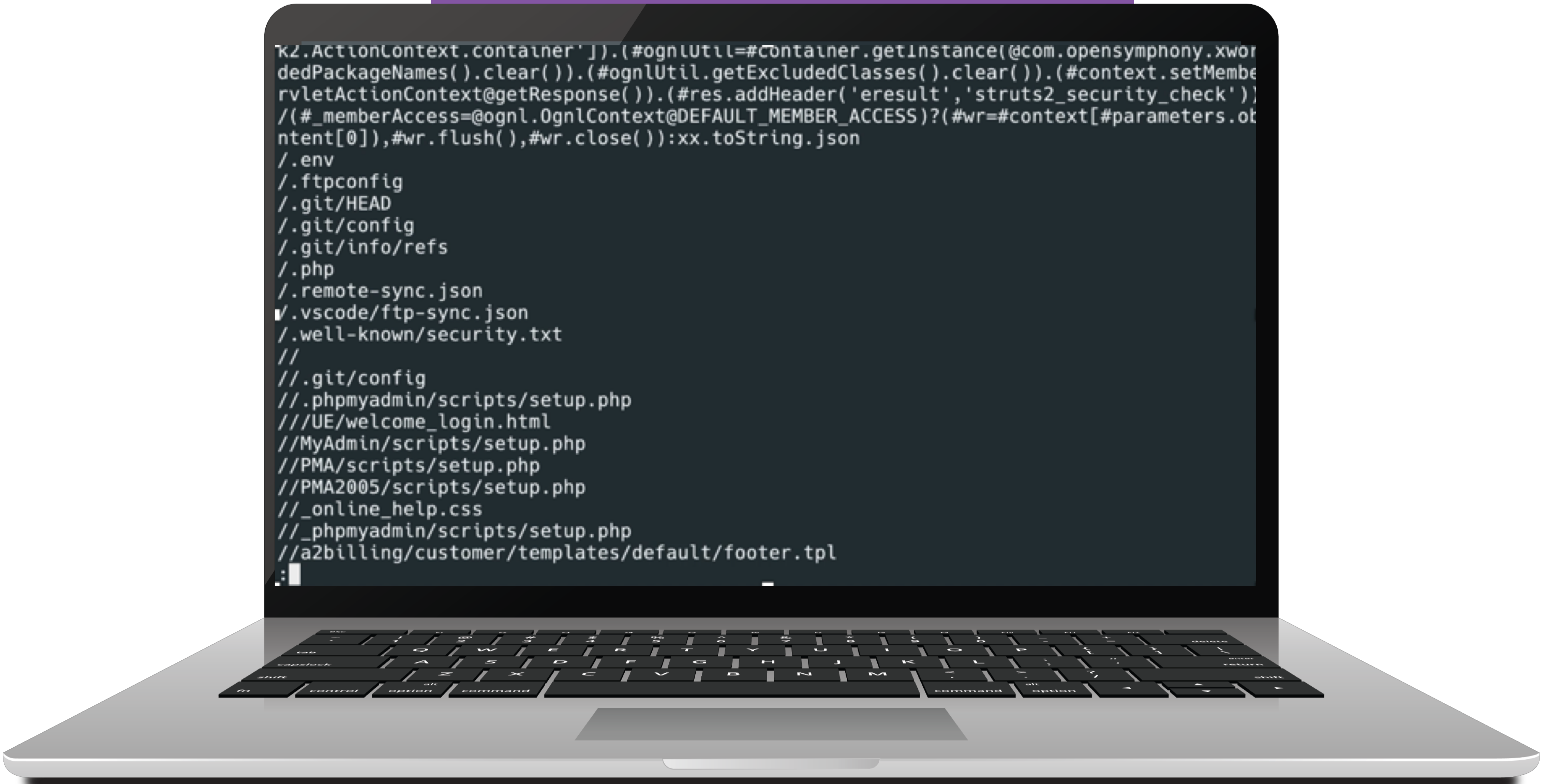
WEAK **PASSWORDS**

INSECURE **APPLICATIONS**

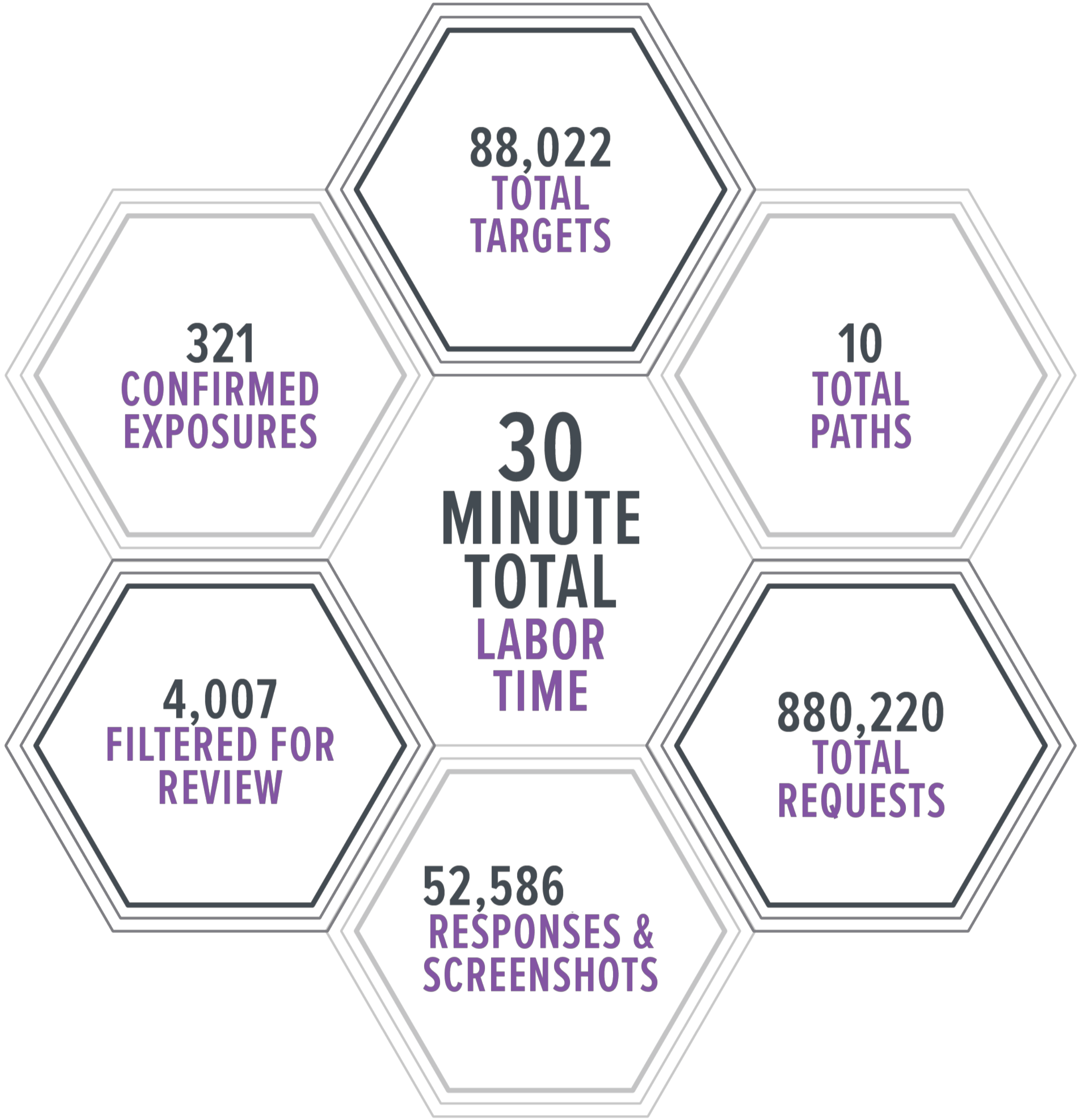
SENSITIVE **INFO LEAKS**

MISSING **PATCHES**

SINGLE **MISCONFIGURATION**



```
k2.ActionContext.container']).(#ognlUtil=#container.getInstance(@com.opensymphony.xwor
dedPackageNames().clear()).(#ognlUtil.getExcludedClasses().clear()).(#context.setMembe
rvletActionContext@getResponse()).(#res.addHeader('eresult','struts2_security_check'))
/(#_memberAccess=@ognl.OgnlContext@DEFAULT_MEMBER_ACCESS)?(#wr=#context[#parameters.ob
ntent[0]),#wr.flush(),#wr.close()):xx.toString.json
/.env
/.ftpconfig
/.git/HEAD
/.git/config
/.git/info/refs
/.php
/.remote-sync.json
/.vscode/ftp-sync.json
/.well-known/security.txt
//
//.git/config
//.phpmyadmin/scripts/setup.php
///UE/welcome_login.html
//MyAdmin/scripts/setup.php
//PMA/scripts/setup.php
//PMA2005/scripts/setup.php
//_online_help.css
//_phpmyadmin/scripts/setup.php
//a2billing/customer/templates/default/footer.tpl
:
```



88,022 TOTAL TARGETS

321 CONFIRMED EXPOSURES

10 TOTAL PATHS

30 MINUTE TOTAL LABOR TIME

4,007 FILTERED FOR REVIEW

880,220 TOTAL REQUESTS

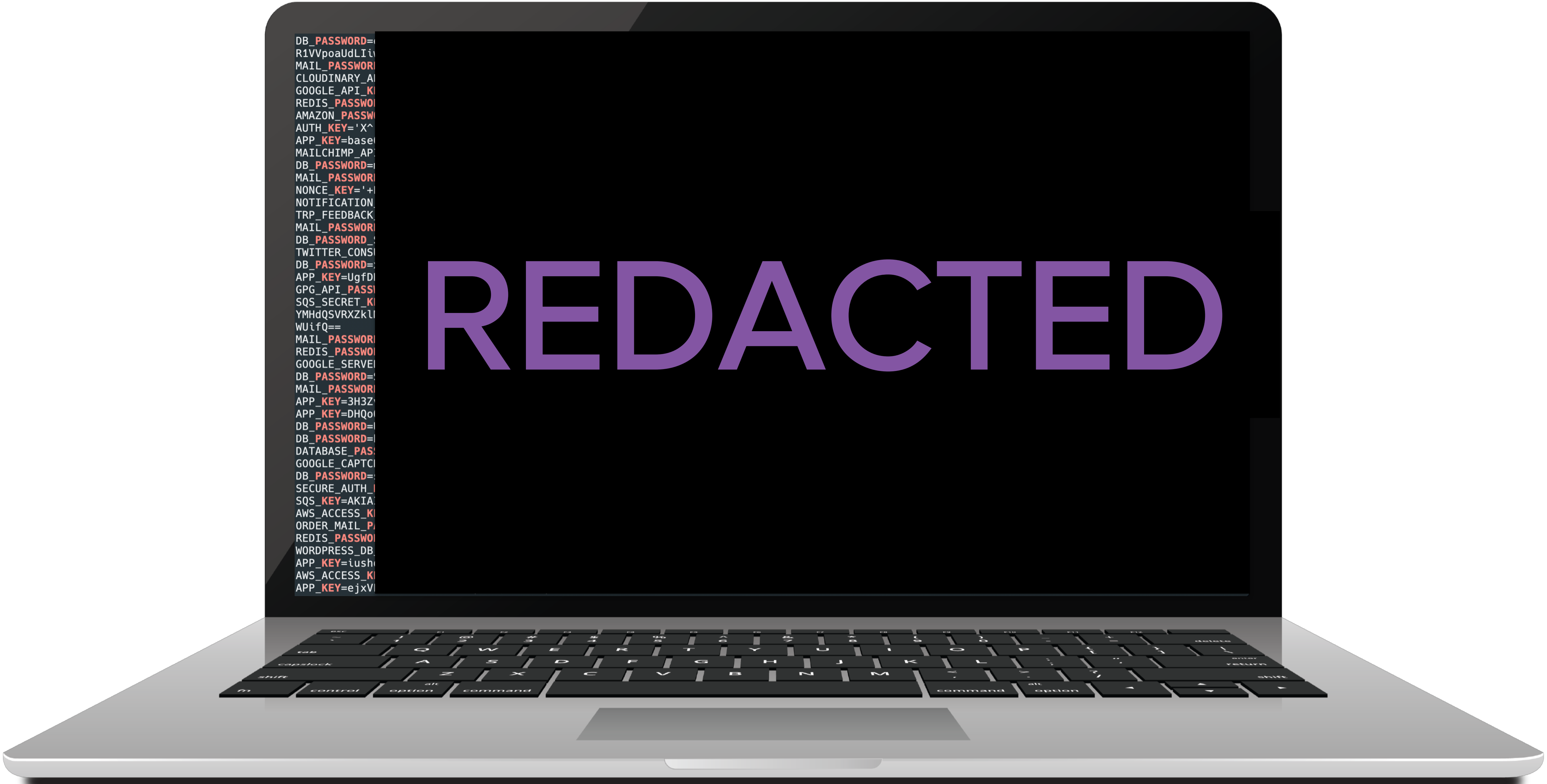
52,586 RESPONSES & SCREENSHOTS

QUESTION ONE

WHAT DID WE **OBSERVE?**

QUESTION TWO

WHAT’S IN THE LIST **OF TARGETS?**



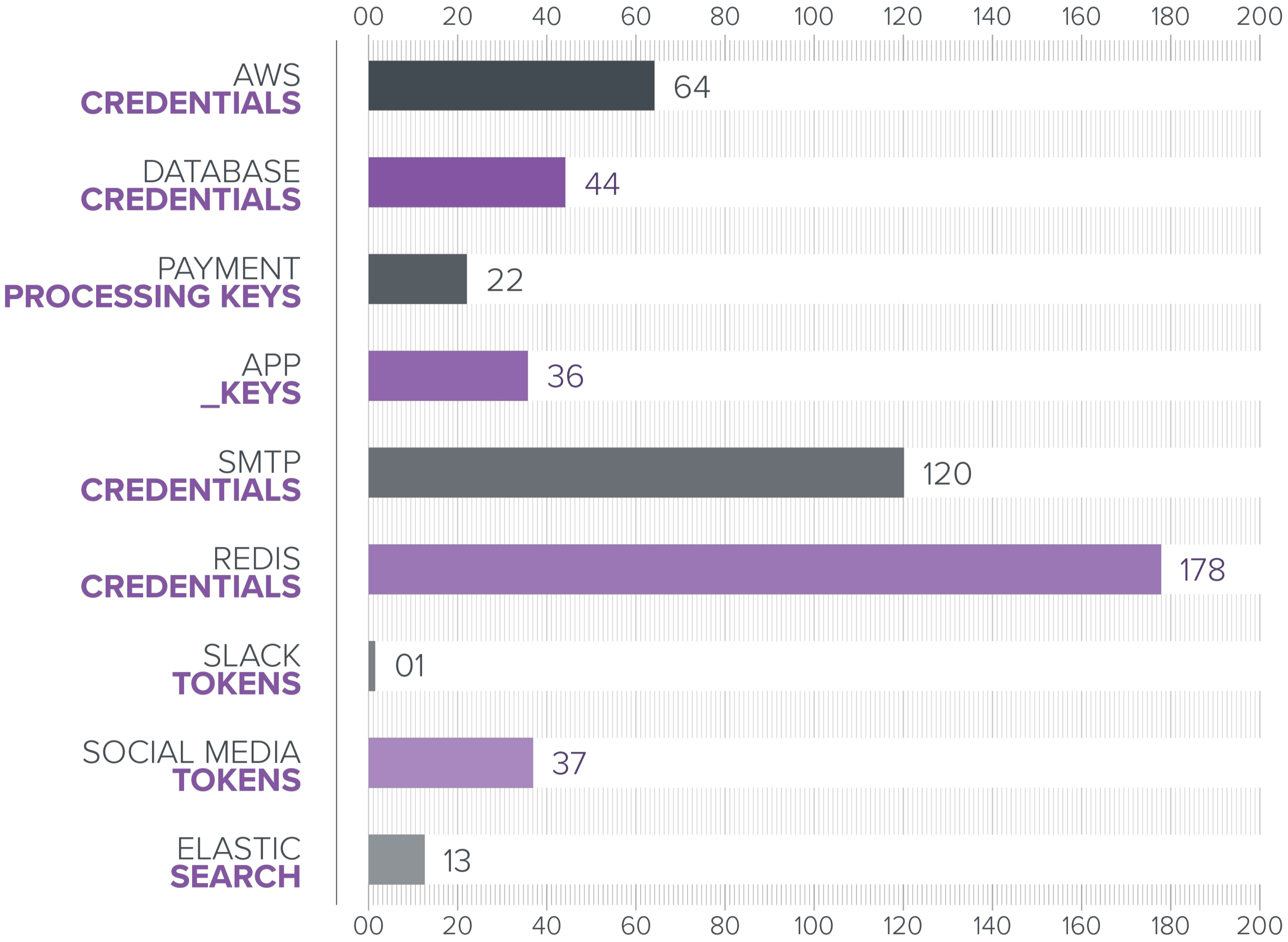
```
DB_PASSWORD=
R1VVpoaUdLIi
MAIL_PASSWOR
CLOUDINARY_A
GOOGLE_API_K
REDIS_PASSWO
AMAZON_PASSW
AUTH_KEY='X^
APP_KEY=base
MAILCHIMP_AP
DB_PASSWORD=
MAIL_PASSWOR
NONCE_KEY='+
NOTIFICATION
TRP_FEEDBACK
MAIL_PASSWOR
DB_PASSWORD_
TWITTER_CONS
DB_PASSWORD=
APP_KEY=UgfD
GPG_API_PASS
SQS_SECRET_K
YMHdQSVRXZkl
WUifQ==
MAIL_PASSWOR
REDIS_PASSWO
GOOGLE_SERVE
DB_PASSWORD=
MAIL_PASSWOR
APP_KEY=3H3Z
APP_KEY=DHQo
DB_PASSWORD=
DB_PASSWORD=
DATABASE_PAS
GOOGLE_CAPTC
DB_PASSWORD=
SECURE_AUTH_
SQS_KEY=AKIA
AWS_ACCESS_K
ORDER_MAIL_P
REDIS_PASSWO
WORDPRESS_DB
APP_KEY=iush
AWS_ACCESS_K
APP_KEY=ejxV
```

REDACTED

```
APIKEY=75177
DB_PASSWORD=
APP_KEY=FUxn
MSQC_PASSWOR
APP_KEY=base
MAIL_PASSWOR
LOGGED_IN_KE
PUSHER_APP_K
PS_COOKIE_KE
DB_PASSWORD=
AWS_KEY='AKI
GCM_KEY=AAAA
Ofc4dUj7LOOU
APIKEY=40800
GOOGLE_API_K
MAIL_PASSWOR
FIREBASE_KEY
DB_PASSWORD=
APP_KEY=base
DB_PASSWORD=
DB_PASSWORD=
AWS_ACCESS_K
APP_KEY=base
DB_PASSWORD=
AWS_S3_KEY=A
APP_KEY=base
APP_KEY=base
APP_KEY=1X5e
APP_KEY=base
API_KEY="AIz
DB_PASSWORD=
DB_PASSWORD=
MAIL_PASSWOR
DB_PASSWORD=
GOOGLE_CAPTC
APP_FCM_KEY=
M0SetHPWZQBS
MAIL_PASSWOR
MAIL_PASSWOR
FB_API_KEY=1
APP_GCM_KEY=
MAIL_PASSWOR
AWS_KEY=AKIA
APP_KEY=base
MAIL_PASSWOR
```

REDACTED

ELASTICBEANSTALK **LOOT**



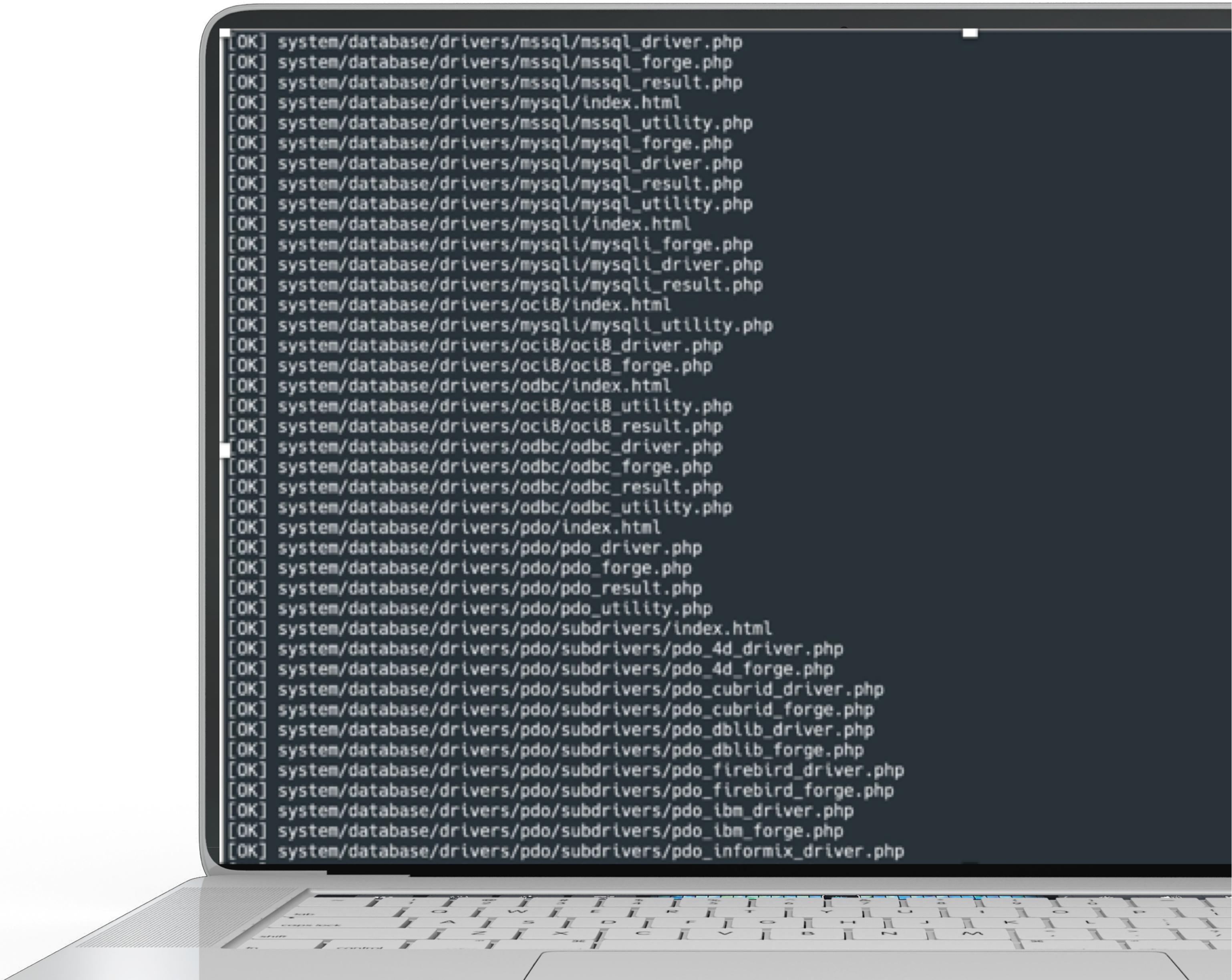
SOURCE CODE LEAK

CRITICAL EXPOSURE

`/.git/config`

Source Code Contains

- Encryption Keys
- DB Passwords
- API Tokens
- Internal Systems
- Application Vulnerabilities



```
[OK] system/database/drivers/mssql/mssql_driver.php
[OK] system/database/drivers/mssql/mssql_forge.php
[OK] system/database/drivers/mssql/mssql_result.php
[OK] system/database/drivers/mysql/index.html
[OK] system/database/drivers/mssql/mssql_utility.php
[OK] system/database/drivers/mysql/mysql_forge.php
[OK] system/database/drivers/mysql/mysql_driver.php
[OK] system/database/drivers/mysql/mysql_result.php
[OK] system/database/drivers/mysql/mysql_utility.php
[OK] system/database/drivers/mysqli/index.html
[OK] system/database/drivers/mysqli/mysqli_forge.php
[OK] system/database/drivers/mysqli/mysqli_driver.php
[OK] system/database/drivers/mysqli/mysqli_result.php
[OK] system/database/drivers/oci8/index.html
[OK] system/database/drivers/mysqli/mysqli_utility.php
[OK] system/database/drivers/oci8/oci8_driver.php
[OK] system/database/drivers/oci8/oci8_forge.php
[OK] system/database/drivers/odbc/index.html
[OK] system/database/drivers/oci8/oci8_utility.php
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[OK] system/database/drivers/pdo/pdo_forge.php
[OK] system/database/drivers/pdo/pdo_result.php
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[OK] system/database/drivers/pdo/subdrivers/pdo_4d_forge.php
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[OK] system/database/drivers/pdo/subdrivers/pdo_firebird_driver.php
[OK] system/database/drivers/pdo/subdrivers/pdo_firebird_forge.php
[OK] system/database/drivers/pdo/subdrivers/pdo_ibm_driver.php
[OK] system/database/drivers/pdo/subdrivers/pdo_ibm_forge.php
[OK] system/database/drivers/pdo/subdrivers/pdo_informix_driver.php
```

HISTORY

CONTENT DISCOVERY OF YESTERYEARS

CONTENT DISCOVERY 10 YEARS AGO

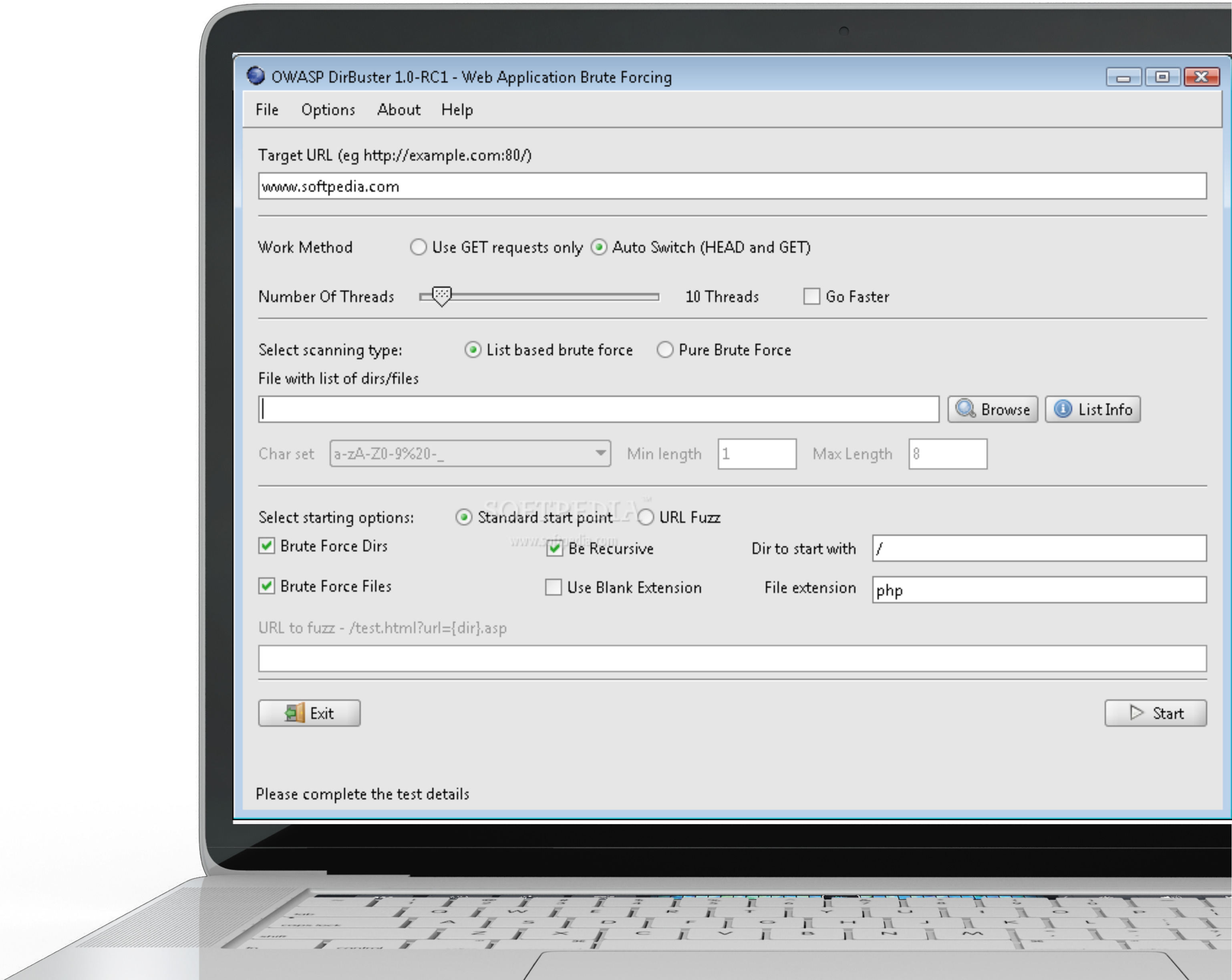
EVOLVING OLD WAYS

OWASP DirBuster (2008)

Multi-threaded Crawling

Wordlist Path Brute-forcing

- Directory
- File



OWASP DirBuster 1.0-RC1 - Web Application Brute Forcing

Target URL (eg http://example.com:80/)

www.softpedia.com

Work Method ○ Use GET requests only ● Auto Switch (HEAD and GET)

Number Of Threads 10 Threads □ Go Faster

Select scanning type: ● List based brute force ○ Pure Brute Force

File with list of dirs/files

Char set a-zA-Z0-9%20-_ Min length 1 Max Length 8

Select starting options: ● Standard start point ○ URL Fuzz

☑ Brute Force Dirs ☑ Be Recursive Dir to start with /

☑ Brute Force Files □ Use Blank Extension File extension php

URL to fuzz - /test.html?url={dir}.asp

Please complete the test details

Wednesday, January 23, 2019
06:25:40
198.23.249-
CSS
Script
Images
(2596)
(1406)
(846)
404
/c* (1366)
(769)
(994)
404
/p* (847)
/a* (1094)
404
00045247

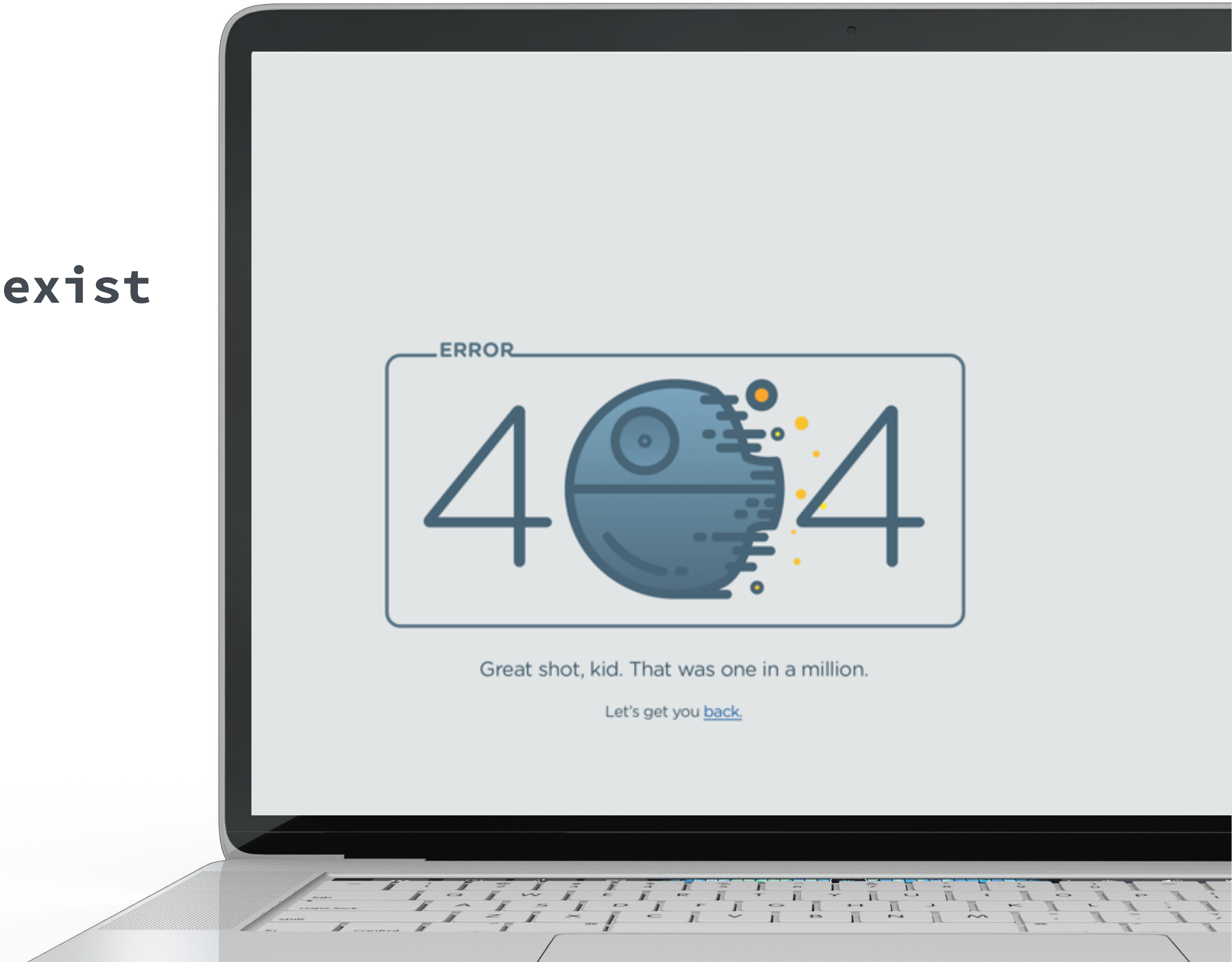
CONTENT DISCOVERY FAILS

EVOLVING OLD WAYS

`/thisdefinitelydoesnotexist`

Use “Fail Cases”

- Soft 404 Checking
- DOM Difference Analysis
- Content Length



Great shot, kid. That was one in a million.

Let's get you back.

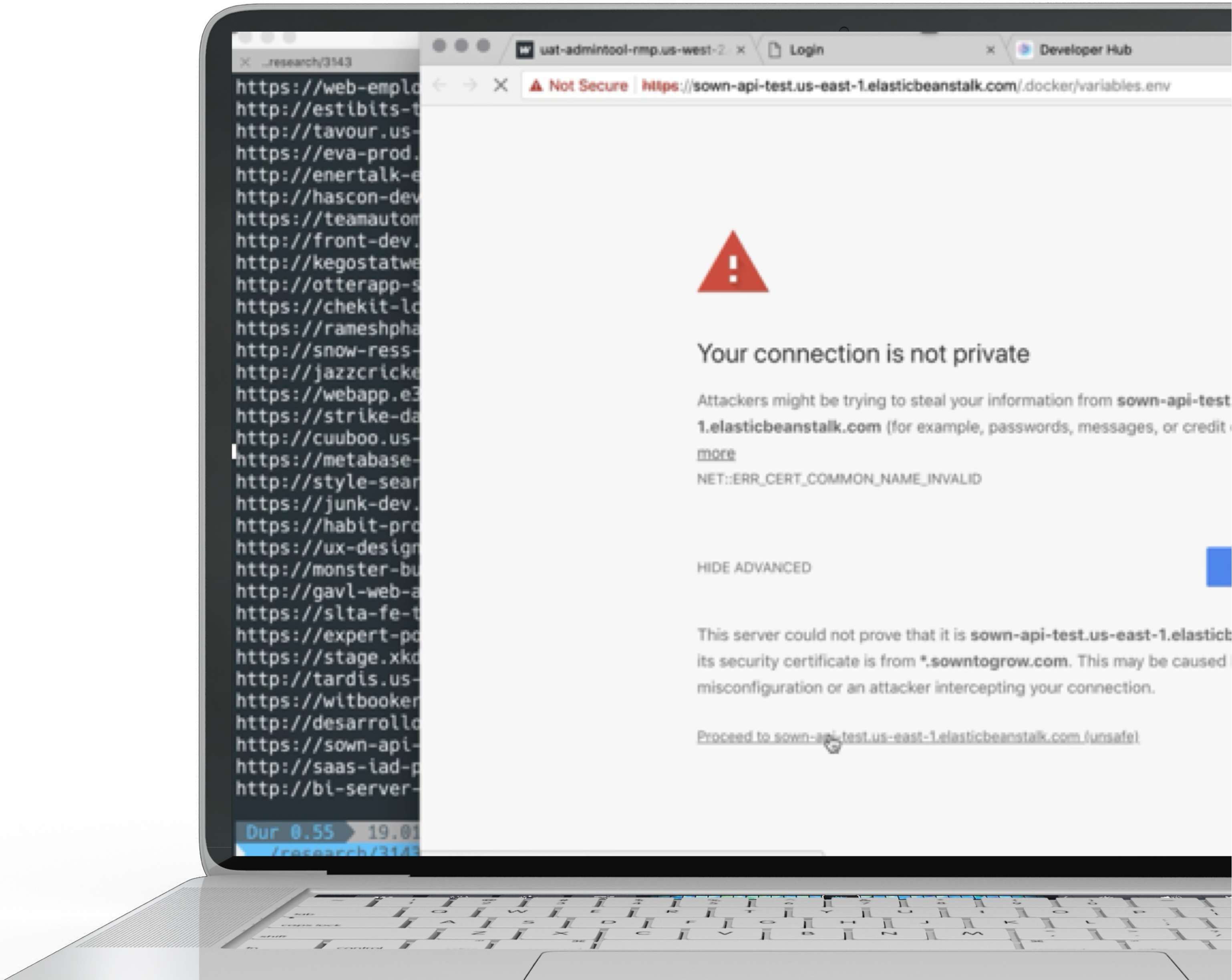
CONTENT DISCOVERY FAILS

PAINFUL + TIME CONSUMING

`/.docker/variables.env`

Manual Review

- Load Times
- SSL Errors
- Human Errors



```
https://web-emplo
http://estibits-t
http://tavour.us-
https://eva-prod.
http://enertalk-e
http://hascon-dev
https://teamautom
http://front-dev.
http://kegostatwe
http://otterapp-s
https://chekit-lo
https://rameshpha
http://snow-ress-
http://jazzcricke
https://webapp.e3
https://strike-da
http://cuuboo.us-
https://metabase-
http://style-sear
https://junk-dev.
https://habit-pro
https://ux-design
http://monster-bu
http://gavl-web-a
https://slta-fe-t
https://expert-po
https://stage.xkd
http://tardis.us-
https://witbooker
http://desarrollo
https://sown-api-
http://saas-iad-p
http://bi-server-

Dur 0.55  19.01
/research/3143
```

https://sown-api-test.us-east-1.elasticbeanstalk.com/.docker/variables.env

Your connection is not private

Attackers might be trying to steal your information from **sown-api-test**
1.elasticbeanstalk.com (for example, passwords, messages, or credit
more

NET::ERR_CERT_COMMON_NAME_INVALID

This server could not prove that it is **sown-api-test.us-east-1.elasticb**
its security certificate is from ***.sowntogrow.com**. This may be caused
misconfiguration or an attacker intercepting your connection.

Proceed to sown-api-test.us-east-1.elasticbeanstalk.com (unsafe)

LIKE FINDING A

NEEDLE IN A **HAYSTACK**

PROCESS PROBLEMS

CONTENT DISCOVERY 2008 - 2018

INCONSISTENCY – Actions performed pertaining to content discovery during assessments are inconsistent despite the value proposition. It’s not feasible to run large-scale comprehensive dictionaries on every target in a small time window using traditional techniques.

DIVERGENCE – Information storage is disparate as new targets are discovered throughout an assessment. Penetration testers often work off of separate datasets and ensuring all targets were reviewed the same way is problematic.

EFFICIENCY – Results validation is time consuming when false positives are too numerous. Too much noise and not enough signal. Dictionaries that are used are often outdated or inefficiently utilized.

CONTENT DISCOVERY + SCREENSHOTS

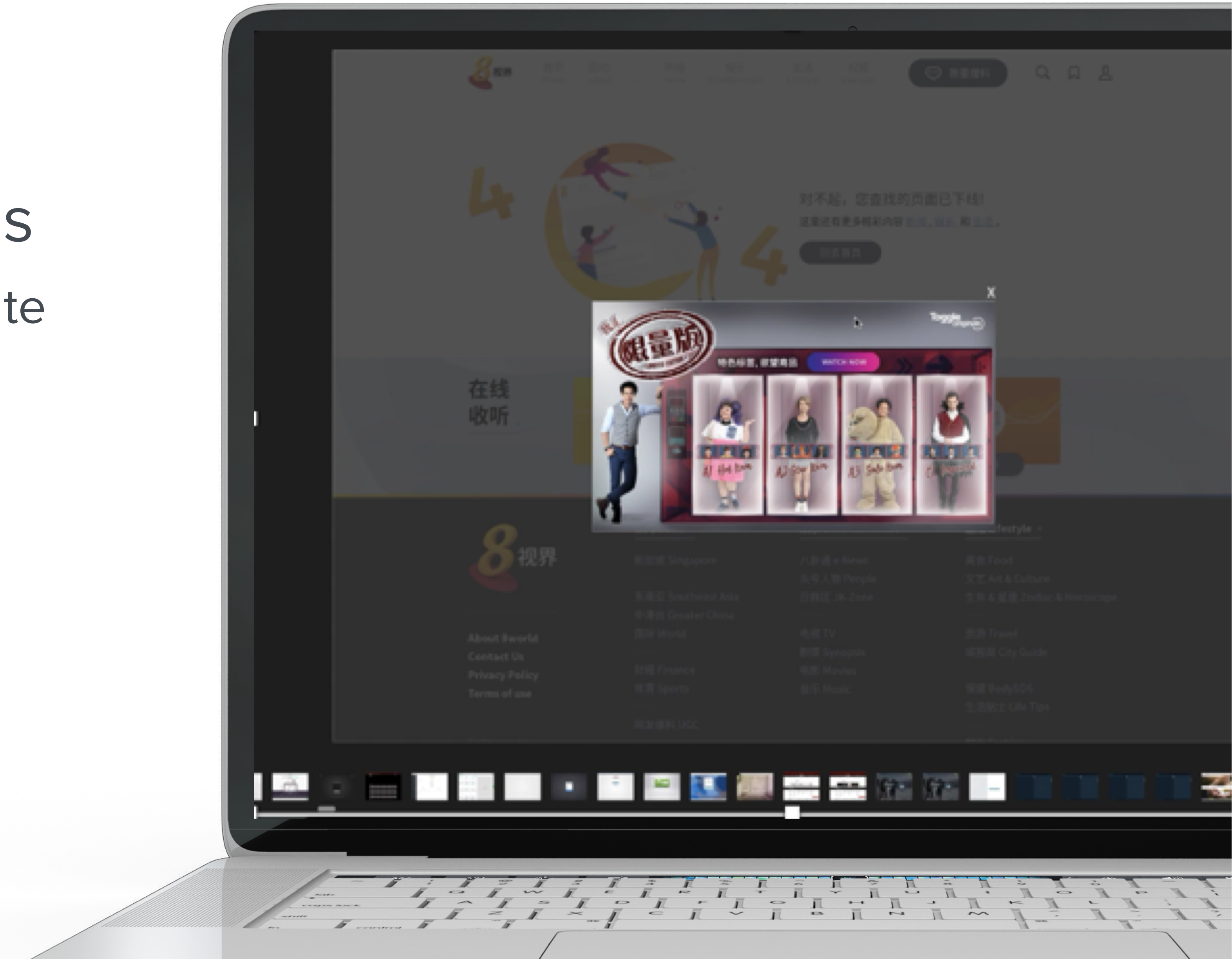
EVOLVING OLD WAYS

Pre-render Applications

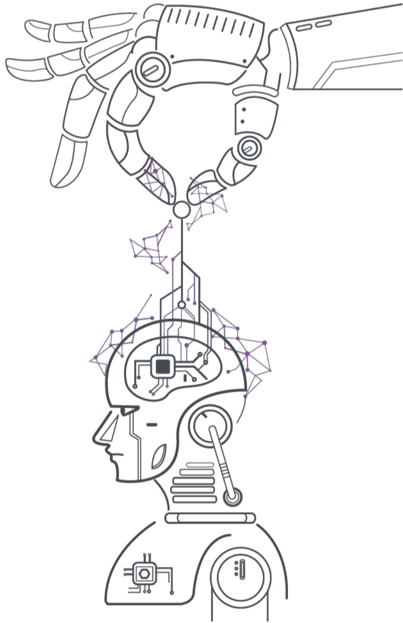
- Approximately 100 per minute
- Tag for further review

Goal

- Find Content to Attack
- Sensitive Information



HUMANS ARE NOT THE SOLUTION



WHAT IF THERE WERE A WAY

TO GET THE

SAME RESULTS...

...WITHOUT HAVING TO DO

404 CHECKING

& SIGNATURES...

QUESTION

…AT SCALE?

EXPLORING SOLUTIONS FOR HUMANS

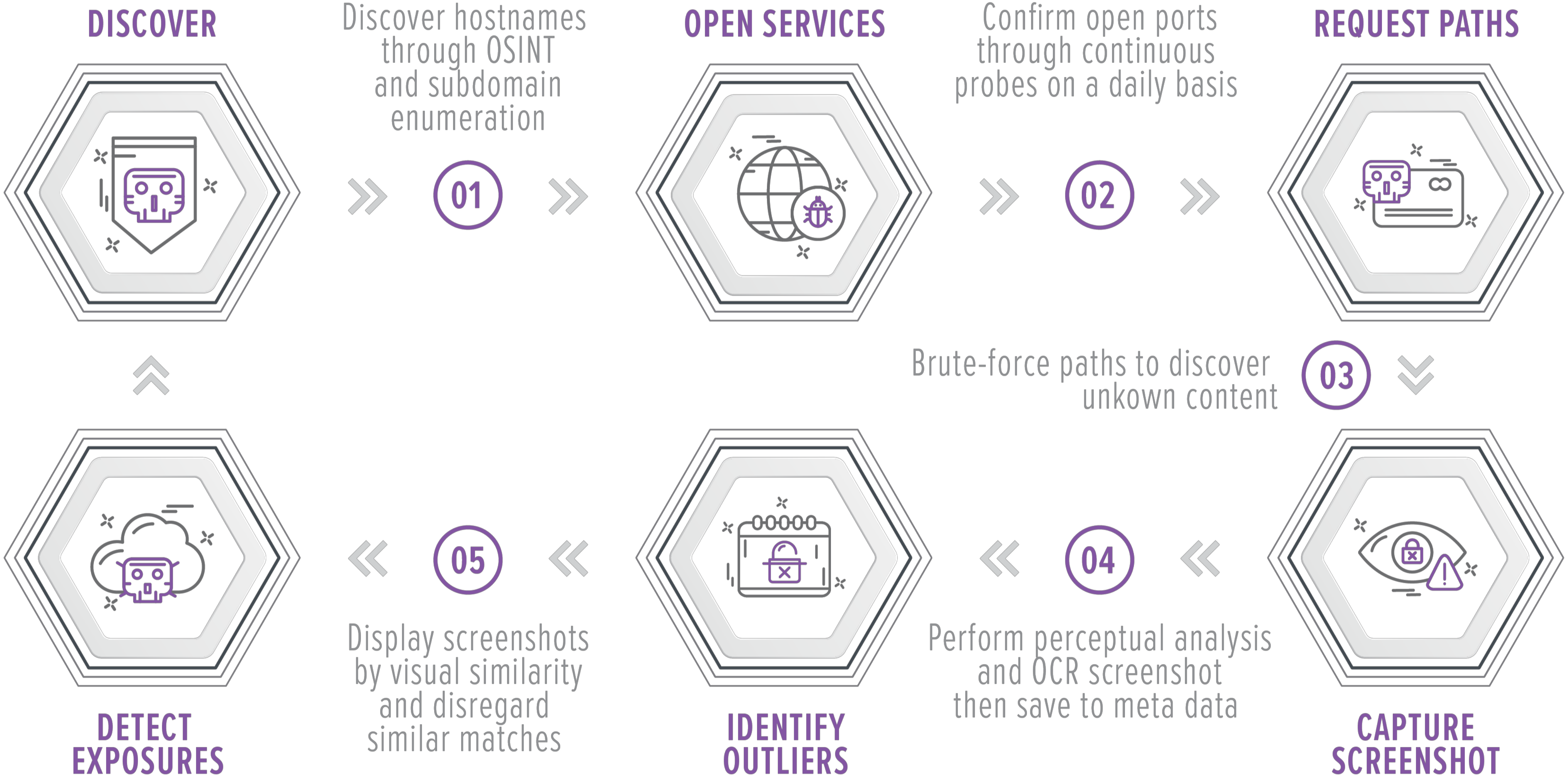
GOAL

MAKE IT EASY **FOR HUMAN**

TO GET EYES ON
INTERESTING SCREENSHOTS
FROM URL PATH BRUTE-FORCE

HOW PERCEPTUAL ANALYSIS HELPS BUG HUNTERS

AUTOMATED TRIAGE



DISCOVER

01 Discover hostnames through OSINT and subdomain enumeration

OPEN SERVICES

02 Confirm open ports through continuous probes on a daily basis

REQUEST PATHS

03 Brute-force paths to discover unkown content

CAPTURE SCREENSHOT

04 Perform perceptual analysis and OCR screenshot then save to meta data

IDENTIFY OUTLIERS

05 Display screenshots by visual similarity and disregard similar matches

DETECT EXPOSURES

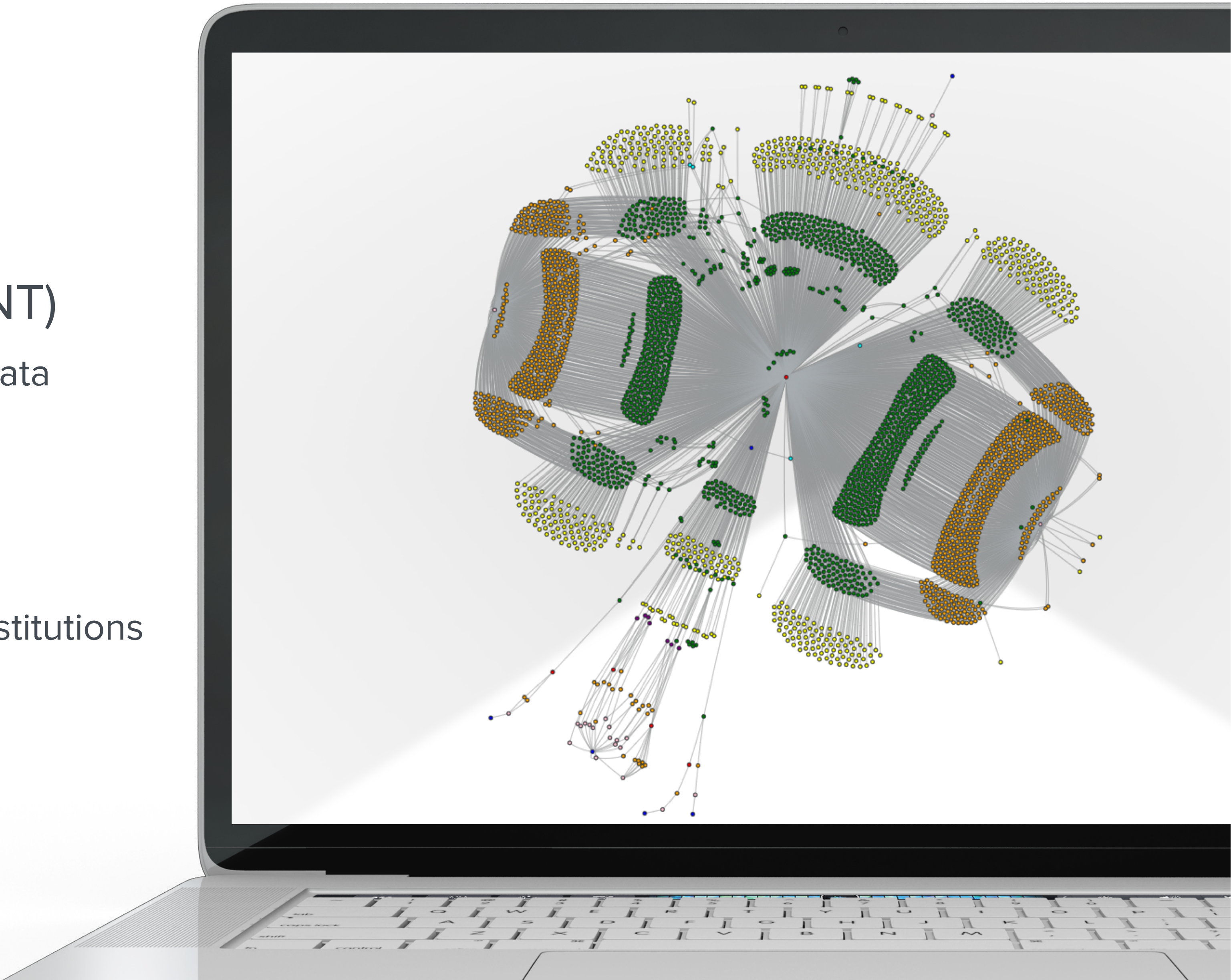
TARGET DISCOVERY 2018

DOZENS OF SOURCES

OWASP Amass (2018)

Open Source Intelligence (OSINT)

- Scrape web pages with DNS dragnet data
- Aggregate Passive DNS API data
- Crawling internet archives
- Recursive brute-forcing subdomains
- Permutations/alternative character substitutions
- Reverse DNS lookups
- Querying ASNs and netblocks



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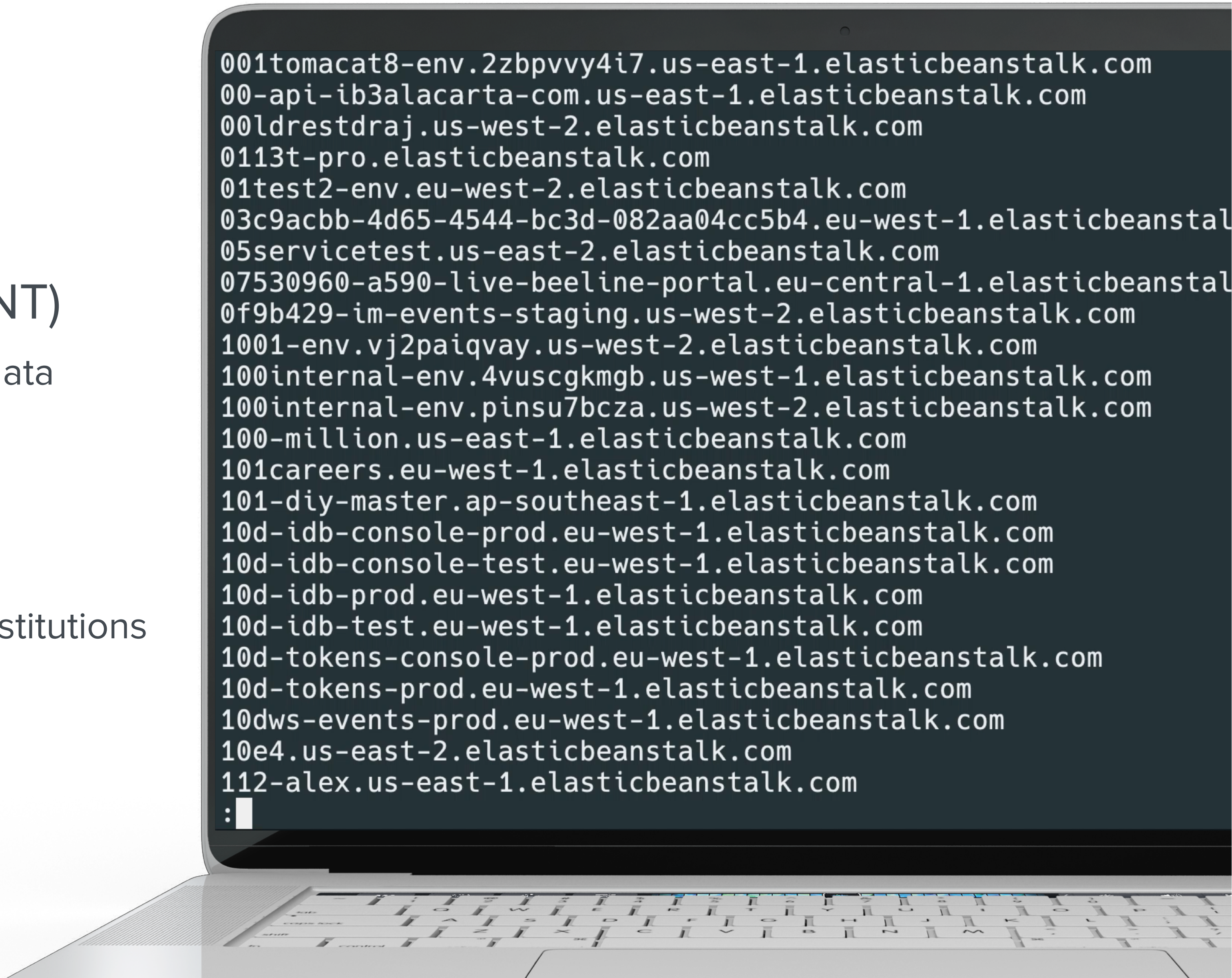
- Reverse DNS lookups
- Querying ASNs and netblocks



```
001tomacat8-env.2zbpvvy4i7.us-east-1.elasticbeanstalk.com
00-api-ib3alacarta-com.us-east-1.elasticbeanstalk.com
00ldrestdraj.us-west-2.elasticbeanstalk.com
0113t-pro.elasticbeanstalk.com
01test2-env.eu-west-2.elasticbeanstalk.com
03c9acbb-4d65-4544-bc3d-082aa04cc5b4.eu-west-1.elasticbeanstal
05servicetest.us-east-2.elasticbeanstalk.com
07530960-a590-live-beeline-portal.eu-central-1.elasticbeanstal
0f9b429-im-events-staging.us-west-2.elasticbeanstalk.com
1001-env.vj2paiqvay.us-west-2.elasticbeanstalk.com
100internal-env.4vuscgkmgb.us-west-1.elasticbeanstalk.com
100internal-env.pinsu7bcza.us-west-2.elasticbeanstalk.com
100-million.us-east-1.elasticbeanstalk.com
101careers.eu-west-1.elasticbeanstalk.com
101-diy-master.ap-southeast-1.elasticbeanstalk.com
10d-idb-console-prod.eu-west-1.elasticbeanstalk.com
10d-idb-console-test.eu-west-1.elasticbeanstalk.com
10d-idb-prod.eu-west-1.elasticbeanstalk.com
10d-idb-test.eu-west-1.elasticbeanstalk.com
10d-tokens-console-prod.eu-west-1.elasticbeanstalk.com
10d-tokens-prod.eu-west-1.elasticbeanstalk.com
10dws-events-prod.eu-west-1.elasticbeanstalk.com
10e4.us-east-2.elasticbeanstalk.com
112-alex.us-east-1.elasticbeanstalk.com
:
```

TECHNOLOGY STACK

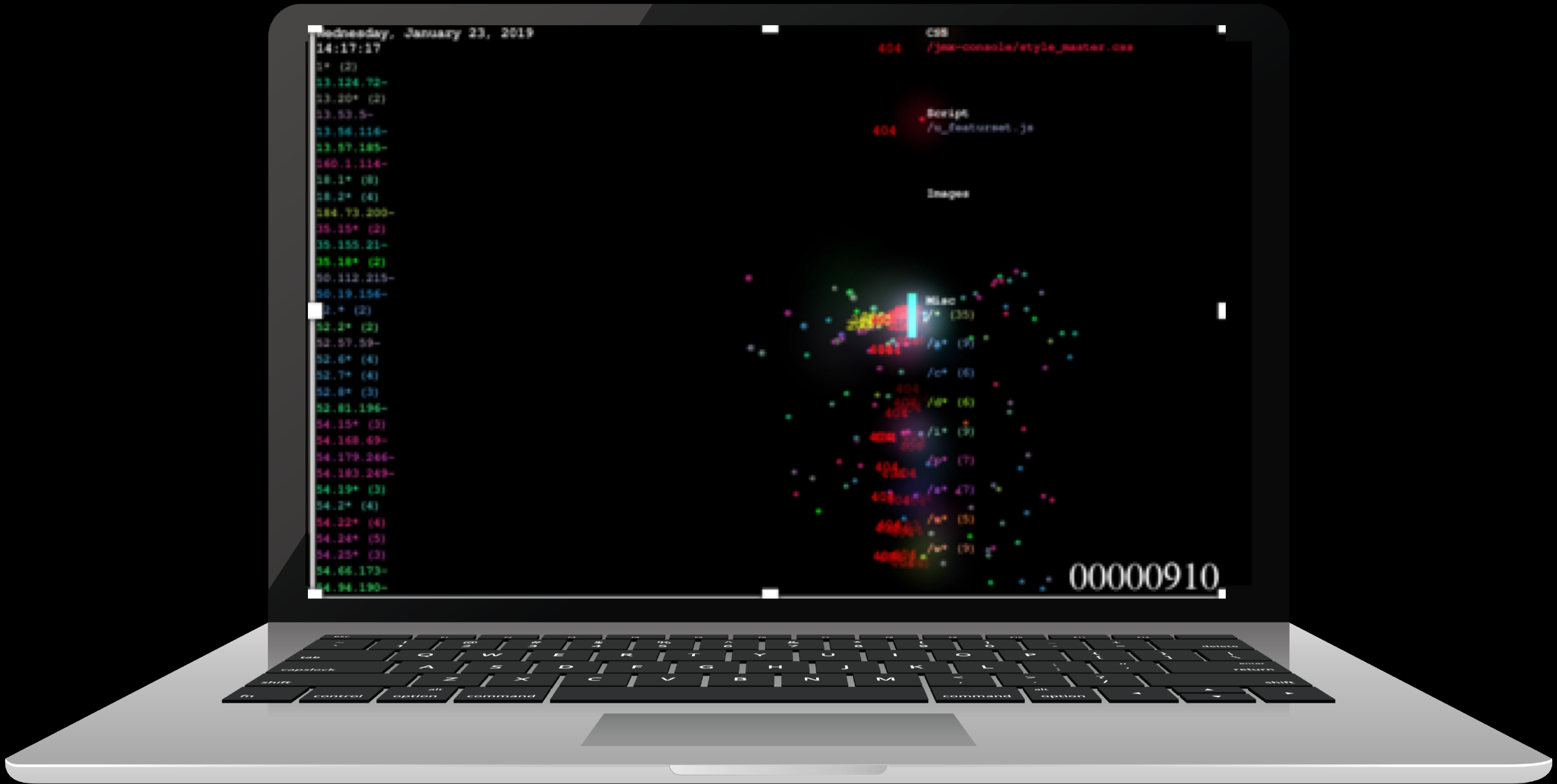
REKOGNITION

ELASTICSEARCH

AWS LAMBDA

HEADLESS CHROME

S3 STORAGE



```
Wednesday, January 23, 2019
14:17:17
1* (2)
13.124.72-
13.20* (2)
13.53.5-
13.56.116-
13.57.185-
160.1.116-
18.1* (8)
18.2* (4)
184.73.200-
35.15* (2)
35.155.21-
35.18* (2)
50.112.215-
50.19.156-
52.* (2)
52.2* (2)
52.57.59-
52.6* (4)
52.7* (4)
52.8* (3)
52.81.196-
54.15* (3)
54.160.69-
54.179.246-
54.183.249-
54.19* (3)
54.2* (4)
54.22* (4)
54.24* (5)
54.25* (3)
54.66.173-
54.94.190-
```

```
      CSS
404   /jmx-console/style_master.css

      Script
404   /c_featureset.js

      Images

      Misc
      /* (35)
      /a* (9)
      /c* (6)
      /d* (6)
      /i* (9)
      /p* (7)
      /s* (7)
      /w* (5)
      /w* (9)

00000910
```

PERCEPTUAL **ANALYSIS**

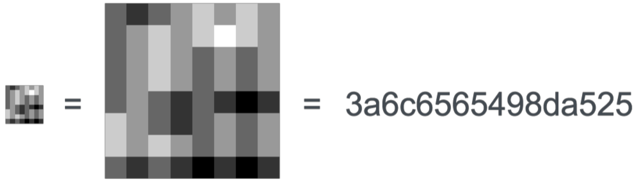
WHAT IS IT?

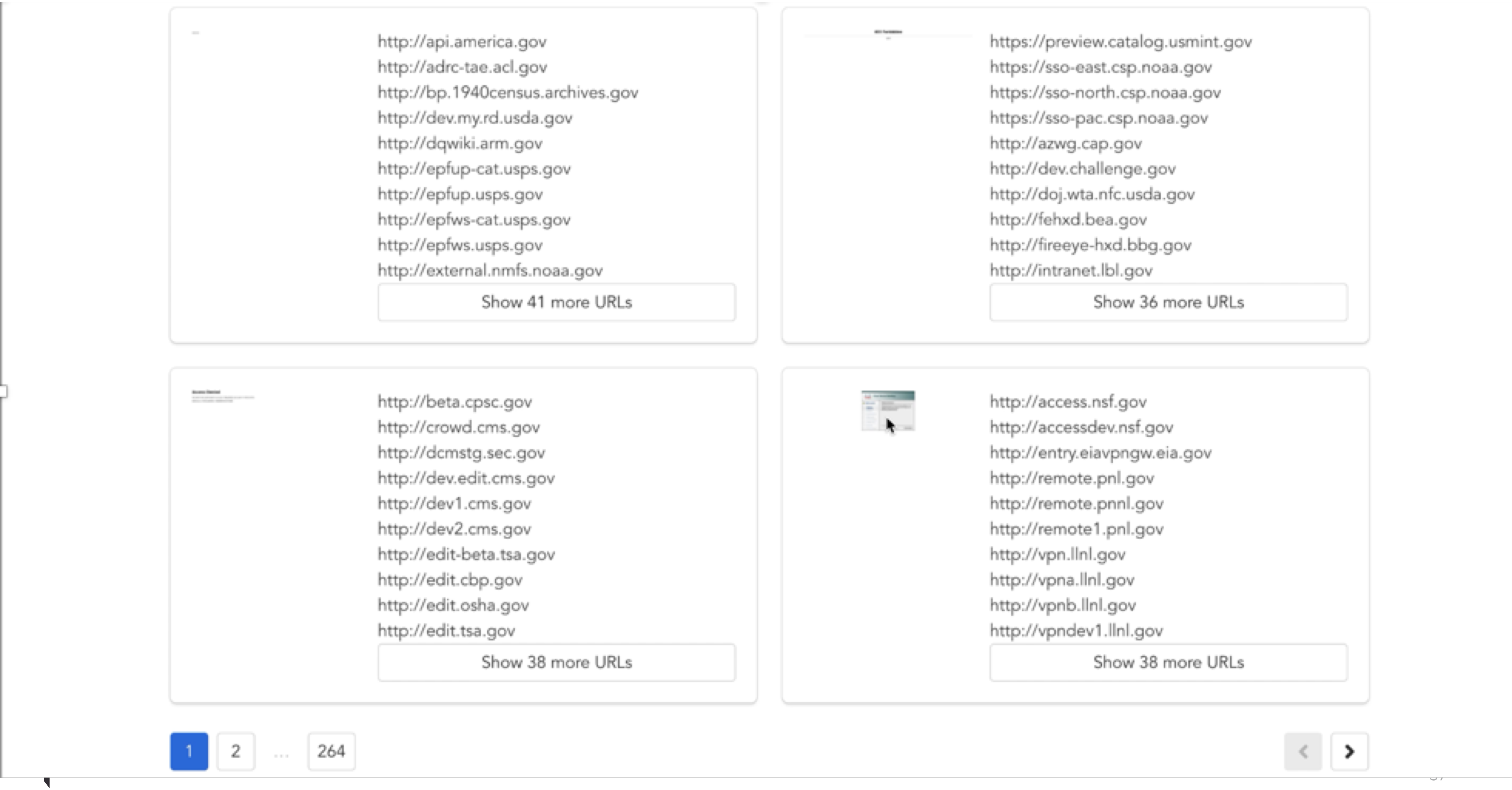
APPROACH

- Reduce size. Shrink the image to a constant in order to ignore size differences
- Reduce color. Convert to grayscale to reduce colors
- Compute difference. Observe difference between adjacent pixels to identify gradient direction and store difference in bits.
- Assign bits. Each bit represents if the left pixel is brighter than the right pixel.

STEPS

- Shrink to 9x8 or 72 pixels
- Convert to 72 colors
- Compute 9 pixel differences or 8 differences per row which becomes 64 bits
- Assign 1 if P[x] < P[x+1] else 0





http://api.america.gov
http://adrc-tae.acl.gov
http://bp.1940census.archives.gov
http://dev.my.rd.usda.gov
http://dqwiki.arm.gov
http://epfup-cat.usps.gov
http://epfup.usps.gov
http://epfws-cat.usps.gov
http://epfws.usps.gov
http://external.nmfs.noaa.gov

https://preview.catalog.usmint.gov
https://sso-east.csp.noaa.gov
https://sso-north.csp.noaa.gov
https://sso-pac.csp.noaa.gov
http://azwg.cap.gov
http://dev.challenge.gov
http://doj.wta.nfc.usda.gov
http://fehxd.bea.gov
http://fireeye-hxd.bbg.gov
http://intranet.lbl.gov

http://beta.cpsc.gov
http://crowd.cms.gov
http://dcmstg.sec.gov
http://dev.edit.cms.gov
http://dev1.cms.gov
http://dev2.cms.gov
http://edit-beta.tsa.gov
http://edit.cbp.gov
http://edit.osha.gov
http://edit.tsa.gov

http://access.nsf.gov
http://accessdev.nsf.gov
http://entry.eiavpngw.eia.gov
http://remote.pnl.gov
http://remote.pnnl.gov
http://remote1.pnl.gov
http://vpn.llnl.gov
http://vpna.llnl.gov
http://vpnb.llnl.gov
http://vpndev1.llnl.gov

FUTURE ENHANCEMENTS

OCR OF SCREENSHOTS

- To perform inclusive AND exclusive filtering based on text

ML

- To perform unsupervised categorization of screenshots and supervised training for valid consumer facing

COLLABORATIVE FILTERING

- To manage human analysis in real-time & centralize results

CONCLUSION

THANK YOU FOR YOUR TIME