Secrets leakage detection & prevention

Linux Day (Torino, 2024-10-26)

How many of you have ever (accidentally) hardcoded *secrets* into a repository?

whoami

- **Antonio Francesco Sardella**
  - `m3ssap0`
- Application Security Engineering Manager @ *Prima*
- Organizer of *Meethack* (Torino)
  - https://meethack.it/
- Links
  - https://m3ssap0.github.io
  - https://github.com/m3ssap0
  - https://infosec.exchange/@m3ssap0

Agenda

- Houston, we have a *problem*
- *Detection* is important…
- … but *Prevention* is better!
- *Paved roads*, the cultural change
- Let’s wrap it up!
- Questions?

https://en.wikipedia.org/wiki/Smokey_Bear

Houston, we have a *problem*

Leaked secrets could lead to data breaches

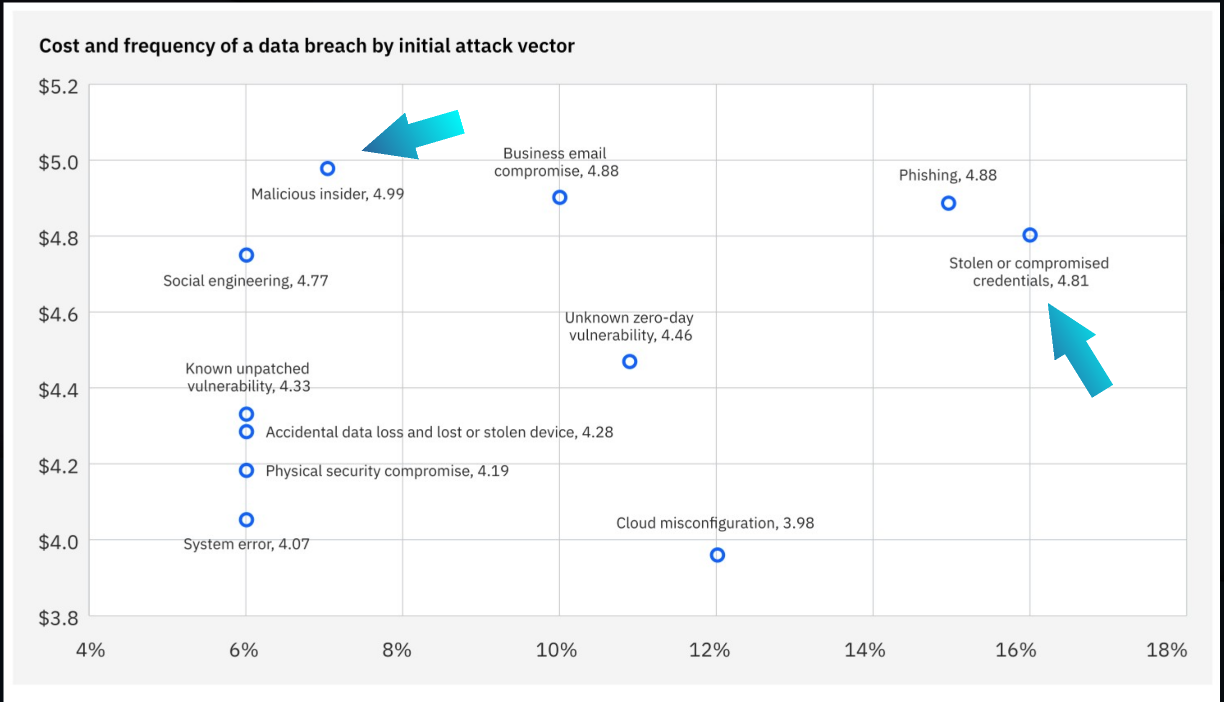


Figure 7. Measured in USD millions; percentage of all breaches

- The usage of **stolen or compromised credentials** is the most common initial vector for a data breach.
  - With a frequency of 16% and a cost of 4.81M USD.
- The **malicious insider** is the highest initial vector, in terms of cost, for a data breach.
  - With a frequency of 7% and a cost of 4.99M USD.
- *“Assume breach”*

“Cost of a Data Breach Report 2024”, Ponemon Institute

They are called *secrets* for a reason

Secrets encompass confidential information, such as: passwords, encryption keys, API tokens, digital certificates, etc.

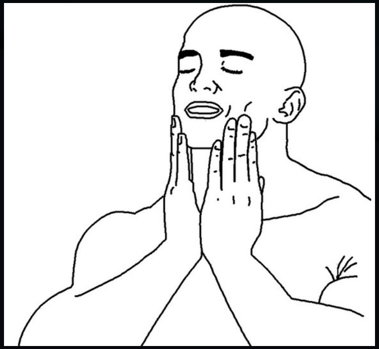
Secrets are pivotal for authenticating and authorizing access to secured resources and systems.

Detection is important...

Detection lets you know when there is a problem

- Secrets detection is part of *Static Application Security Testing* (*SAST*).
- There are several tools, commercial or not, able to perform this kind of checks:
  - *gitleaks* - https://github.com/gitleaks/gitleaks
  - *trufflehog* - https://github.com/trufflesecurity/trufflehog
  - *ggshield* - https://github.com/GitGuardian/ggshield
  - *detect-secrets* - https://github.com/Yelp/detect-secrets
  - *git-secrets* - https://github.com/awslabs/git-secrets
  - *Semgrep Secrets* - https://semgrep.dev/products/semgrep-secrets
  - ...
- The **concepts are the same** for all the tools!

Detection has its own limitations



Sometimes detection is easier…

```
aws_secret="AKIAIMNOJVGFDXXXE4OA"
```

Sometimes detection is harder…

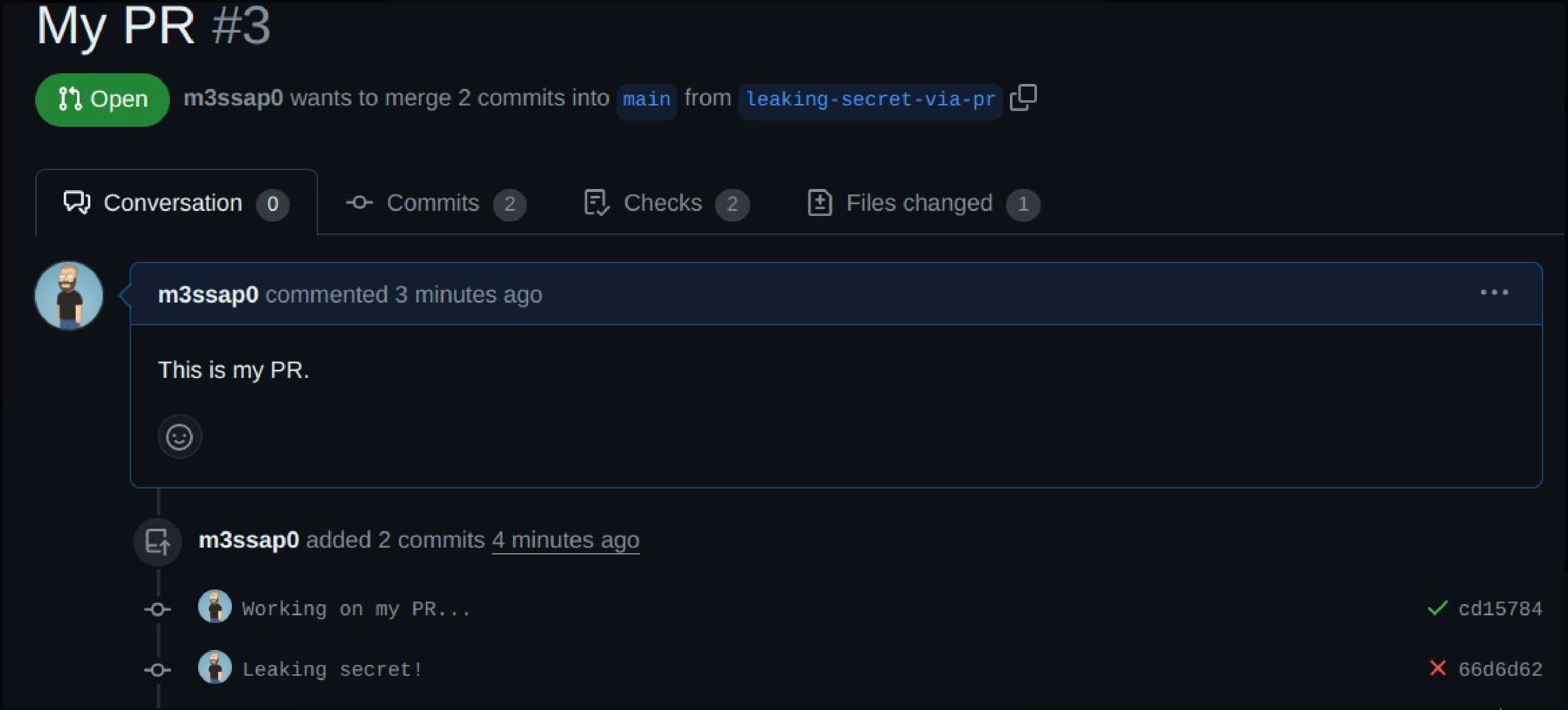
```
password_field_label="password-fld-lbl-1"

my_password="$up3rP4ssw0rd!"
```

Centralize detection in CI/CD to spot problems

- It’s unrealistic to scale Application Security activities without leveraging on automation.
- Look for plugins for your CI/CD ecosystem.
  - Gitleaks has an official GitHub Action.

https://github.com/gitleaks/gitleaks-action

You push a secret...



My PR #3

Open m3ssap0 wants to merge 2 commits into `main` from `leaking-secret-via-pr`

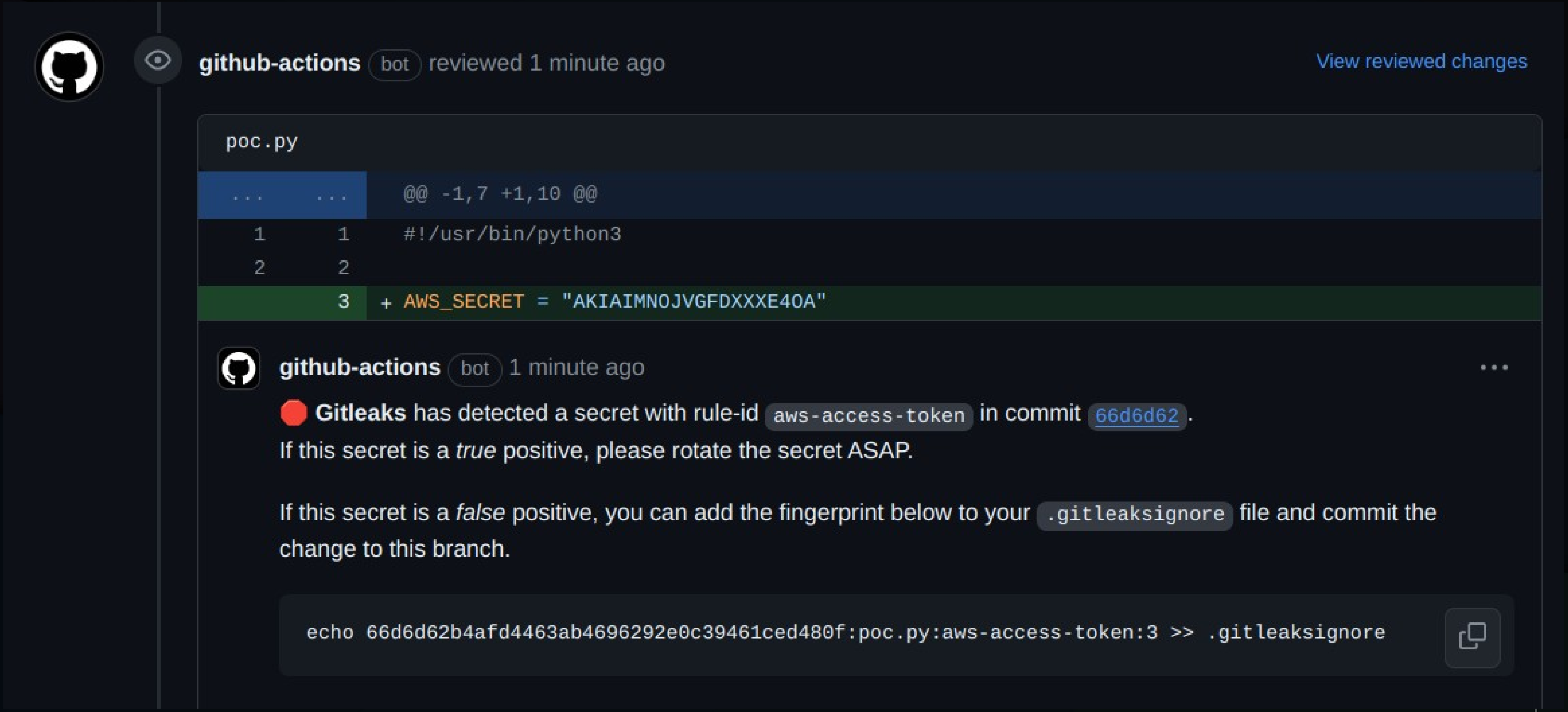
m3ssap0 commented 3 minutes ago

This is my PR.

m3ssap0 added 2 commits 4 minutes ago

```
Working on my PR...     ✓ cd15784
Leaking secret!         ✗ 66d6d62
```

… and it’s detected!



github-actions bot reviewed 1 minute ago

View reviewed changes

poc.py

```
...   ...   @@ -1,7 +1,10 @@
 1     1    #!/usr/bin/python3
 2     2
       3  + AWS_SECRET = "AKIAIMNOJVGFDXXXE4OA"
```

github-actions bot 1 minute ago

🛑 **Gitleaks** has detected a secret with rule-id `aws-access-token` in commit `66d6d62`.
If this secret is a *true* positive, please rotate the secret ASAP.

If this secret is a *false* positive, you can add the fingerprint below to your `.gitleaksignore` file and commit the change to this branch.

```
echo 66d6d62b4afd4463ab4696292e0c39461ced480f:poc.py:aws-access-token:3 >> .gitleaksignore
```

Example of a GitHub workflow

```yaml
name: gitleaks
on: [pull_request, push, workflow_dispatch]
permissions:
  contents: read
  discussions: write
  pull-requests: write
jobs:
  scan:
    name: gitleaks
    runs-on: ubuntu-latest
    steps:
      - uses: actions/checkout@v3
        with:
          fetch-depth: 0
      - uses: gitleaks/gitleaks-action@v2
        env:
          GITHUB_TOKEN: ${{ secrets.GITHUB_TOKEN }}
```

Allow access to commit list and to add comments.

https://github.com/gitleaks/gitleaks-action

Customize the solution based on your needs

- ~166 standard rules provided by Gitleaks.
- Rules are based on regexes.
- You can create your custom rules via TOML files and use them
  - with the `-c` param of the executable
  - or the `GITLEAKS_CONFIG` environment variable of the GitHub Action.

https://github.com/gitleaks/gitleaks/blob/master/config/gitleaks.toml

Example of a Gitleaks TOML file

```toml
# Your custom Gitleaks configuration file.
title = "Your custom Gitleaks rules"

# Extending default rules.
[extend]
useDefault = true

[[rules]]
# Put your custom rules here.
```

https://github.com/gitleaks/gitleaks?tab=readme-ov-file#configuration

Example of a Gitleaks rule

https://github.com/gitleaks/gitleaks/blob/82d737d8519f6d55566435083498aaa078d68f45/config/gitleaks.toml#L125

```
[[rules]]

id = "aws-access-token"

description = "Identified a pattern that may indicate AWS credentials, risking unauthorized cloud resource access and data breaches on AWS platforms."

regex = '''(?:A3T[A-Z0-9]|AKIA|ASIA|ABIA|ACCA)[A-Z0-9]{16}'''

keywords = [

    "akia","asia","abia","acca",

]
```

Keywords are used for **pre-regex check filtering**.

Rules that contain keywords will perform a quick string compare check to make sure the keyword(s) are in the content being scanned.

https://github.com/gitleaks/gitleaks?tab=readme-ov-file#configuration

… but *Prevention* is better!

Pre-commit hooks can prevent leaks

- A leaked secret – even if detected – is still a leaked secret.
- *Pre-commit* hooks can be configured in your workstation to perform scan locally, blocking dangerous commits and preventing leaks from happening.

How to setup a global *pre-commit* hook

- Install Gitleaks (it requires Go).
- Create a folder to store global hooks, for example:

  `/home/<your_user>/gitconfig/hooks`

- In that folder, create a file named **exactly**:

  `pre-commit`

- In that file, write the script to perform the check (Python example in the next slide).
- Make the file executable.
- Edit global git config file, usually `.gitconfig` in your home, to add the lines on the right.

```
[core]
	hooksPath = /home/<your_user>/gitconfig/hooks
[hooks]
	gitleaks = true
```

Example of global *pre-commit* hook in Python

```python
def gitleaksEnabled():
    out = subprocess.getoutput('git config --bool hooks.gitleaks')
    if out == 'false':
        return False
    return True

if gitleaksEnabled():
    exitCode = os.WEXITSTATUS(os.system('gitleaks protect -v --staged --redact'))
    if exitCode == 1:
        print('Warning: gitleaks has detected sensitive information in your changes.')
        sys.exit(1)
else:
    print('gitleaks precommit disabled (enable with `git config hooks.gitleaks true`)')
```

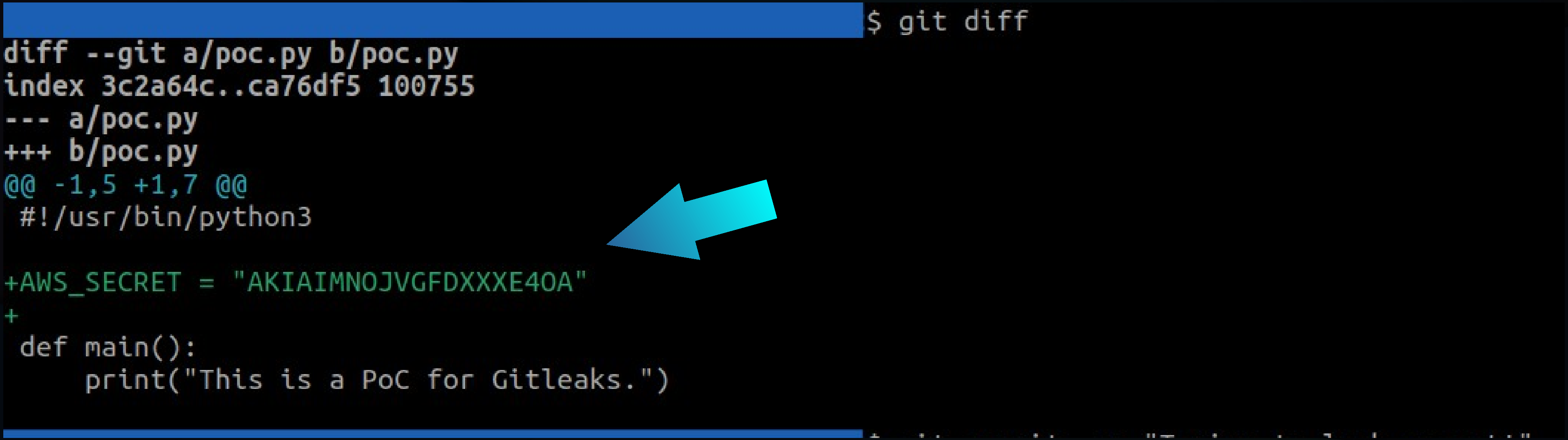
Used to scan uncommitted changes in a git repo. This command should be used on developer machines.

To check for changes in commits that have been **`git add`**ed.

Redact secrets from logs and stdout.

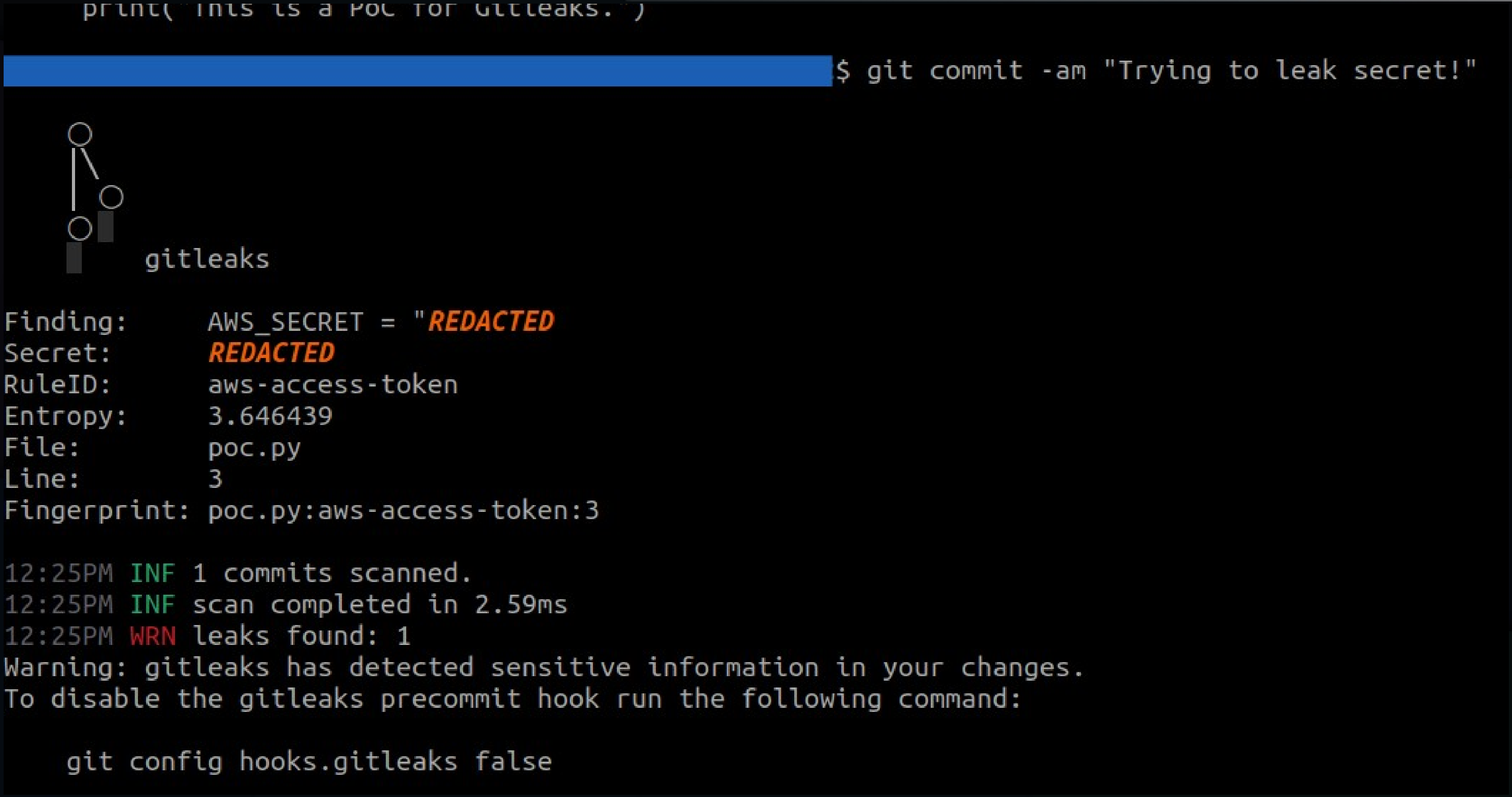
https://github.com/gitleaks/gitleaks/blob/master/scripts/pre-commit.py

Trying to commit a secret...



```
$ git diff
diff --git a/poc.py b/poc.py
index 3c2a64c..ca76df5 100755
--- a/poc.py
+++ b/poc.py
@@ -1,5 +1,7 @@
 #!/usr/bin/python3

+AWS_SECRET = "AKIAIMNOJVGFDXXXE4OA"
+
 def main():
     print("This is a PoC for Gitleaks.")
```

… it gets blocked on the dev workstation!



```
    print("This is a PoC for Gitleaks.")

[redacted]$ git commit -am "Trying to leak secret!"

       gitleaks

Finding:     AWS_SECRET = "REDACTED
Secret:      REDACTED
RuleID:      aws-access-token
Entropy:     3.646439
File:        poc.py
Line:        3
Fingerprint: poc.py:aws-access-token:3

12:25PM INF 1 commits scanned.
12:25PM INF scan completed in 2.59ms
12:25PM WRN leaks found: 1
Warning: gitleaks has detected sensitive information in your changes.
To disable the gitleaks precommit hook run the following command:

    git config hooks.gitleaks false
```

Alternative: the *pre-commit* Python framework

- https://pre-commit.com/
- Allows the usage of multiple hooks.
- Needs `.pre-commit-config.yaml` file in the repository.

```
repos:
  - repo: https://github.com/gitleaks/gitleaks
    rev: v8.19.0
    hooks:
      - id: gitleaks
```

https://github.com/gitleaks/gitleaks?tab=readme-ov-file#pre-commit

Paved roads, the cultural change

Make the wrong road also the hard one

- *Paved roads* aka *secure defaults*, *golden paths*, ...
- Give to software engineers solutions, not just problems to solve.
- Invest in the adoption of secrets management tools:
  - *HashiCorp Vault* - https://www.vaultproject.io/
  - *Google Cloud Secret Manager*
  - *AWS Secrets Manager*
  - *Azure Key Vault*
  - ...
- Software engineers will have a concrete solution to their problem and you will effectively manage the secrets ecosystem.

Vault Agent can inject credentials in config files

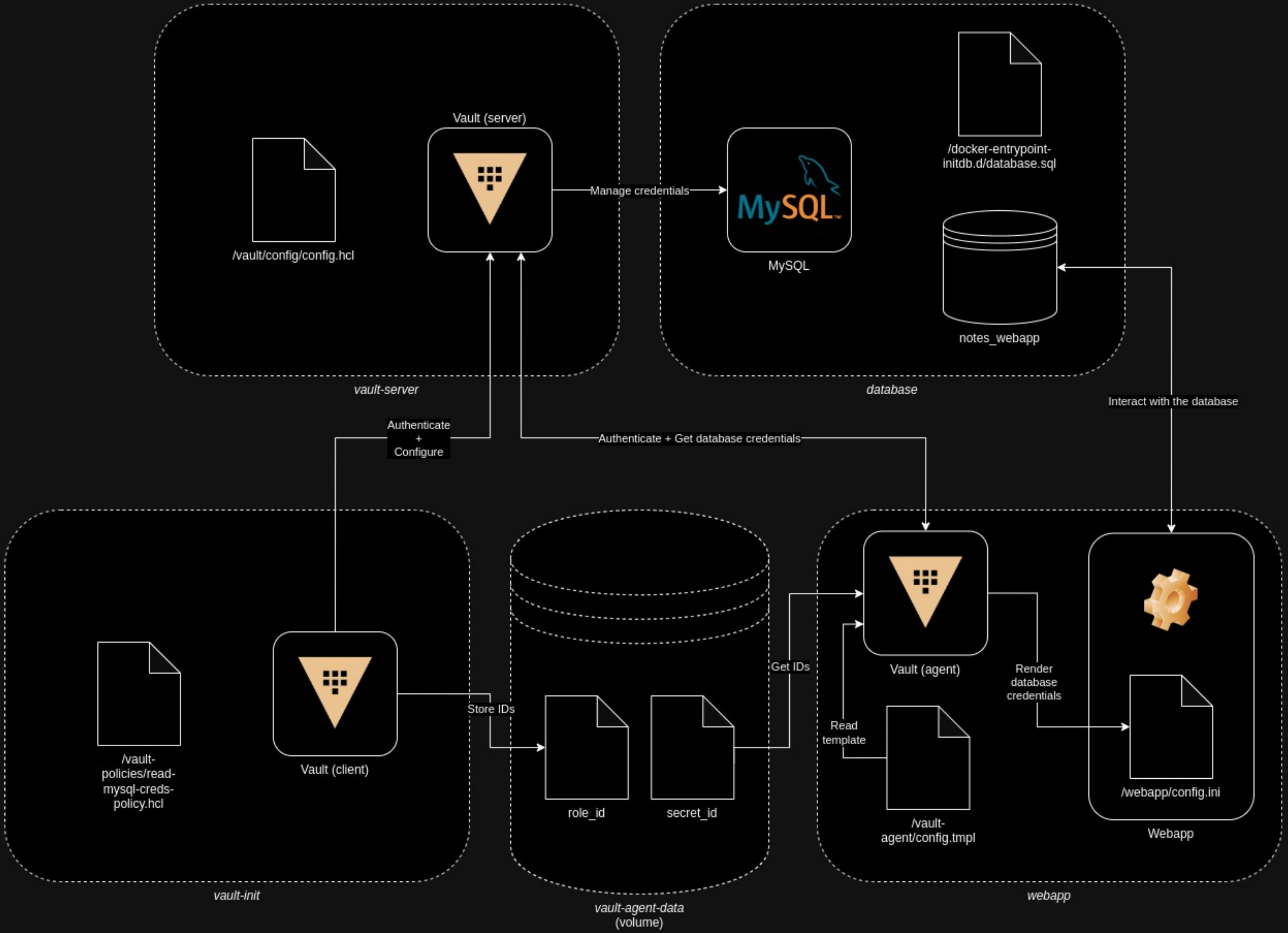
- Credentials are centrally managed by the Vault Server.
  - For example, they are periodically rotated.
- Vault Agent contacts the Server and auth*, retrieve credentials and produces config files that can be consumed by the applications.
  - Useful technique to integrate “legacy applications”.
  - A template is used to define the config file.

```
{{ with secret "database/creds/mysql-role" }}
[DATABASE]
MYSQL_HOST = database
MYSQL_USER = {{ .Data.username }}
MYSQL_PASSWORD = {{ .Data.password }}
MYSQL_DB = notes_webapp
{{ end }}
```

https://developer.hashicorp.com/vault/tutorials/vault-agent/agent-templates

(Recorded) demo time

https://github.com/m3ssap0/vault-webapp-integration-poc


Vault (server)
/vault/config/config.hcl
Manage credentials
MySQL
/docker-entrypoint-initdb.d/database.sql
notes_webapp
vault-server
database
Interact with the database
Authenticate + Configure
Authenticate + Get database credentials
/vault-policies/read-mysql-creds-policy.hcl
Vault (client)
Store IDs
role_id
secret_id
Get IDs
Vault (agent)
Read template
/vault-agent/config.tmpl
Render database credentials
/webapp/config.ini
Webapp
vault-init
vault-agent-data (volume)
webapp

Let’s wrap it up!

A problem, but complementary ways to solve it

- Secrets leaked in source code can be used by malicious actors to compromise other platforms in your ecosystem.
- Automatic tools exist to perform checks.
  - Centralize the scan to scale.
  - Customize the solution with your own rules.
  - Prevent at development workstations.
- Invest in the culture and provide solutions via usable secure defaults.

Thank you! Questions?

https://m3ssap0.github.io

https://github.com/m3ssap0

https://infosec.exchange/@m3ssap0

BACKUP

2023

Cost and frequency of a data breach by initial attack vector

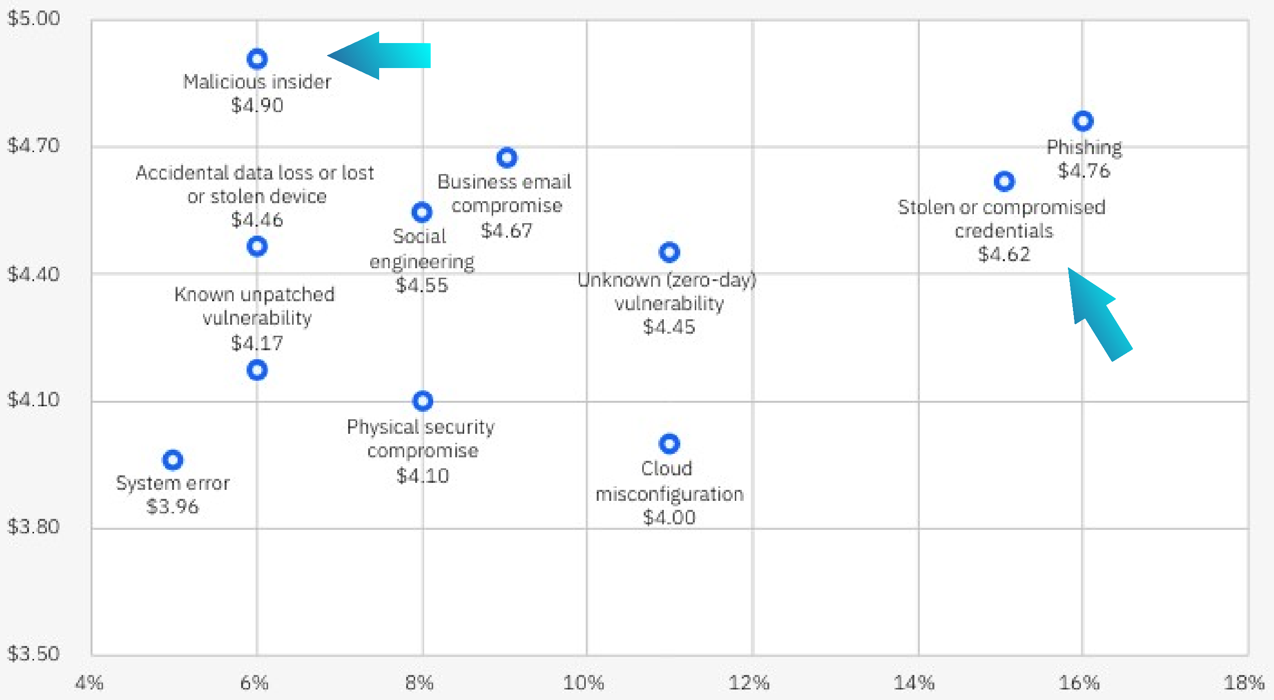


Figure 10. Measured in USD millions

"Cost of a Data Breach Report 2023", Ponemon Institute

2024

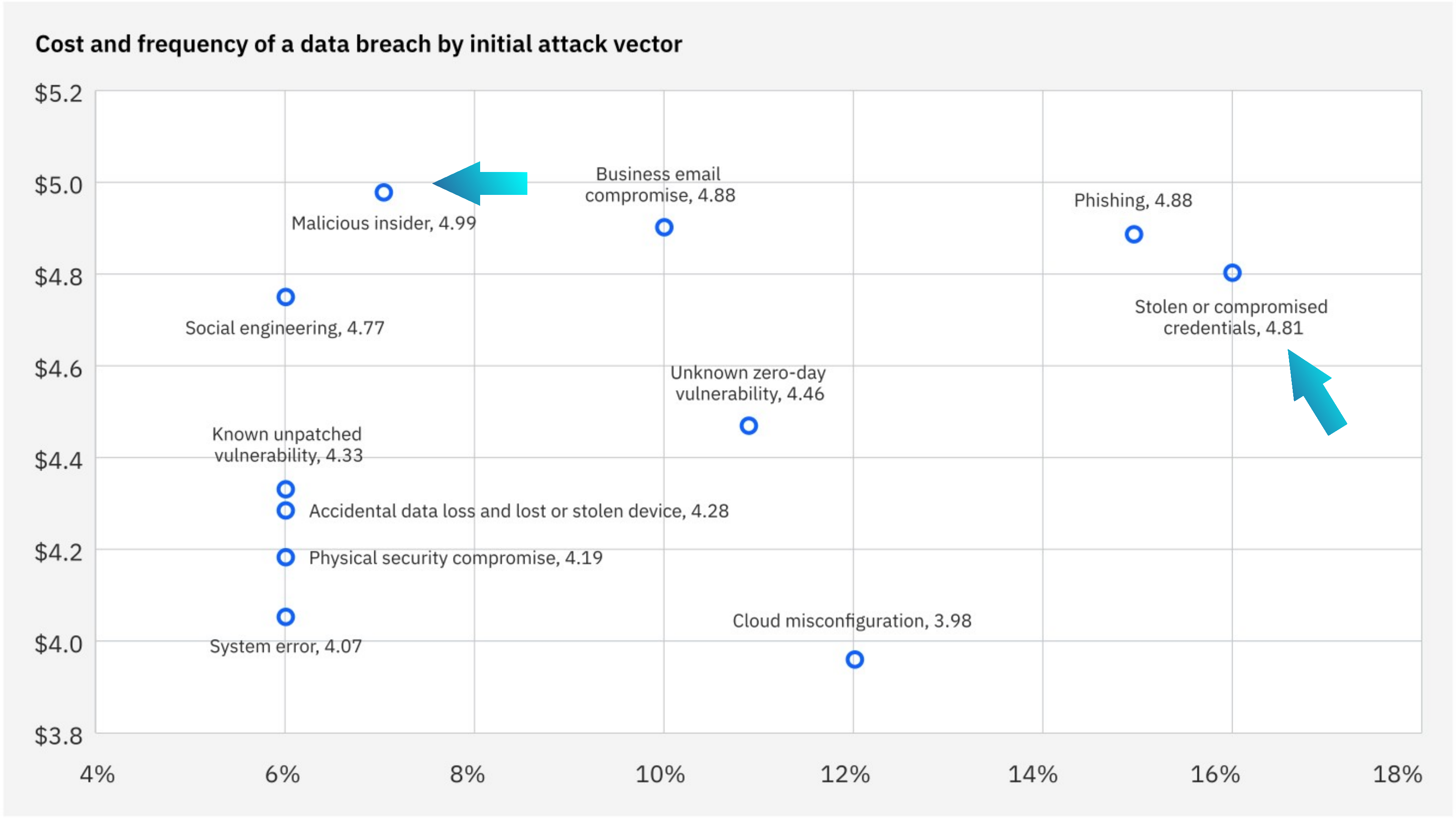


Figure 7. Measured in USD millions; percentage of all breaches

“Cost of a Data Breach Report 2024”, Ponemon Institute