Web Application Development

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WAD 2020 Lecture Notes – #7 «Web Security»

Web Security

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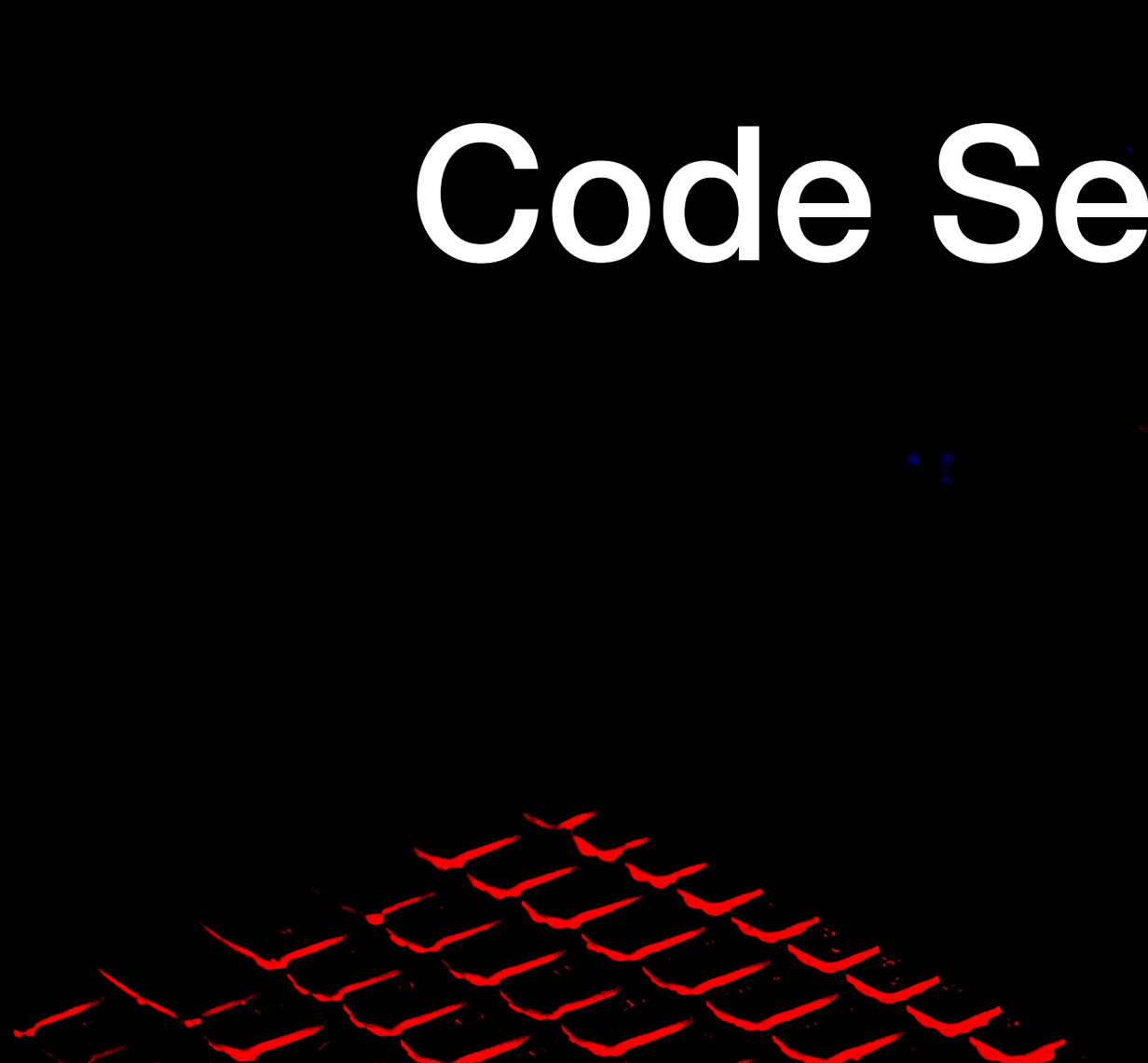
Web security

- 💻 Code security
- ⚖️ Paper security
- 🕸️ Environment security
- 📆 Organisational security

Code Security



Code security

- Your code
- Included code
- Data and configurations

.gitignore

```
{
  "heroku": "mongodb://admin:P12345678@ds1234.mlab.com:41952/heroku_kmd1234w?retry
Writes=false&w=majority,
  "mysql_admin": "root",
  "mysql_password": "supersecret"
}
```

Configuration file (config.json)

```
config.json
node_modules
logs
uploads
.env
```

.gitignore


```
{
  "heroku": "",
  "mysql_admin": "",
  "mysql_password": ""
}
```

Configuration file sample (config.json.sample)

.env

Branch: master ▾ | New pull request | Create new file | Upload files | Find file | Clone or download ▾

GeekaN2 Add notEmpty directive (#175) ... ✓ Latest commit 1b68800 2 days ago

.github	Add affectedUsers field (#194)	2 days ago
docker	Feature / user notifications (#192)	
migrations	Feature / user notifications (#192)	
src	Add notEmpty directive (#175)	
static	API now can host static files (#189)	
.dockerignore	Add typescript compiler (#100)	
.editorconfig	refactor: added eslint and editorconfig	
.env.sample	[Feature] Different secrets for tokens (#173)	
.eslintrc.js	Notifications support (#72)	

https://github.com/codex-team/hawk.api.nodejs

.env.sample

```
# API server port
PORT=4000

# Hawk API database URL
MONGO_HAWK_DB_URL=mongodb://mongodb:27017/hawk

# Events database URL
MONGO_EVENTS_DB_URL=mongodb://mongodb:27017/hawk_events

# JWT secret for user's refresh token
JWT_SECRET_REFRESH_TOKEN=abacaba

# JWT secret for user's access token
JWT_SECRET_ACCESS_TOKEN=belarus

# JWT secret for project's tokens (used in catcher)
JWT_SECRET_PROJECT_TOKEN=qwerty

# Tinkoff access keys
TINKOFF_TERMINAL_KEY=""
TINKOFF_SECRET_KEY=""
BILLING_DEBUG=true
BILLING_COMPANY_EMAIL="team@hawk.so"
```

Vulnerabilities

Distribution of all vulnerabilities by CVSS Scores

CVSS Score	Number Of Vulnerabilities	Percentage
0-1	703	0.60
1-2	914	0.70
2-3	4880	4.00
3-4	4556	3.70
4-5	27455	22.20
5-6	23785	19.30
6-7	17054	13.80
7-8	27369	22.20
8-9	553	0.40
9-10	16185	13.10
Total	123454	

Weighted Average CVSS Score: **6.6**

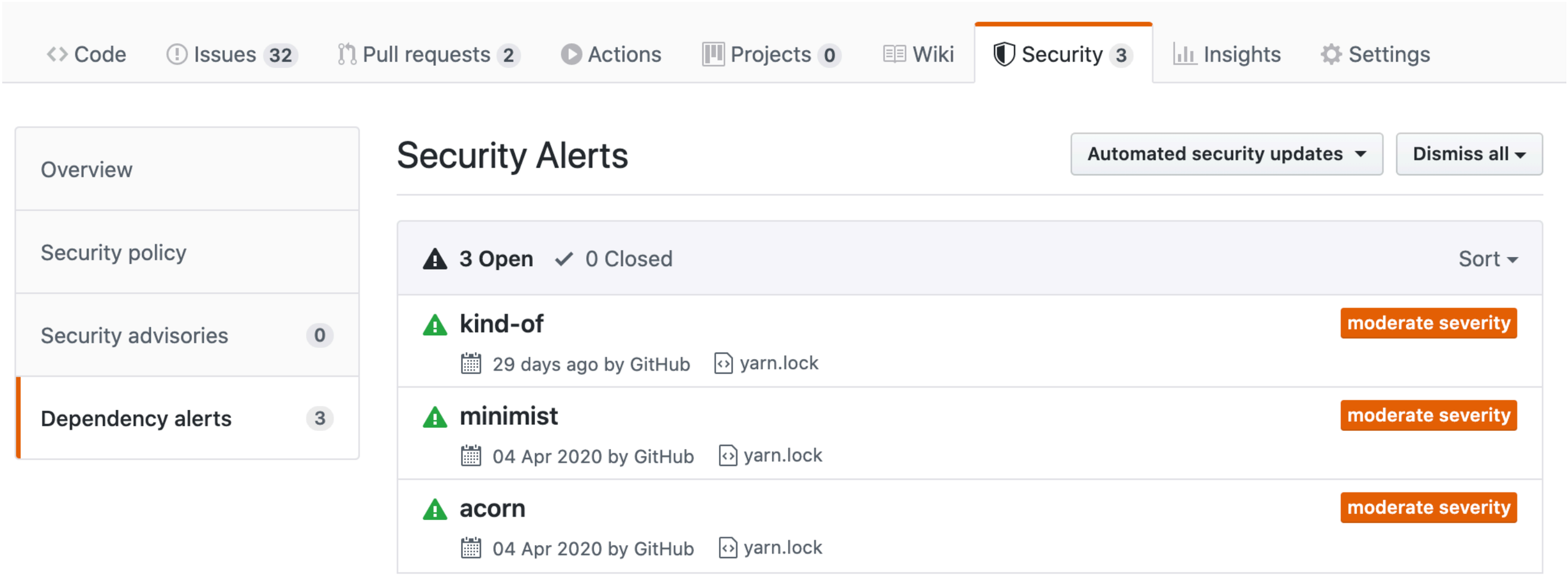
– Products Affected By CVE-2019-1010083

#	Product Type	Vendor	Product	Version	Update	Edition	Language	
1	Application	Palletsprojects	Flask	0.1				Version Details Vulnerabilities
2	Application	Palletsprojects	Flask	0.2				Version Details Vulnerabilities
3	Application	Palletsprojects	Flask	0.3				Version Details Vulnerabilities
4	Application	Palletsprojects	Flask	0.3.1				Version Details Vulnerabilities
5	Application	Palletsprojects	Flask	0.4				Version Details Vulnerabilities
6	Application	Palletsprojects	Flask	0.5				Version Details Vulnerabilities
7	Application	Palletsprojects	Flask	0.5.1				Version Details Vulnerabilities
8	Application	Palletsprojects	Flask	0.5.2				Version Details Vulnerabilities
9	Application	Palletsprojects	Flask	0.6				Version Details Vulnerabilities

https://www.cvedetails.com/

https://www.cvedetails.com/cve/CVE-2019-1010083/

GitHub Security Alerts



https://help.github.com/en/github/managing-security-vulnerabilities/about-security-alerts-for-vulnerable-dependencies

Dependabot

codex-bot / github

Code | Issues 4 | Pull requests 7 | Actions | Proj

Filters | is:pr is:open

7 Open | 39 Closed | Author | Label

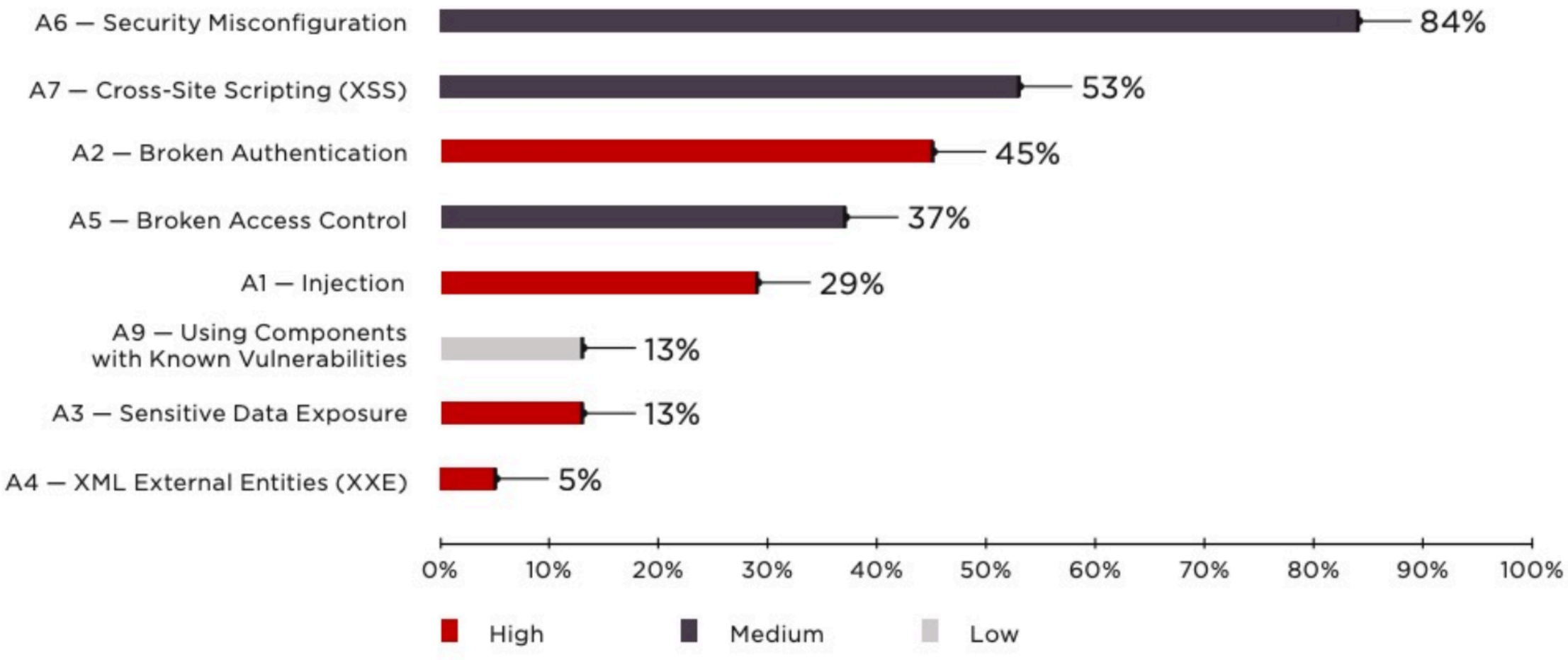
- Bump setuptools from 35.0.2 to 46.3.1 dependencies
  #76 opened 2 hours ago by dependabot-preview bot
- Bump aioamqp from 0.10.0 to 0.14.0 dependencies
  #75 opened 6 hours ago by dependabot-preview bot
- Bump wheel from 0.29.0 to 0.34.2 dependencies
  #74 opened 6 hours ago by dependabot-preview bot
- Bump aiohttp from 2.0.7 to 3.6.2 dependencies
  #73 opened 6 hours ago by dependabot-preview bot
- Bump pipdeptree from 0.10.1 to 0.13.2 dependencies
  #72 opened 6 hours ago by dependabot-preview bot
- Bump pika from 0.10.0 to 1.1.0 dependencies
  #71 opened 6 hours ago by dependabot-preview bot

```
aioamqp==0.10.0
requests
pymongo
apscheduler
aiohttp==2.0.7
asyncio==3.4.3
pika==0.10.0
pipdeptree==0.10.1
wheel==0.29.0
```

requirements.txt

OWASP

Most common vulnerabilities



https://www.ptsecurity.com/ww-en/analytics/web-vulnerabilities-2020/

Threat analysis

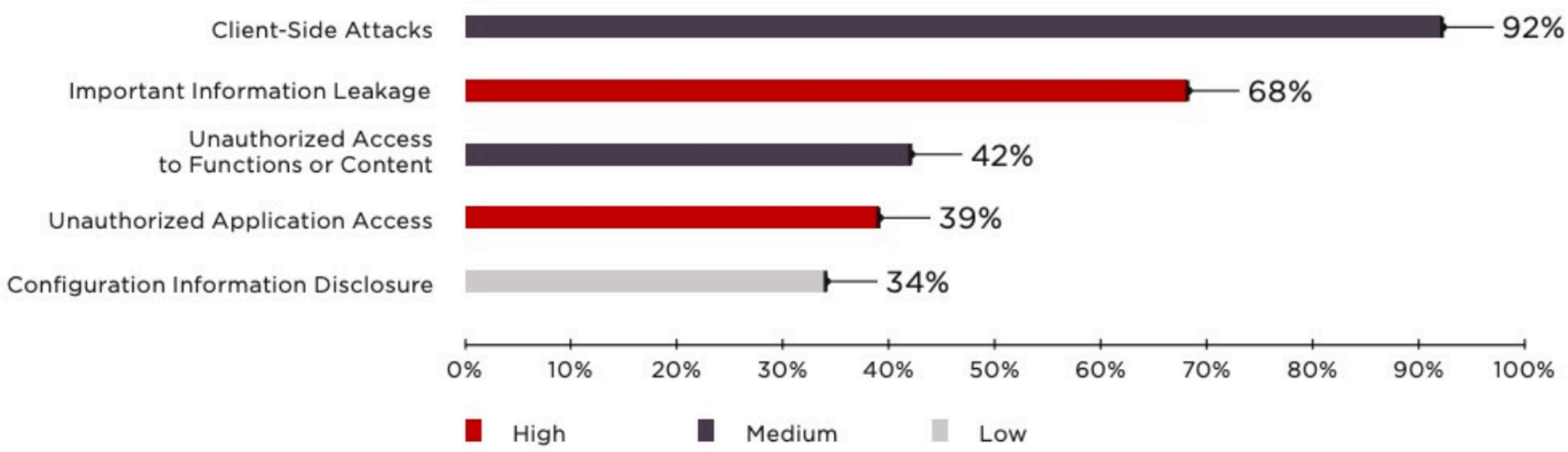


Figure 9. Top 5 most common treats (percentage of applications)

https://www.ptsecurity.com/ww-en/analytics/web-vulnerabilities-2020/

OWASP Top 10

- Injection
- XSS

Just use common libraries

Injection

```
SELECT * FROM Users WHERE login=user AND password=pwd
```

user = «123 OR 1=1 --»

```
SELECT * FROM Users WHERE login=123 OR 1=1 -- AND password=pwd
```

```
<div>{{ input_from_user }}</div>
```

input_from_user = «<script>alert(document.cookie)</script>»

```
<div><script>alert(document.cookie)</script></div>
```

OWASP Top 10

- XXE
- Insecure Deserialization

You probably never come across

OWASP Top 10

- Broken authentication
- Sensitive Data Exposure
- Broken Access Control

Logic of your code

OWASP Top 10

- Security Misconfiguration
- Using Components with Known Vulnerabilities
- Insufficient Logging & Monitoring

DevOps

Flask Security

- Content security policy (CSP)
- HTTPS
- CSRF: https://flask-wtf.readthedocs.io/en/stable/csrf.html
- Set-Cookie options
- Headers: X-Frame-Options, X-XSS-Protection, X-Content-Type-Options

https://expressjs.com/en/advanced/best-practice-security.html

https://flask.palletsprojects.com/en/1.1.x/security/

Literature

- .gitignore: https://git-scm.com/docs/gitignore
- CVE database: https://www.cvedetails.com/
- Dependabot: https://dependabot.com/
- OWASP Top 10: https://owasp.org/www-project-top-ten/
- Cheatsheet: https://cheatsheetseries.owasp.org/
- Web security: https://developer.mozilla.org/en-US/docs/Web/Security
- Flask security: https://flask.palletsprojects.com/en/1.1.x/security/
- Cookie security: https://web.dev/samesite-cookies-explained/

Paper Security

Paper security

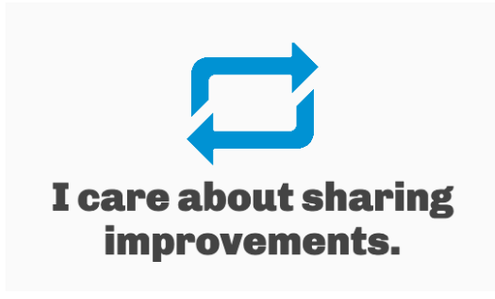
- All about licences

- Protect your code from reuse

- Protect yourself from legal issues

GitHub license

- Apache License 2.0
- GNU General Public License v3.0
- MIT License



No license :(

When you make a creative work (which includes code),

the work is under exclusive copyright by default.

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GitHub license

codex-team / capella

Unwatch 25 | Unstar 69 | Fork 12

Code | Issues 14 | Pull requests 0 | Actions | Security 0 | Insights | Settings

Cloud service for image storage and delivery https://capella.pics/ Edit

cloud-service pictures api image-storage filter crop-image resize-images capella codex open-source Manage topics

521 commits | 3 branches | 0 packages | 10 releases | 12 contributors | MIT

codex-team / editor.js

Sponsor | Used by 543 | Unwatch 174 | Unstar 11.8k | Fork 720

Code | Issues 195 | Pull requests 16 | Actions | Projects 0 | Security 1 | Insights | Settings

A block-styled editor with clean JSON output https://editorjs.io Edit

editor wysiwyg redactor codex-editor javascript typescript ui json raw-data Manage topics

518 commits | 34 branches | 0 packages | 6 releases | 1 environment | 15 contributors | Apache-2.0

Choose license

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Permissions
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- ✓ Distribution
- ✓ Private use

Limitations
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- ✗ Warranty

Conditions
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Literature

- Choose license: https://choosealicense.com/
- GitHub licenses: https://help.github.com/en/github/creating-cloning-and-archiving-repositories/licensing-a-repository
- In simple words: https://tldrlegal.com/license/mit-license

Environment Security

Environment security

- Configuration hardening
- Logging and monitoring
- Intrusion detection and prevention

Firewall

- Find listening ports

```
netstat -tulpn
```

- Uncomplicated Firewall

```
ufw allow 22      ufw allow 80          ufw allow 443

ufw enable        ufw status verbose    ufw disable
```

```
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), deny (routed)
New profiles: skip

To                         Action      From
--                         ------      ----
443                        ALLOW IN    Anywhere
80                         ALLOW IN    Anywhere
22022                      ALLOW IN    Anywhere
443 (v6)                   ALLOW IN    Anywhere (v6)
80 (v6)                    ALLOW IN    Anywhere (v6)
22022 (v6)                 ALLOW IN    Anywhere (v6)
```

Nginx logging

```
server {
    listen       80;
    server_name  localhost;

    access_log /var/log/nginx/access.log;
    error_log /var/log/nginx/error.log;

    location / {
        proxy_pass http://flask-simple:5000/;
    }
}
```

```
37.49.230.229 - - [15/May/2020:14:43:53 +0000] "POST /cgi-bin/
ViewLog.asp HTTP/1.1" 400 0 "-" "python-requests/2.20.0" "-"
188.37.65.2 - - [15/May/2020:16:00:24 +0000] "POST /cgi-bin/
ViewLog.asp HTTP/1.1" 400 0 "-" "python-requests/2.20.0" "-"
94.19.207.227 - - [15/May/2020:16:30:49 +0000] "GET /HNAP1/ HTTP/1.1"
404 232 "http://31.184.255.217:8080/" "Mozilla/5.0 (Windows NT 5.1;
rv:9.0.1) Gecko/20100101 Firefox/9.0.1" "-"
```

Docker logging

- Show docker-compose logs

```
docker-compose logs
```

- Show docker logs

```
docker ps
```

```
docker logs <CONTAINER_ID> -f
```

SSH hardening

- Change port in **/etc/ssh/sshd_config** to random

```
Port 17384
```

- Create SSH key and place it to ~/.ssh/authorized_keys
- Create SSH config **~/.ssh/config** on your laptop (example):

```
Host wad
    HostName 31.184.255.217
    Port 22022
    User root
    IdentityFile ~/.ssh/id_rsa
```

- Use **ssh wad** CLI command to connect

Fail2ban

- Find listening ports

  ```
  apt-get install fail2ban
  ```

- Add **enabled = true** to /etc/fail2ban/jail.conf and restart

  ```
  service fail2ban restart
  ```

- Show stats

  ```
  fail2ban-client status

  fail2ban-client status sshd
  ```

Fail2ban

```
[sshd]

# To use more aggressive sshd
# normal (default), ddos, ext
# See "tests/files/logs/sshd"
#mode   = normal
enabled = true
maxretry = 3
port    = ssh
logpath = %(sshd_log)s
backend = %(sshd_backend)s
```

/etc/fail2ban/jail.conf

```
root@cs785268:~# fail2ban-client status
Status
|- Number of jail:      1
`- Jail list:   sshd
root@cs785268:~# fail2ban-client status sshd
Status for the jail: sshd
|- Filter
|  |- Currently failed: 1
|  |- Total failed:     8
|  `- File list:        /var/log/auth.log
`- Actions
   |- Currently banned: 1
   |- Total banned:     1
   `- Banned IP list:   95.213.200.245
```

SSH protection enabled
Banned one IP

Literature

- UFW: https://www.digitalocean.com/community/tutorials/how-to-set-up-a-firewall-with-ufw-on-ubuntu-18-04

- Nginx logs: https://www.journaldev.com/26756/nginx-access-logs-error-logs

- Docker logs: https://docs.docker.com/engine/reference/commandline/logs/

- SSH setup: https://www.digitalocean.com/community/tutorials/how-to-set-up-ssh-keys-on-ubuntu-1804

- Fait2ban setup: https://www.techrepublic.com/article/how-to-install-fail2ban-on-ubuntu-server-18-04/

Organisational security

Organisational security

- Security audit

- Automated security checking

Literature

- Vulnerability scanners: https://www.acunetix.com/

- Nmap: https://securitytrails.com/blog/nmap-vulnerability-scan

Teams

Team 1	Time picker	https://github.com/itmo-wad/time-picker
Team 2	📆🙋‍♂️ Who when can	https://github.com/itmo-wad/Who_when_can
Team 3	🔄🍕 Ur-opinion	https://github.com/itmo-wad/Ur-opinion
Team 4	📝☁️ CommentCloud	https://github.com/itmo-wad/CommentCloud
Team 5	🧸❓ Cozy quiz	https://github.com/itmo-wad/Cozy_quiz
Team 6	🇨🇭🔪 Swiss knife	https://github.com/itmo-wad/Swiss-knife
Team 7	😄⛏️ Emoji picker	https://github.com/itmo-wad/Emoji-picker

!?

Quiz time

https://quiz.itmo.xyz/

Practice time