Enforcing Code & Security Standards with Semgrep

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@r2cdev

tl;dw - This Talk

- Secure code is hard
- Static analysis tools are too noisy / too slow
- grep isn't expressive enough
- Need something, fast, code-aware, flexible, powerful... **open source**!

Semgrep: Fast and syntax-aware semantic code pattern search for many languages: like grep but for code

Semgrep

Use to:

- Search: Find security bugs
- Guard: Enforce specific patterns and best practices
- Migrate: Easily upgrade from deprecated APIs

Semgrep Trophy Case

CVEs			
CVE	**Semgrep rule**	**Affected software**	**Description**
CVE-2019-5479	javascript.lang.security.detect-non-literal-require	larbitbase-api < v0.5.5	An unintended require vulnerability in <v0.5.5 larvitbase-api may allow an attacker to load arbitrary non-production code (JavaScript file).
CVE-2020-8128	javascript.lang.security.detect-non-literal-require	jsreport < 2.5.0	An unintended require and server-side request forgery vulnerabilities in jsreport version 2.5.0 and earlier allow attackers to execute arbitrary code.
CVE-2020-8129	javascript.lang.security.detect-non-literal-require	script-manager < 0.8.6	An unintended require vulnerability in script-manager npm package version 0.8.6 and earlier may allow attackers to execute arbitrary code.
CVE-2020-7739	javascript.phantom.security.audit.phantom-injection	phantomjs-seo	This affects all versions of package phantomjs-seo. It is possible for an attacker to craft a url that will be passed to a PhantomJS instance allowing for an SSRF attack.

whois?

me:

Grayson Hardaway, security engineer @ r2c

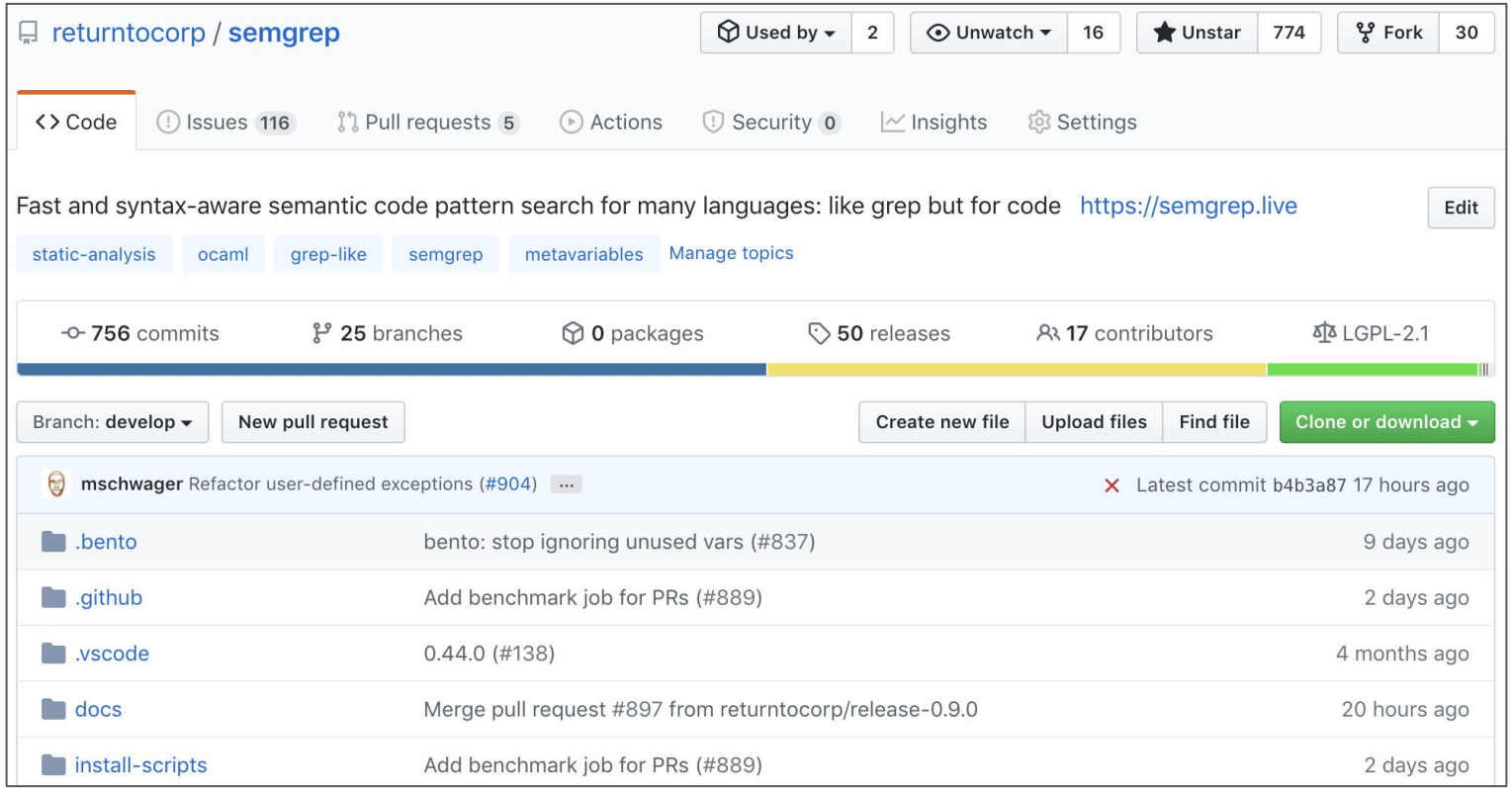
Formerly: U.S. Department of Defense

r2c:

We're an SF based static analysis startup on a mission to profoundly improve software security and reliability.

Outline

1. Background 🏞️
2. `grep` and Abstract Syntax Trees (ASTs) 🌲
3. Learn Semgrep! 🎓
4. Integration into CI/CD ⚙️
5. Get started with Rulesets 📖



github.com/returntocorp/semgrep

Semgrep, Est. 2009

First version of Semgrep (sgrep/pfff) was written at Facebook circa 2009 and was used to enforce nearly 1000 rules!

The original author, Yoann Padioleau (@aryx), joined r2c last year. Yoann was the first static analysis hire at Facebook and previously PhD @ Inria, contributor to coccinelle.lip6.fr

Language Support

Language	Status
Go	GA
Java	GA
JavaScript	GA
JSON	GA
Python	GA
Ruby	beta
TypeScript	beta
JSX	beta
TSX	beta
OCaml	alpha
PHP	alpha
C	alpha

`grep` and Abstract Syntax Trees (ASTs)

grep, ASTs, and Semgrep

```
exec("ls")

exec(some_var)

exec   (arg)

exec(
    bar
)

other_exec(foo)

// exec(foo)

print("exec(bar)")
```

✔️ Easy - `exec\(`

✔️ Easy - `exec\(`

⚠️ Handle whitespace `exec\s*\(`

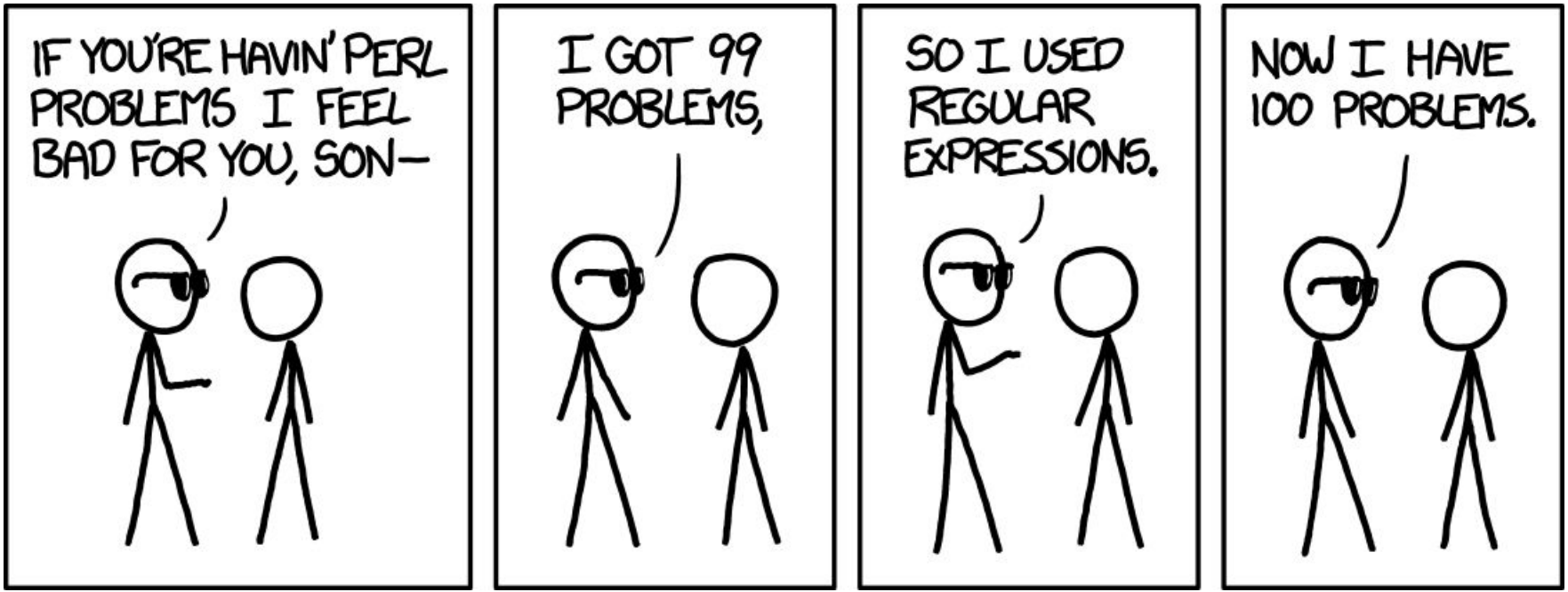
⚠️ 😅 Handle whitespace/newlines

🛑😅😅 Method suffix matches `exec`

🛑😅😅 Is this a comment?

🛑😅😅 Is this a string literal?

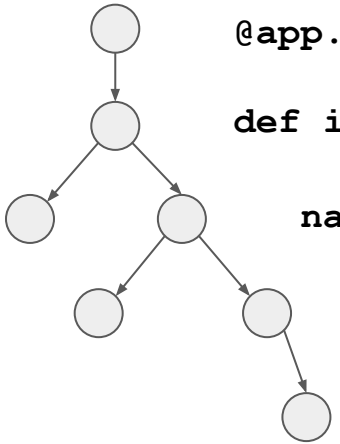
xkcd 1171


IF YOU'RE HAVIN' PERL PROBLEMS I FEEL BAD FOR YOU, SON—
I GOT 99 PROBLEMS,
SO I USED REGULAR EXPRESSIONS.
NOW I HAVE 100 PROBLEMS.

Code is not a string, it's a tree

string **!=**  **tree**

```
@app.route("/index")
def index():
    rep = response.set_cookie(name(),
secure=False, s=func())
    return rep
```

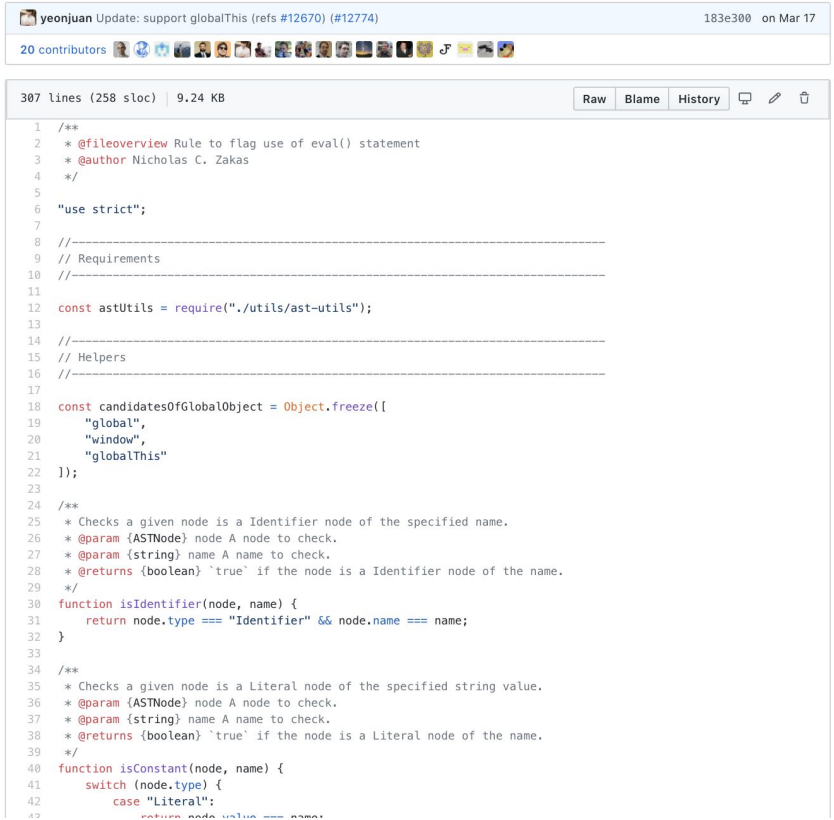


```
@app.route("/index")

def index():

   name(), func()

      response.set_cookie(

        return rep
```

Tree Matching 🌲

- Many tree matching tools: Bandit, Dlint, ESLint, Flake8, Golint, Gosec, Pylint, RuboCop, TSLint, and more!
- Have to become an **expert in every AST syntax** for every language your team uses
- Need **programming language expertise** to cover all idioms: languages have “more than one way to do it”
- **Commercial SAST tools?**
  - Complicated
  - Slow (not CI friendly)
  - Expensive

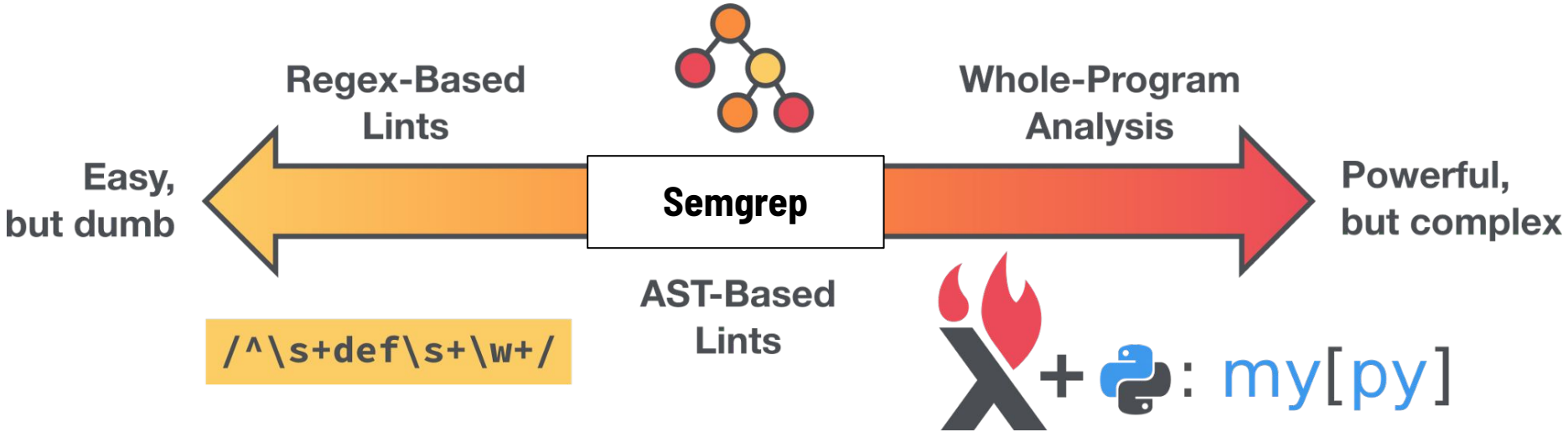
Find calls to `eval()` in only 307 LOC 👍



https://github.com/eslint/eslint/blob/master/lib/rules/no-eval.js

Static Analysis at Scale: An Instagram Story

Benjamin Woodruff Follow
Aug 15, 2019 · 13 min read



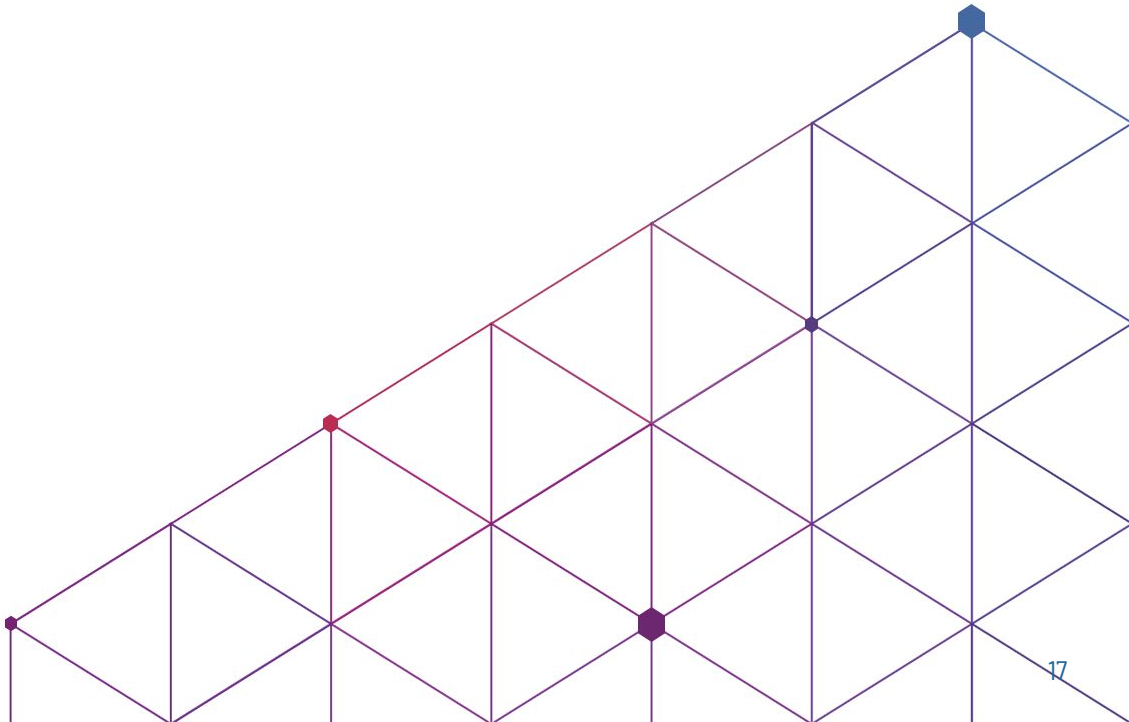
https://instagram-engineering.com/static-analysis-at-scale-an-instagram-story-8f498ab71a0c

Semgrep lets you reason about your **analysis** the way you reason about your **code**.

https://r2c.dev/blog/2020/why-i-moved-to-semgrep-for-all-my-code-analysis/

Tutorials

1. Ellipsis (“...”) operator 💬
2. Metavariables
3. Composing Patterns
4. Advanced Features



Finding Banned, Deprecated, or Dangerous Functions

```
exec("ls")
```

⇒ https://semgrep.live/EwOP

Full Solution: https://semgrep.live/7KGk

Hard-coded Secrets, Constant String Arguments

```
s3 = boto3.client(
  "s3",
  aws_secret_access_key = "abcd...",
  aws_access_key_id = "AKIA...")
```

⇒ https://semgrep.live/RGO8/

Full Solution: https://semgrep.live/A89w/

Tutorials

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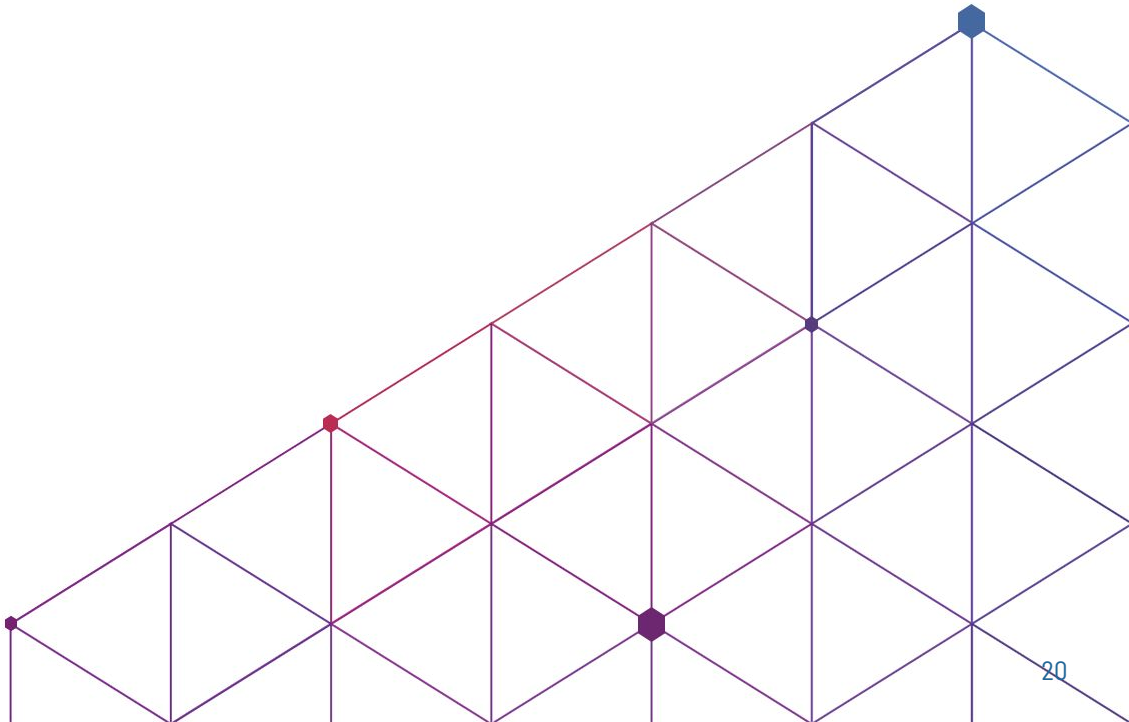

Matching Comparisons with Metavariables

```
5 == 5
7 == 8
if "cat" == "cat":
  print("Yep, they're cats")
```

https://semgrep.live/61o

Full Solution: https://semgrep.live/oB9

Send File (Approximate Data Flow)

```
@app.route("/get_file/<filename>")
def get_file(filename):
  logger.info(f"Getting file {filename}")
  return flask.send_file(filename,
     as_attachment=True)
```

https://semgrep.live/7dv

Solution: https://semgrep.live/EN8

Tutorials

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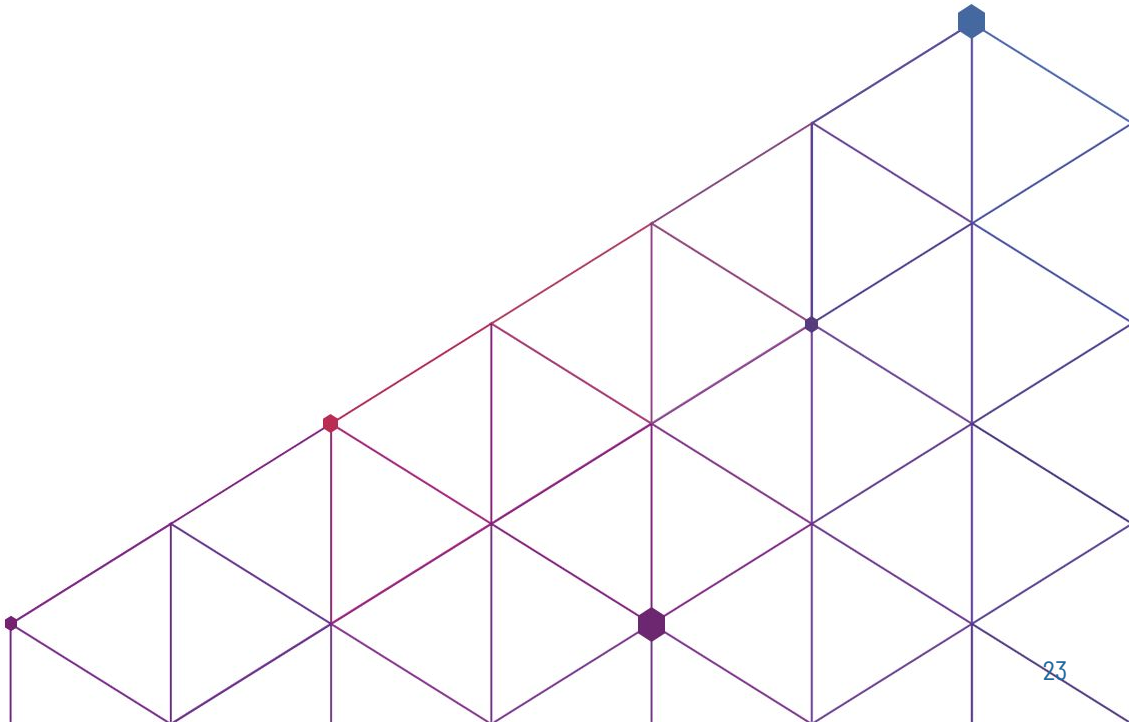
4. Advanced Features



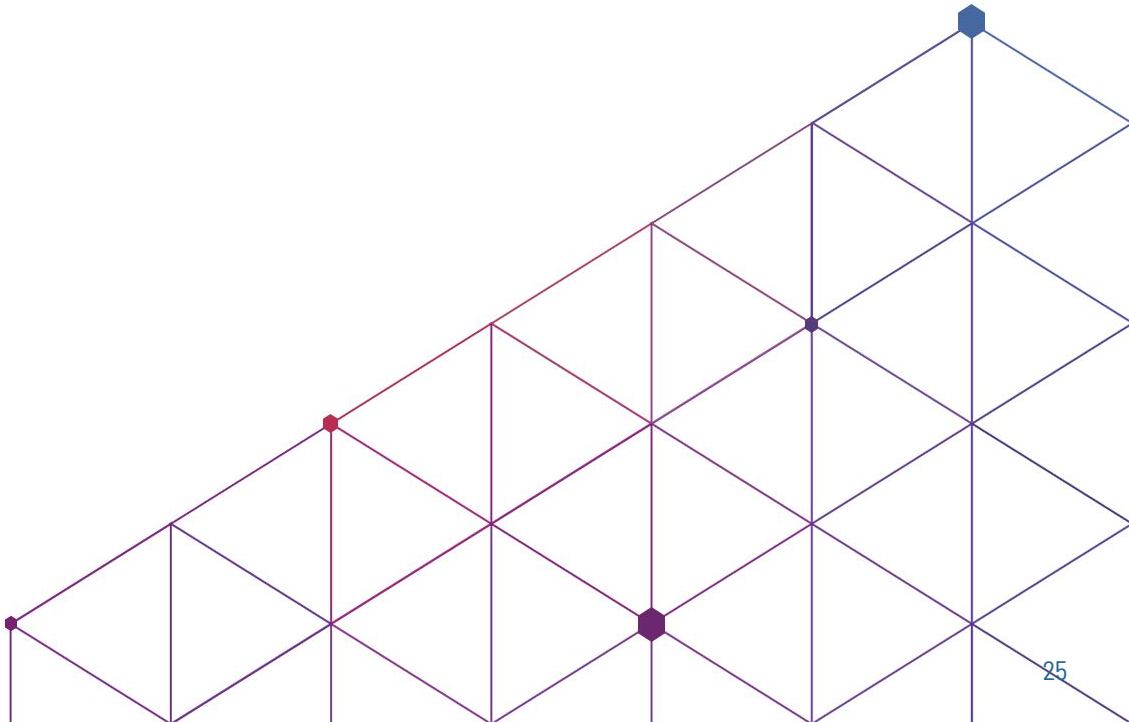
Finding Insecure SSL Configurations (Composing patterns)

```
&tls.Config{
   KeyLogWriter: w,
   MinVersion: tls.VersionSSL30,
   Rand: randSource{},
   InsecureSkipVerify: true,
}
```

⇒ https://semgrep.live/DbYd

Tutorials

1. Ellipsis (“...”) operator
2. Metavariables
3. Composing Patterns
4. Advanced Features 🧒🔬



Order of API Calls Must be Enforced (Business Logic)

```
/*
* In this financial trading application, every transaction
* MUST be verified before it is made
*
* Specifically:verify_transaction() must be called on a transaction
* object before that object is passed to make_transaction()
*/
```

https://semgrep.live/6JqL

Full Solution: https://semgrep.live/ogZ6

Detect HTTP (Inline String Regexes)

```
func bad1() {
   req, err := http.NewRequest("GET", "http://example.com", nil)
}
```

```
pattern: |
   http.NewRequest(..., "=~/[hH][tT][tT][pP]://.*/", ...)
```

https://semgrep.dev/editor?registry=problem-based-packs.insecure-transport.go-stdlib.http-customized-request

Automatically fix an insecure SSL configuration (Autofix)

```
&tls.Config{
   KeyLogWriter: w,
   MinVersion: tls.VersionSSL30,
   Rand: randSource{}
}
```

https://semgrep.dev/xxyA/

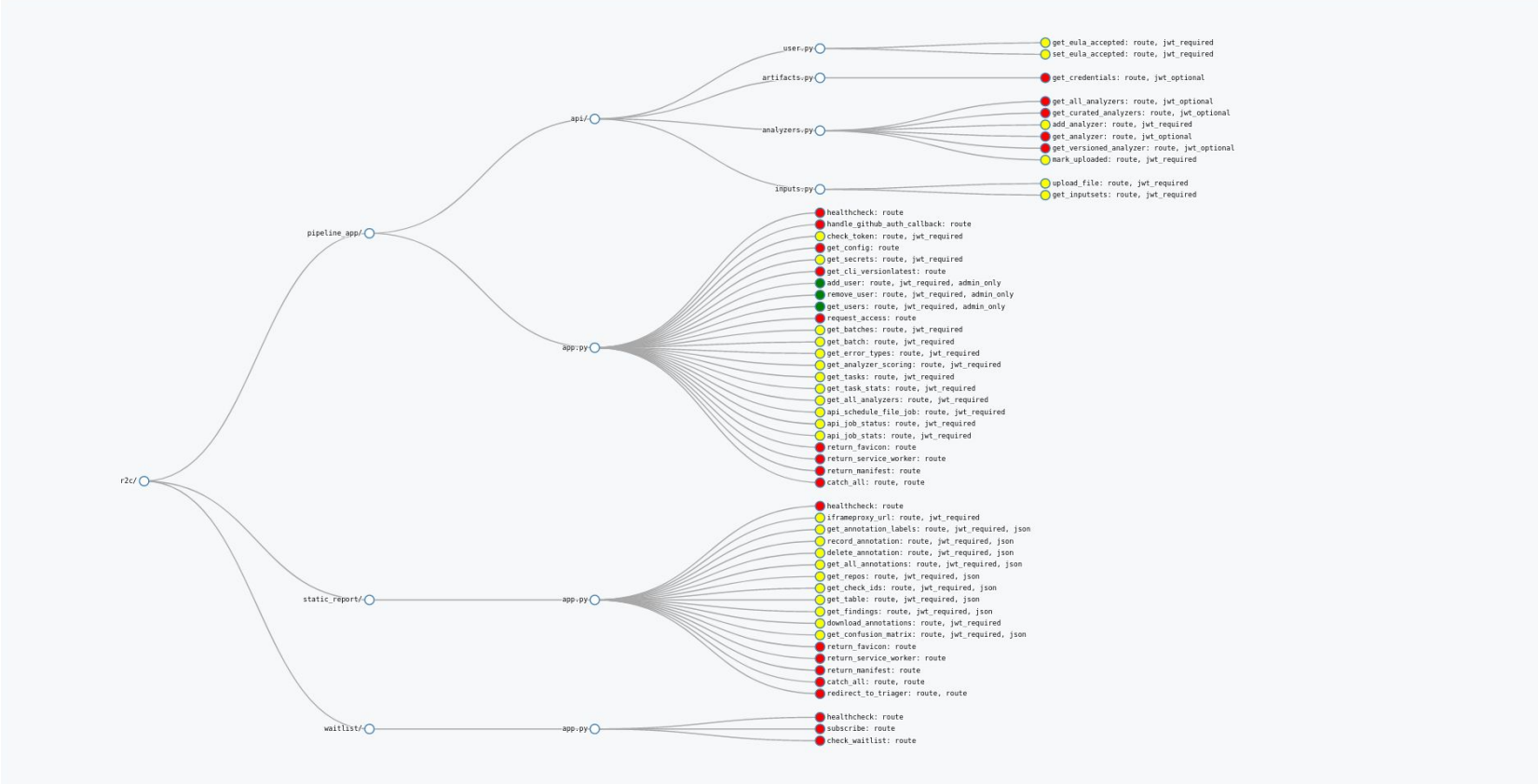
Identify API endpoints in Java Spring (Message Interpolation)

```
@RequestMapping(method = RequestMethod.GET)
@Authorize(Permissions.ADMIN)
@ResponseBody
public ResponseEntity<Map<String, Object>> list() {
  return new ResponseEntity<>(result, HttpStatus.OK);
}
```

https://semgrep.live/clintgibler:spring-routes-try

Full Solution: https://semgrep.live/clintgibler:spring-routes

Visualizing API endpoints



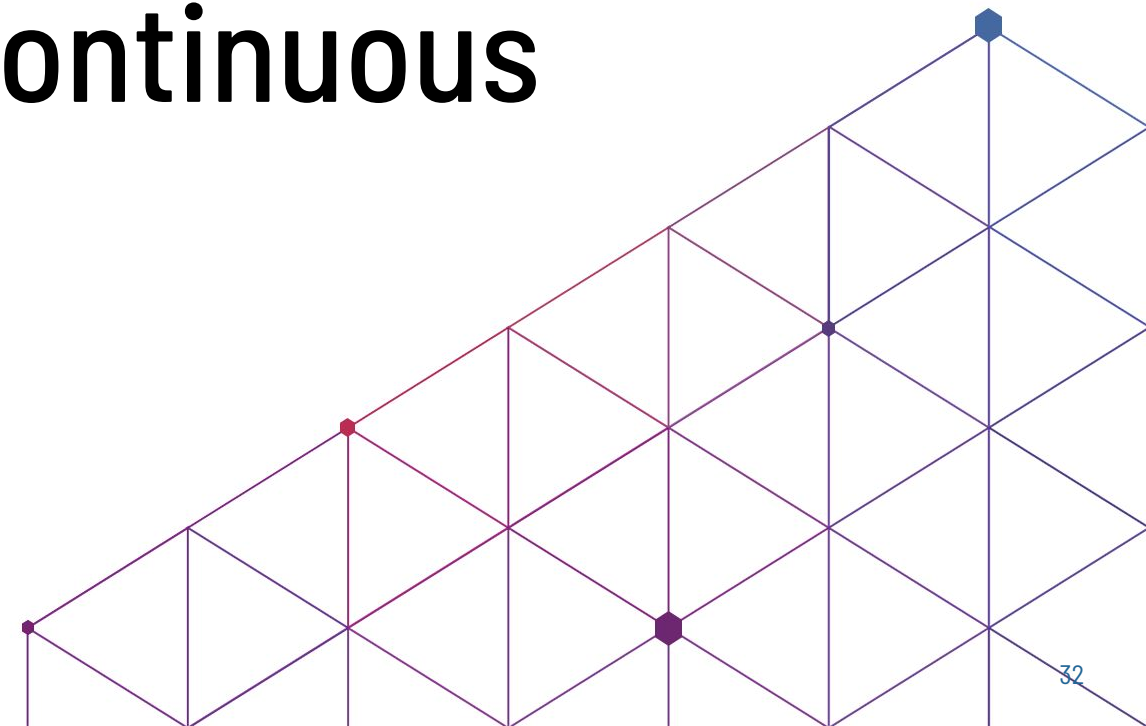
Terraform (Generic Language Support)

```
resource "aws_s3_bucket" "b" {
  bucket = "my-tf-test-bucket"
  acl    = "public-read-write"
  ...
```

```
pattern: |
   acl = "public-read-write"
```

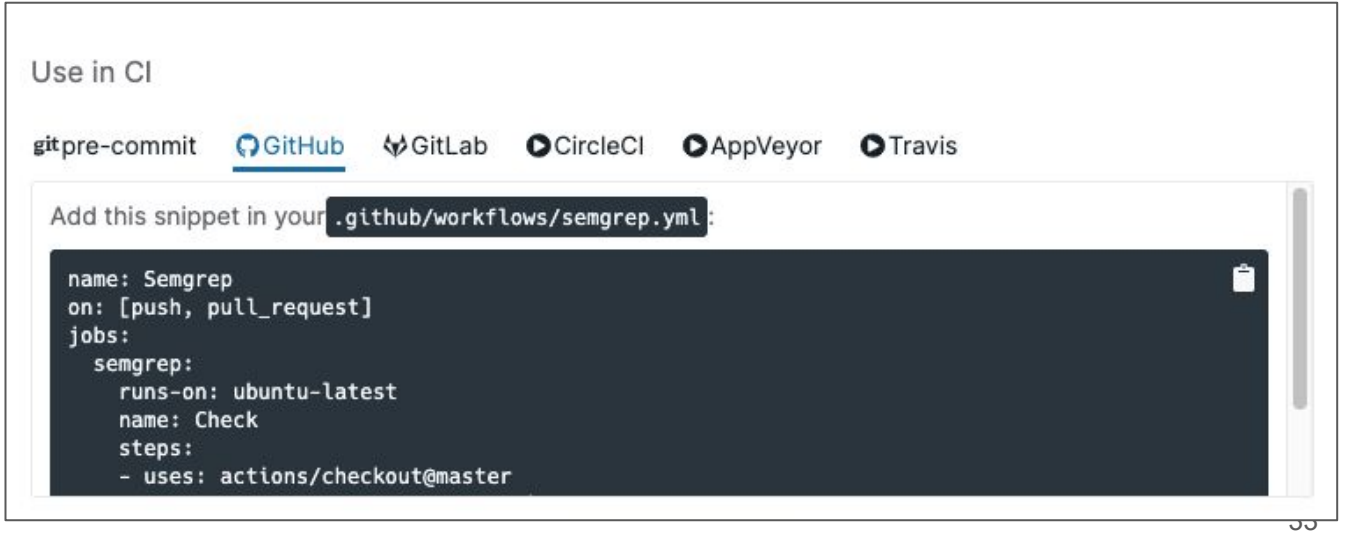
https://semgrep.dev/s/ne0Z/

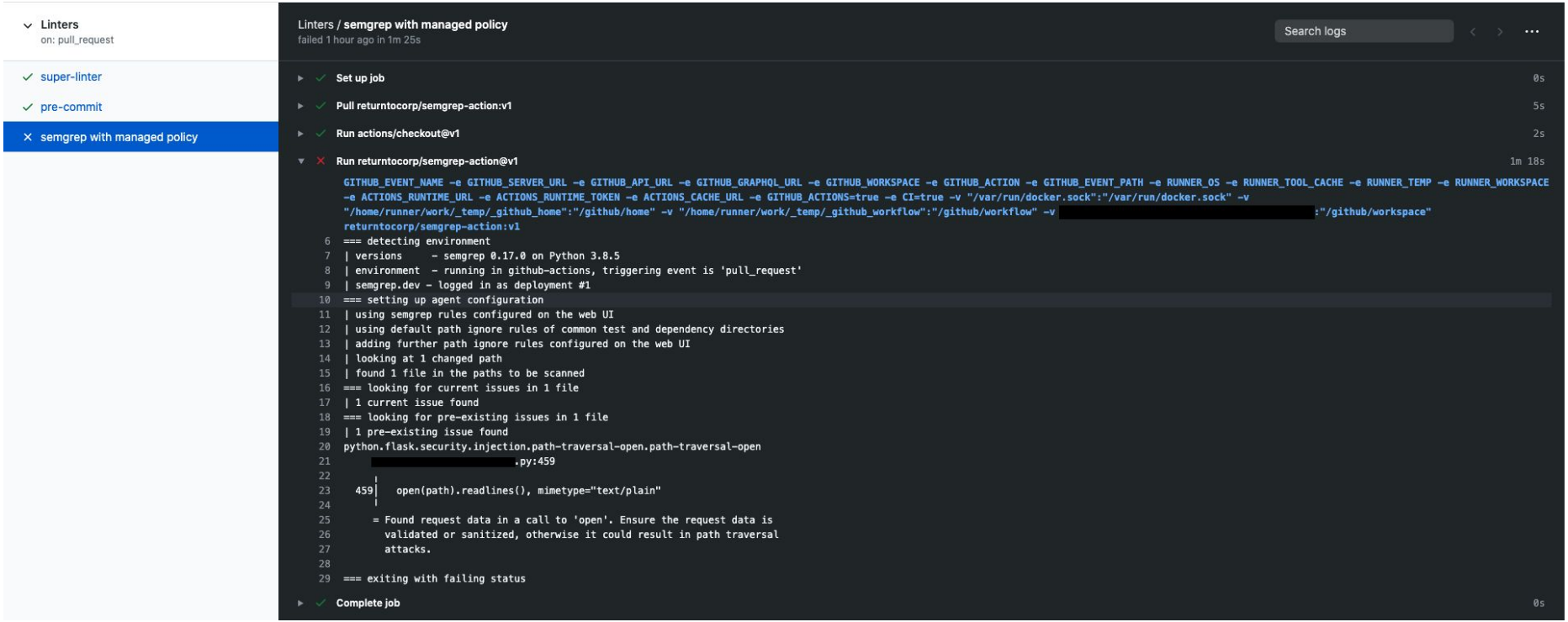
Guard with Continuous Integration



Integrations

- Enforce secure defaults + secure frameworks at CI time
  - Easy to add to CI as either a Docker container or Linux binary
  - JSON output → easy to integrate with other systems




Linters
on: pull_request
super-linter
pre-commit
semgrep with managed policy
Linters / semgrep with managed policy
failed 1 hour ago in 1m 25s
Search logs
Set up job 0s
Pull returntocorp/semgrep-action:v1 5s
Run actions/checkout@v1 2s
Run returntocorp/semgrep-action@v1 1m 18s
GITHUB_EVENT_NAME -e GITHUB_SERVER_URL -e GITHUB_API_URL -e GITHUB_GRAPHQL_URL -e GITHUB_WORKSPACE -e GITHUB_ACTION -e GITHUB_EVENT_PATH -e RUNNER_OS -e RUNNER_TOOL_CACHE -e RUNNER_TEMP -e RUNNER_WORKSPACE -e ACTIONS_RUNTIME_URL -e ACTIONS_RUNTIME_TOKEN -e ACTIONS_CACHE_URL -e GITHUB_ACTIONS=true -e CI=true -v "/var/run/docker.sock":"/var/run/docker.sock" -v "/home/runner/work/_temp/_github_home":"/github/home" -v "/home/runner/work/_temp/_github_workflow":"/github/workflow" -v [redacted]:"/github/workspace"
returntocorp/semgrep-action:v1
=== detecting environment
| versions - semgrep 0.17.0 on Python 3.8.5
| environment - running in github-actions, triggering event is 'pull_request'
| semgrep.dev - logged in as deployment #1
=== setting up agent configuration
| using semgrep rules configured on the web UI
| using default path ignore rules of common test and dependency directories
| adding further path ignore rules configured on the web UI
| looking at 1 changed path
| found 1 file in the paths to be scanned
=== looking for current issues in 1 file
| 1 current issue found
=== looking for pre-existing issues in 1 file
| 1 pre-existing issue found
python.flask.security.injection.path-traversal-open.path-traversal-open
[redacted].py:459
459| open(path).readlines(), mimetype="text/plain"
= Found request data in a call to 'open'. Ensure the request data is validated or sanitized, otherwise it could result in path traversal attacks.
=== exiting with failing status
Complete job 0s

```
=== setting up agent configuration
| using semgrep rules configured on the web UI
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| adding further path ignore rules configured on the web UI
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python.flask.security.injection.path-traversal-open.path-traversal-open
     [redacted].py:459
      |
  459|   open(path).readlines(), mimetype="text/plain"
      |

     = Found request data in a call to 'open'. Ensure the request data is
       validated or sanitized, otherwise it could result in path traversal
       attacks.

=== exiting with failing status
```
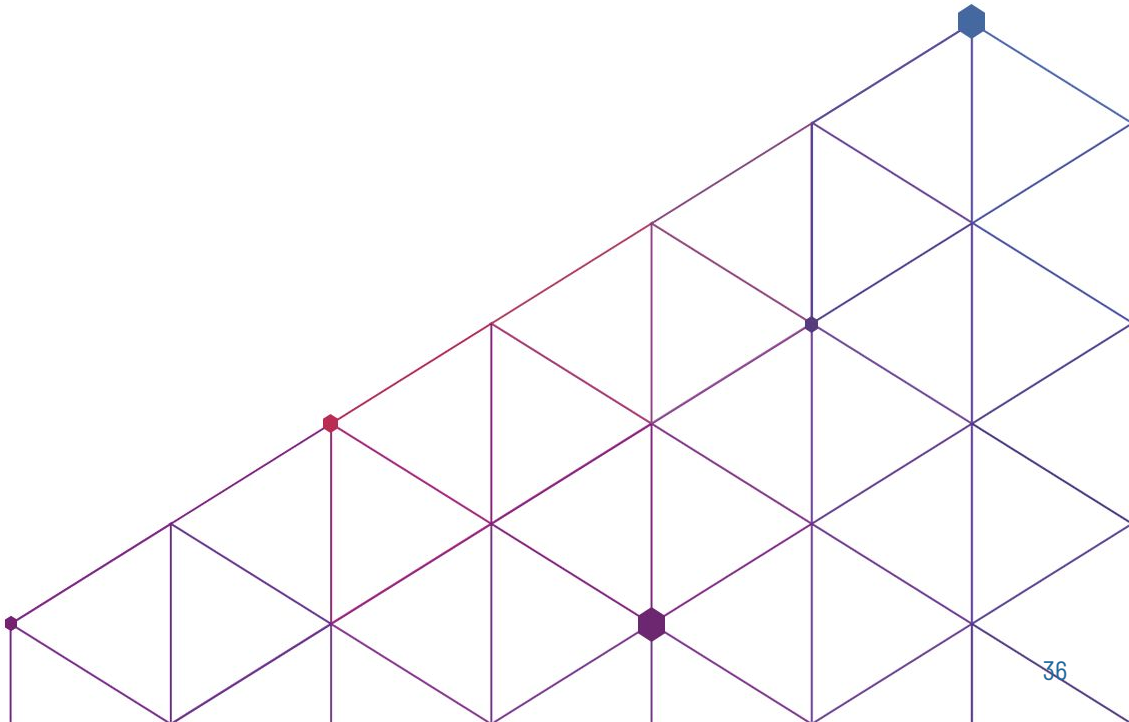
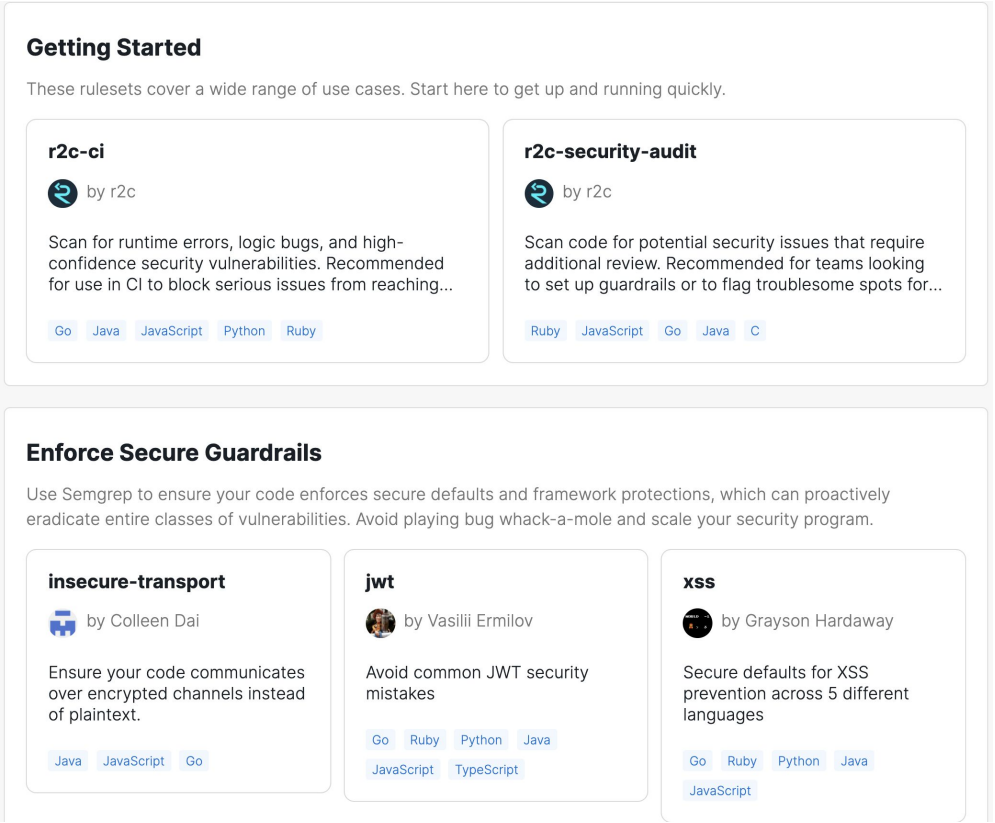

Registry



Community rule registry

Community participation

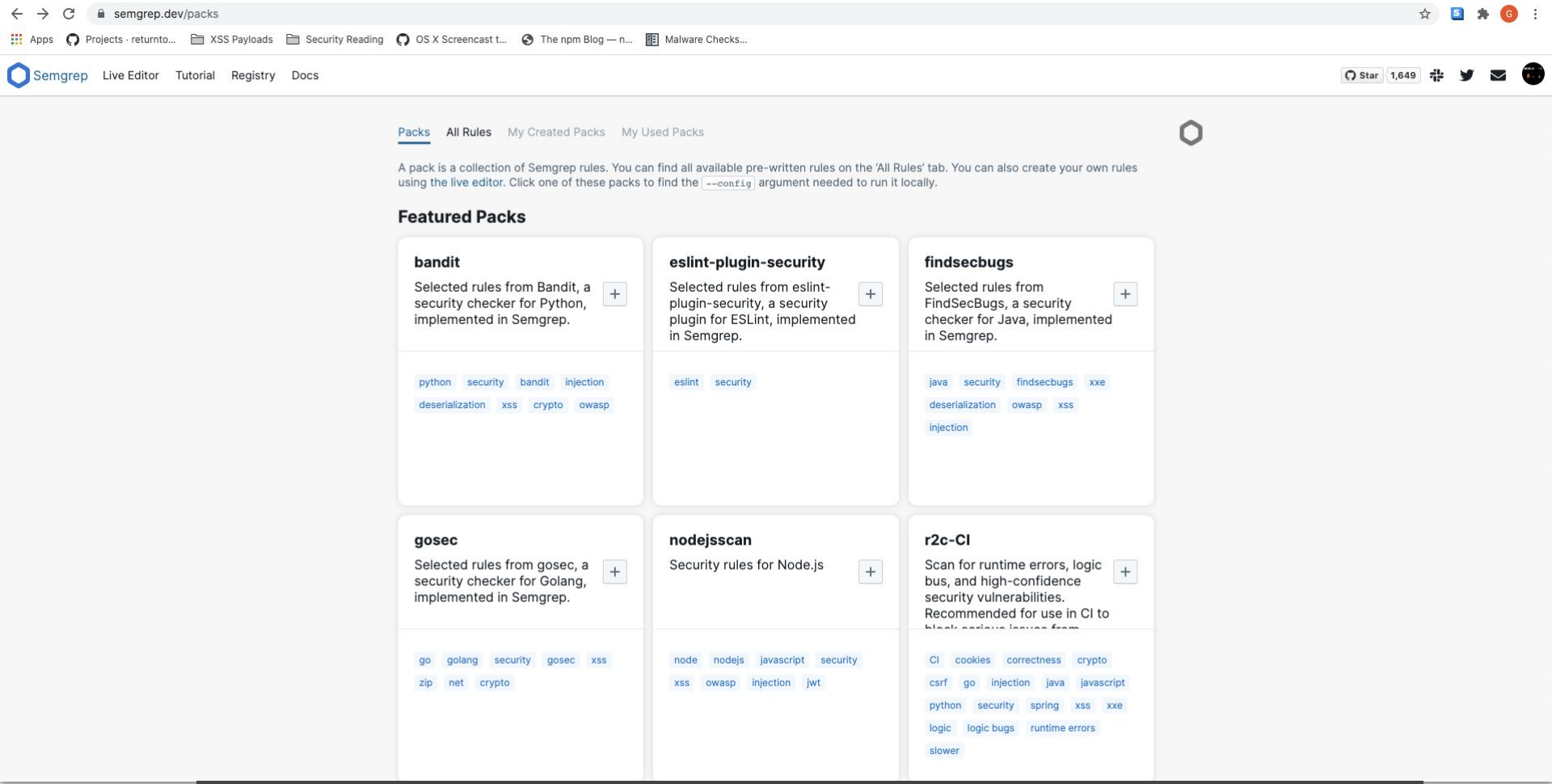
- > 900 rules by r2c + community
- Community contributors
  - **NodeJSScan**
  - **Damian Gryski, author of Go-Perf-Book**
  - **OWASP Contributors**
  - **You?**
- Organized into sets
  - XSS
  - JWT
  - Best practices
  - etc.



Community rule registry

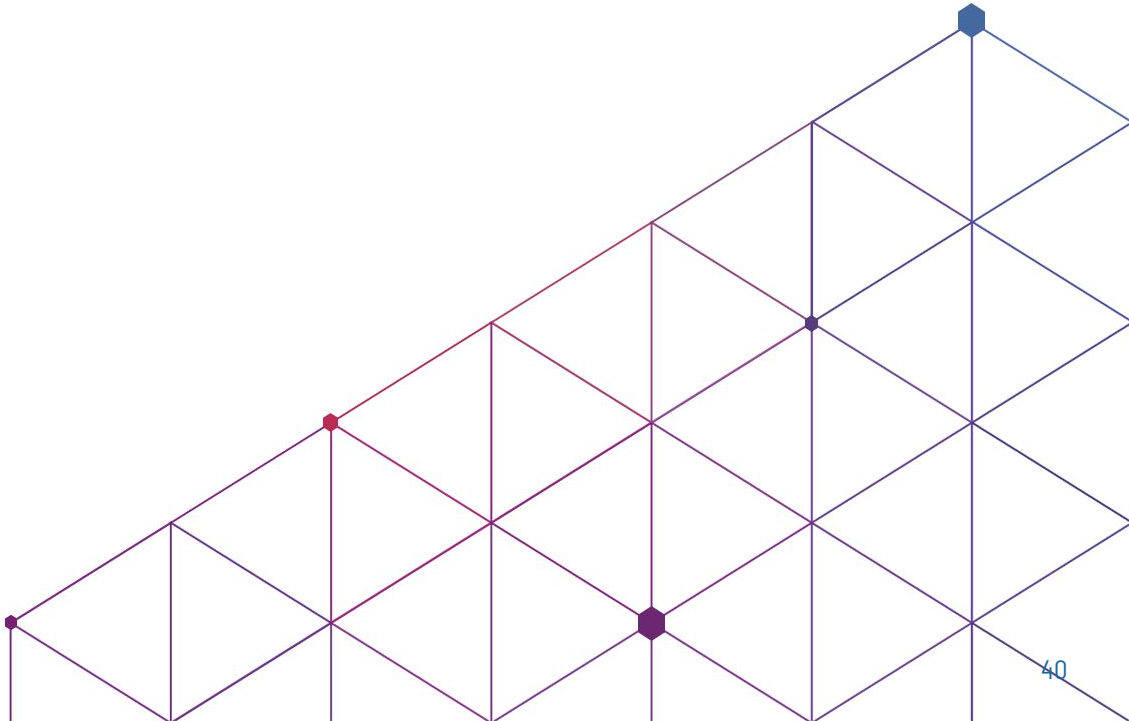
semgrep.live/registry ⇒ github.com/returntocorp/**semgrep-rules**

```
$ brew install semgrep
$ semgrep --config=<url>
```




```
$ semgrep --config=https://semgrep.dev/p/gosec
```

Summary



Integration points

- Editor / IDE (VS Code Extension in beta)
- Git pre-commit hook
- CI/CD pipeline

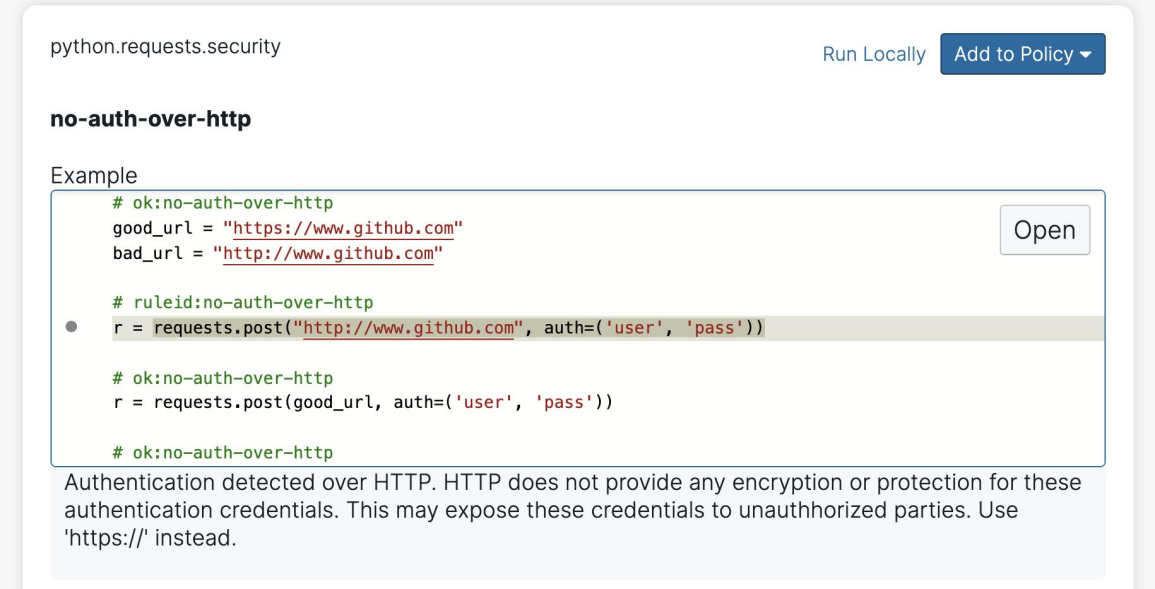
- If using managed Semgrep on semgrep.dev, rules can either **block** or **notify**

Getting started with rules

- Choose existing rule sets from semgrep.dev

```
$ semgrep --config=https://semgrep.dev/p/r2c-CI
```

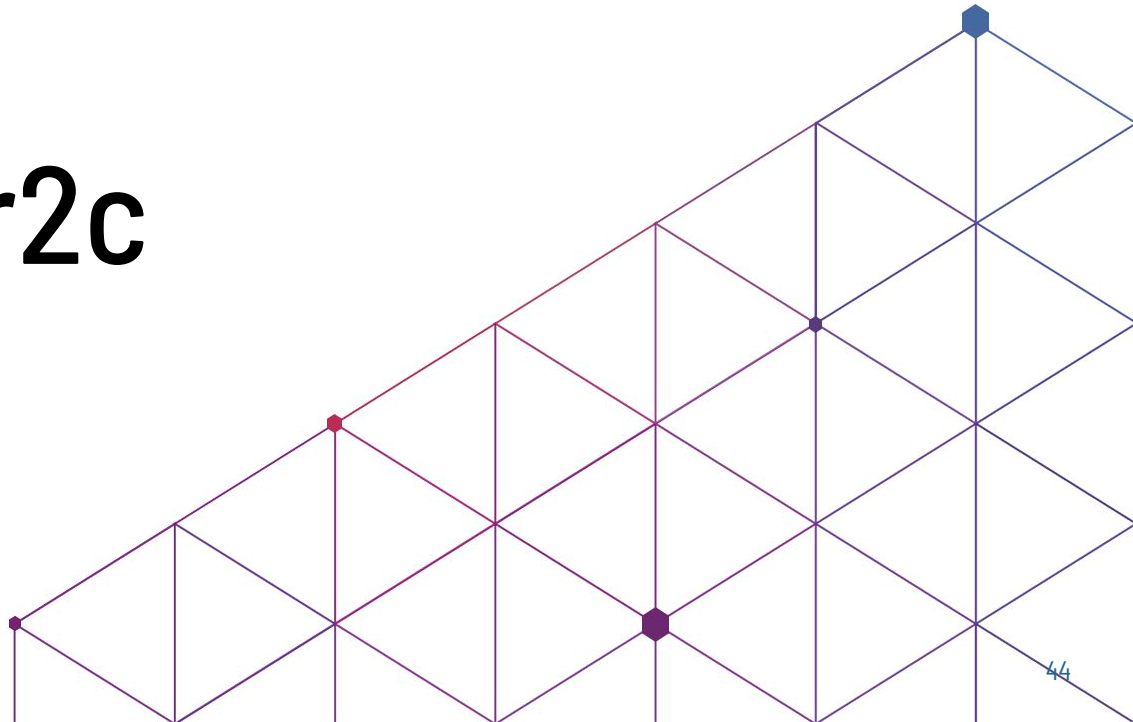
- Create your own rule set from existing rules
- Write your own!



Set your **security policy in stone** with **automated scanning**.

https://r2c.dev/blog/2020/fixing-leaky-logs-how-to-find-a-bug-and-ensure-it-never-returns/

Case Study: r2c



```
logging.getLogger("sqlalchemy.engine.base.Engine").setLevel(logging.INFO)
```

This configures SQLAlchemy to log all SQL statements, together with passed parameters. Let's look at some of the output we saw:

```
INFO:werkzeug:127.0.0.1 - - [25/Sep/2020 11:50:01] "POST /api/auth/authenticate
INFO:sqlalchemy.engine.base.Engine:BEGIN (implicit)
INFO:sqlalchemy.engine.base.Engine:SELECT token.id AS token_id, token.token AS
FROM token
WHERE token.token = %(token_1)s
 LIMIT %(param_1)s
INFO:sqlalchemy.engine.base.Engine:{'token_1': $2a$10$KVsyW1jjKn.pvkVi3w9Rn.1mw
```

...Uh-oh.

```python
class ObfuscatedString(types.TypeDecorator):
    """
    String column type for use with SQLAlchemy models whose
    content should not appear in logs or exceptions
    """

    impl = types.String

    class Repr(str):
        def __repr__(self) -> str:
            return "********"

    def process_bind_param(self, value: Optional[str], dialect: Any) -> Optiona
        return self.Repr(value) if value else None

    def process_result_value(
        self, value: Optional[Repr], dialect: Any
    ) -> Optional[str]:
        return str(value) if value else None


setattr(db, "ObfuscatedString", ObfuscatedString)
```

```
class Token(db.Model):
    ...
    token = db.Column(db.ObfuscatedString, ...)
    ...
```

We then re-enabled INFO logging, and checked that we were properly obfuscating text:

```
INFO:werkzeug:127.0.0.1 - - [25/Sep/2020 13:48:55] "GET /api/agent/deployments/
INFO:sqlalchemy.engine.base.Engine:BEGIN (implicit)
INFO:sqlalchemy.engine.base.Engine:SELECT token.id AS token_id, token.token AS
FROM token
WHERE token.token = %(token_1)s
 LIMIT %(param_1)s
INFO:sqlalchemy.engine.base.Engine:{'token_1': ********, 'param_1': 1}
```

For completeness, we also validated in our development database console that the correct values were stored and retrieved.

Great success! 🚢 Ship it.

```yaml
rules:
- id: obfuscate-sensitive-string-columns
  patterns:
    - pattern: |
        $COLUMN = db.Column(db.String, ...)
    - metavariable-regex:
        metavariable: $COLUMN
        regex: '.*(?<![A-Za-z])(token|key|email|secret)(?![A-RT-Za-rt-z]).*'
  message: |
    '$COLUMN' may expose sensitive information in logs and exceptions. Use
    'db.ObfuscatedString' instead of 'db.String'.
  severity: WARNING
```

Coming Soon

Improved language support, new languages (Kotlin on deck)

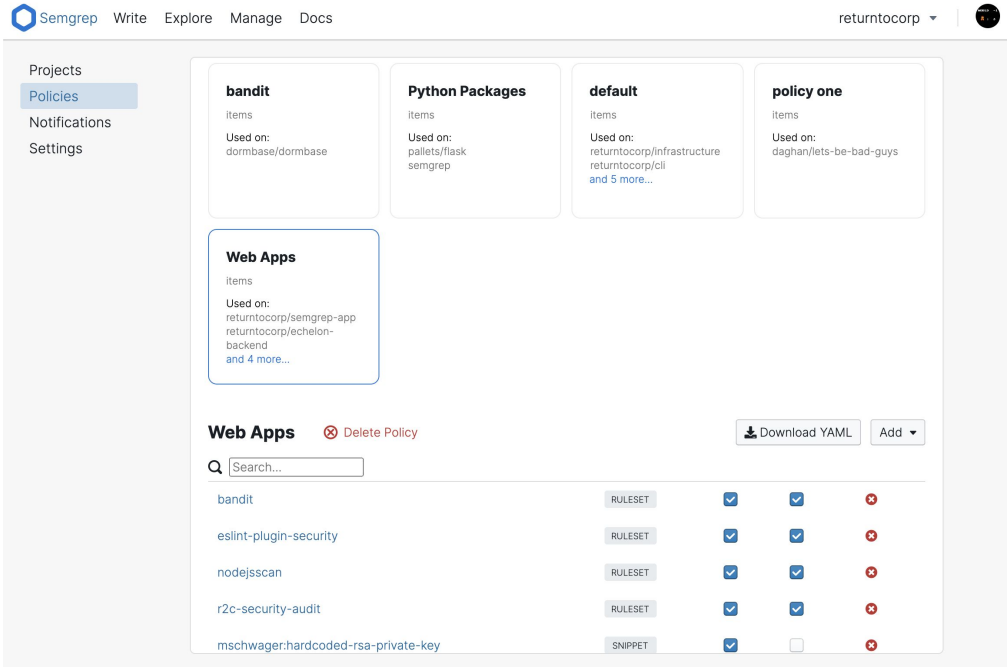
More rules + prevention cheatsheets

Semgrep Community

Centrally manage Semgrep on your repos!

VS Code extension (in beta!)

"Generic" patterns



Semgrep

lightweight static analysis for many languages

Locally:

1. `brew install semgrep`
2. `pip install semgrep`

Online editor:

semgrep.live

Semgrep

lightweight static analysis for many languages

?

Grayson Hardaway | grayson@r2c.dev

r2c.dev | @r2cdev | r2c Community Slack

https://**r2c.dev**/survey ← plz :)