GitHub Actions & Security



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## What are GitHub workflows?

**Execute one or more Actions** 

## Workflows triggered by events:

- Push
- Comment
- Creating an Issue
- Release
- Etc.

## What are GitHub Actions?

Steps in the workflows

• Basis: Run a shell script

- Create your own
- Use an existing one from the marketplace



#### Marketplace / Search results

Types

Apps

Actions

Actions

An entirely new way to automate your development workflow.

10543 results filtered by Actions ×



#### Categories

API management

Chat

Code quality

Code review

Continuous integration

Dependency management

Deployment



aws

#### Deploy to Cloud Run

Q Search for apps and actions

By google-github-actions 🕢

Use this action to deploy a container in the Google Container Registry to Cloud Run 53 stars



#### Amazon ECS "Deploy Task Definition" **Action for GitHub Actions**

By aws-actions 🕢

Registers an Amazon ECS task definition, and deploys it to an ECS service 228 stars



#### **Buildah Build**

By redhat-actions 🕢

Build a container image, with or without a Dockerfile

36 stars

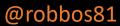


#### Glo Add Label To Cards

By Axosoft 🕢

GitHub action to add a label to Glo Boards cards

3 stars



# Workflow example

```
dotnetcore-webapp / .github / workflows / dotnetcore.yml
ያ main ▾
    name: .NET Core
    on: [push]
     jobs:
      build-and-deploy:
        environment: Production
9
        runs-on: ubuntu-latest
10
        steps:
         - uses: actions/checkout@v1
         - name: Setup .NET Core
13
          uses: actions/setup-dotnet@v1
14
          with:
            dotnet-version: 3.0.100
16
17
        # dotnet build
18
19
         name: Build with dotnet
          run:
            dotnet build --configuration Release ./dotnet-core-webapp/dotnetcore-webapp.csproj
```

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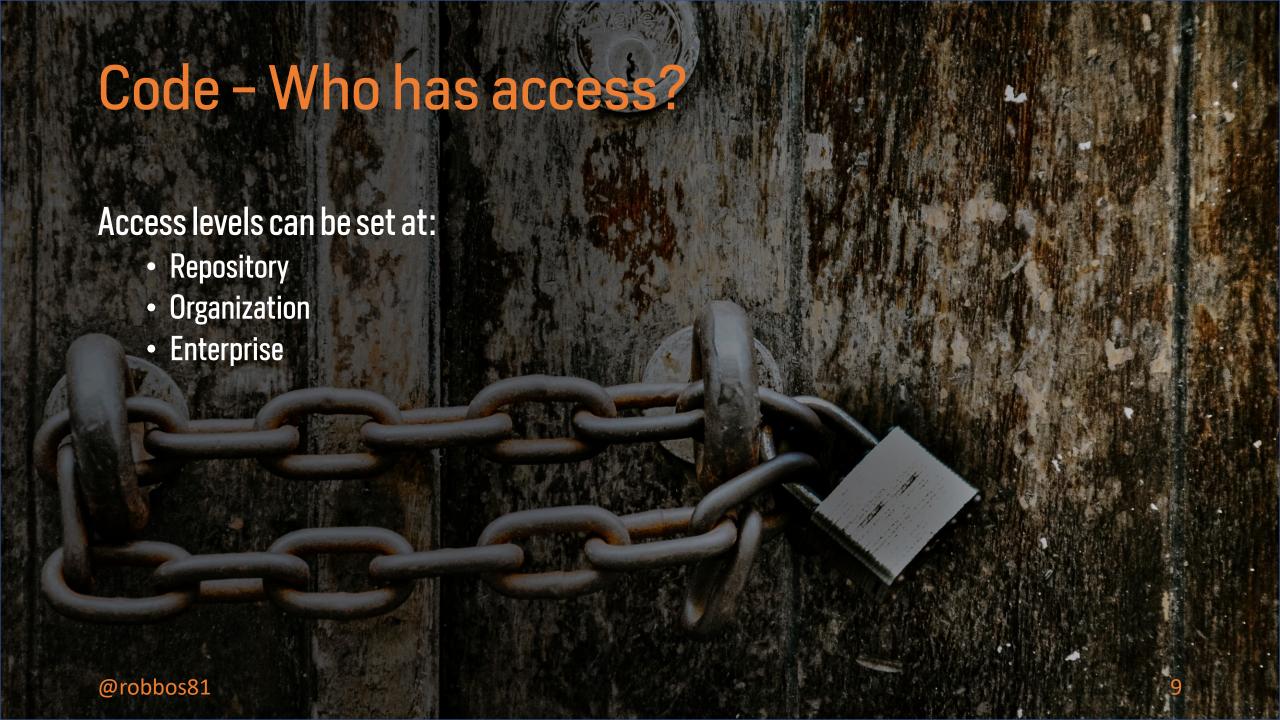


# GitHub Actions Security

- Repository security
- Runners and security
- Actions and security
- Forking actions
- Keeping up to date

# Repository security

- Access to code
- Workflow secrets
- Your code



## Code - Who has access?

#### **Permission levels**

Less

No access

Read only access

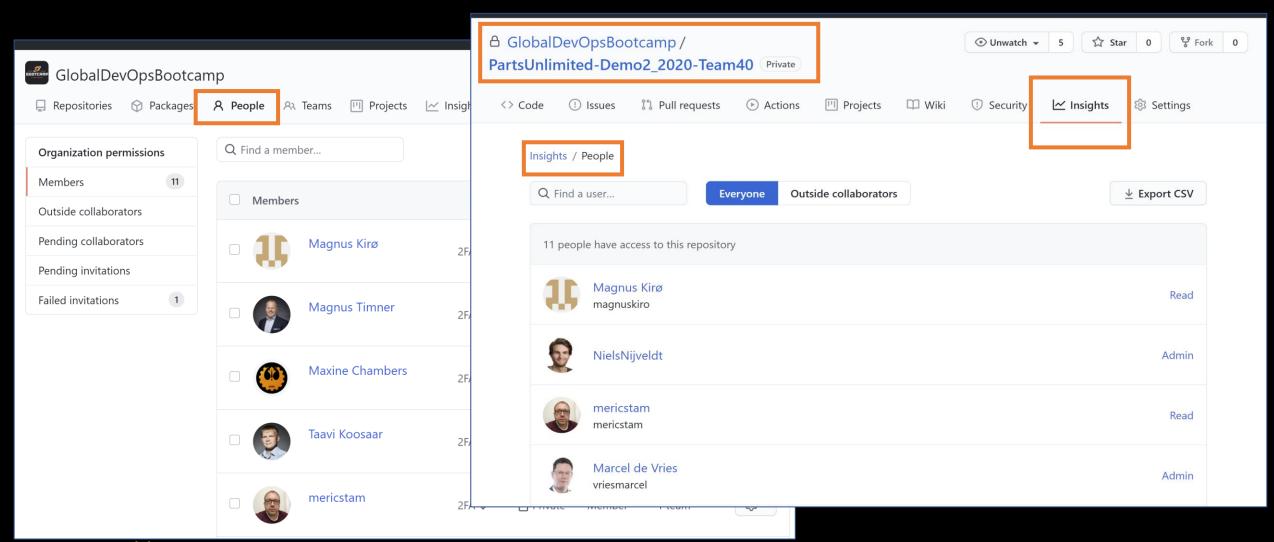
Triage: manage issues & pull requests

Write access

Maintain: No sensitive or destructive actions

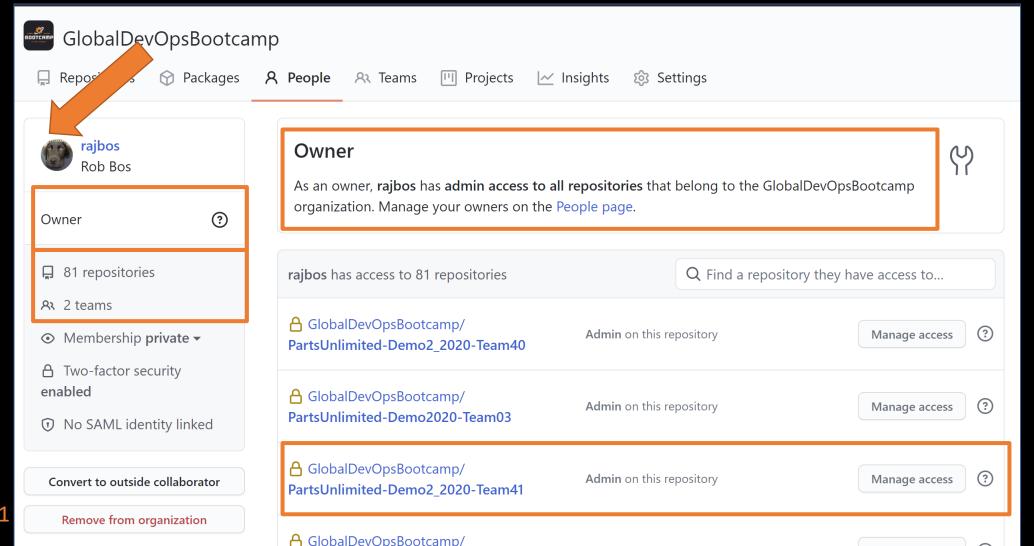
Admin: full access

# Configuring access



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## From the user



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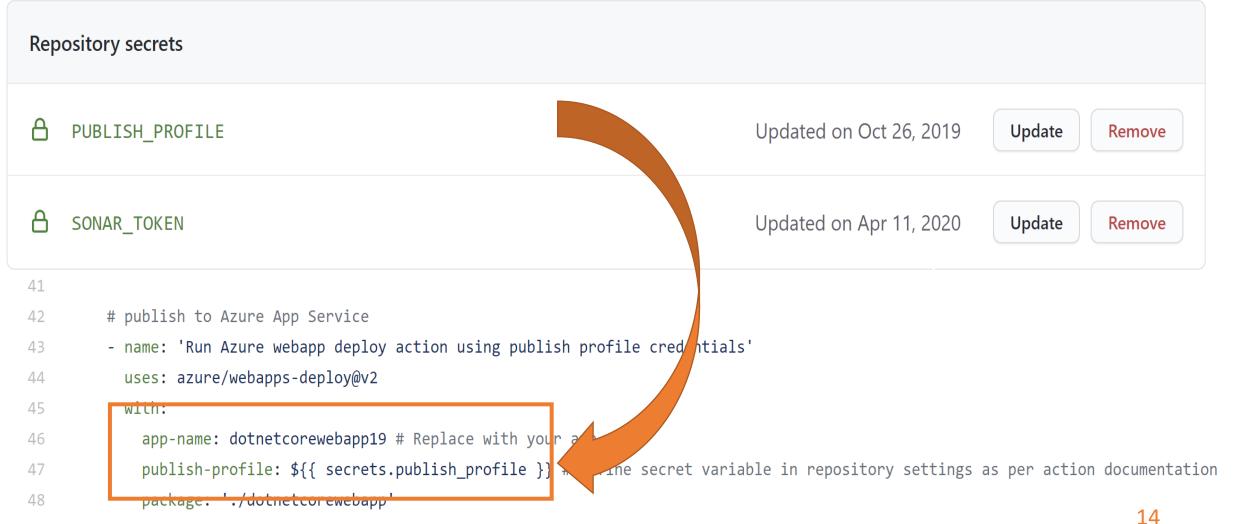
12

# Repository security

- Access to code
- Workflow secrets
- Your code

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## Workflow secrets



## Workflow secrets

### Encrypted client side before reaching GitHub:

- Encrypted with the public key for your org or repo (created and stored by GitHub)
- Used when using the UI
- Encrypt yourself before posting to the REST API

Secrets are **not** shared to forked repositories

## Who has access to your secrets?

For creating at repo level: Repository Owner access

For creating at org level: Admin access to the org

Set an access policy for the secrets:

- All repositories
- Private repositories
- Only selected repositories

## Who has access to your secrets?

Encrypted until used, then injected as:

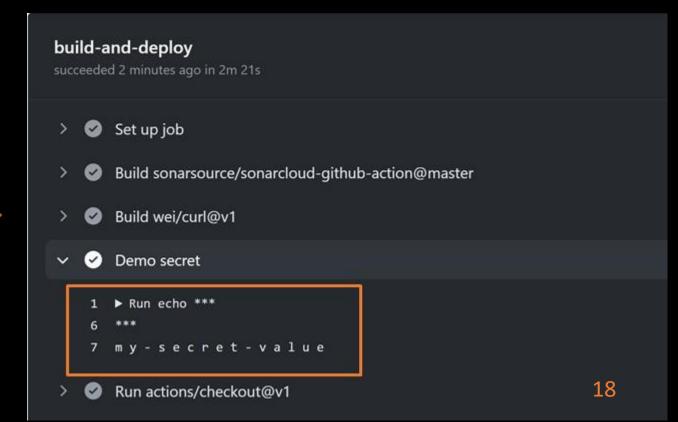
- An environment variable
- Direct input

Will be redacted in logs

Don't use structured data (like json): hard to redact

## Who has access to your secrets?

- Actions can do anything with them!
- Anyone with access to the Action Logs should be considered to have access to your secrets



# Repository security

- Access to code
- Workflow secrets
- Your code/repo

## Your code

## Anything in your repository:

- Workflow files
- Shell scripts
- Your own code
- Dependencies:
  - Packages
  - Containers

### **Best practices:**

- Static code analysis
  - Check your own code!

- Third party dependency scanning
  - 99% of your code, is not yours:
    - Scan for known vulnerabilities
  - Keep your dependencies up to date!

## Your code/repo – trace changes

Who made changes:

- Code: Git commit history

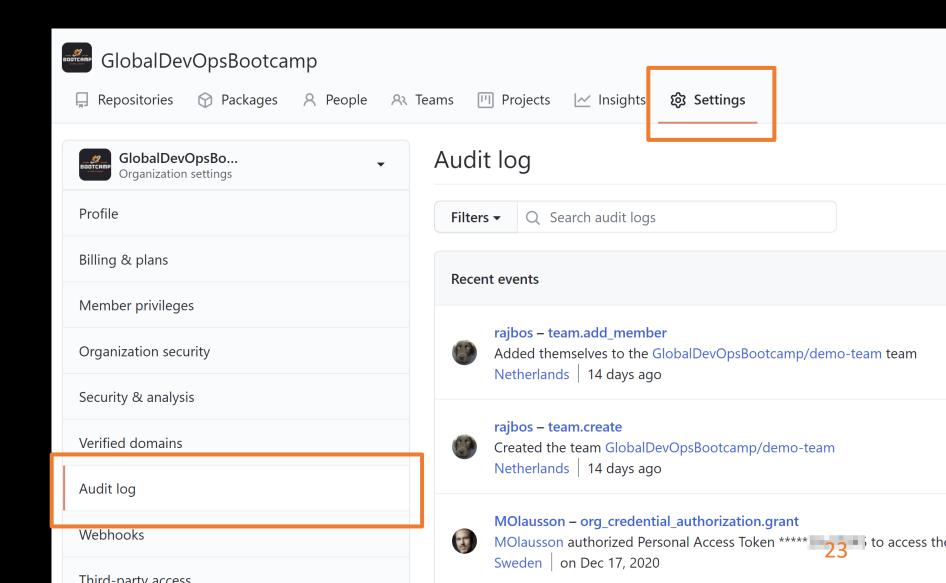
- Everything around your code is in the audit log

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# Your code/repo — trace changes (org level)

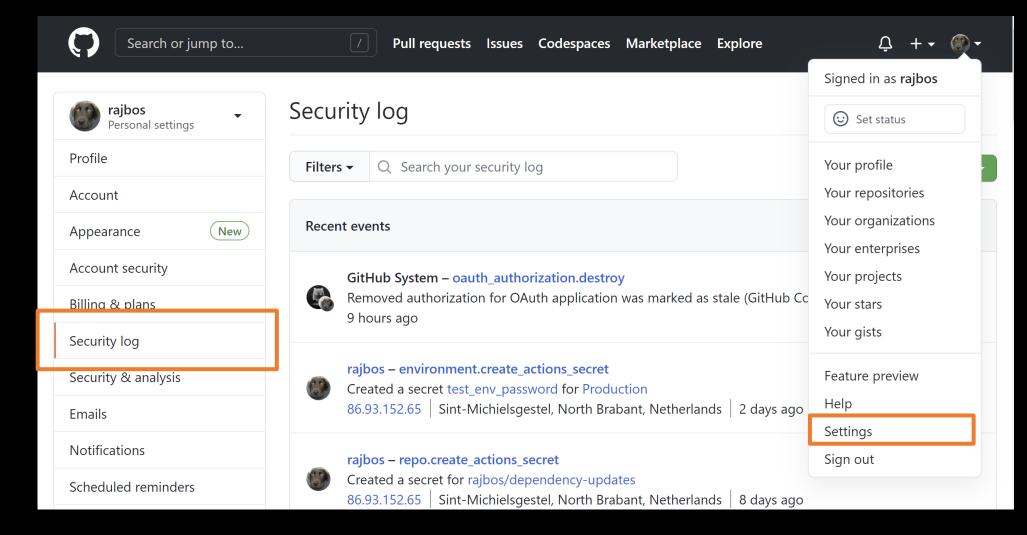
## Audit log:

- Access
- Secrets
- Access Tokens
- OAuth grants
- Enabling features
- Etc.



## Your code/repo – trace changes

#### **Account level:**



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## Workflow Runners

#### Actions execute on runners

#### Self hosted

- Cloud / On premises hosted by yourself
- OS + Tools update = YOUR responsibility
- Enables specific environment setup
- No usage limits

#### GitHub hosted

- OS + Tools update = GitHub's responsibility
- Per minute rating applies after the free minutes
- Clean execution environment with every run

```
name: .NET Core Deploy to IIS
on:
  push:
   branches:
      - "self-hosted"
jobs:
 build-and-deploy:
   runs-on: self-hosted
   steps:
    uses: actions/checkout@v1
    - name: Setup .NET Core
      uses: actions/setup-dotnet@v1
     with:
       dotnet-version: 3.0.100
```

```
1  name: .NET Core
2
3  on: [push]
4
5  jobs:
6  build-and-deploy:
7
8  runs-on: ubuntu-latest
9
10  steps:
11  - uses: actions/checkout@v1
12  - name: Setup .NET Core
13  uses: actions/setup-dotnet@v1
14  with:
15  dotnet-version: 3.0.100
```

## **Workflow Runners**

## Security

- Environment scope
  - Network
  - Shared state between runs

• User: limit its access!

## Best practice: Run the action inside of a container

```
jobs:
    my_first_job:
    steps:
        - name: My first step
        uses: docker://gcr.io/cloud-builders/gradle
```

```
test-box:
    runs-on: ubuntu-latest
    container:
     image: azul/zulu-openjdk-alpine:8-jre
· · steps: · ·
     uses: actions/checkout@v2
     name: What OS is running
     run: uname -a
     name: What java version do we have
      run: java -version
```

## Workflow runners

Best practice: Don't use self hosted runners for public repositories

## **Example:**

- Your repo
- New fork
- Adds malicious code
- Create pull request to your repo
- Workflow is executed on your self hosted runner?

## Persisting data between runs

#### Run 1:

- Download dependencies
- Build the code
- Somehow overwrite the dependency cache

#### **Run 2:**

- Use cached dependencies
- Build the code
- Malicious dependency in build artefact

Solarwind attack:

https://xpir.it/Solorigate

## Workflow runners – Best practice

## Don't share runners (and machines!) between repositories:

• Run 1 can influence Run 2

#### Risks:

- Malicious programs
- Escaping the runner sandbox
- Exposing access to the (network) environment
- Persisting unwanted or dangerous data



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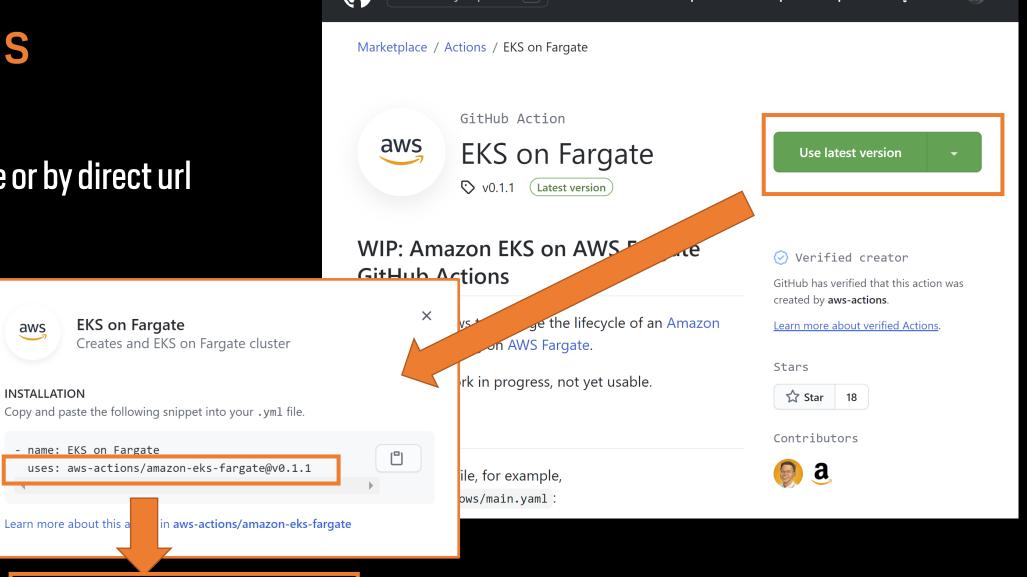
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## Marketplace or by direct url

aws

INSTALLATION



Pulls Issues Codespaces Marketplace Explore

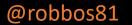
Search or jump to...

https://github.com/aws-actions/amazon-eks-fargate

Learn more about this a

- name: EKS on Fargate

**EKS on Fargate** 



## Actions and security



Are you running just any action from the internet?



Scary! Especially in an enterprise or on local runners

# Attack vectors

- 1. Data Theft
- 2. Data Integrity Breaches
- 3. Availability

## Protective measures

## Manually:

- 1. Check the action repo code before use
- 2. Check its container images and dependencies before use

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## Protective measures

```
uses: shprink/nonharmful-and-must-have-actions@v1
with:
  my-secret: ${{ secrets.MY_SECRET }}
```

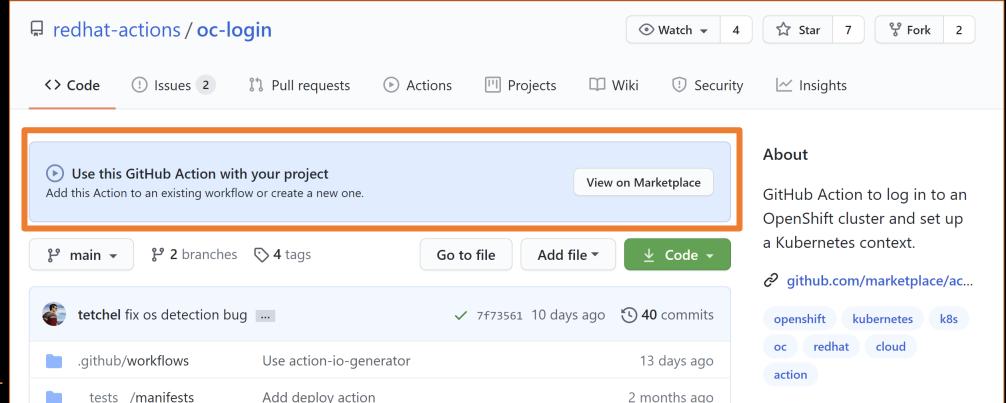
https://github.com/shprink/nonharmful-and-must-have-actions

If the repo has an action.yml, you can use it in your workflow

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#### Only use actions listed in the marketplace?

There is no real verification process for it ⊗



#### Actions

An entirely new way to automate your development workflow.

**45 results** for "z" filtered by

Actions x





#### **OWASP ZAP Baseline Scan**

By zaproxy 🚱 Scans the web ap 135 stars

with the OWASP ZAP Baseline Scan



#### **Zeebe Action**

By jwulf

A GitHub action to interact with Zeebe and Camunda Cloud 6 stars

Verified creator

GitHub has verified that this action was created by **pachyderm**.

Learn more about verified Actions.

### Verified Creator

#### Verification process:

- GitHub Profile information is present and accurate
- Two factor authentication is on for the organization
- Domain verification through a txt record

See: <a href="https://xpir.it/verified-publisher">https://xpir.it/verified-publisher</a>

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#### Limiting actions altogether

#### Actions permissions

- Allow all actions
  - Any action can be used, regardless of who authored it or whe
- O Disable Actions

The Actions tab is hidden and no workflows can run.

Allow local actions only

Only actions defined in a repository within rajbos can be used

Allow select actions

Only actions that match specified criteria can be used. Learn r

#### Actions permissions

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Allow select actions

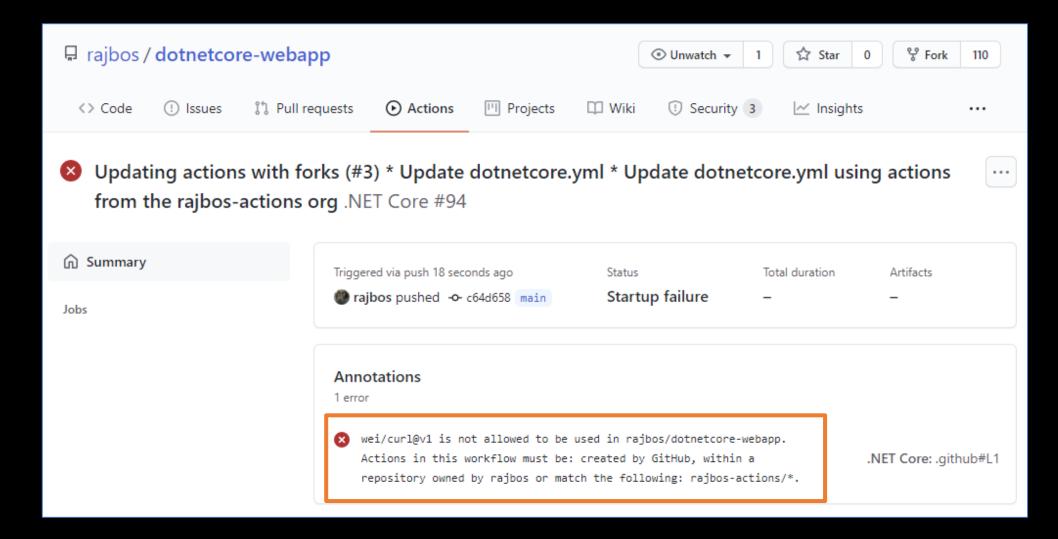
Only actions that match specified criteria can be used. Learn more about allowing specific actions to run.

- ✓ Allow actions created by GitHub
- Allow Marketplace actions by verified creators

Allow specified actions

rajbos-actions/\*,

Wildcards, tags, and SHAs are allowed. Examples: monalisa/octocat@\*, monalisa/octocat@v2, monalisa/\*



#### Pin the action version:

uses: gaurav-nelson/github-action-markdown-link-check@v1

uses: gaurav-nelson/github-action-markdown-link-chec c@v1.0.1

#### **Best practice:** Pin the Action's commit SHA:

uses: gaurav-nelson/github-action-markdown-link-check@44a942b2f7ed0dc101d556f281e906fb79f1f478

### Recommendation

Best practice: Limit to local actions and fork action repositories

- Create a separate org to test actions in
  - Enable DevOps teams to own the actions

#### Actions permissions

Allow all actions

Any action can be used, regardless of who authored it or where it is defined.

Disable Actions

The Actions tab is hidden and no workflows can run.

Allow local actions only

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Allow select actions

Only actions that match specified criteria can be used. Learn more about allowing specific actions to run.

### Workflow attack vectors

Forks of public repos

Common fields

# Forks of public repos

```
on:
       - push
                                                   Safe, runs on merge commit, read only access
       - pull request
       pull_request_target
 6
                                                   High risks! Runs on the target, has read +
                                                   write access and can access secrets
     jobs:
       build-and-deploy:
 9
         environment: PullRequestEnvironment
10
11
         runs-on: ubuntu-latest
12
13
         steps:
15
         - uses: actions/checkout@v1
```

https://xpir.it/gh-pwn-request

### Common fields

github.event.issue.title github.event.issue.body github.event.pull\_request.title github.event.pull\_request.body github.event.comment.body github.event.review.body github.event.review\_comment.body github.event.pages.\*.page\_name github.event.commits.\*.message github.event.head\_commit.message github.event.head\_commit.author.email github.event.head\_commit.author.name github.event.commits.\*.author.email github.event.commits.\*.author.name github.event.pull\_request.head.ref github.event.pull\_request.head.label github.event.pull\_request.head.repo.default\_branch github.head\_ref

### Common fields

```
- name: Check title
run: |
   title="${{ github.event.issue.title }}"
   if [[ ! $title =~ ^.*:\ .*$ ]]; then
      echo "Bad issue title"
      exit 1
   fi
```

Payload: a"; echo test

### Remediation

```
- name: print title
env:
   TITLE: ${{ github.event.issue.title }}
run: echo '$TITLE'
```

https://xpir.it/actions-untrusted-input

# GitHub Actions Security

Repository security
Runners and security
Actions and security

Forking actions

Keeping up to date



## Forking actions

#### Pros:

- More secure
- Backup of actions that can be deleted or moved to a different org/repo

#### Cons:

- More maintenance work
  - Fork needs to be created
  - Kept up to date
- Limits the usage of new actions in your org, as someone create the new action (and by that take responsibility for enabling its use)



# GitHub Actions Security

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## Updates

- Actions are updated regularly
- Wait for a deprecation message?
- How do you stay up to date?
- Auto update with a PR?
- Read the changes in the source repo

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## Staying up to date

#### Follow @githubactions on Twitter!





## Update action versions

Review the Action
 Use Actions + Commit SHA + Dependabot

2. Review the Action
Fork the Actions repo, update your forks and use Dependabot

# Option 1: Use SHA + Dependabot

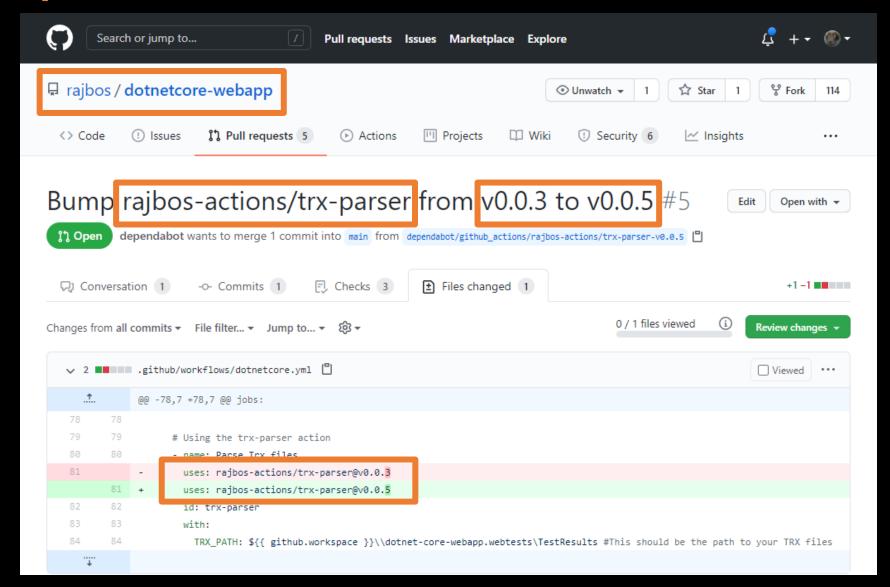
Best practice: Pin the Action's commit SHA:

uses: gaurav-nelson/github-action-markdown-link-check@44a942b2f7ed0dc101d556f281e906fb79f1f478

Add.github/dependabot.yml to the repo

```
#Dependabot will check the dependencies in this repo for updates
     version: 2
     updates:
         package-ecosystem: "github-actions
         -directory: "/"
         -schedule:
         --- # Check for updates to GitHub Actions every weekday
        ···interval: "daily"
9
10
11
     --- package-ecosystem: "nuget"
     ----directory: "/"
     ----schedule:
     ---- ** Check for updates to on nuget packages every weekday
     ----interval: "daily"
```

## Use Dependabot



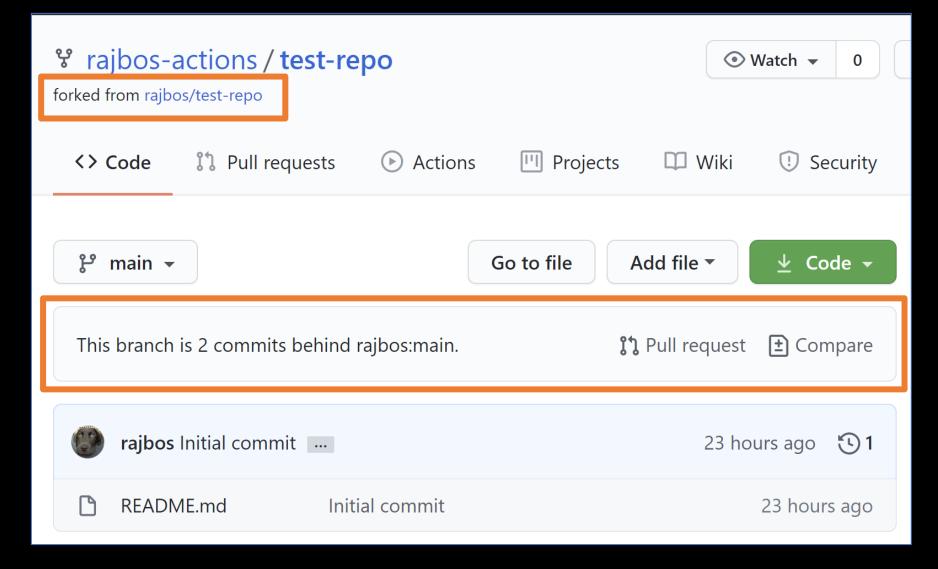
## Update action versions

Review the Action
 Use Actions + Commit SHA + Dependabot

2. Review the Action

Fork the Actions repo, update your forks and use Dependabot

## Keep you forked action up to date



## Keep your forked action up to date

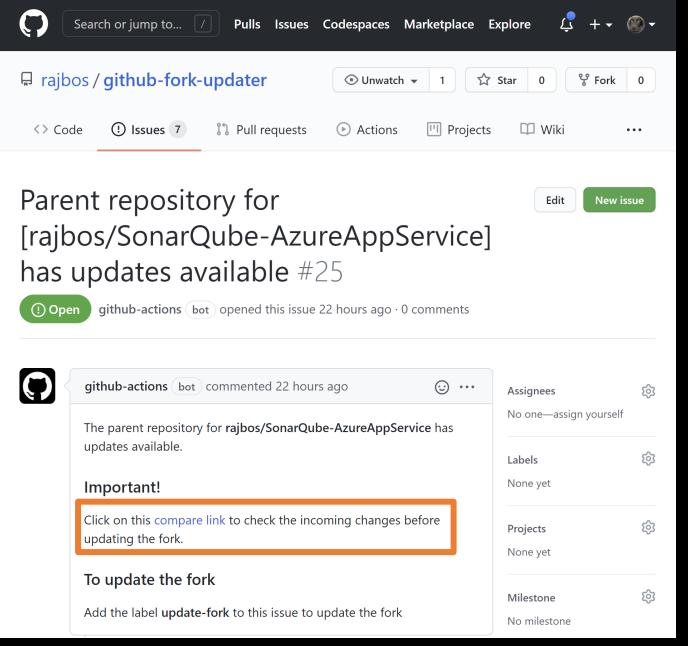
Fork a repo and automate it!

https://github.com/rajbos/github-fork-updater

#### **Contains:**

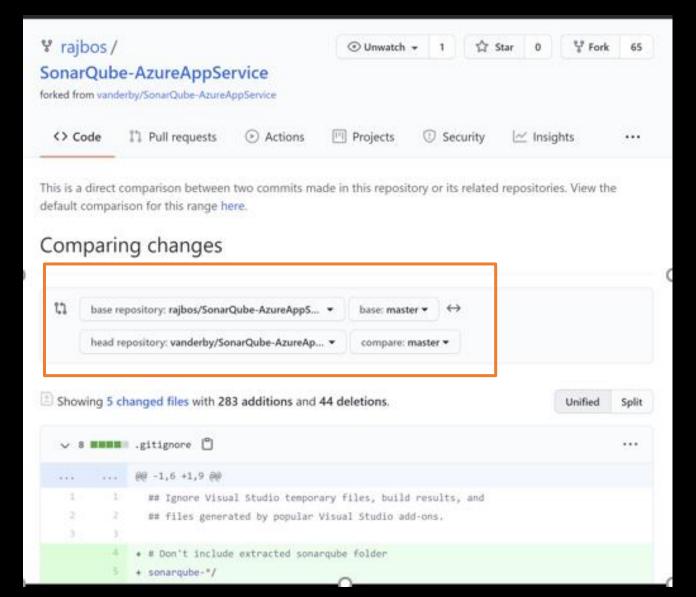
- Scheduled workflow
- Creates an issue
- Review the changes
- Label the issue
- Pull in changes

### Creates issues



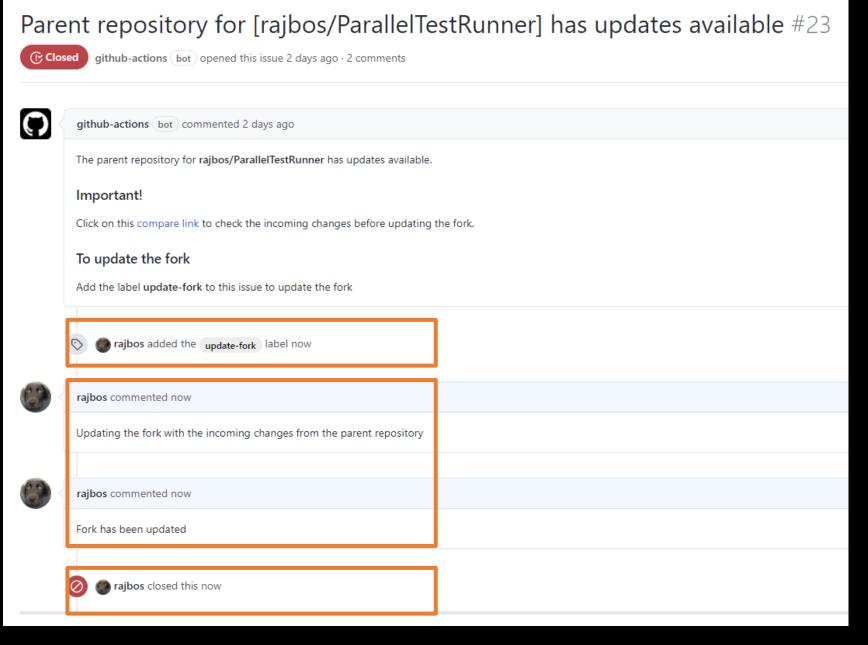
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# Review before merging



### Automation

- Add a label
- Fork gets updated
- Issue gets closed



## Pros of forking

- Backup of the action
- Full control over updates
- Pull in updates with validation centrally
- Only allow actions from your actions organization

- Skip commit SHA lookup and updating in every workflow
- Skip adding Dependabot in every repository



Repository security
Runners and security
Actions and security

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Keeping up to date

## Best practices summarized

- Treat workflow secrets very carefully: best to think of them as public
- Review actions' source code
- Pin actions to commit SHA
- Don't trust incoming Pull Requests on public repos
- Fork the action repo and limit actions to local actions only
- Have an organization setup to test with
- Keep your forked actions up to date

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