

AST1501 - Introduction to Research

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Automating tasks

Why to automate tasks

Why to automate tasks

- There are a lot of things that we have to do
 - That are kind of annoying to do
 - So we put them off
 - And off
 - And off
 - And often we don't end up doing them for a long time
- If we can automate much of these tasks, we're much more likely to do them!

Tasks that can be automated

- Updating your personal website
- Testing your code
- Updating your code's documentation
- Publishing your code
- ...

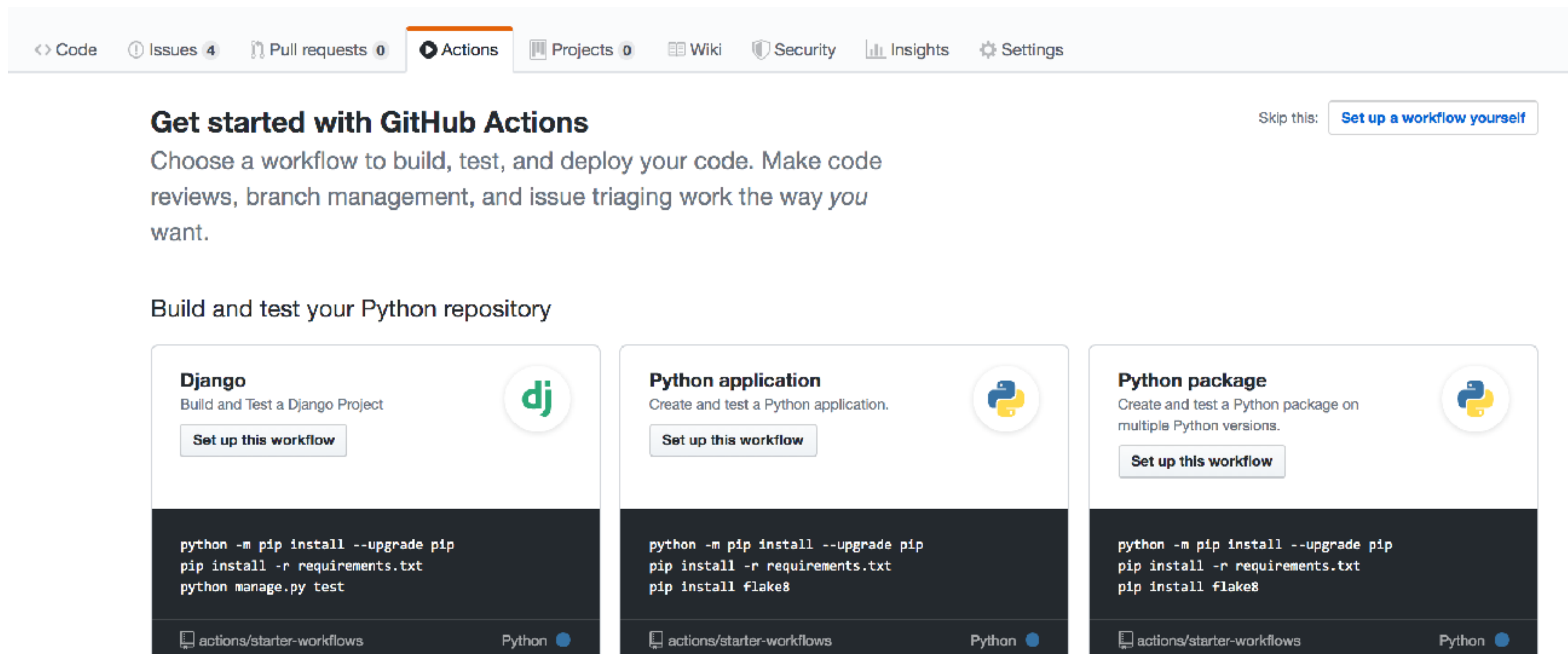
GitHub Actions

GitHub Actions

- In 2019, GitHub released a CI/CD (continuous-integration/continuous-delivery) service that is automatically part of every GitHub repository
—> GitHub Actions
- Configured with YAML files (.yml), GitHub Actions has some big advantages over other similar services:
 - Easily configure multiple different runs to do (CI tests, building documentation, building a website, responding to issues/pull requests, pushing to AWS S3, ...)
 - Re-use atomic steps defined in other GitHub repositories (e.g., setup python, setup Miniconda, setup an SSH agent)
 - More free runners available (up to 20 Linux/Windows, 5 MacOS)

Setting up GitHub actions for your repository

Go to “Actions” tab



The screenshot shows the GitHub repository interface with the 'Actions' tab selected. The navigation bar includes links for Code, Issues (4), Pull requests (0), Actions, Projects (0), Wiki, Security, Insights, and Settings. Below the navigation bar, the 'Get started with GitHub Actions' section is visible, followed by a 'Skip this: Set up a workflow yourself' link. The main content area is titled 'Build and test your Python repository' and features three workflow cards: 'Django', 'Python application', and 'Python package'. Each card includes a description, a 'Set up this workflow' button, a code block with the workflow steps, and a footer indicating the source and language.

<> Code ⓘ Issues 4 🔄 Pull requests 0 🎯 Actions 📁 Projects 0 📖 Wiki 🛡 Security 📊 Insights ⚙ Settings

Get started with GitHub Actions

Choose a workflow to build, test, and deploy your code. Make code reviews, branch management, and issue triaging work the way *you* want.

Skip this: [Set up a workflow yourself](#)

Build and test your Python repository

Django

Build and Test a Django Project

[Set up this workflow](#)

```
python -m pip install --upgrade pip
pip install -r requirements.txt
python manage.py test
```

actions/starter-workflows Python

Python application

Create and test a Python application.

[Set up this workflow](#)

```
python -m pip install --upgrade pip
pip install -r requirements.txt
pip install flake8
```

actions/starter-workflows Python

Python package

Create and test a Python package on multiple Python versions.

[Set up this workflow](#)

```
python -m pip install --upgrade pip
pip install -r requirements.txt
pip install flake8
```

actions/starter-workflows Python

Setting up GitHub actions for your repository

or just add a `.yaml` file under `.github/workflows`

```
name: Test exampy

on: [push]

jobs:
  build:
    runs-on: ubuntu-latest
    strategy:
      matrix:
        python-version: [3.7, 3.8]
        numpy-version: [1.16,1.17,1.18]
        exclude:
          - python-version: 3.8
            numpy-version: 1.16
          - python-version: 3.8
            numpy-version: 1.17
    steps:
      - uses: actions/checkout@v2
      - name: Set up Python ${ matrix.python-version }
        uses: actions/setup-python@v1
        with:
          python-version: ${ matrix.python-version }
```

Note: action versions out of date on this slide

```
- name: Install dependencies
  run: |
    python -m pip install --upgrade pip
    pip install numpy==${{ matrix.numpy-version }}
- name: Install package
  run: |
    pip install -e .
- name: Test with pytest
  run: |
    pip install pytest
    pip install pytest-cov
    pip install scipy
    pytest -v tests/ --cov=exampy/
```

```

name: Test exampy

on: [push]

jobs:
  build:
    runs-on: ubuntu-latest
    strategy:
      matrix:
        python-version: [3.7, 3.8]
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          - python-version: 3.8
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            numpy-version: 1.17
    steps:
      - uses: actions/checkout@v2
      - name: Set up Python ${ matrix.python-version }
        uses: actions/setup-python@v1
        with:
          python-version: ${ matrix.python-version }
      - name: Install dependencies
        run: |
          python -m pip install --upgrade pip
          pip install numpy==${ matrix.numpy-version }
      - name: Install package
        run: |
          pip install -e .
      - name: Test with pytest
        run: |
          pip install pytest
          pip install pytest-cov
          pip install scipy
          pytest -v tests/ --cov=exampy/

```

<— Informative name

**<— When to run the workflow
(e.g., on: [push,pull request])**

<— Job(s)

Each one runs independently

**<— Operating system
(can be ubuntu, mac, windows)**

**<— Define a matrix of different builds,
(can't 'include', so exclude)**

**<— Arbitrary sequence of steps:
1) check out the repository**


<— 2) setup Python

**<— 3) install dependencies
with pip**

<— 4) install package

**<— 5) install test dependencies
and run tests**

Note: action versions out of date on this slide

 [jobovy](#) / [exampy](#)

 Unwatch ▾ 1

 Star 1

 Fork 0

 Code

 Issues 0

 Pull requests 0

 Actions

 Projects 0

 Wiki

 Security

 Insights

 Settings

Workflows

[New workflow](#)

 All workflows

 Test exampy

All workflows

Event ▾

Status ▾


Branch ▾


Actor ▾

 **Add GitHub action to test exampy**

Test exampy #1: Commit f850194 pushed by jobovy

master

 21 seconds ago ...

 14s



Fix exclusion syntax

master



93cf2da

Test exampy

on: push

✓ build (3.7, 1.16)

✓ build (3.7, 1.17)

✓ build (3.7, 1.18)

✓ build (3.8, 1.18)

Test exampy / build (3.7, 1.16)

succeeded 24 seconds ago in 21s

Search logs

< > ...

▶ ✓	Set up job	2s
▶ ✓	Run actions/checkout@v2	1s
▶ ✓	Set up Python 3.7	0s
▶ ✓	Install dependencies	8s
▶ ✓	Install package	1s
▶ ✓	Test with pytest	9s
▶ ✓	Post actions/checkout@v2	0s
▶ ✓	Complete job	0s

Easy to use multiple operating systems:

```
name: Test exampy

on: [push]

jobs:
  build:
    runs-on: ${ matrix.os }
    strategy:
      matrix:
        os: [ubuntu-latest, windows-latest, macos-latest]
        python-version: [3.7, 3.8]
        numpy-version: [1.16,1.17,1.18]
        exclude:
          - os: ubuntu-latest
            python-version: 3.8
            numpy-version: 1.16
          - os: ubuntu-latest
            python-version: 3.8
            numpy-version: 1.17
          - os: windows-latest
            python-version: 3.8
            numpy-version: 1.16
          - os: windows-latest
            python-version: 3.8
            numpy-version: 1.17
          - os: macos-latest
            python-version: 3.8
            numpy-version: 1.16
          - os: macos-latest
            python-version: 3.8
            numpy-version: 1.17
    steps:
```



Run integration tests on all three major OS using Act...

master



6c26f8e

Test exampy on: push

- ✓ build (ubuntu-latest, 3.7, ...)
- ✓ build (ubuntu-latest, 3.7, ...)
- ✓ build (ubuntu-latest, 3.7, ...)
- ✓ build (ubuntu-latest, 3.8, ...)
- ✓ build (windows-latest, 3....)
- ✓ build (windows-latest, 3....)
- ✓ build (windows-latest, 3....)
- ✓ build (windows-latest, 3....)
- ✓ build (macos-latest, 3.7, ...)
- ✓ build (macos-latest, 3.7, ...)
- ✓ build (macos-latest, 3.7, ...)
- ✓ build (macos-latest, 3.8, ...)



Test exampy

This run

Workflow file

Create status badge ▾



12 completed jobs in 1m 34s

Artifacts



No artifacts were generated.

Annotations

Re-using other actions

- GitHub users can define their own 'actions' that you can re-use in your own workflows: e.g.,
 - – `uses: actions/checkout@v4`
 - – `name: Set up Python ${{ matrix.python-version }}`
`uses: actions/setup-python@v5`
`with:`
`python-version: ${{ matrix.python-version }}`
- Take arguments in the `with:` section
- Make sure to
 - a) use a released version (e.g., `@v4`),
 - b) check that you can trust the action if you give it passwords or other permissions

Using secrets

- If as part of a workflow, you need to authenticate, you can add ‘secrets’ to your GitHub repository that can be used by actions (usernames, passwords, SSH keys, API keys, tokens, etc.)
- Use as `${{ secrets.SECRET_NAME }}`
- Not shared with forks, quite secure
- But always try to make secrets specific to GitHub, so can be easily revoked (e.g., set up special SSH key for GitHub use rather than using your normal one)
- SSH keys: set up special GitHub private key with *no passphrase*

Options

[Manage access](#)[Branches](#)[Webhooks](#)[Notifications](#)[Integrations & services](#)[Deploy keys](#)[Autolink references](#)[Secrets](#)

Moderation

[Interaction limits](#)

Settings

Repository name

exampy

Rename

☐ Template repository

Template repositories let users generate new repositories with the same directory structure and files. Indicate if **jobovy/exampy** can be used as a template for creating other repositories.

Social preview

Upload an image to customize your repository's social media preview.

Images should be at least 640×320px (1280×640px for best display).

[Download template](#)

Options

Manage access

Branches

Webhooks

Notifications

Integrations & services

Deploy keys

Autolink references

Secrets

Actions

Moderation

Interaction limits

Secrets

Secrets are environment variables that are **encrypted** and only exposed to selected actions. Anyone with **collaborator** access to this repository can use these secrets in a workflow.

Secrets are not passed to workflows that are triggered by a pull request from a fork. [Learn more](#).

[Add a new secret](#)

Options

Manage access

Branches

Webhooks

Notifications

Integrations & services

Deploy keys

Autolink references

Secrets

Actions

Moderation

Interaction limits

Secrets

Secrets are environment variables that are **encrypted** and only exposed to selected actions. Anyone with **collaborator** access to this repository can use these secrets in a workflow.

Secrets are not passed to workflows that are triggered by a pull request from a fork. [Learn more](#).

[Add a new secret](#)**Name**

SSH_PRIVATE_KEY

Value

PRIVATE KEY HERE (get with cat private_key | pbcopy)

Add secret

Once you hit 'Add secret',
you can never see the value again

Practical example: update your website on lepus

```
name: Update website

on: [push]

jobs:
  build_website:
    name: Build main website
    runs-on: ubuntu-latest
    if: "!contains(github.event.head_commit.message, 'ci skip')"
    steps:
      # check-out this repository
      - uses: actions/checkout@v4
      # Build main website
      - name: Build website
        run: |
          mkdir build
          make web ONLINEPATH=build
      # Setup SSH agent
      - uses: webfactory/ssh-agent@v0.9.0
        if: startsWith(github.ref,'refs/heads/main') && github.event_name != 'pull_request'
        with:
          ssh-private-key: ${ secrets.SSH_PRIVATE_KEY }
      # Upload to lepus, to quickly upload new website
      - name: Upload
        if: startsWith(github.ref,'refs/heads/main') && github.event_name != 'pull_request'
        working-directory: build
        run: rsync --rsh="ssh -o StrictHostKeyChecking=no -o UserKnownHostsFile=/dev/null -o HostkeyAlgorithms=+ssh-rsa -o PubkeyAcceptedAlgorithms=+ssh-rsa" -azv ./
        bovy@lepus.astro.utoronto.ca:/home/bovy/web/
```

```
build_cv:
  name: Build CV
  runs-on: ubuntu-latest
  if: "!contains(github.event.head_commit.message, 'ci skip')"
  steps:
    # check-out this repository
    - uses: actions/checkout@v4
    # Setup SSH agent
    - uses: webfactory/ssh-agent@v0.9.0
      if: startsWith(github.ref, 'refs/heads/main') && github.event_name != 'pull_request'
      with:
        ssh-private-key: ${ secrets.SSH_PRIVATE_KEY }
    # Install LaTeX for CV building
    - name: Install LaTeX
      run: |
        sudo paperconfig -p letter
        sudo apt-get update
        sudo apt-get install -qq --no-install-recommends dvipng texlive-latex-base texlive-latex-extra texlive-fonts-recommended graphviz xzdec
    # Build CV
    - name: Build CV
      working-directory: CV
      run: |
        mkdir ../build
        make web ONLINEPATH=../build
    # Upload to lepus, including CV now
    - name: Upload
      if: startsWith(github.ref, 'refs/heads/main') && github.event_name != 'pull_request'
      working-directory: build
      run: rsync -e"ssh -o StrictHostKeyChecking=no -o UserKnownHostsFile=/dev/null -o HostkeyAlgorithms=+ssh-rsa -o PubkeyAcceptedAlgorithms=+ssh-rsa" -azv ./
bovy@lepus.astro.utoronto.ca:/home/bovy/web/
```


Practical example: update your website on GitHub Pages

```
44     - name: Deploy 🚀  
45       if: github.event_name != 'pull_request'  
46       uses: JamesIves/github-pages-deploy-action@v4  
47       with:  
48         folder: _site
```

Practical example: update your website on AWS/S3

```
24      # Push to Amazon S3
25      - name: Upload website
26        uses: jakejarvis/s3-sync-action@v0.5.1
27        with:
28          args: --acl public-read --follow-symlinks --delete
29        env:
30          AWS_S3_BUCKET: ${ secrets.AWS_S3_BUCKET }
31          AWS_ACCESS_KEY_ID: ${ secrets.AWS_ACCESS_KEY_ID }
32          AWS_SECRET_ACCESS_KEY: ${ secrets.AWS_SECRET_ACCESS_KEY }
33          AWS_REGION: 'us-east-2'
34          SOURCE_DIR: 'src'          # optional: defaults to entire repository
```


You can define multiple workflows

galpy / .github / workflows /

Add file



dependabot[bot] and jobovy Bump the actions group with 1 update



0937430 · last week



History

Name	Last commit message	Last commit date
..		
build.yml	Bump the actions group with 1 update	last week
build_pyodide_wheels.yml	Bump the actions group with 1 update	2 weeks ago
build_windows.yml	Update test suite to Python 3.12 (#603)	last week
stale.yml	Bump actions/stale from 8 to 9	2 months ago
wheels.yml	Bump actions/upload-artifact and actions/download-artifact from 3 to 4 (2 months ago

You can define multiple workflows

galaxiesbook / .github / workflows /

Add file








dependabot[bot] and jobovy Bump the actions group with 1 update



1838667 · 1 hour ago



History

Name	Last commit message	Last commit date
 ..		
 check-links.yml	Bump actions/checkout from 3 to 4 (#15)	5 months ago
 check-notebooks.yml	Bump the actions group with 1 update	3 weeks ago
 publish-website.yml	Bump actions/setup-node from 3 to 4 (#17)	4 months ago
 update-website.yml	Bump the actions group with 1 update	1 hour ago

You can do almost anything!

- GitHub actions is extremely flexible and because you can re-use actions, someone else has almost certainly already figured out how to do what you want to do!
- Some non-trivial things I've used:
 - Set up an SSH agent
 - Caching data and code between runs —> actions/cache
 - Getting a list of files changed since the previous push to GitHub —> tj-actions/changed-files@v42
 - Using a job to create a matrix of other jobs to run
 - Only running a workflow when creating a tag (useful for automating releases)

**Using Dependabot to keep your
actions up-to-date**

Using Dependabot to keep your actions up-to-date

- As we've seen, re-usable actions have a version that needs to be specified
- These are updated from time to time and it's hard to track when this happens
- Dependabot does this for you!
- How? Write a dependabot.yml file in your .github/ folder

```
.github > ! dependabot.yml
1  version: 2
2  updates:
3  - package-ecosystem: "github-actions"
4    directory: "/"
5    schedule:
6      interval: "weekly"
7    groups:
8      actions:
9      patterns:
10     - '*'
11
```

Using Dependabot to keep your actions up-to-date

jobovy / galpy

Type to search

<> Code

Issues 5

Pull requests

Discussions

Actions

Wiki

Security

Insights

Settings

Bump actions/setup-python from 4 to 5 #615

Edit <> Code

Merged

jobovy merged 1 commit into main from dependabot/github_actions/actions/setup-python-5 on Dec 10, 2023


Conversation 1

Commits 1

Checks 102

Files changed 4

+4 -4

 **dependabot** bot commented on behalf of github on Dec 10, 2023

Contributor

...

Bumps [actions/setup-python](#) from 4 to 5.


► Release notes


► Commits

📊 compatibility 95%

Dependabot will resolve any conflicts with this PR as long as you don't alter it yourself. You can also trigger a rebase manually by commenting `@dependabot rebase`.

► Dependabot commands and options



 Bump actions/setup-python from 4 to 5

Verified ✓ 1c762dc

Reviewers

No reviews

Assignees

No one—assign yourself

Labels

dependencies

Projects

None yet

Milestone

No milestone

Development

Successfully merging this pull request may close

Using Dependabot to keep your actions up-to-date

The screenshot shows a GitHub interface for the repository 'jobovy / galpy'. The top navigation bar includes links for Code, Issues (5), Pull requests, Discussions, Actions, Wiki, Security, Insights, and Settings. The main heading of the pull request is 'Bump the actions group with 1 update #630'. A purple 'Merged' badge is present, followed by the text 'jobovy merged 1 commit into main from dependabot/github_actions/actions-1a2505a5f7 last week'. Below this, a summary bar shows 'Conversation 0', 'Commits 1', 'Checks 88', and 'Files changed 1'. The pull request details section shows a comment from 'dependabot bot' stating it commented on behalf of 'github' last week. The comment text reads: 'Bumps the actions group with 1 update: codecov/codecov-action. Updates codecov/codecov-action from 3 to 4'. It lists expandable sections for 'Release notes', 'Changelog', and 'Commits'. A 'compatibility 100%' badge is shown. The comment concludes with: 'Dependabot will resolve any conflicts with this PR as long as you don't alter it yourself. You can also trigger a rebase manually by commenting @dependabot rebase .'. At the bottom, there is a section for 'Dependabot commands and options'.

jobovy / galpy

Code Issues 5 Pull requests Discussions Actions Wiki Security Insights Settings

Bump the actions group with 1 update #630

Merged jobovy merged 1 commit into main from dependabot/github_actions/actions-1a2505a5f7 last week

Conversation 0 Commits 1 Checks 88 Files changed 1

dependabot bot commented on behalf of github last week Contributor

Bumps the actions group with 1 update: [codecov/codecov-action](#).

Updates [codecov/codecov-action](#) from 3 to 4

- Release notes
- Changelog
- Commits

compatibility 100%

Dependabot will resolve any conflicts with this PR as long as you don't alter it yourself. You can also trigger a rebase manually by commenting `@dependabot rebase`.

► Dependabot commands and options