Tudat Developer

None

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1. Welcome

Welcome to the Tudat Developer documentation! This documentation is intended for developers who want to contribute to the Tudat project. It contains information on how to set up your development environment, how to build Tudat, and how to contribute to the project.

1.1 Getting Started

To get started, you should first read the Primer section of the documentation. This section contains information on how to set up your development environment, how to build Tudat, and how to contribute to the project.

1.2 Guides

The Guides section contains more in-depth information on specific topics. These guides are intended for developers who want to contribute to the Tudat project.

1.3 Reference

The Reference section contains information on the Tudat codebase. This section is intended for developers who want to contribute to the Tudat project.

2. Primer

2.1 Documentation

Effective documentation is a critical component of any software development project, for several reasons. First, as Guido van Rossum, the creator of Python, has noted, "Code is more often read than written." This means that code that is not properly documented can be difficult to understand and maintain, even for the original author.

As Jeff Atwood, the founder of Coding Horror, has noted, "Code tells you how; Comments tell you why." Documentation provides context and explanation for the code, helping other developers to understand the purpose and functionality of the code, as well as its intended usage.

Finally, as Daniele Procida, the author of "Documentation: An Introduction for Technical Writers and Engineers," has noted, "It doesn't matter how good your software is, because if the documentation is not good enough, people will not use it." In order for software to be widely adopted and successful, it must be accompanied by high-quality documentation that is easy to understand and use.

In summary, effective project documentation is critical for ensuring that code is maintainable, understandable, and usable by other developers. By providing context, explanation, and instruction, documentation can help to ensure that software is widely adopted and successful.

2.1.1 Diátaxis Framework

A systematic framework for technical documentation authoring.

The Diátaxis framework systematically addresses the structure of technical documentation by identifying four documentation modes:

1. **Tutorials**: *Learning-oriented*
2. **How-To Guides**: *Problem-oriented*
3. **Reference**: *Information-oriented*
4. **Explanation**: *Understanding-oriented*

Each mode serves a distinct user need and requires a unique approach to creation. The name Diátaxis comes from the Greek "dia" (across) and "taxis" (arrangement).

The framework advocates for a hierarchical approach to organizing and presenting information, with the four modes of documentation deriving its structure from the relationship between them. Additionally, Diátaxis emphasizes the importance of the following components:

- **Content**: The information presented in the documentation, including text, images, diagrams, and code snippets. The content should be accurate, concise, and easy to understand.
- **Navigation**: The way in which users can move through the documentation to find the information they need. The framework recommends providing multiple ways to navigate the documentation, such as a table of contents, search functionality, and hyperlinks.
- **Presentation**: The way in which the content is visually presented to the user. The framework advocates for a clean and consistent visual design, with a focus on readability and usability. By following the Diátaxis framework, technical writers can create documentation that is well-organized, easy to navigate, and visually appealing, helping to improve user experience and increase the effectiveness of the documentation.

diataxis.png

Example

The document that you are currently reading is an example of the "Explanation" mode of the Diátaxis framework, which provides high-level overviews and context to help users understand a product or technology.

Learn more about the Diátaxis framework from the Diátaxis Framework website.

3. Reference

3.1 Environment Variables

> **Note**
>
> You are free to use any combination of setting and accessing environment variables that you prefer. You must just ensure that the environment variables are set before you run the script that uses them, and that the environment variables are accessible from the script that uses them.

3.1.1 Python

defined using `os.environ`

In Python, you can define environment variables using the `os.environ` dictionary. The following code snippet demonstrates how to define an environment variable named `VAR` in Python:

```
import os

os.environ["VAR"] = "value"
```

> **Warning**
>
> This is **not** a recommended way to define environment variables for sensitive information such as API keys. This method is not secure, as the environment variables are stored in plain text in the Python script.

defined using `python-dotenv`

An alternative, more secure way to define environment variables in Python is to use the `python-dotenv` library. This library allows you to define environment variables in a `.env` file and load them into your Python script.

1. Install the `python-dotenv` library using `pip`:

```
pip install python-dotenv
```

2. Create a `.env` file in the same directory as your Python script and define the environment variables in the following format:

```
VAR=value
```

3. Load the environment variables into your Python script using the `load_dotenv` function:

```
from dotenv import load_dotenv
load_dotenv()
```

retrieved using `os.environ.get`

Following the definition of environment variables, you can access them in your Python script using the `os.environ.get` function.

```
import os

my_variable = os.environ.get("VAR",
                             None)  # Returns None if VAR is not set
if my_variable:
    # Use my_variable in your script
    print("VAR is set to:", my_variable)
else:
```

```
    # VAR is not set, handle the error appropriately
    print("VAR is not set.")
```

3.1.2 C++

defined using `setenv`

In C++, you can define environment variables using the `setenv` function.

```
#include <stdlib.h>

setenv("VAR", "value", 1);  // 1 indicates that the variable is overwritten if it already exists
                            // 0 indicates that the variable is not overwritten if it already exists
```

retrieved using `getenv`

Following the definition of environment variables, you can access them in your C++ script using the `getenv` function.

```
#include <stdlib.h>

char* my_variable = getenv("VAR");

if (my_variable) {
    // Use my_variable in your script
    std::cout << "VAR is set to: " << my_variable << std::endl;
} else {
    // VAR is not set, handle the error appropriately
    std::cout << "VAR is not set." << std::endl;
}
```

3.1.3 Unix (Linux, macOS)

defined using `export`

In Unix-based systems, environment variables can be defined temporarily in the current terminal session using the `export` keyword. This can also be done within a Bash script (`.sh`).

```
export VAR="value"
```

defined in `~/.bashrc`

In Unix-based systems, environment variables can be defined persistently across terminal sessions by adding the `export` statements to your shell profile file.

1. Open your shell profile file using a text editor (e.g. `nano ~/.bashrc`).
2. Add the `export` statements to the file (preferably at the end).
3. Save the file and close the text editor.
4. Restart your terminal session.
5. Verify that the environment variables are set by running the following command:

```
env | grep VAR
```

> **Note**
>
> If you are using **zsh**, you should use `~/.zshrc` instead of `~/.bashrc` .

retrieved using `$VAR`

Following the definition of environment variables, you can access them in your Bash script using the `$VAR` syntax.

```
if [ -n "$VAR" ]; then
    # Use $VAR in your script
    echo "VAR is set to: $VAR"
else
    # VAR is not set, handle the error appropriately
    echo "VAR is not set."
fi
```

3.1.4 Windows

defined using `set`

In Windows, environment variables can be defined temporarily in the current terminal session using the `set` keyword. This can also be done within a Batch script (`.bat`).

```
set VAR=value
```

defined using `setx`

In Windows, environment variables can be defined persistently across terminal sessions by adding the `setx` statements to your system environment variables.

1. Open the "System Properties" window by pressing `Windows + Pause/Break` on your keyboard.
2. Click "Advanced system settings" on the left.
3. Click "Environment Variables" on the bottom right.
4. Click "New" under "System variables" and add the environment variables.
5. Click "OK" to save the changes.
6. Restart your terminal session.
7. Verify that the environment variables are set by running the following command:

```
set | findstr VAR
```

retrieved using `%VAR%`

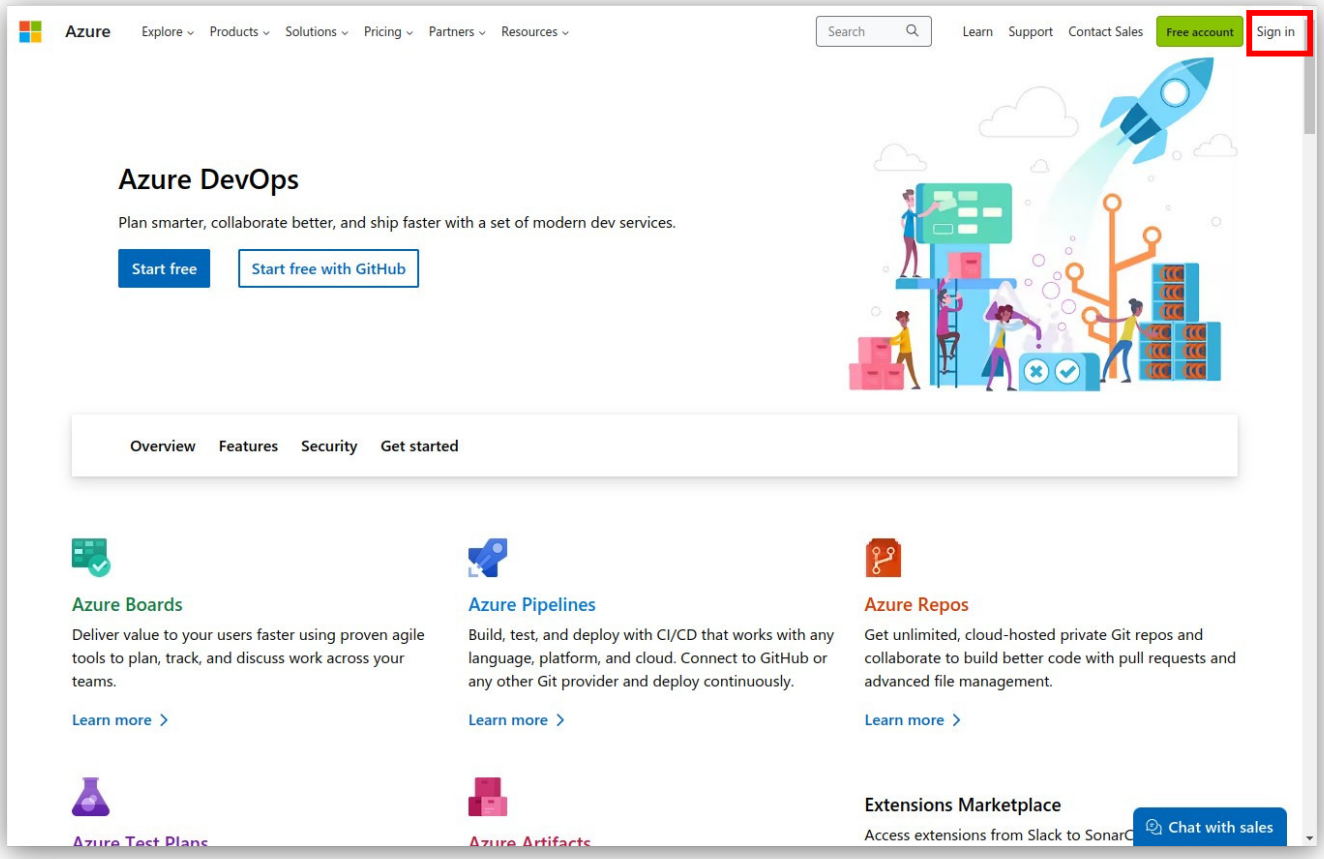
Following the definition of environment variables, you can access them in your Batch script using the `%VAR%` syntax.

```
if defined VAR (
    rem Use %VAR% in your script
    echo VAR is set to: %VAR%
) else (
    rem VAR is not set, handle the error appropriately
    echo VAR is not set.
)
```

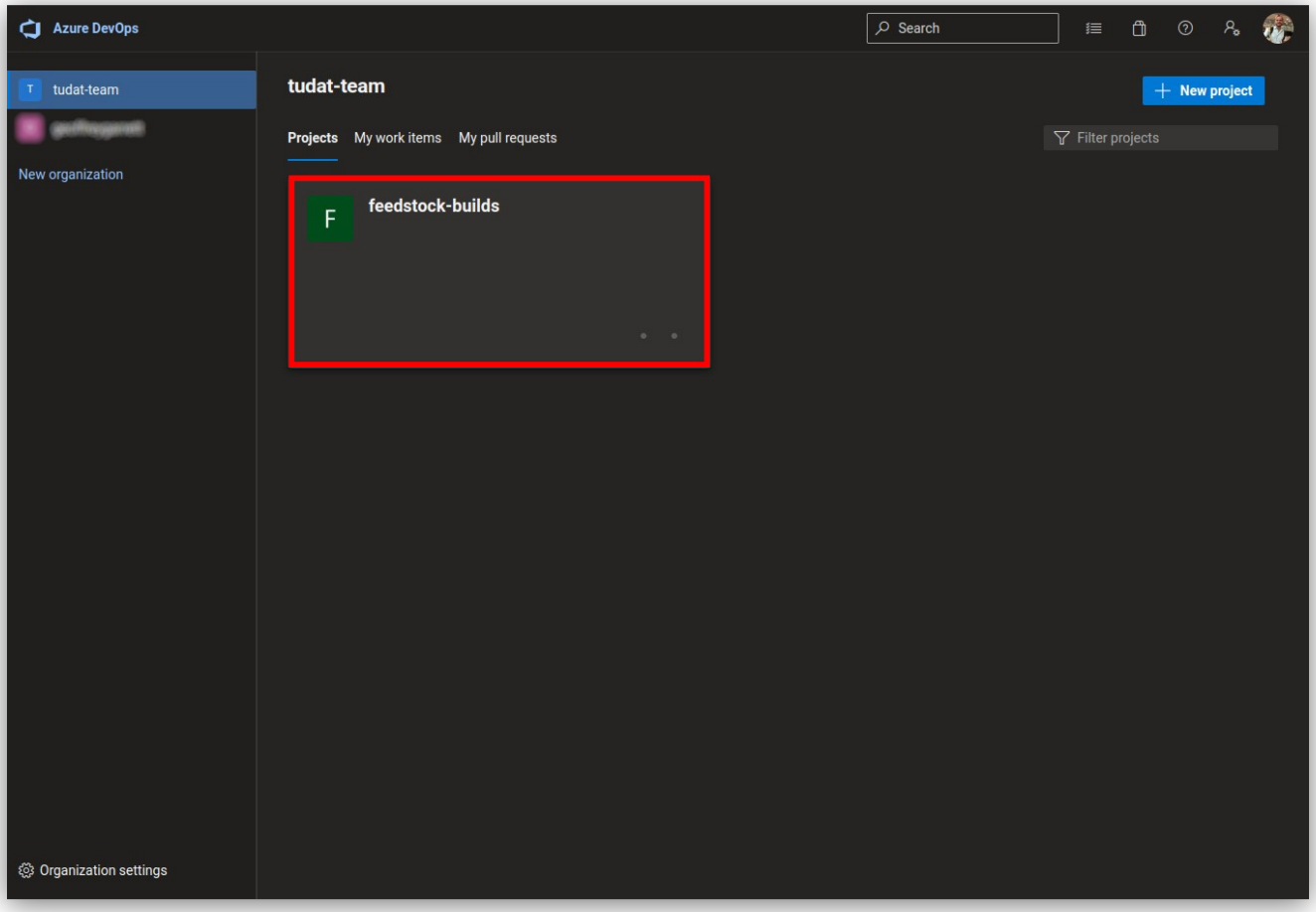
3.1.5 Azure Pipelines

> **Note**
>
> This section is intended for maintainers of the feedstock repositories (at current). If you are not a maintainer, you can safely ignore this section.

1. Navigate to `dev.azure.com` and sign in.

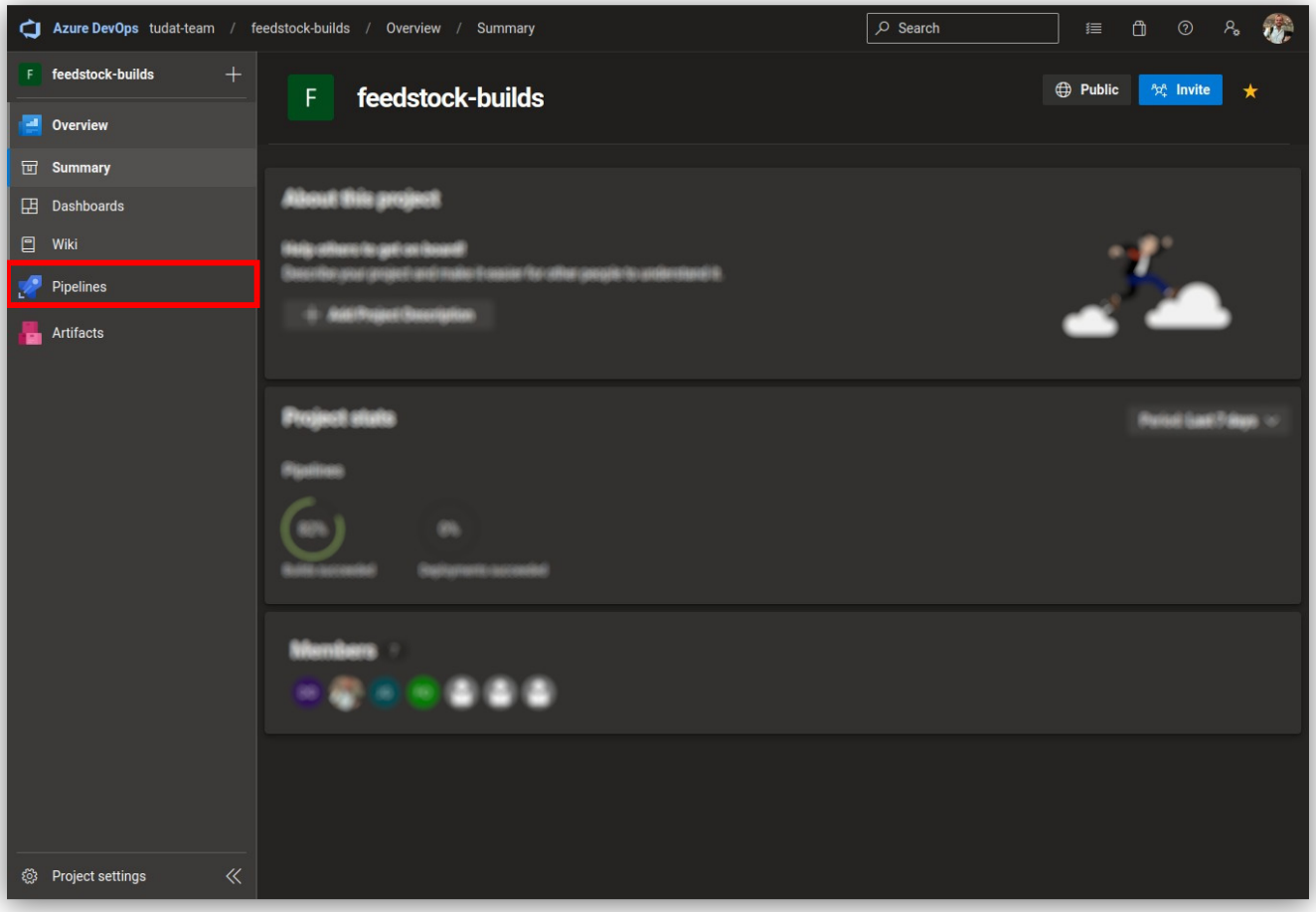


1. Click the `feedstock-builds` project under the `tudat-team` organization.

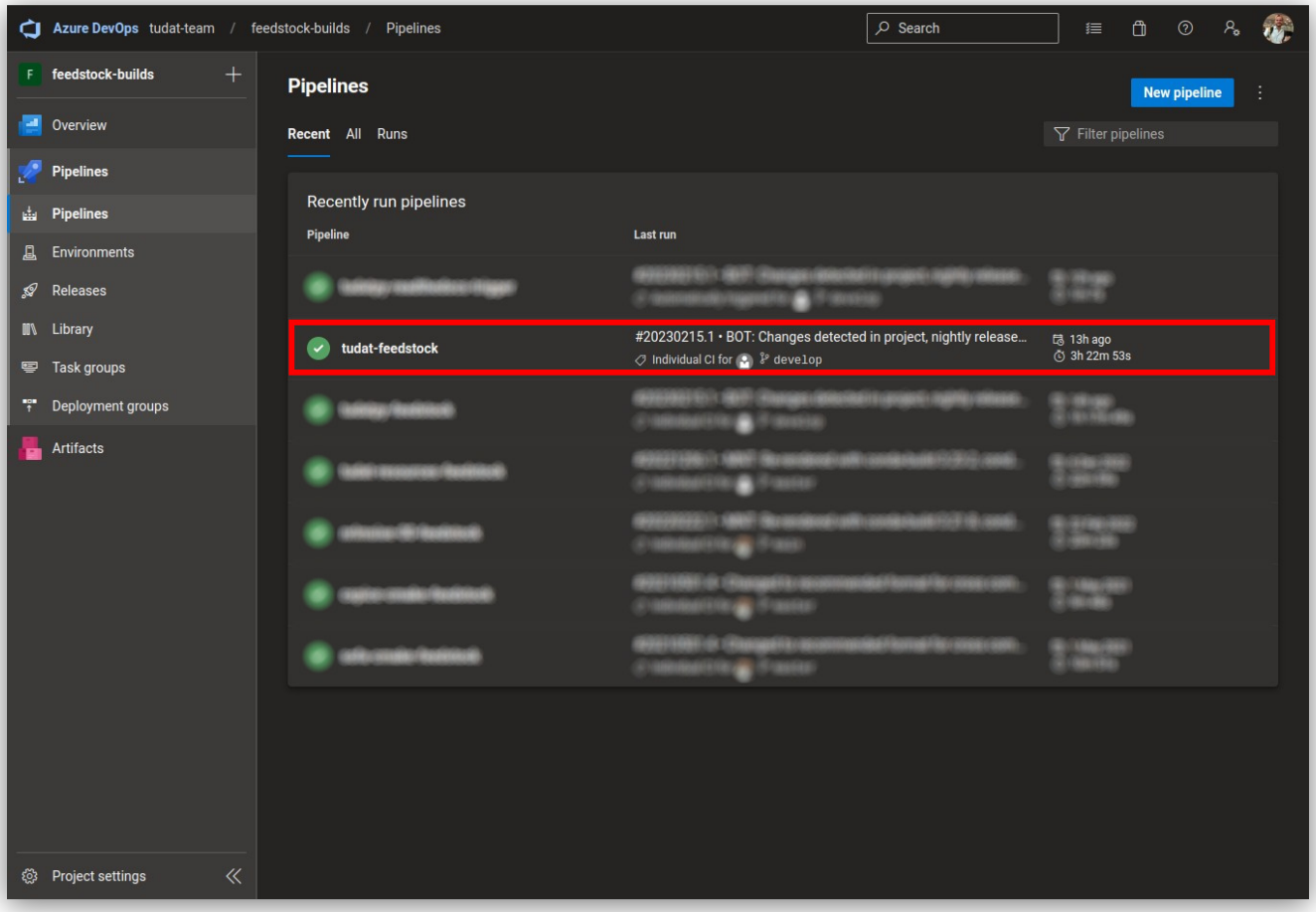


defined for a pipeline

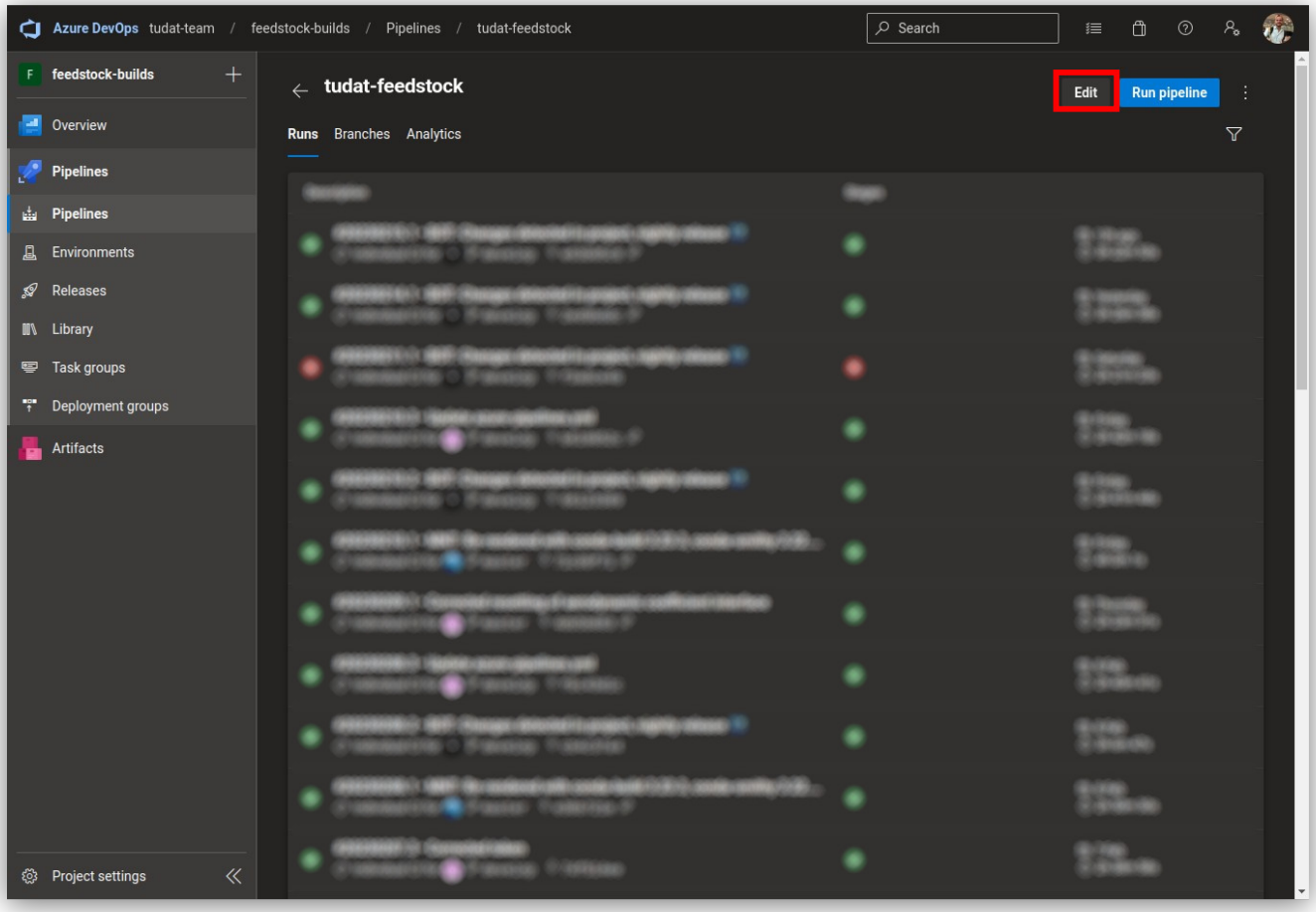
1. After navigating to the project, click " Pipelines" under the `feedstock-builds` project.



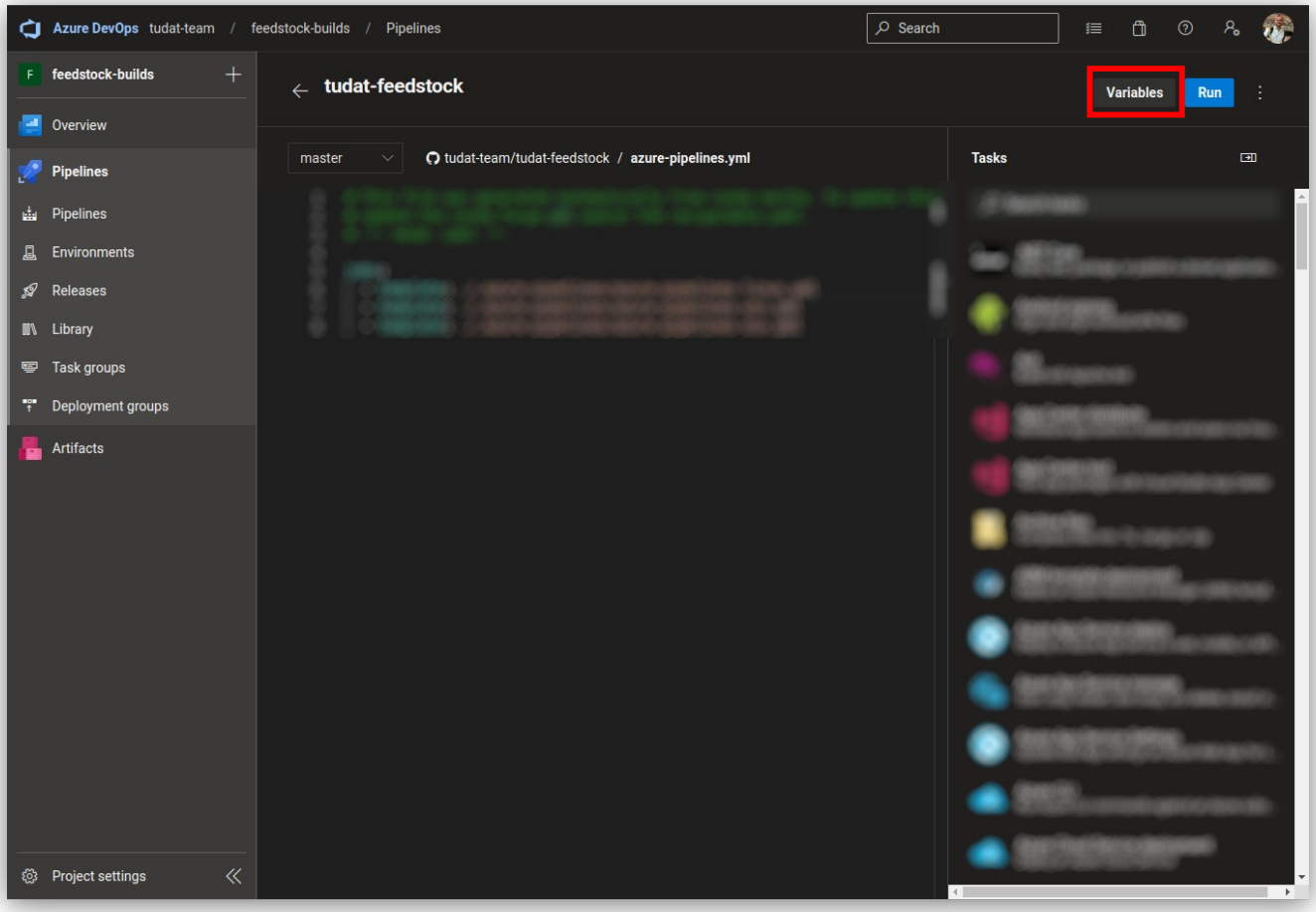
1. Click on the specific pipeline in which you want to set the environment variable (e.g. `tudat-feedstock`).



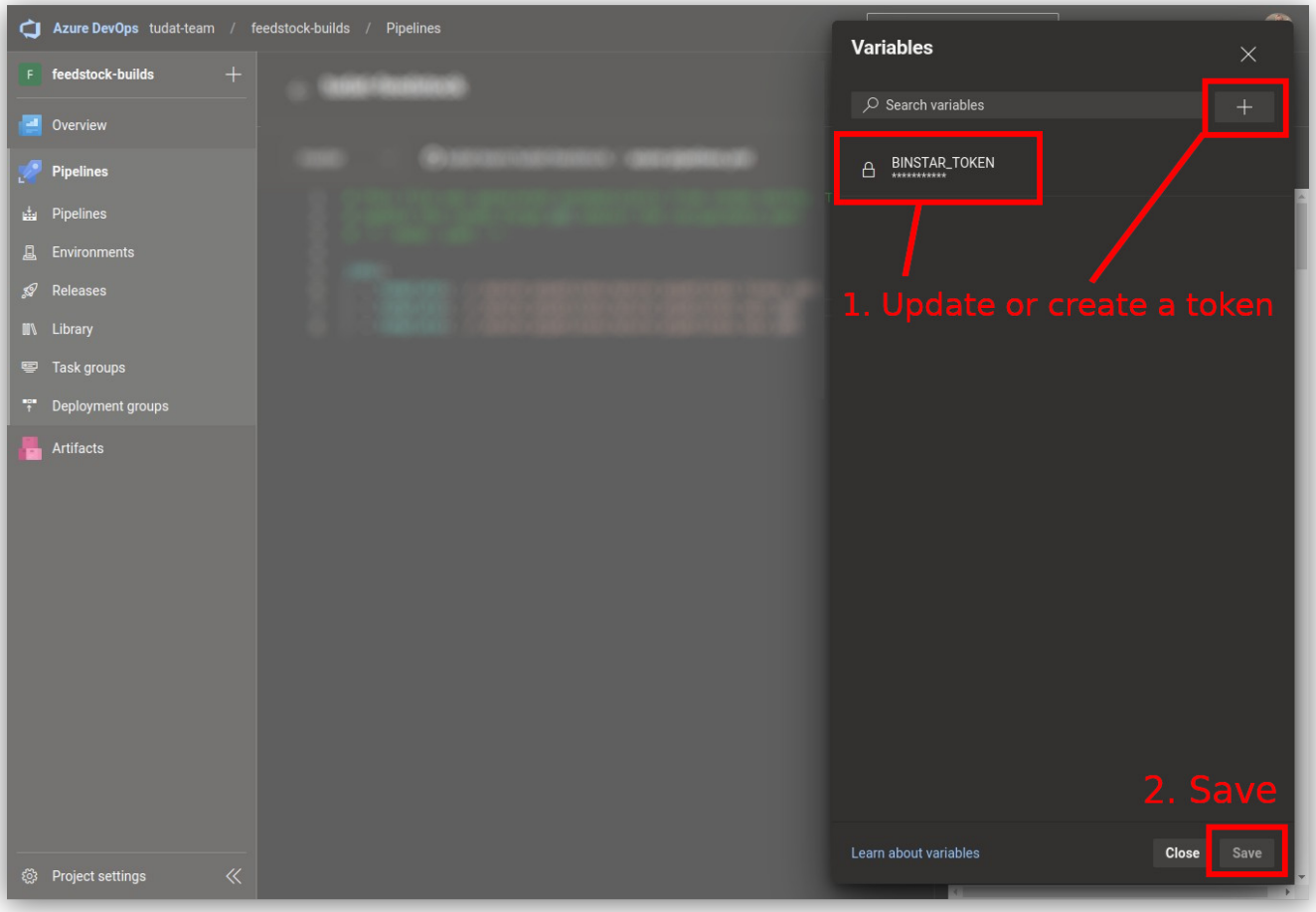
1. Click "Edit" in the top-right of the page.



1. Click "Variables" in the top-right of the page.



1. Update an existing token (e.g. `BINSTAR_TOKEN`), or create a new one with the `+` icon.



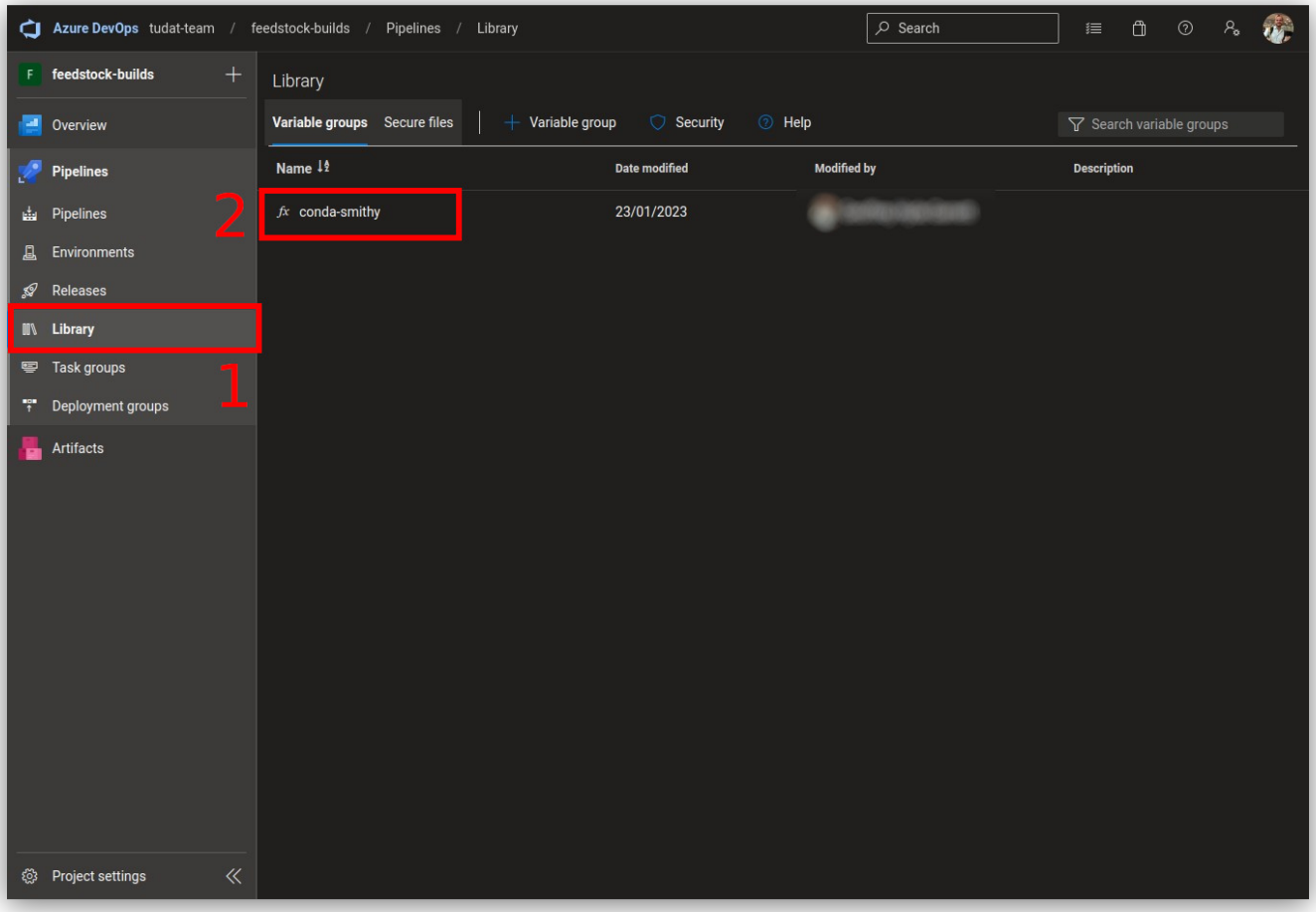
!!! note It is crucial to keep the environment variables private and secure. Ensure that you do not share them or commit them to a public repository, as this could lead to security issues.

defined across all pipelines

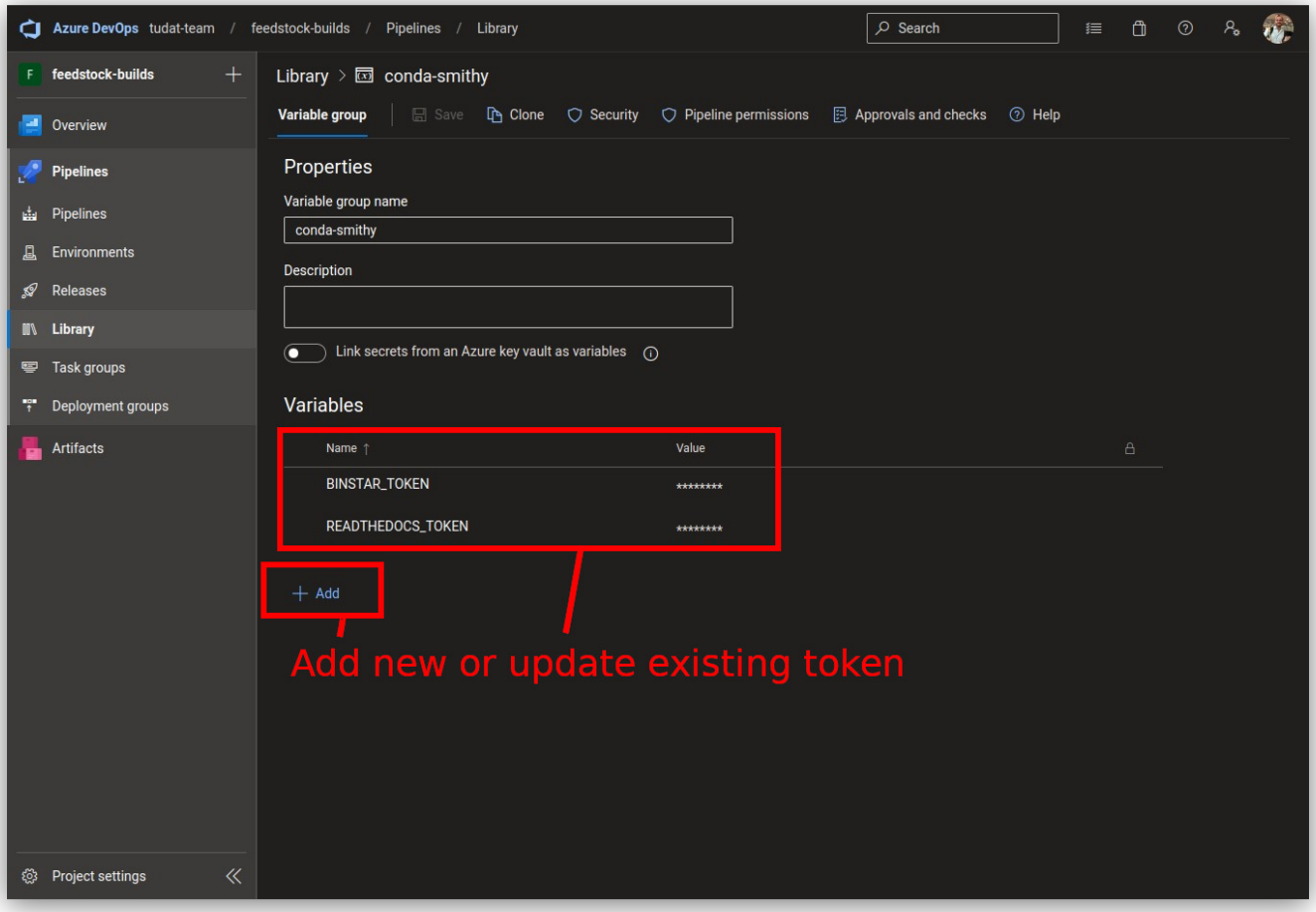
!!! failure

This section is the desired way of defining environment variables in Azure. However, it is currently not possible to define environment variables in an Azure project due to `conda-smithy` overwriting the `pipeline.yaml`. This is a known issue, and we are working on a solution. In the meantime, please use the method described in the previous section. This section therefore exists for future reference.

1. After navigating to the project, click " Library" under the `feedstock-builds` project and select the target " variable group".



1. Add a new variable by clicking `+ Add` or edit an existing one by clicking the name of value of the variable.



1. Make the variable group available by adding the following lines to the `pipeline.yaml` file in the root of the feedstock repository.

```
variables:
  - group: <variable_group_name>
```

!!! note The `<variable_group_name>` should be the name of the variable group you created in step 1.

!!! failure As mentioned, this will be overwritten by `conda-smithy`. It was expected that by adding:

```
    ```yaml
    azure:
       variables:
          - group: <variable_group_name>
    ```

    to the `conda-forge.yml` file, the `pipeline.yaml` would be updated accordingly, as [hinted at here](https://conda-forge.org/docs/maintainer/conda_forge_yml.html#azure). However, this is
not the case. We are working on a solution.
```

3.2 Managing Access Tokens

An important part of the continuous integration (CI) process is the use of access tokens to authenticate the user to the relevant services. This section describes how to generate access tokens for the following services:

- Anaconda Cloud
- GitHub

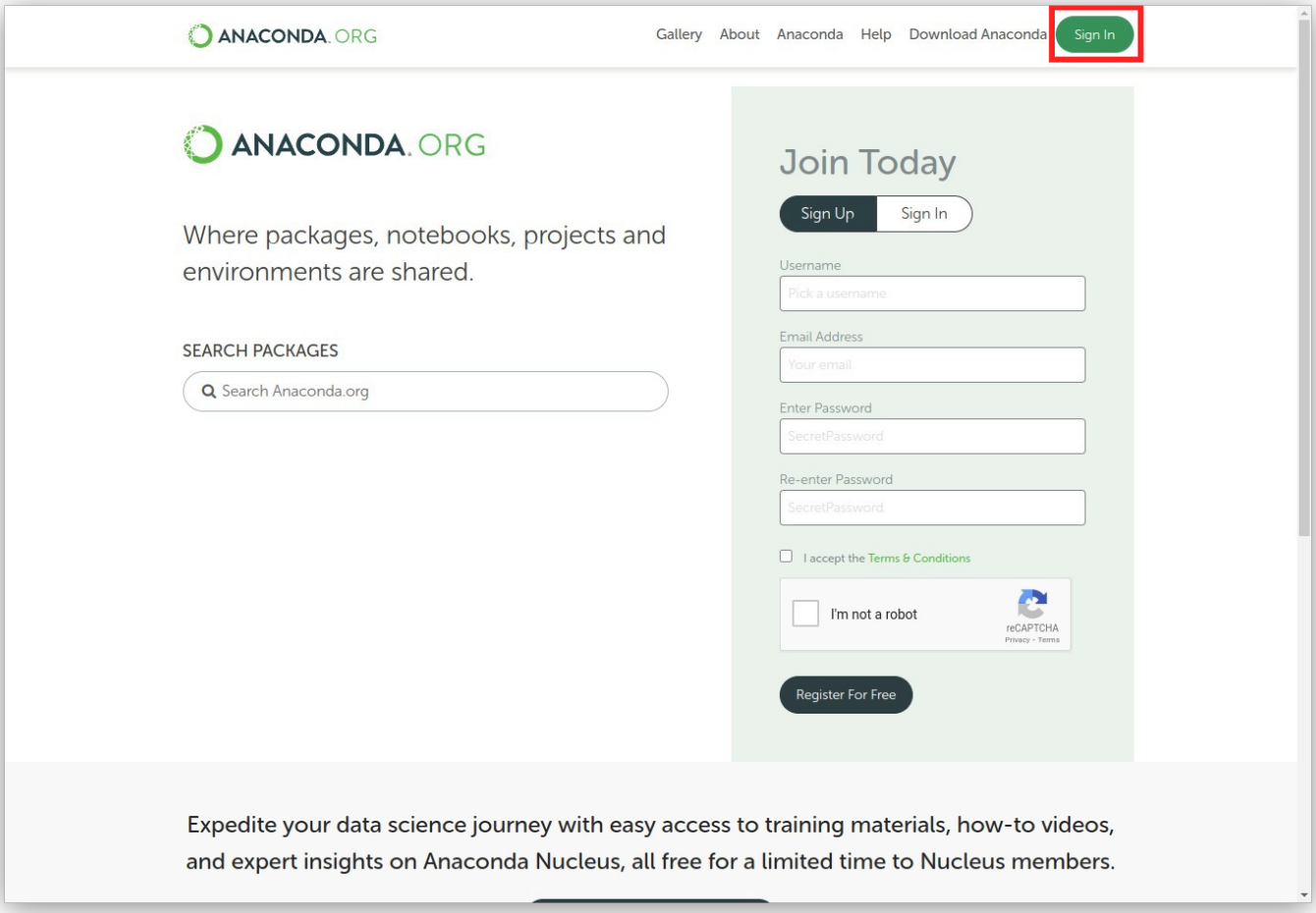
3.2.1 Generating Access Tokens

Access tokens are used to authenticate the user to the relevant service. The following sections describe how to generate access tokens for the following services:

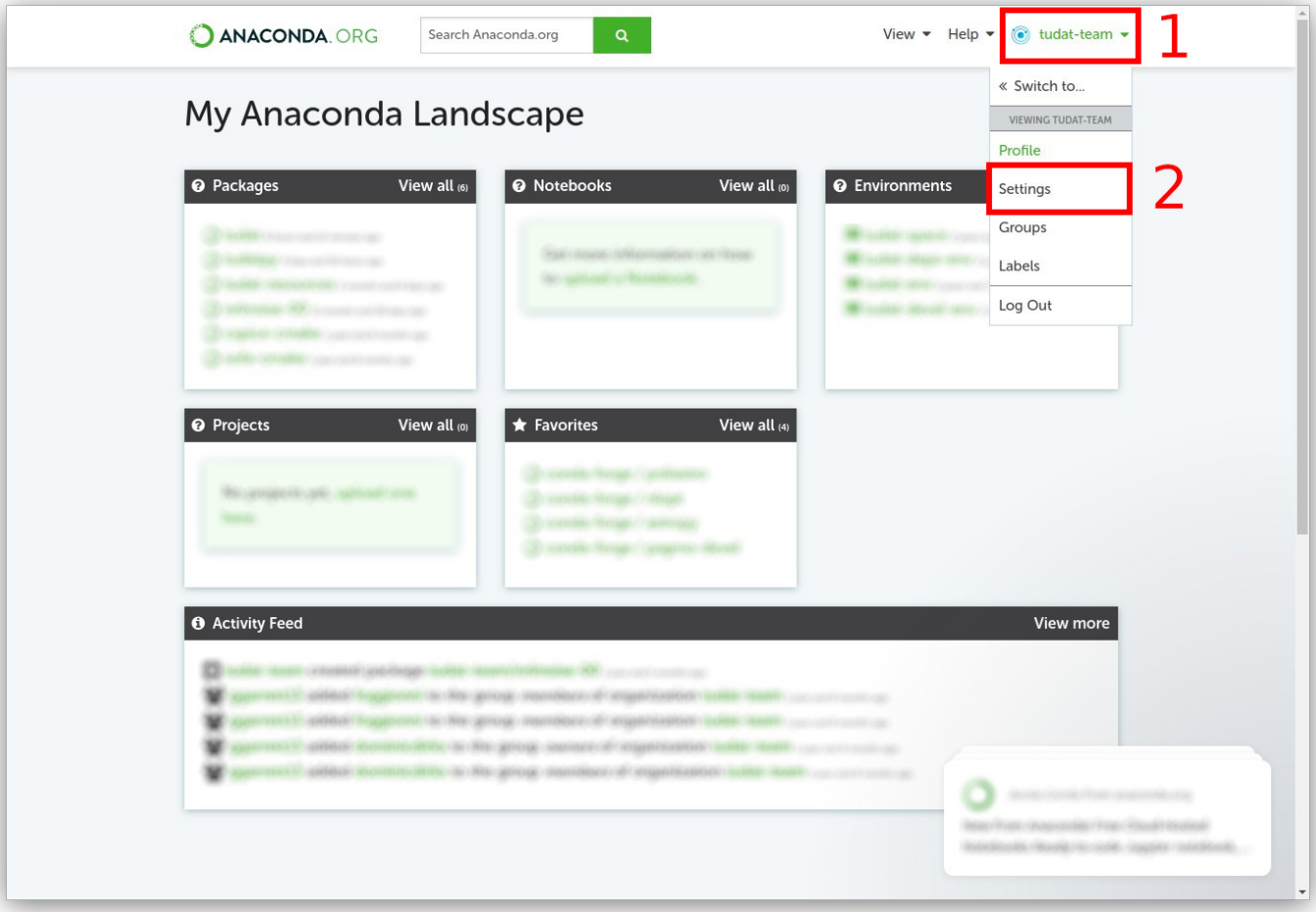
Organization Tokens on Anaconda Cloud

> **Note**
>
> This section is intended for maintainers of the feedstock repositories (at current). If you are not a maintainer, you can safely ignore this section.

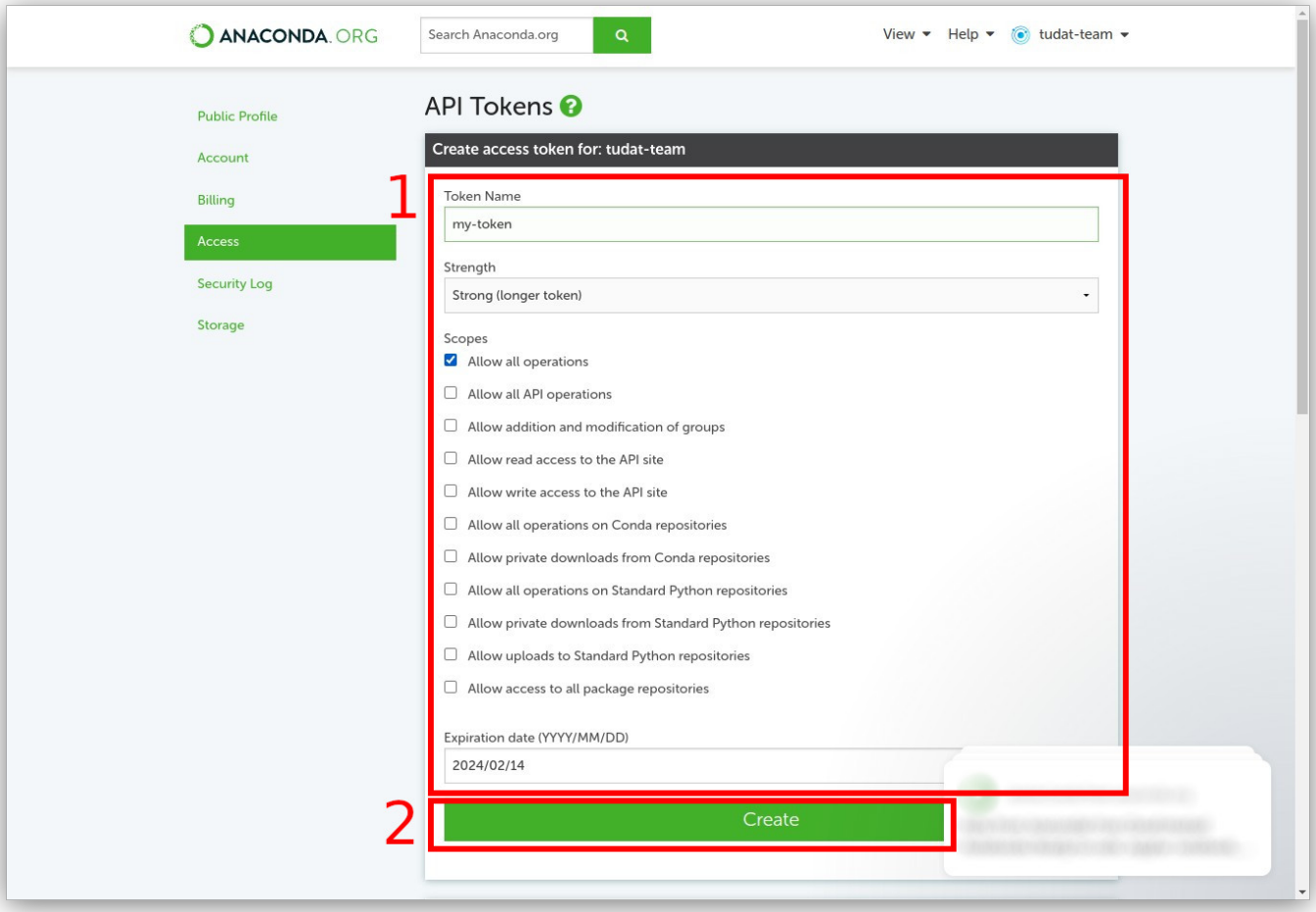
1. Navigate to https://anaconda.org/ and sign in.



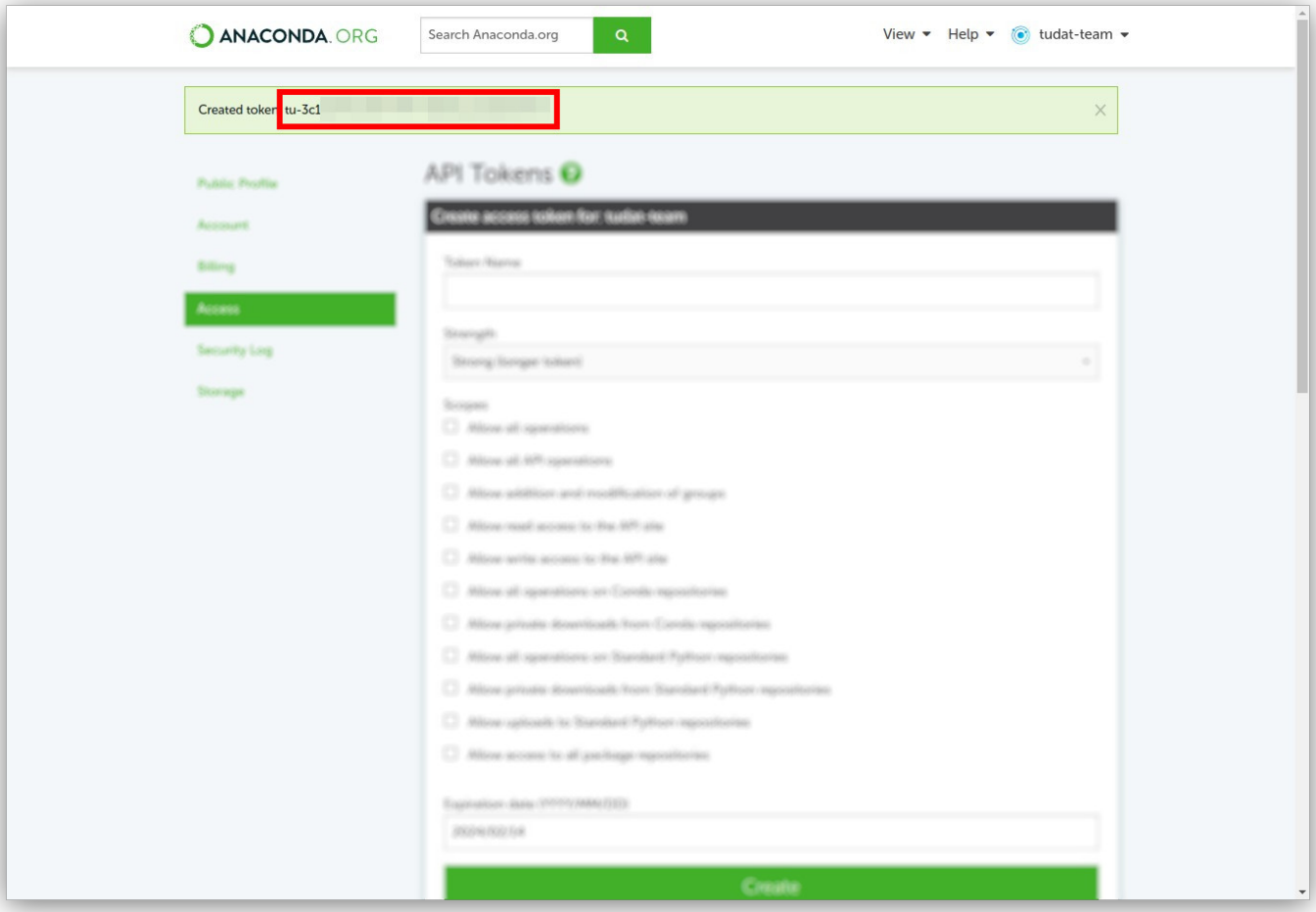
2. Go to the organization page, for example, if the organization is named "tudat-team", the URL would be https://anaconda.org/tudat-team.
3. Click on the organization profile ("tudat-team") at the top-right of the page, followed by "Settings".



4. Fill in the details for creating a new token: name your token, provide the appropriate scope, and specify an expiration date. Then, click "Create".



5. The newly created organization token will be displayed. Copy the token and keep it safe, as it will only be shown once.

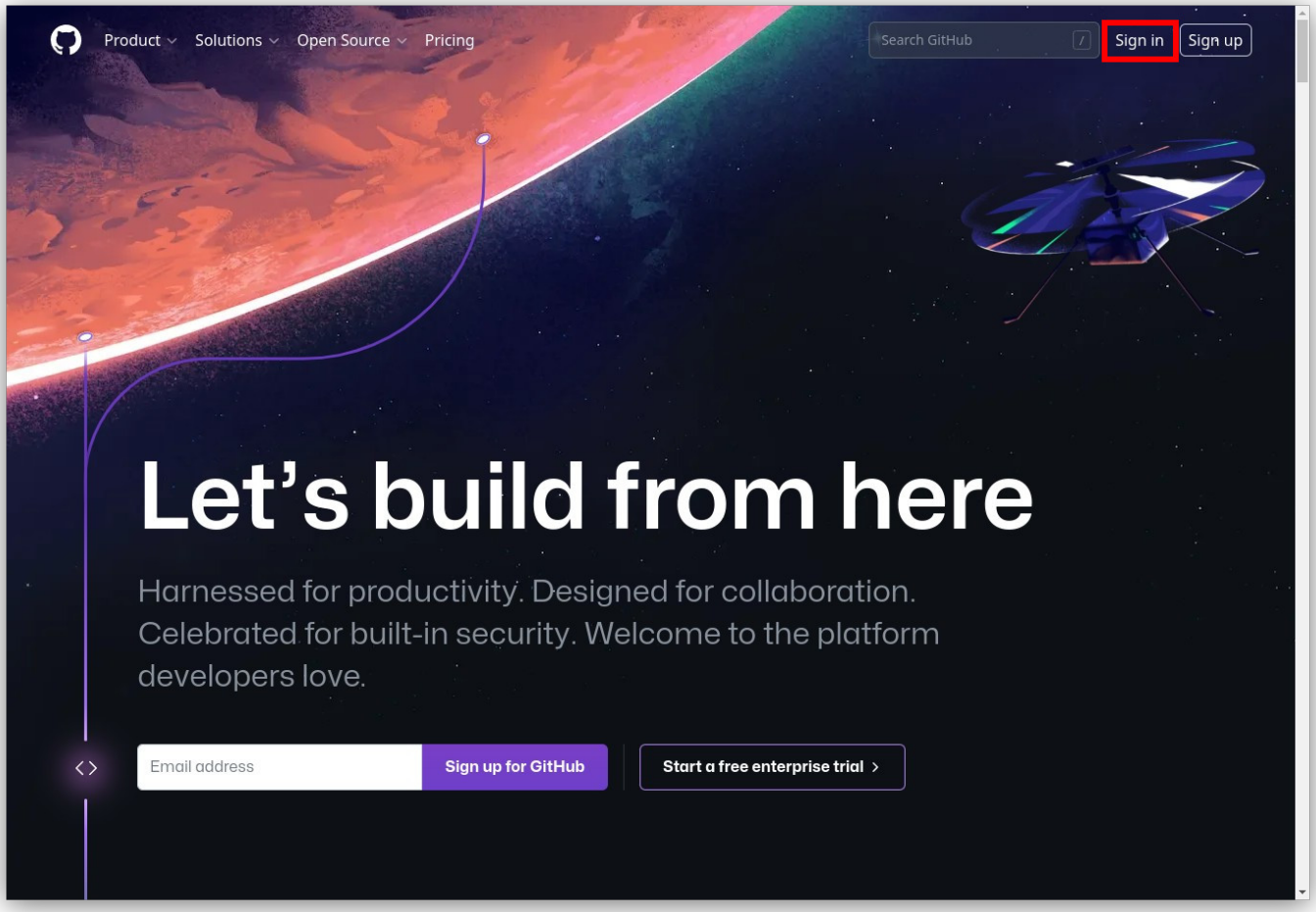


Important

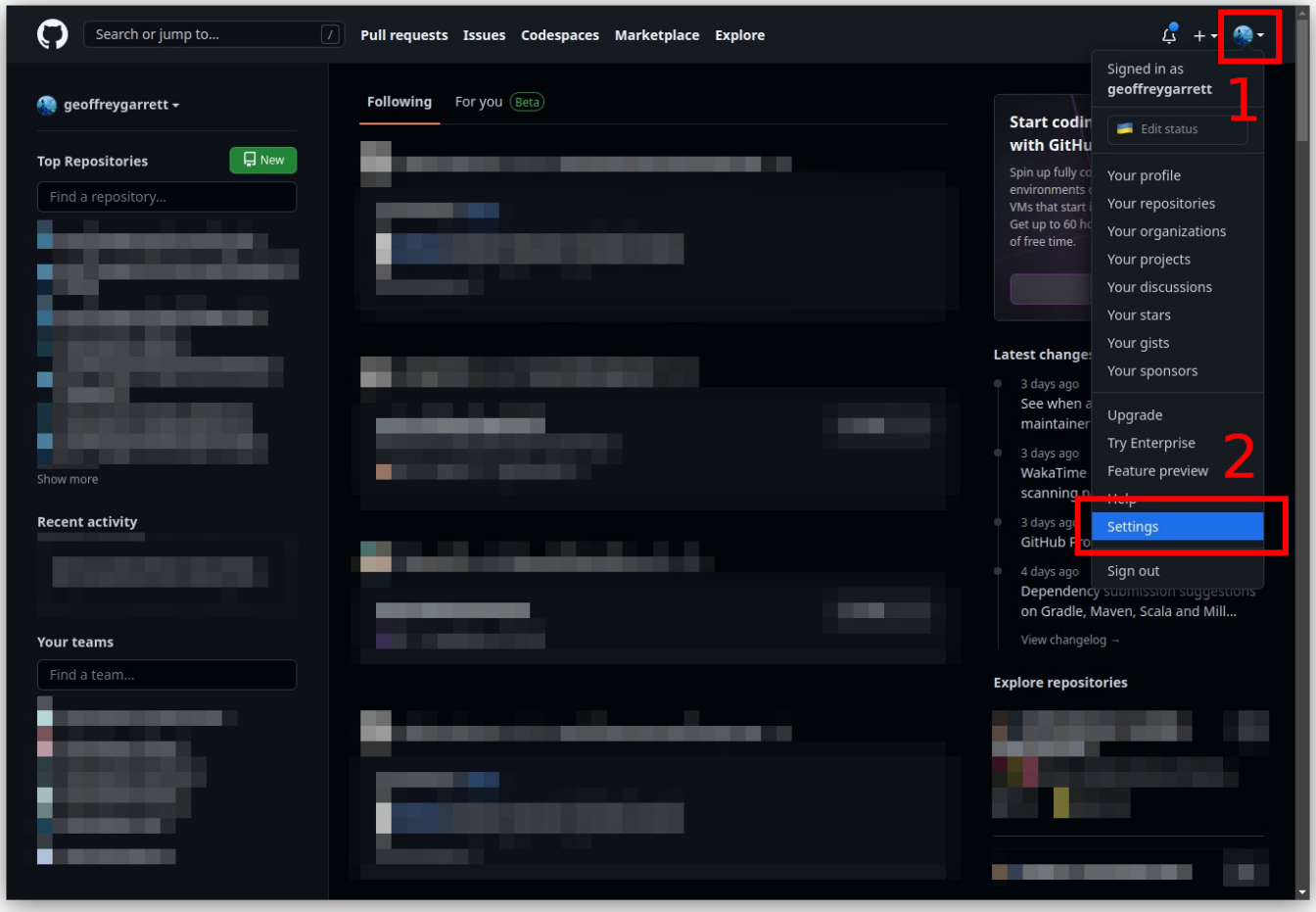
It is crucial to keep the organization token private and secure. Ensure that you do not share it or commit it to a public repository, as this could lead to security issues.

User Tokens on GitHub

1. Navigate to GitHub and sign in.

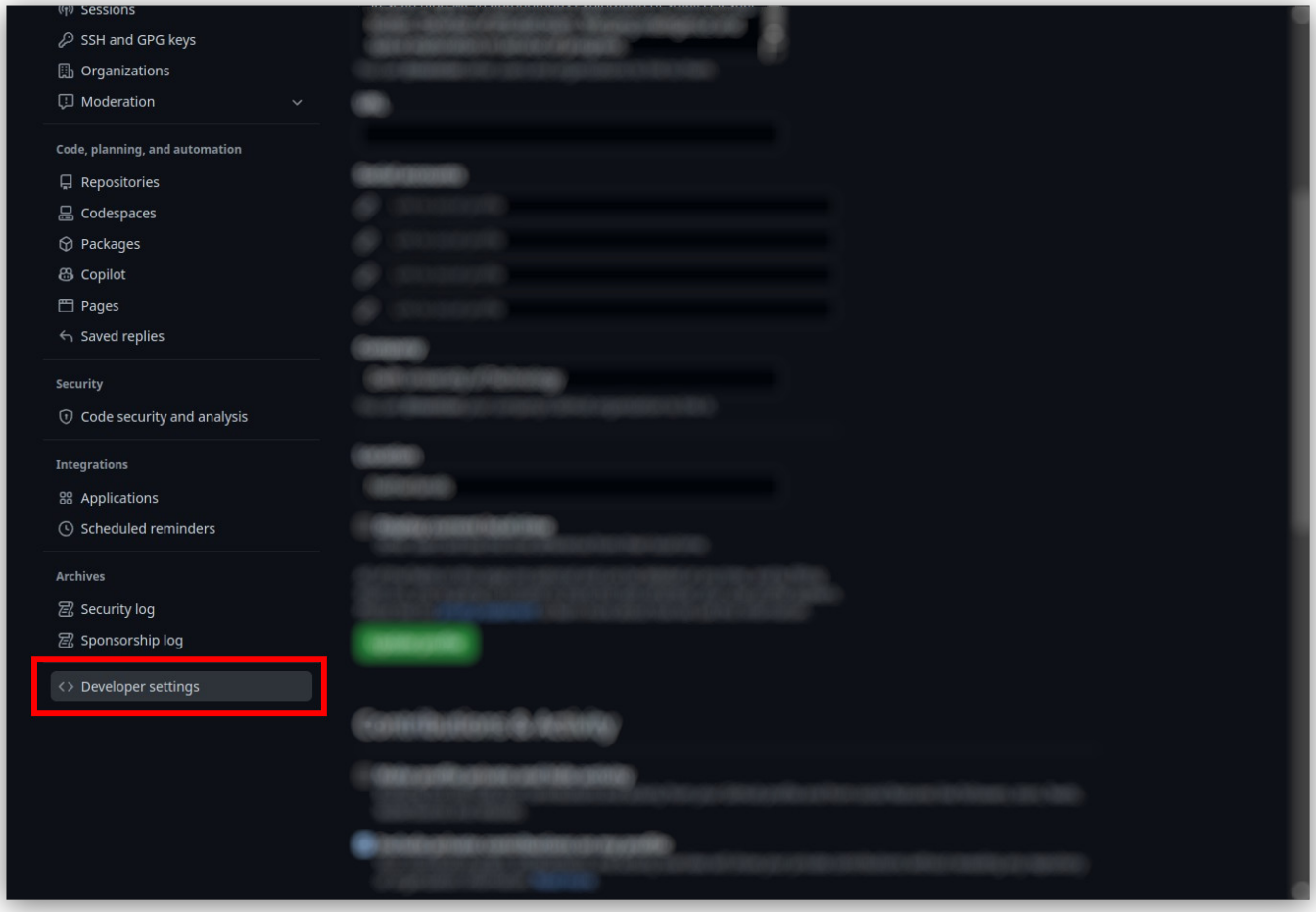


2. Click on your profile picture at the top-right of the page to reveal a drop-down menu, select "Settings".

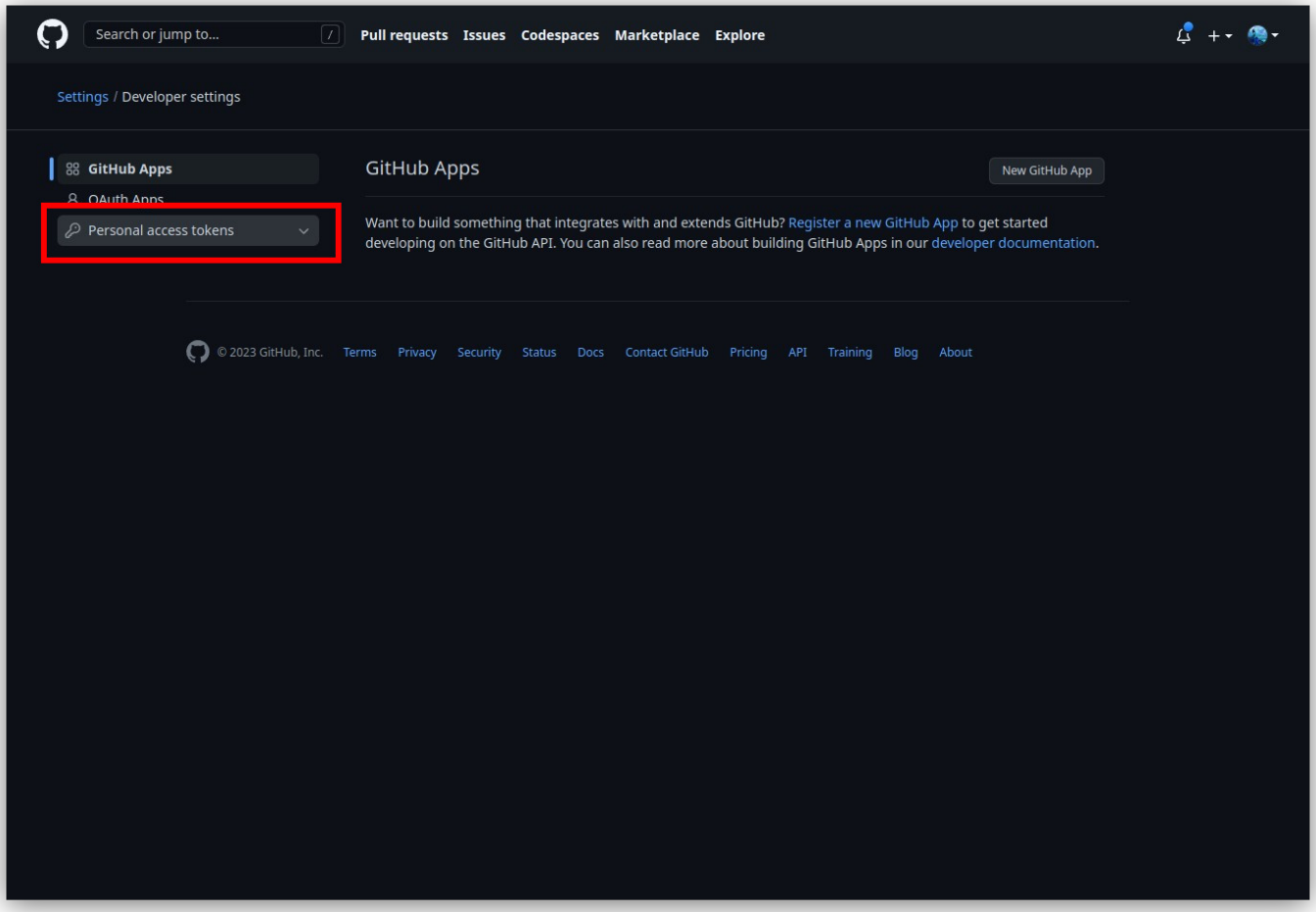


> **Tip**
>
> Dark mode makes you a better developer.

3. Click on "Developer settings".



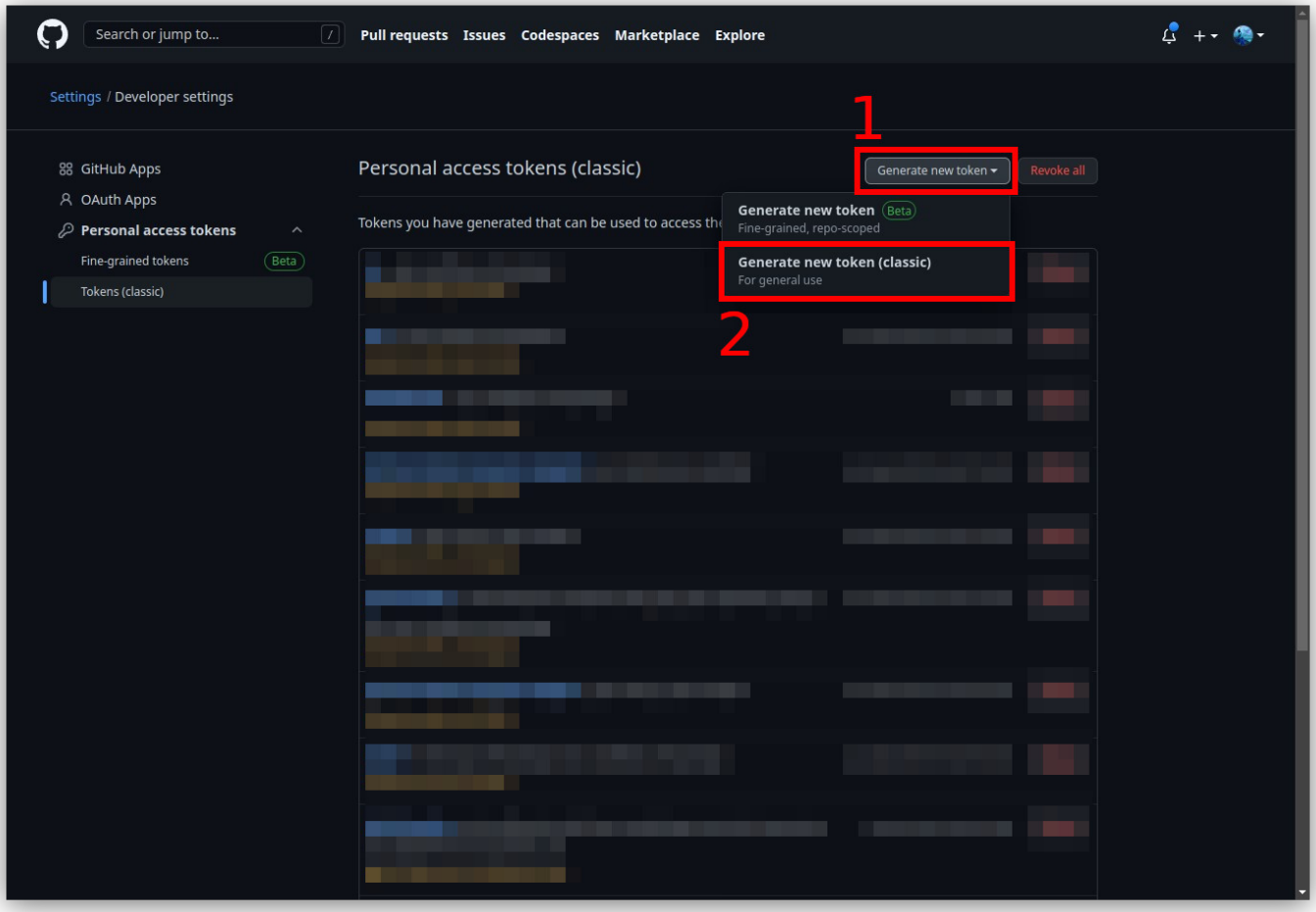
4. Click on "Personal access tokens".



Note

Currently, we use the classic tokens. Any developer is free to use the new fine-grained tokens, which are in Beta at the time of writing the current documentation, so long as it works. That developer must just modify the documentation accordingly.

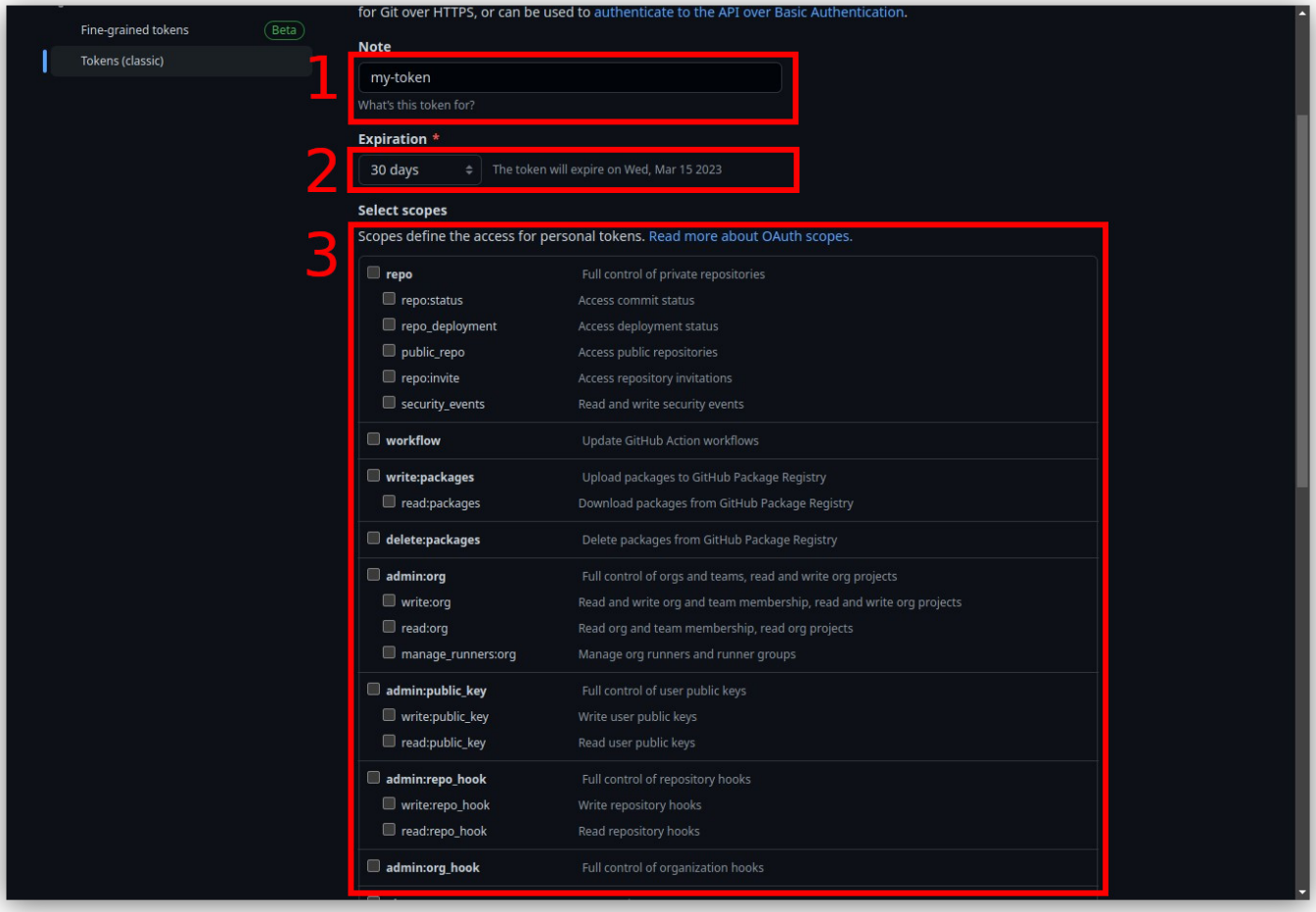
5. Click on "Generate new token (classic)".



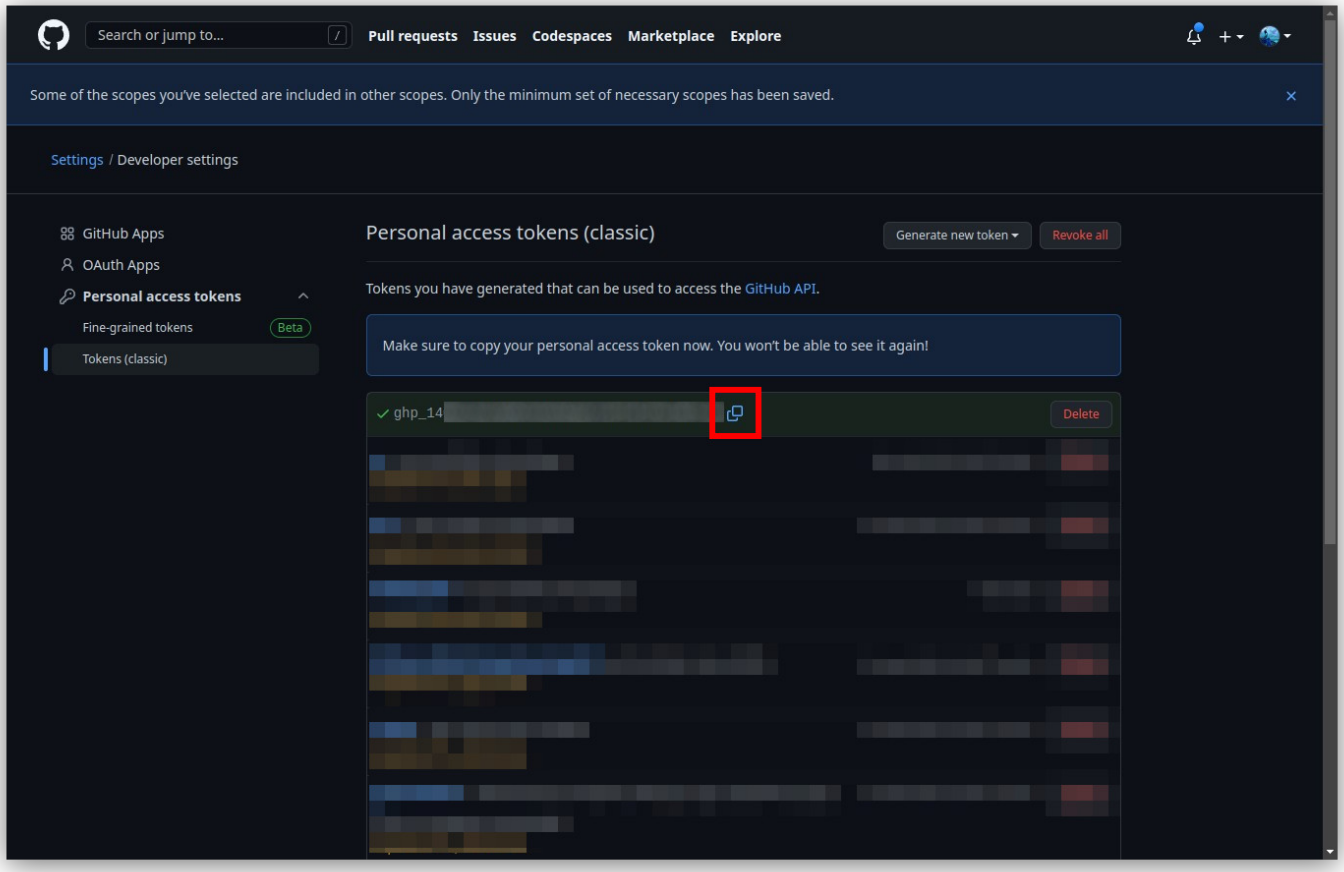
Important

The correct selection of the scopes is pertinent to the continued operation of the dependent systems. This may influence one to over-scope the permissions, in order to avoid having to scrutinize the required ones to save time, however over-scoping is a bad practice and should be avoided, so as to avoid any malicious attempts. See the documentation stating the required scopes from the relevant service.

6. Name your token, set an expiration time-delta, select the appropriate scopes, and finally click "Generate token".



7. Click on the copy icon provided, next to the token (or copy it yourself).



Important

It is important to never commit code with the token. If this is done, the token will be deactivated immediately, automatically in most cases by the relevant service. For example, if you commit a Github token to Github, it will be automatically deleted. This is a good safety feature to have, but if done with a token which multiple components in our system are dependent on, the amount of work to rectify this will be tedious and better avoided through taking mental note of this now.

3.2.2 Storing Access Tokens

Access tokens should be stored in a secure manner, so that they are not exposed to the public. This is done by storing them as environment variables, which are not committed to the repository.

Azure Pipelines

See Environment Variables on Azure Pipelines.

3.3 GitFlow Workflow

- Want to add a feature? See Feature
- Want to release a new stable version? See Release
- Want to fix a non-critical bug? See Bugfix
- Want to fix a bug in a release? See Hotfix

gitGraph commit tag: "v1.0.0" id: "Initial commit" type: HIGHLIGHT branch release/v1.1.0 branch develop branch feature/feature1 branch feature/feature2 branch hotfix/v1.0.1 branch bugfix/v1.1.1

3.3.1 Develop

gitGraph commit commit branch develop checkout develop commit commit checkout main merge develop commit commit

3.3.2 Feature

%%{init: { 'logLevel': 'debug', 'theme': 'base', 'gitGraph': {'rotateCommitLabel': false}} }%% gitGraph commit tag: "v1.0.0" branch release/v1.1.0 branch develop commit branch feature/feature1 commit commit commit checkout develop commit branch feature/feature2 commit id: "feat(api): ..." commit checkout develop merge feature/feature1 merge feature/feature2 commit checkout release/v1.1.0 merge develop checkout main merge release/v1.1.0 commit tag: "v1.1.0"

3.3.3 Release

3.3.4 Hotfix

3.3.5 Bugfix

3.4 Diátaxis Framework Modes

The Diátaxis framework is a systematic approach to technical documentation that was developed to address the challenge of structuring documentation in a clear and logical way. The framework consists of four distinct modes of documentation, each of which serves a distinct user need and requires a unique approach to creation.

Mode	Focus	Purpose
Tutorials	Learning-oriented	Used to teach new users how to use a product or technology.
How-To Guides	Problem-oriented	Provide solutions to specific problems or use cases.
Technical Reference	Information-oriented	Provides detailed information on the features, functions, and capabilities of a product or technology.
Explanation	Understanding-oriented	Provides conceptual information and context to help users understand a product or technology.

diataxis.png

By adopting the Diátaxis framework, technical writers can ensure that their documentation is tailored to the user's needs and provides the information they need in a clear and concise manner. The framework has gained widespread adoption in the technical writing community and is considered a best practice for creating effective technical documentation.

3.4.1 Tutorials

Tutorials walk users through a process or task step-by-step. They should be structured in a clear and logical way, with each step building on the previous one. Tutorials should also include visuals and examples to help users understand the process.

Example: A tutorial on how to create a new user account in a software application.

Remember

- Clearly state the learning objective
- Break down the task into clear and concise steps
- Use images, diagrams, and examples to aid understanding
- Provide feedback and reinforcement to encourage learning

3.4.2 How-To Guides

How-to guides provide solutions to specific problems or use cases. They should be focused and concise, providing clear and actionable steps to solve the problem.

Example: A how-to guide on how to troubleshoot a connectivity issue with a networking device.

Remember

- Clearly state the problem or use case
- Provide a clear and concise solution
- Use screenshots or other visuals to help users understand the solution
- Test the solution to ensure it works as expected

3.4.3 Technical Reference

Technical reference documentation provides detailed information on the features, functions, and capabilities of a product or technology. It should be well-organized and easy to navigate, with a clear and concise description of each feature or function.

Example: Technical reference documentation for a software library, detailing each of its APIs and functions.

Remember

- Clearly define each feature or function
- Provide detailed information on each feature or function, including syntax, parameters, and return values
- Organize the information in a clear and logical manner
- Provide examples of how to use each feature or function

3.4.4 Explanation

Explanation provides conceptual information and context to help users understand a product or technology. It should be clear and concise, providing context and explanation in a way that is easy to understand.

Example: An explanation of the importance of project documentation and an overview of the Diátaxis framework.

Remember

- Provide high-level overviews of the product or technology
- Provide conceptual information and context to help users understand the product or technology
- Explain why the product or technology is important and how it fits into the broader technology landscape
- Use analogies or other relatable examples to aid understanding

3.5 Common Commands

3.5.1 `conda smithy`

```
conda smithy rerender --feedstock_directory ./foo-feedstock
```

> **Concerning the `conda-forge.yml`**
>
> A change to the `conda-forge.yml` file will not automatically trigger a re-rendering of the feedstock. To have the changes to `conda-forge.yml` reflected in the feedstock, you need to manually update the file and then re-render the feedstock.

3.5.2 `mkdocs`

```
mkdocs new [dir-name]  # Create a new project.
```

```
mkdocs.yml    # The configuration file.
docs/
    index.md  # The documentation homepage.
    ...       # Other markdown pages, images and other files.
```

```
mkdocs serve  # Start the live-reloading docs server.
```

```
mkdocs build  # Build the documentation site.
```

```
mkdocs -h     # Print help message and exit.
```

> **Further reference**
>
> • MkDocs: Project documentation with Markdown

3.5.3 Project layout

3.6 Documentation Styling

Further reference

- MkDocs Material: Our chosen theme
- MkDocs Material Reference: Best quick-hand reference for styling