qc_dev - Quantum Computing Development Image

This image supports the use of a Docker container for the development of Quantum Computing projects in an Ubuntu environment.

Table of Contents

1. Installed core components

With the following command you can check in detail which software versions are included in the Docker image:

```
apt list --installed
```

Version 1.0.1

Component	Version	Remark	Status
asdf	v0.8.1-fe5b71d	base version	
dos2unix	7.4.0	base version	
G++ & GCC	9.3.0	base version	
Git	2.25.1	base version	
GNU Autoconf	2.69	base version	
GNU Automake	1.16.1	base version	
GNU Make	4.2.1	base version	
htop	2.2.0	base version	
LCOV	1.14	base version	
openssl	1.1.1f	base version	
Python	3.9.6		
- jupyterlab	3.1.4	base version [only with vm]	
- notebook	6.4.2	base version [only with vm]	
- pip	21.1.3	base version	

Component	Version	Remark	Status
Ubuntu	20.04.2 LTS	base version [focal]	
Vim	8.2.2269	base version	
wget	1.20.3	base version	

Version 1.0.0

Component	Version	Remark	Status
asdf	v0.8.1-a1ef92a		
curl	7.77.0		
Docker Compose	1.29.2		
Docker Engine	20.10.7		
dos2unix	7.4.2		
GCC	10.3.0		
Git	2.32.0		
htop	3.0.5		
Python	3.9.6		
- pip	21.1.3		
Ubuntu	20.04.2 LTS	focal	
Vim	8.2.3083		
wget	1.21.1		

2. Creating a new Quantum Computing development container

2.1 Getting started

```
> REM Assumptions:
> REM   - the name of the Docker container should be: my_qc_dev
> REM   - the path the host repository is: //C/projects/my_repro
> REM   - the directory name for this repository inside the container should be:
my_repro_dir
> REM   - you want to use the latest version of the Konnexions development image
> docker run --name my_qc_dev \
             -v //C/projects/my_repro:/my_repro_dir \
             konnexionsgmbh/qc_dev:latest

> REM Stopping the container
> docker stop my_qc_dev
> REM Restarting the container
> docker start my_qc_dev

> REM Entering a running container
> docker exec -it my_qc_dev bash
```

2.2 Detailed syntax

A new container can be created with the `docker run` command.

Syntax:

```
docker run -it
           [--name <container_name>] \
           konnexionsgmbh/qc_dev[:<version>]
           [<cmd>]
```

Parameters:

- **container_name** - an optional container identification
- **directory_repository** - an optional host repository directory - the default value is expecting the repository inside the container
- **version** - an optional version number of the image or the constant `latest`
- **cmd** - an optional command to be executed in the container, default is `bash` for running the `bash` shell

Detailed documentation for the command `docker run` can be found here.

Examples:

1. Creating a new Docker container named `my_qc_dev` using a repository inside the Docker container:

   `docker run -it --name my_qc_dev konnexionsgmbh/qc_dev:latest`

2. Creating a new Docker container named `my_qc_dev` using the host repository of a Windows directory `D:\projects\my_repro`:

   `docker run -it --name my_qc_dev -v //D/projects/my_repro:/my_repro konnexionsgmbh/qc_dev:latest`

3. Creating a new Docker container named `my_qc_dev` using the host repository of a Linux directory `/my_repro`:

   `docker run -it --name my_qc_dev -v /my_repro:/my_repro konnexionsgmbh/qc_dev:latest`

3. Working with an existing Quantum Computing development container

3.1 Starting a stopped container

A previously stopped container can be started with the `docker start` command.

Syntax:

```
docker start <container_name>
```

Parameter:

- **container_name** - the mandatory container identification, that is an UUID long identifier, an UUID short identifier or a previously given name

Detailed documentation for the command `docker start` can be found here.

3.2 Entering a running container

A running container can be entered with the `docker exec` command.

Syntax:

```
docker exec -it <container_name> <cmd>
```

Parameter:

- **container_name** - the mandatory container identification, that is an UUID long identifier, an UUID short identifier or a previously given name
- **cmd** - the command to be executed in the container, e.g. `bash` for running the `bash` shell

Detailed documentation for the command `docker exec` can be found here.

4. Best practices

4.1 Use of a root repository directory on the host computer

If all relevant repositories are located within a common parent directory, then development work in all these repositories can be done within a single Konnexions development container.

Example:

In the following example we assume that the host directory is named `C:\Temp\my_projects` and should be mapped to the `projects` directory in the container.

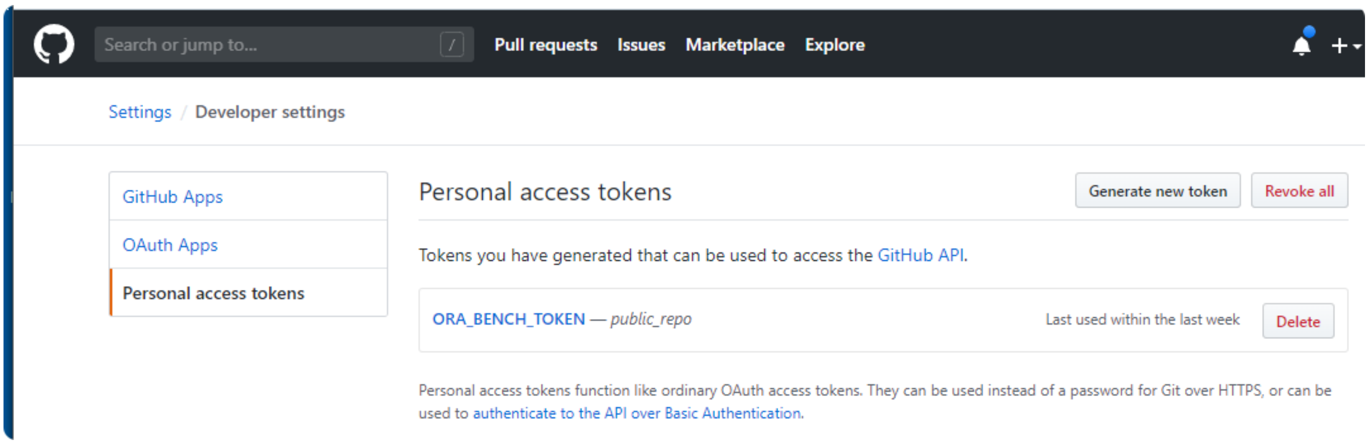
```
>C:\Temp\my_projects>docker run -it --name qc_dev -v
//C/Temp/my_projects:/projects konnexionsgmbh/qc_dev:latest
root@35b9310932f1:/# cd projects
root@35b9310932f1:/projects# ls -ll
total 0
```

4.2 Use of private GitHub repositories inside the container

To access private repositories in GitHub, you must first create a new personal access token in GitHub and then add it to your git configuration inside the container.

1. Create a new personal access token in GitHub

- With the following URL you can create the access token: https://github.com/settings/tokens



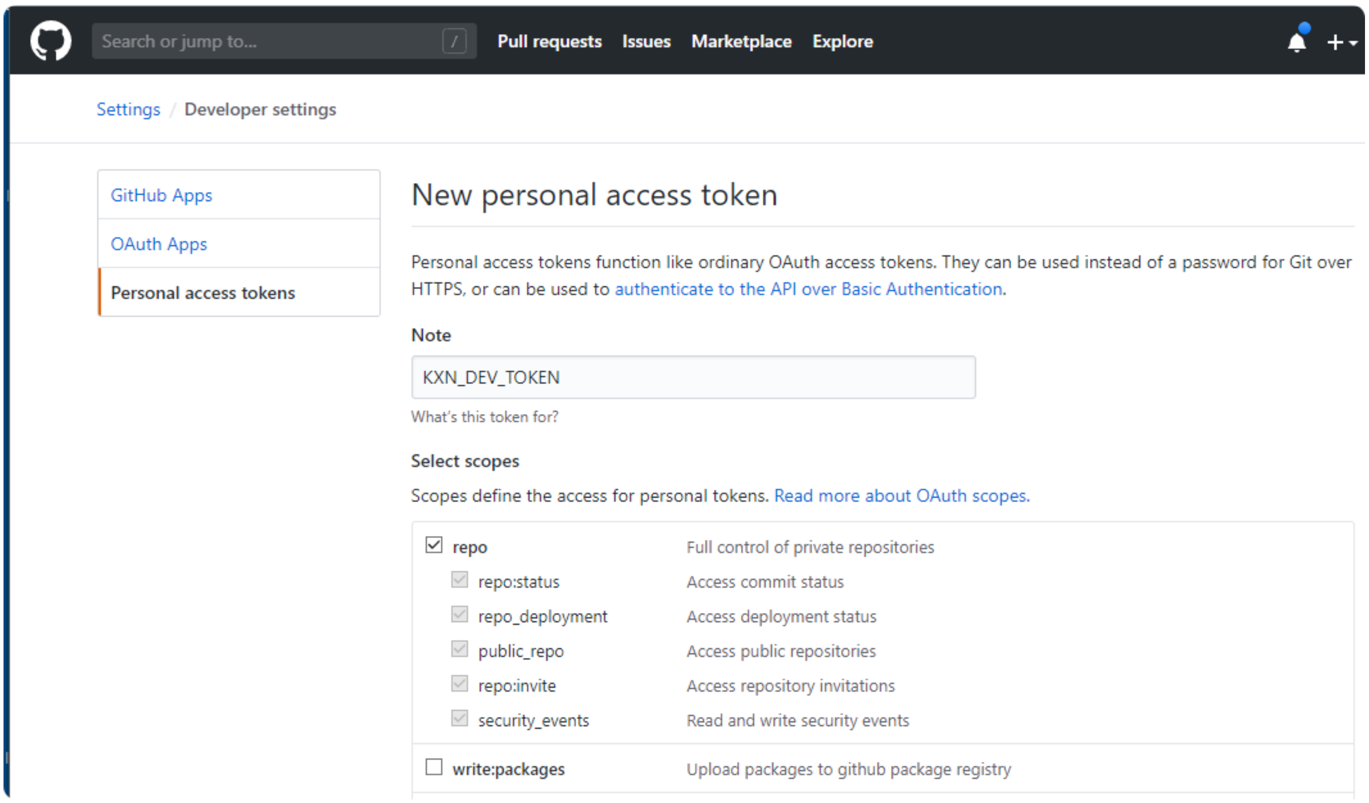
Personal access tokens

Tokens you have generated that can be used to access the GitHub API.

ORA_BENCH_TOKEN — *public_repo* Last used within the last week

Personal access tokens function like ordinary OAuth access tokens. They can be used instead of a password for Git over HTTPS, or can be used to authenticate to the API over Basic Authentication.

- Press the button `Generate new token`



New personal access token

Personal access tokens function like ordinary OAuth access tokens. They can be used instead of a password for Git over HTTPS, or can be used to authenticate to the API over Basic Authentication.

Note

KXN_DEV_TOKEN

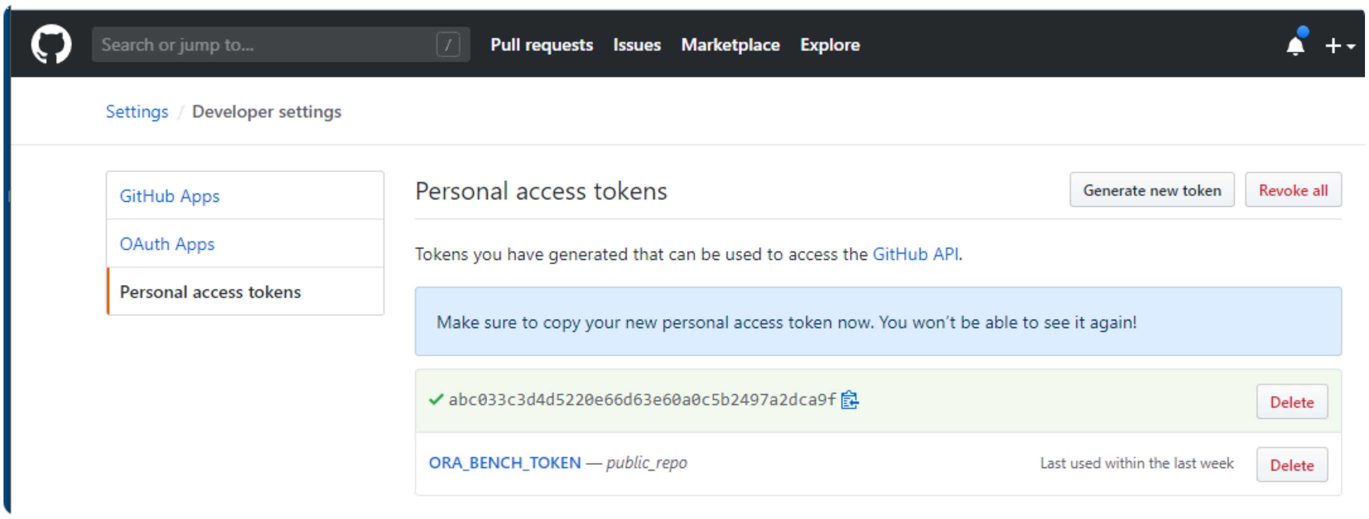
What's this token for?

Select scopes

Scopes define the access for personal tokens. Read more about OAuth scopes.

✓ repo	Full control of private repositories
✓ repo:status	Access commit status
✓ repo_deployment	Access deployment status
✓ public_repo	Access public repositories
✓ repo:invite	Access repository invitations
✓ security_events	Read and write security events
☐ write:packages	Upload packages to github package registry

- Name the new token, select the scopes and press the button `Generate token`



Personal access tokens

Tokens you have generated that can be used to access the GitHub API.

Make sure to copy your new personal access token now. You won't be able to see it again!

✓ abc033c3d4d5220e66d63e60a0c5b2497a2dca9f

ORA_BENCH_TOKEN — *public_repo* Last used within the last week

- Write down the secret code and keep it in a safe place

2. Setting up the Docker container on the host machine

In the following example we assume that the host directory is named `C:\Temp\my_projects` and should be mapped to the `projects` directory in the container.

```
C:\Temp\my_projects>docker run -it --name qc_dev -v //C/Temp/my_projects:/projects
konnexionsgmbh/qc_dev:latest
Unable to find image 'konnexionsgmbh/qc_dev:latest' locally
latest: Pulling from konnexionsgmbh/qc_dev
d51af753c3d3: Pull complete
...
a6bb30d1a5cf: Pull complete
Digest: sha256:5f6d6afc566ef9142d2d85b85dd331c0558eafaaf286179fd0ae787988c1b89b
Status: Downloaded newer image for konnexionsgmbh/qc_dev:latest
```

3. Initial configuration of git in the container

```
root@332206c300f1:/# export XDG_CONFIG_HOME=/projects
root@332206c300f1:/# mkdir -p $XDG_CONFIG_HOME/git/
root@332206c300f1:/# touch $XDG_CONFIG_HOME/git/config
root@332206c300f1:/# touch $XDG_CONFIG_HOME/git/credentials
root@332206c300f1:/# git config --file=$XDG_CONFIG_HOME/git/config
credential.helper 'store --file=/projects/git/credentials'
root@332206c300f1:/# git config --file=$XDG_CONFIG_HOME/git/config user.name "John
Doe"
root@332206c300f1:/# git config --file=$XDG_CONFIG_HOME/git/config user.email
"john.doe@company.com"
root@332206c300f1:/# git config --list --show-origin
file:/projects/git/config       credential.helper=store --
file=/projects/git/credentials
file:/projects/git/config       user.name=John Doe
file:/projects/git/config       user.email=john.doe@company.com
```

4. Verification of the settings

```
root@332206c300f1:/# cat /projects/git/config
[credential]
        helper = store --file=/projects/git/credentials
[user]
        name = John Doe
[user]
        email = john.doe@company.com
```

5. Clone a repository for the first time

When prompted provide your github user name and the new personal access token from (1).

```
root@332206c300f1:/# cd projects
root@332206c300f1:~# git clone https://github.com/KonnexionsGmbH/docker_images
Cloning into 'docker_images'...
Username for 'https://github.com': John Doe
Password for 'https://john.doe@company.com':
abc033c3d4d5220e66d63e60a0c5b2497a2dca9f
remote: Enumerating objects: 78, done.
remote: Counting objects: 100% (78/78), done.
remote: Compressing objects: 100% (49/49), done.
remote: Total 78 (delta 33), reused 68 (delta 23), pack-reused 0
Receiving objects: 100% (78/78), 167.83 KiB | 867.00 KiB/s, done.
Resolving deltas: 100% (33/33), done.
```

6. Verify if the clone completed with success

```
root@332206c300f1:~# cat /projects/git/credentials
https://John Doe:abc033c3d4d5220e66d63e60a0c5b2497a2dca9f@github.com
```

7. Verification after a restart of the Docker container

```
C:\Temp\my_projects>docker start qc_dev
qc_dev
C:\Temp\my_projects>docker exec -it qc_dev bash
root@332206c300f1:/# export XDG_CONFIG_HOME=/projects
root@332206c300f1:/# git config --list --show-origin
file:/projects/git/config       credential.helper=store --
file=/projects/git/credentials
file:/projects/git/config       user.name=John Doe
file:/projects/git/config       user.email=john.doe@company.com
```

8. Verification after the removal of the Docker container

- Deleting the Docker container and image

```
C:\Temp\my_projects>docker stop qc_dev
qc_dev

C:\Temp\my_projects>docker rm qc_dev
qc_dev

C:\Temp\my_projects>docker images
REPOSITORY                 TAG                 IMAGE ID            CREATED
SIZE
konnexionsgmbh/qc_dev      latest              51757b5e414e        6 hours ago
3.71GB

C:\Temp\my_projects>docker rmi 51757b5e414e
Untagged: konnexionsgmbh/qc_dev:latest
Untagged:
konnexionsgmbh/qc_dev@sha256:5f6d6afc566ef9142d2d85b85dd331c0558eafaaf286179fd0ae7
87988c1b89b
Deleted: sha256:51757b5e414e5333ace7b163484c06e4685c29312ad09d5d7d648c6936011a60
...
Deleted: sha256:7789f1a3d4e9258fbe5469a8d657deb6aba168d86967063e9b80ac3e1154333f
```

- Recreating the Docker container (and image)

```
C:\Temp\my_projects>docker run -it --name qc_dev -v //C/Temp/my_projects:/projects
konnexionsgmbh/qc_dev:latest
Unable to find image 'konnexionsgmbh/qc_dev:latest' locally
latest: Pulling from konnexionsgmbh/qc_dev
d51af753c3d3: Pull complete
...
a6bb30d1a5cf: Pull complete
Digest: sha256:5f6d6afc566ef9142d2d85b85dd331c0558eafaaf286179fd0ae787988c1b89b
Status: Downloaded newer image for konnexionsgmbh/qc_dev:latest
root@ad1f036bbc44:/# export XDG_CONFIG_HOME=/projects
root@ad1f036bbc44:/# git clone https://github.com/KonnexionsGmbH/docker_images
Cloning into 'docker_images'...
remote: Enumerating objects: 78, done.
remote: Counting objects: 100% (78/78), done.
remote: Compressing objects: 100% (49/49), done.
remote: Total 78 (delta 33), reused 68 (delta 23), pack-reused 0
Receiving objects: 100% (78/78), 167.83 KiB | 895.00 KiB/s, done.
Resolving deltas: 100% (33/33), done.
```

- If we use the same path - where `git/config` and `git/credentials` exist - as in Step 4, `git` access (clone/push/pull) doesn't ask for username/password anymore.