iterative

Versioning and Sharing

Data and Models

Lesson 4

DVC Tools for Data Scientists & Analysts

2021

Course lessons

Lesson 1. Course Introduction

Lesson 2. Practices and Tools for Efficient Collaboration in ML projects

Lesson 3. Pipelines Automation and Configuration Management

Lesson 4. Versioning Data and Models

Lesson 5. Visualize Metrics & Compare Experiments with DVC and Studio

Lesson 6. Experiments Management and Collaboration

Lesson 7. Tools for Deep Learning Scenarios

Lesson 8. Review Advanced Topics and Use Cases

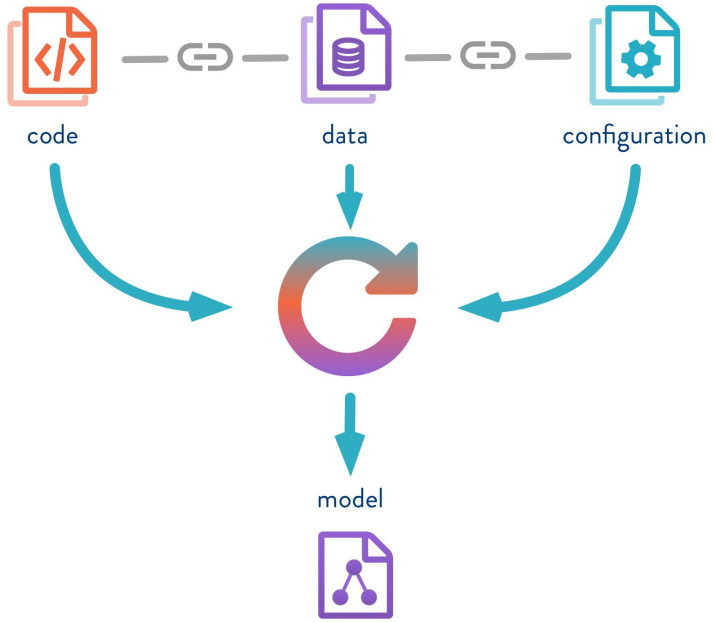
Lesson Outline

- Why does versioning matter?
- How does data versioning work?
- Tracking changes
- Versioning data and models
- Share and access data

Why does versioning matter?

Reproducibility and ethical requirements

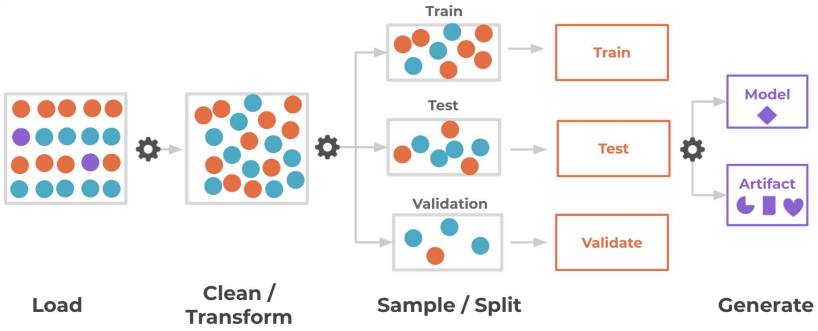
- Reproducible ML experiments requires versioned data, models and experiment artifacts
- Meet regulatory compliance and ethical AI requirements (e.g. for health, banking and other industries)



Data Workflow is complicated

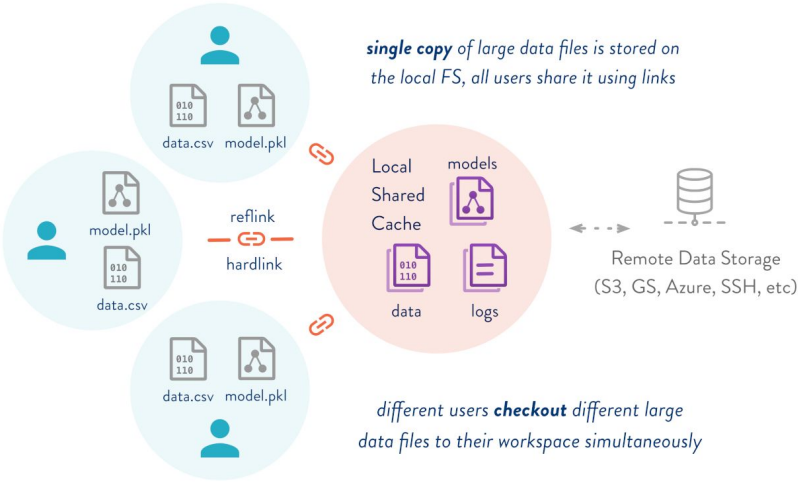
need to be deterministic

- Data processing takes a long time
- Expensive CPU/GPU resources
- Transferring data over the network is slow
- Need to be deterministic and reproducible



Improve team collaboration

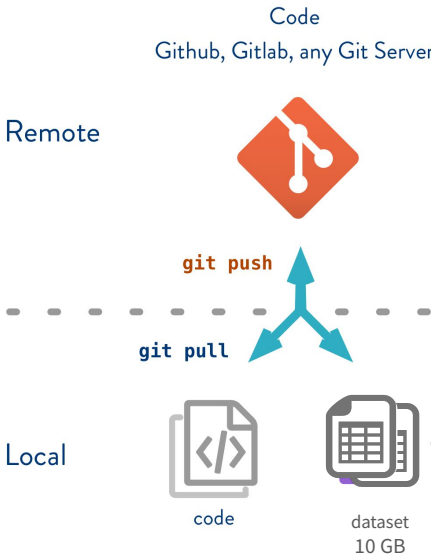
- Avoid manual versioning
  - model.pkl
  - model_LogReg.pkl
  - model_LogReg_C1_pL2.pkl
  - model_LogReg_C01_pL2_final.pkl
  - model_SVM_v1.pkl
  - ....
- Share results and collaborate with a team



How does data versioning work?

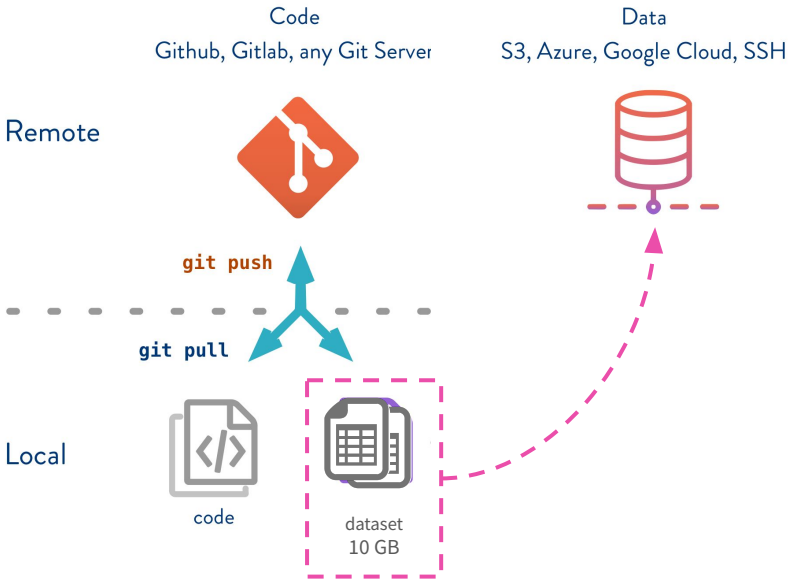
How DVC works with data

- We use Git to version the code
- How to deal with large data set?
  a. ~~Add to Git version control~~
  b. ~~Do versioning manually~~
  c. Use DVC !!!



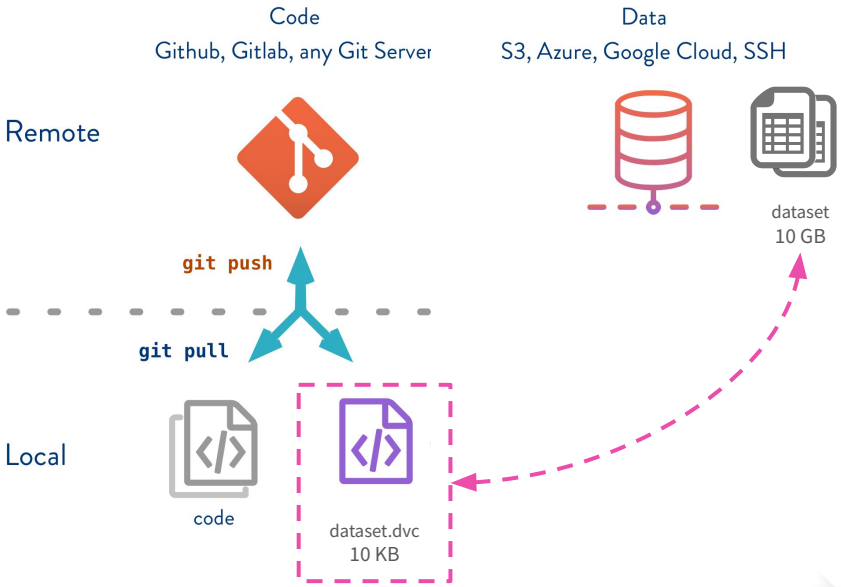
How DVC works with data

- Moves the data into cache or DVC storage



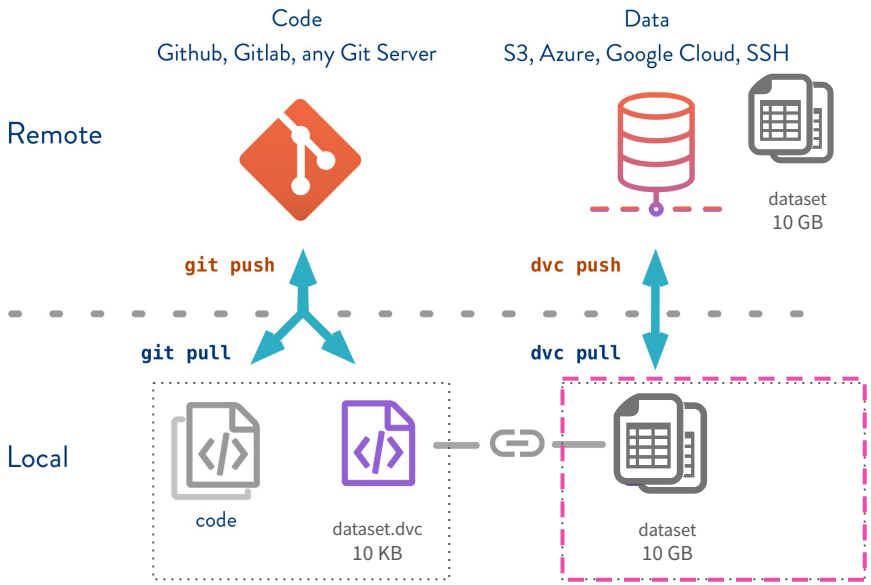
How DVC works with data

- Moves the data into cache or DVC storage
- Creates a metadata file with **.dvc** filename extension
  a. to keep metadata about original file



How DVC works with data

- Moves the data into cache or DVC storage
- Creates a metadata file with **.dvc** filename extension
  a. to keep metadata about original file
- Creates a link with the same name as original data file



Add file to version control

run command

```
$ dvc add data/iris.csv
```

output

```
Adding 'data/iris.csv' to 'data/.gitignore'.
Saving 'data/iris.csv' to '.dvc/cache/57/fce90c81521889c736445f058c4838'.
Saving information to 'data/iris.csv.dvc'.
```

Add .dvc file to Git

run command

```
$ git status
```

output

```
?? data/.gitignore
?? data/iris.csv.dvc
```

run command

```
$ git add .
$ git commit -m "Add a source dataset"
```

output

```
Add a source dataset
 2 files changed, 9 insertions(+)
 create mode 100644 data/.gitignore
 create mode 100644 data/iris.csv.dvc
```

Live code example

How data versioning works?

What happens under the hood?

Add file to version control

run command

```
$ dvc add data/data.xml -v
```

Run command in verbose mode to see more details

output

```
...
Computed stage: 'data/data.xml.dvc' md5: 'None'...
Saving 'data/data.xml' to
'.dvc/cache/a3/04afb96060aad90176268345e10355'...
Removing '.../dvc/course/dvc-2-data-versioning/data/data.xml'...
Created 'reflink': .dvc/cache/a3/04afb96060aad90176268345e10355 ->
data/data.xml
Saving information to 'data/data.xml.dvc'
...
To track the changes with git, run:

        git add data/data.xml.dvc
```

Add file to version control

run command

```
$ dvc add data/data.xml -v
```

output

```
...
Computed stage: 'data/data.xml.dvc' md5: 'None'...
Saving 'data/data.xml' to
'.dvc/cache/a3/04afb96060aad90176268345e10355'...
Removing '.../dvc/course/dvc-2-data-versioning/data/data.xml'...
Created 'reflink': .dvc/cache/a3/04afb96060aad90176268345e10355 ->
data/data.xml
Saving information to 'data/data.xml.dvc'
...
To track the changes with git, run:

        git add data/data.xml.dvc
```

Check is *.dvc file already exists**

Add file to version control

run command

```
$ dvc add data/data.xml -v
```

output

```
...
Computed stage: 'data/data.xml.dvc' md5: 'None'...
Saving 'data/data.xml' to
'.dvc/cache/a3/04afb96060aad90176268345e10355'...
Removing '.../dvc/course/dvc-2-data-versioning/data/data.xml'...
Created 'reflink': .dvc/cache/a3/04afb96060aad90176268345e10355 ->
data/data.xml
Saving information to 'data/data.xml.dvc'
...
To track the changes with git, run:

        git add data/data.xml.dvc
```

Save file to .dvc/cache directory

Add file to version control

run command

```
$ dvc add data/data.xml -v
```

output

```
...
Computed stage: 'data/data.xml.dvc' md5: 'None'...
Saving 'data/data.xml' to
'.dvc/cache/a3/04afb96060aad90176268345e10355'...
Removing '.../dvc/course/dvc-2-data-versioning/data/data.xml'...
Created 'reflink': .dvc/cache/a3/04afb96060aad90176268345e10355 ->
data/data.xml
Saving information to 'data/data.xml.dvc'
...
To track the changes with git, run:

        git add data/data.xml.dvc
```

Remove original file

Add file to version control

run command

```
$ dvc add data/data.xml -v
```

output

```
...
Computed stage: 'data/data.xml.dvc' md5: 'None'...
Saving 'data/data.xml' to
'.dvc/cache/a3/04afb96060aad90176268345e10355'...
Removing '.../dvc/course/dvc-2-data-versioning/data/data.xml'...
Created 'reflink': .dvc/cache/a3/04afb96060aad90176268345e10355 ->
data/data.xml
Saving information to 'data/data.xml.dvc'
...
To track the changes with git, run:

        git add data/data.xml.dvc
```

Creating reflink to the cached file

Add file to version control

run command

```
$ dvc add data/data.xml -v
```

output

```
...
Computed stage: 'data/data.xml.dvc' md5: 'None'...
Saving 'data/data.xml' to
'.dvc/cache/a3/04afb96060aad90176268345e10355'...
Removing '.../dvc/course/dvc-2-data-versioning/data/data.xml'...
Created 'reflink': .dvc/cache/a3/04afb96060aad90176268345e10355 ->
data/data.xml
Saving information to 'data/data.xml.dvc'
...
To track the changes with git, run:

        git add data/data.xml.dvc
```

Create *.dvc metafile**

What is inside ***.dvc files?

run command

```
$ cat data/data.xml.dvc
```

output

```
outs:
- md5: a304afb96060aad90176268345e10355
  path: data.xml
```

run command

```
$ du -sh .dvc/cache/*/*
```

output

```
36M
..dvc/cache/a3/04afb96060aad90176268345e10355
```

dvc add moved the data to the project's cache, and linked it back in a special .dvc file

Add a directory to version control

run command

```
$ dvc add datadir
```

output

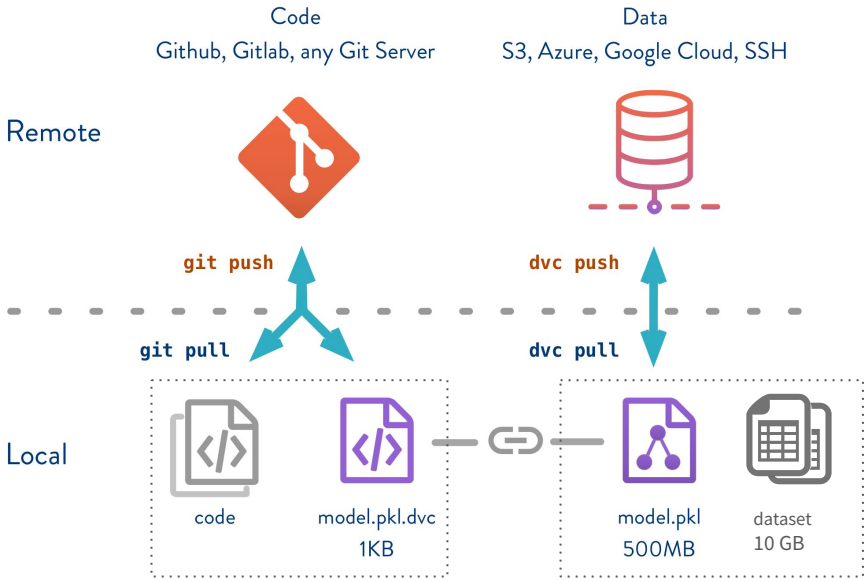
```
Adding...
!
...
 95%|██████████ |Computing file/dir hashes 1.70k/1.80k [00:00<00:00,  3.46kmd5/s]
...
 98%|██████████|Saving datadir          1.76k/1.80k [00:02<00:00,   670file/s]
...
To track the changes with git, run:

        git add datadir.dvc
```

It works similarly for data directory

Version and share data and models remote storage

How DVC works with data

- Automated versioning of DVC pipeline outputs
  - **dvc.yaml** [deps/outs]
- Manually add files & folders for DVC version control
  - **dvc add**



Setup your remote storage

run command

```
$ mkdir -p /tmp/dvc
$ dvc remote add -d myremote /tmp/dvc
$ git commit .dvc/config -m "Configure local remote"
```

/tmp/dvc used as a local ‘remote storage’ named myremote in this example

- Remote storage types: Google Drive, Amazon S3, Azure Blob Storage, Google Cloud Storage, Aliyun OSS, SSH, HDFS, and HTTP

Push data to remote storage

run command

```
$ dvc push
```

output

```
Preparing to upload data to '/tmp/dvc'
Preparing to collect status from /tmp/dvc
...
Collecting information from remote cache...
Querying 1 hashes via object_exists
Indexing new .dir 'b6923e1e4ad16ea1a7e2b328842d56a2.dir' with '1800'
nested files

Everything is up to date.
```

/tmp/dvc used as a local 'remote storage' in this example

Pull data from remote

run command

```
$ dvc pull
```

output

```
Preparing to download data from /tmp/dvc
Preparing to collect status from /tmp/dvc
Collecting information from local cache...
Downloading...

1801 files fetched
```

/tmp/dvc used as a local ‘remote storage’ in this example

Live code example

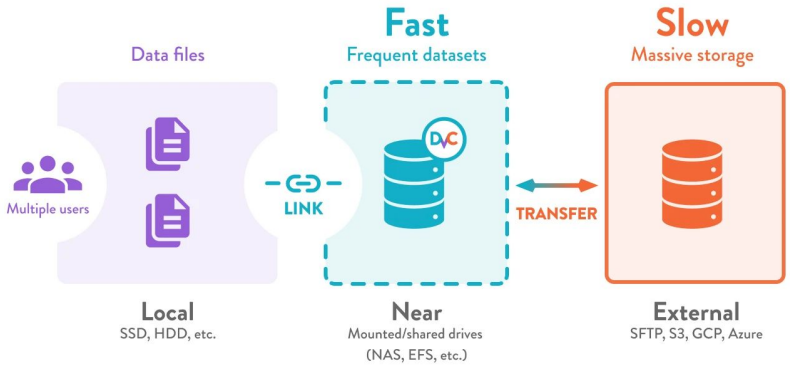
Version and share data and models

Tracking changes and switching between versions

Tracking changes

and switching between versions

- Track status of your data and models
  - **dvc status**
  - local workspace vs. .dvc/cache
  - local .dvc/cache vs. remote storage
- Switching version
  - **dvc checkout**



Track status of your data and models

run command (no changes)

```
$ dvc status
```

output

```
Data and pipelines are up to date.
```

run command (data has changed)

```
$ dvc status
```

output

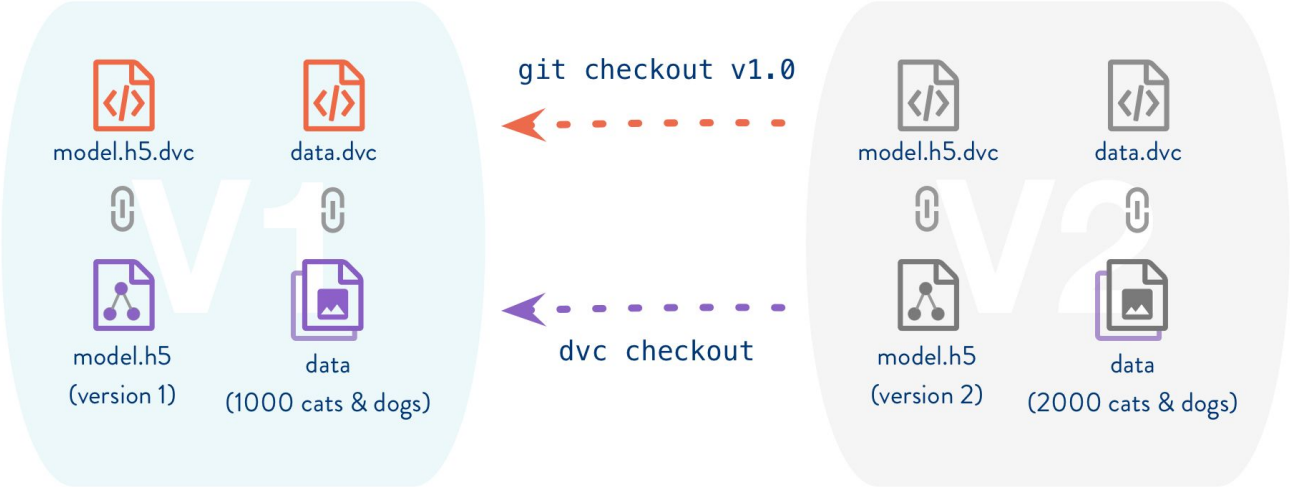
```
datadir.dvc:
        changed outs:
                modified:           datadir
```

type and name/hash of changes detected

Switching versions

run command

```
$ git checkout v1.0
$ dvc checkout data.dvc
```



Live code example

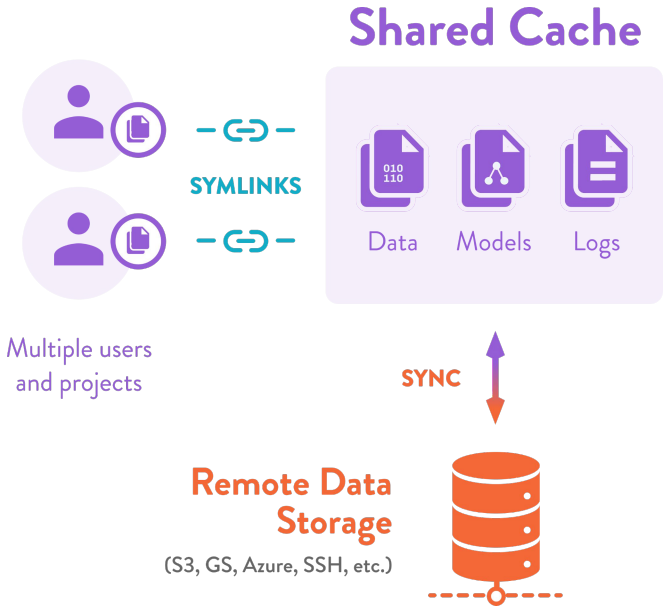
Tracking changes and switching between versions

Data Access

Data access features

from CLI and Python interface

- How do I **download the newest model** to deploy it?
- How do I **download a specific version** of a model?
- How do I **reuse datasets** across different projects?
- **Get features used to train** the model for regulatory compliance?



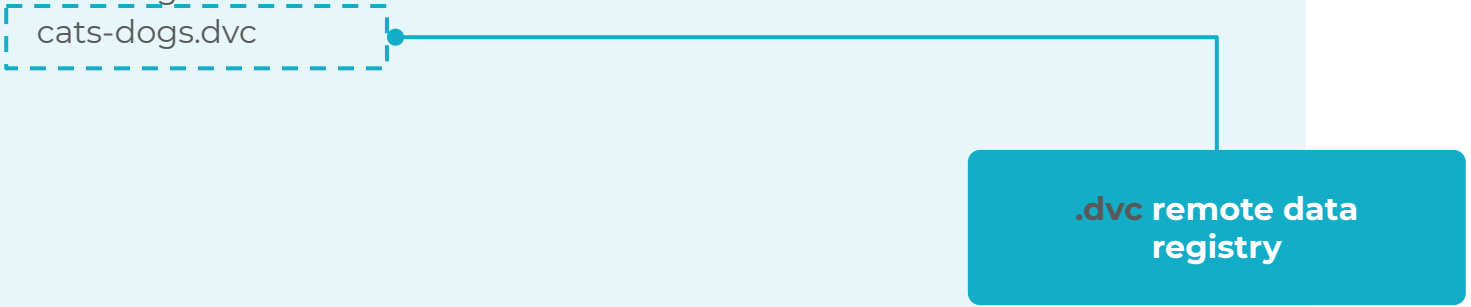
Find a dataset

run command

```
$ dvc list https://github.com/iterative/dataset-registry use-cases
```

output

```
.gitignore
cats-dogs
cats-dogs.dvc
```

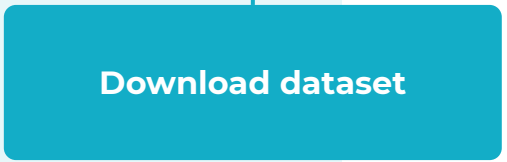


Get dataset

run command

```
$ dvc get https://github.com/iterative/dataset-registry use-cases
```

output



Import the dataset

run command

```
$ dvc import https://github.com/iterative/dataset-registry use-cases
```

output

Download dataset and add it under DVC control

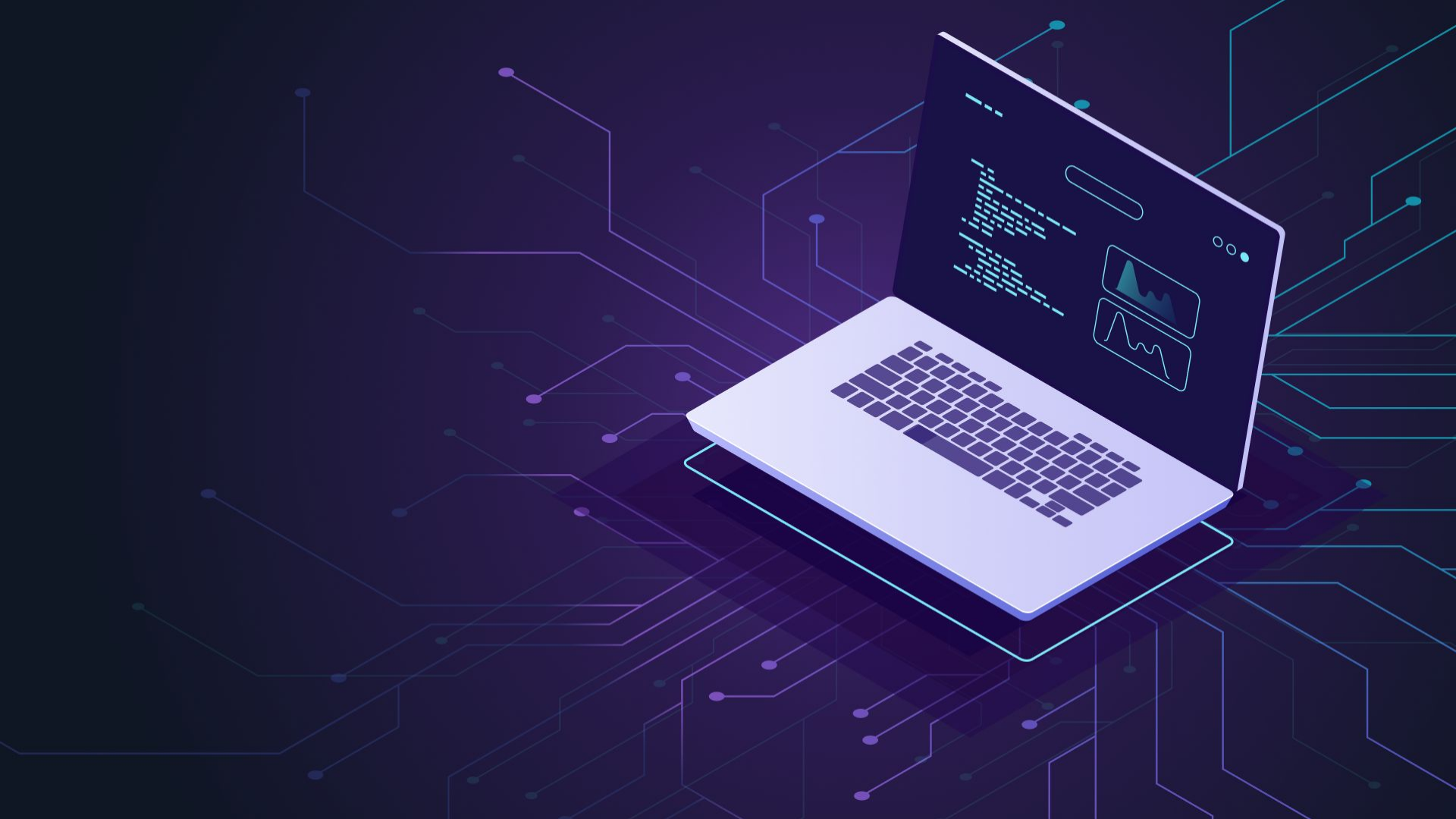
Live code example

Data Access

What have we learned?

What have we learned?

1. How DVC does versioning your data and models
2. How to setup versioning for data and models
3. How to share and access data and models
4. How to switch versions



Links

- Get Started: Data Versioning https://dvc.org/doc/start/data-and-model-versioning
- Get Started: Data and Model Access https://dvc.org/doc/start/data-and-model-access
- Versioning Data and Models https://dvc.org/doc/use-cases/versioning-data-and-model-files
- Sharing Data and Model Files https://dvc.org/doc/use-cases/sharing-data-and-model-files