Data Versioning Motivation

INTRODUCTION TO DATA VERSIONING WITH DVC



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What is Data Versioning?

- Definition
  - Monitors data changes over time
  - Snapshots data over iterations
  - Similar to code versioning
- Benefits
  - Retrieval and scrutiny
  - Data consistency, accountability, and lineage
- Applications
  - Data Science and Machine Learning
  - Data Engineering
  - Financial Analysis, Auditing and Compliance

Data vs Code Versioning

Code Versioning

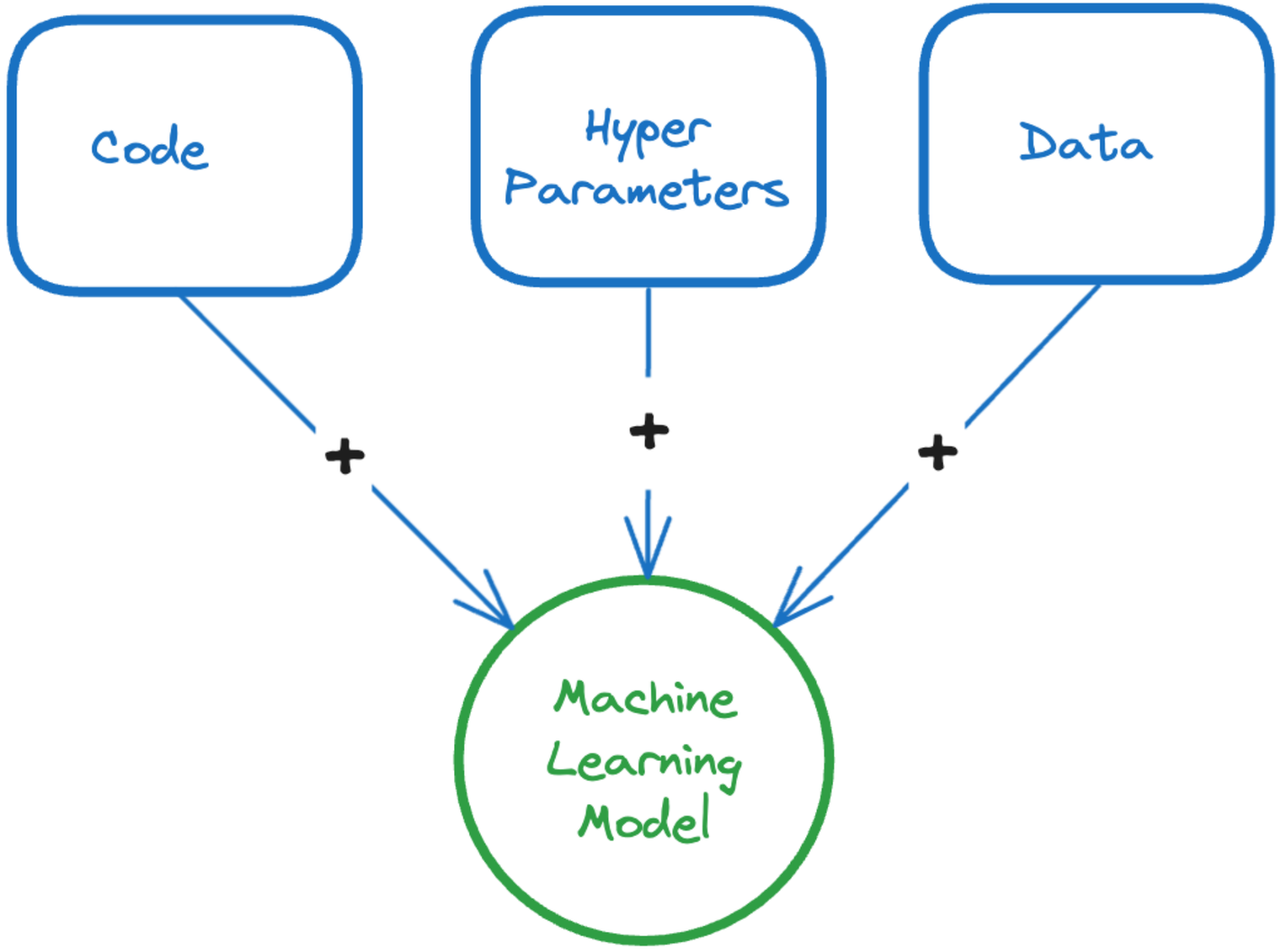
- Well known in software development
- Uses tools like **Git** to do decentralized version control
- Easier to manage as codebases are small

Data Versioning

- Relatively new (SciDB proposed in 2012)
- Toolchains like **DVC** are used in conjunction with Git
- Relatively difficult to manage due to large dataset size

[1] doi: 10.1109/ICDE.2012.102

Why Data Versioning in ML?



Dataset influence

Dataset A

	Booking_ID	number of adults	number of children	number of weekend nights	...	booking status
0	INN32220	2	0	1	...	0
1	INN19707	2	0	0	...	0
2	INN36276	2	0	1	...	0
3	INN02246	2	0	0	...	1
4	INN27306	1	0	0	...	0

Dataset B

	Booking_ID	number of adults	number of children	number of weekend nights	...	booking status
0	INN33507	2	0	0	...	0
1	INN29646	1	0	0	...	0
2	INN34621	2	0	2	...	0
3	INN19236	2	0	0	...	0
4	INN02991	2	0	0	...	0

Dataset influence

Hyperparameters are kept consistent, dataset changed

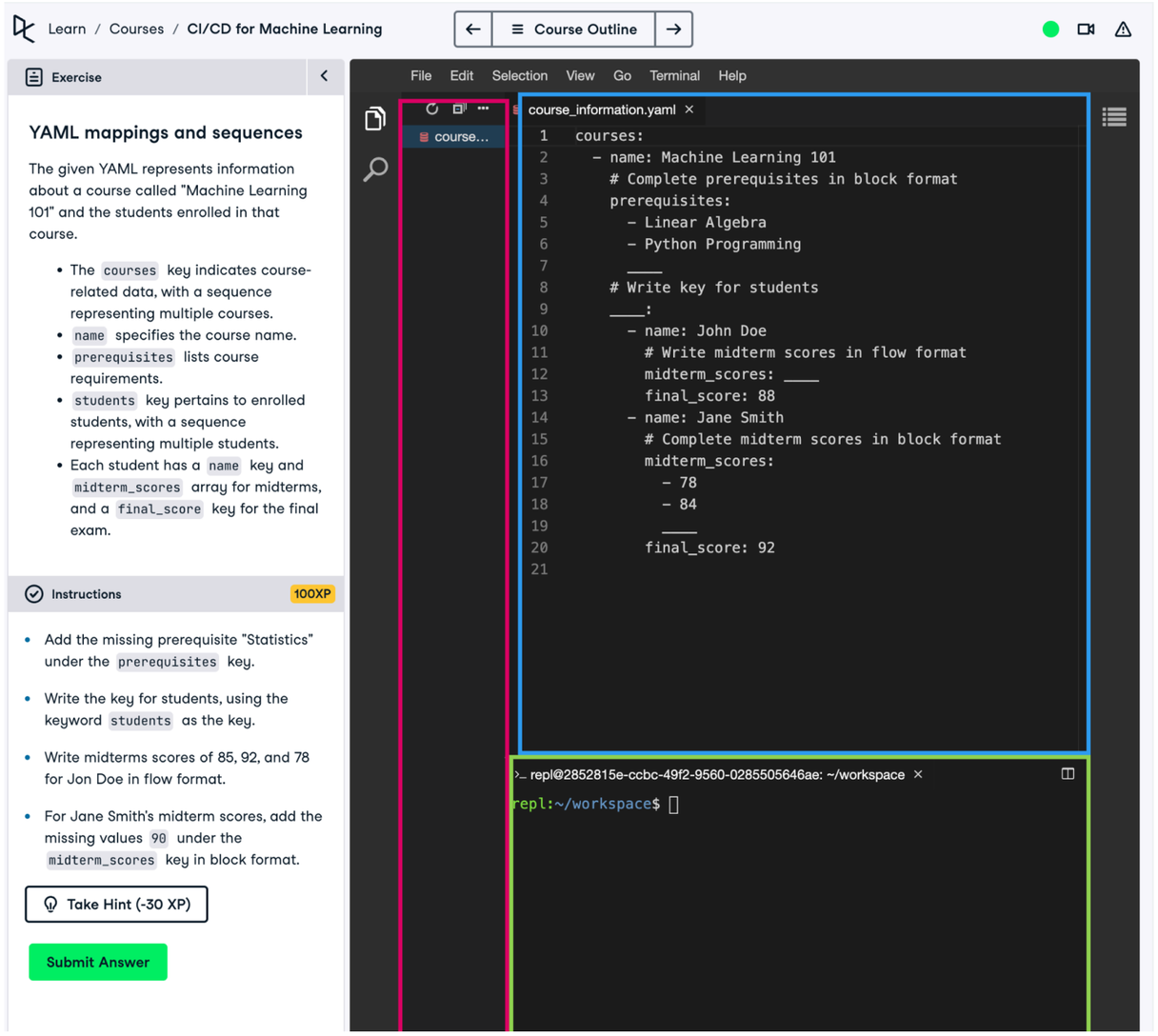
Metric	Dataset A	Dataset B
Precision	0.78	0.79
Recall	0.54	0.57
F1 Score	0.64	0.66
Accuracy	0.80	0.81

Hyperparameters influence

Dataset kept consistent, hyperparameters changed

Metric	`n_estimators=5`	`n_estimators=10`
Precision	0.78	0.85
Recall	0.54	0.52
F1 Score	0.64	0.65
Accuracy	0.80	0.81

Editor Exercises Layout



Let's practice!

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Introduction to DVC

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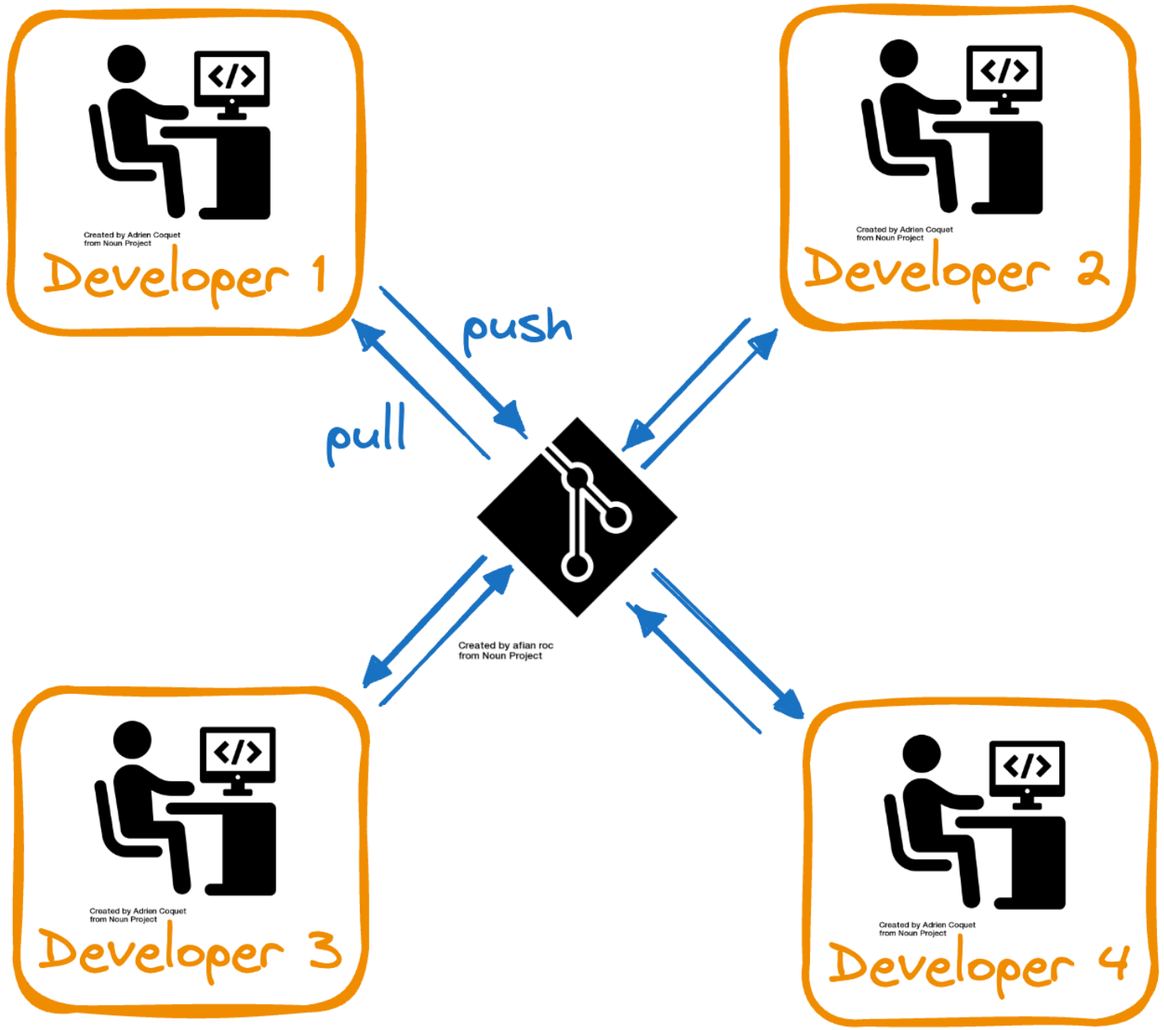
Git as Version Control

- Code version control system
- Independent local development
  - Branch and merge
  - Version history management
- Enables collaboration



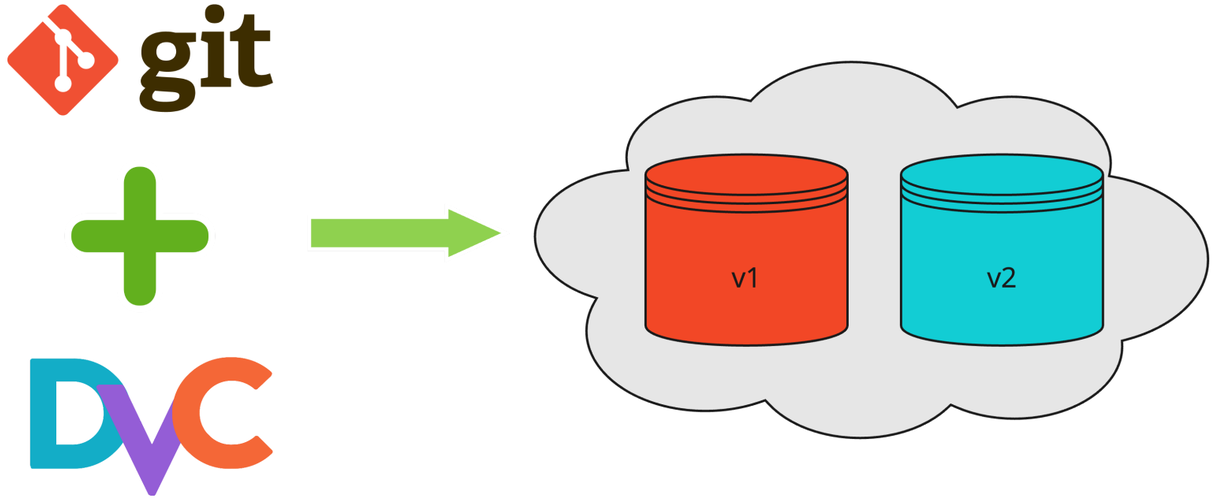
Git as Version Control

- CLI based interaction
- Run on *terminal*, aka *shell*
- Git tracks contents via a repository
  - Actual files/folders to be tracked
  - Git metadata (in `.git` folder)



Data Version Control (DVC)

- DVC: Data Version Control tool
  - Manages data and experiments
  - Similar to Git



- Git tracks metadata, DVC handles data versioning

Git vs DVC CLI

Git

- Initialize repository in working folder

```
$ git init
```

- Adding files to repository (staging changes)

```
$ git add code.py
```

- Commit changes (in version history)

```
$ git commit -m "adding first file"
```

DVC

- Initialize DVC repository in working folder

```
$ dvc init
```

- Adding data files to DVC

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

- Updating all tracked data files

```
$ dvc commit
```

Git vs DVC CLI

Git

- Push code changes to remote server

```
$ git push
```

- Pulling changes from remote

```
$ git pull
```

- Cloning an existing repository from remote (Github)

```
$ git clone \
https://github.com/username/repository-name.git
```

DVC

- Push data changes to remote data server

```
$ dvc push
```

- Synchronizing your DVC project

```
$ dvc pull
```

- Download a file or directory tracked by DVC

```
$ dvc get \
https://github.com/username/repo-name model.pkl
```

Let's practice!

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DVC features and use cases

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DVC features and use cases

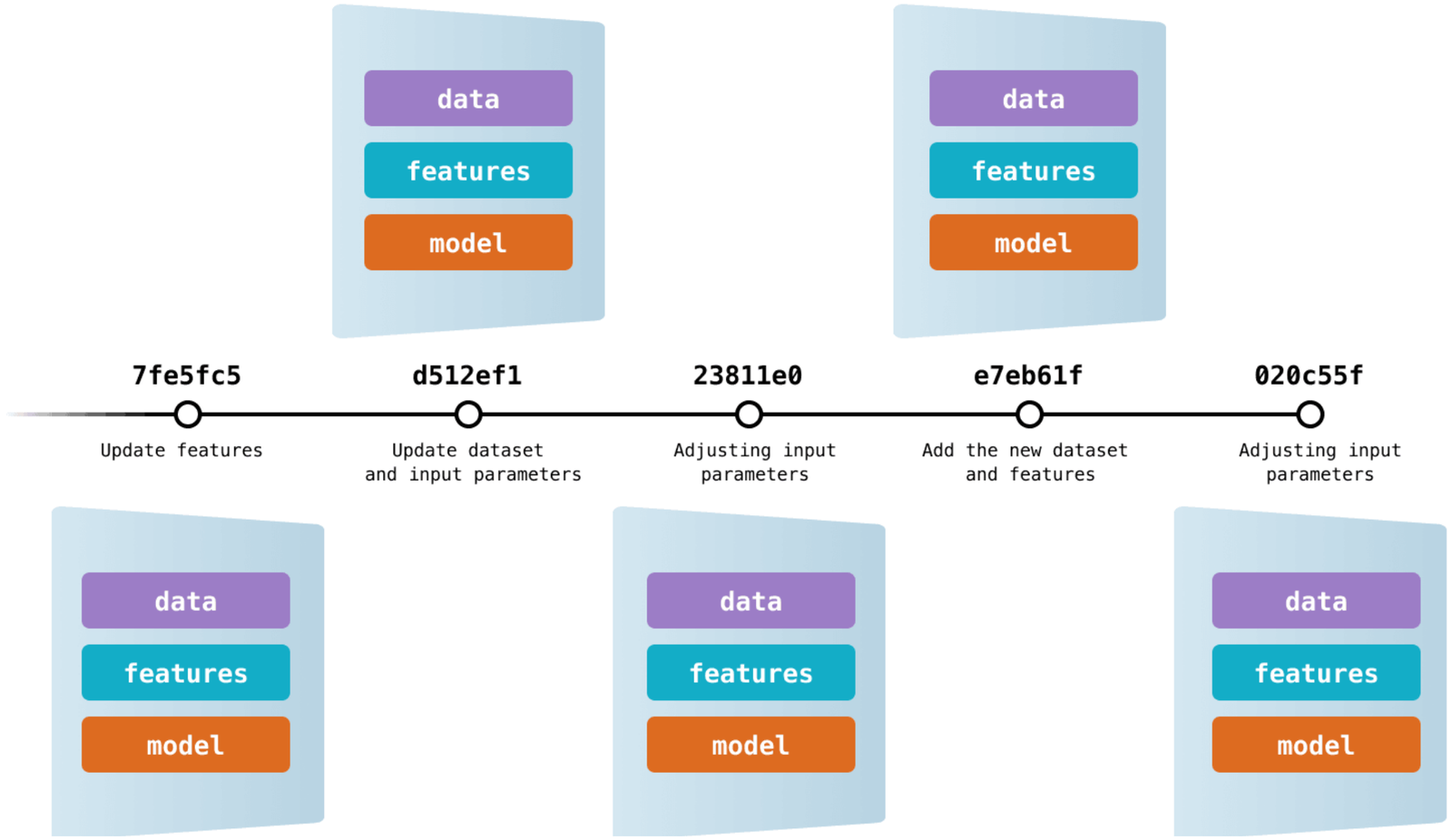
Covered topics

- Versioning data and models
- DVC Pipelines
- Metrics and plots tracking

Advanced topics (not covered)

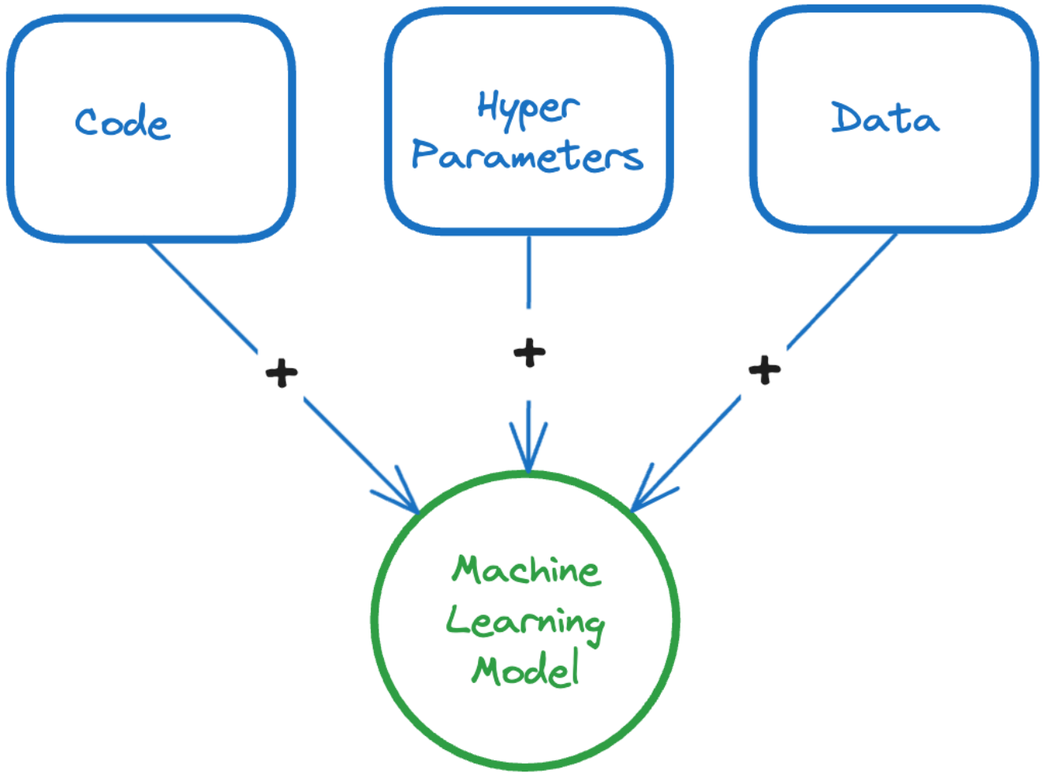
- Experiment tracking
- CI/CD for machine learning
- Data registry

Versioning data and models



[1] https://dvc.org/doc/use-cases/versioning-data-and-models

Pipelines



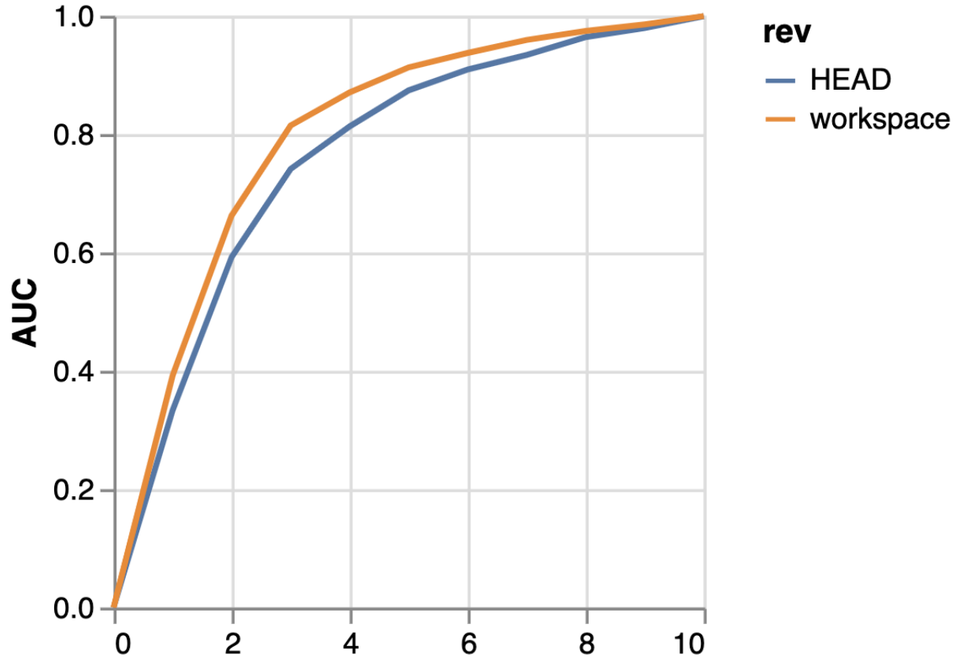
- Define pipeline in `dvc.yaml`

```
stages:
  train:
    cmd: python train.py
    deps:
      - code/train.py
      - data/input_data.csv
      - params/params.json
    outs:
      - model_output/model.pkl
```

- Run with `dvc repro`.

Tracking metrics and plots

```
$ dvc metrics diff
Path                    Metric    HEAD      workspace    Change
dvclive/metrics.json    AUC       0.78912   0.18114      -0.60798
dvclive/metrics.json    TP        215       768          553
```

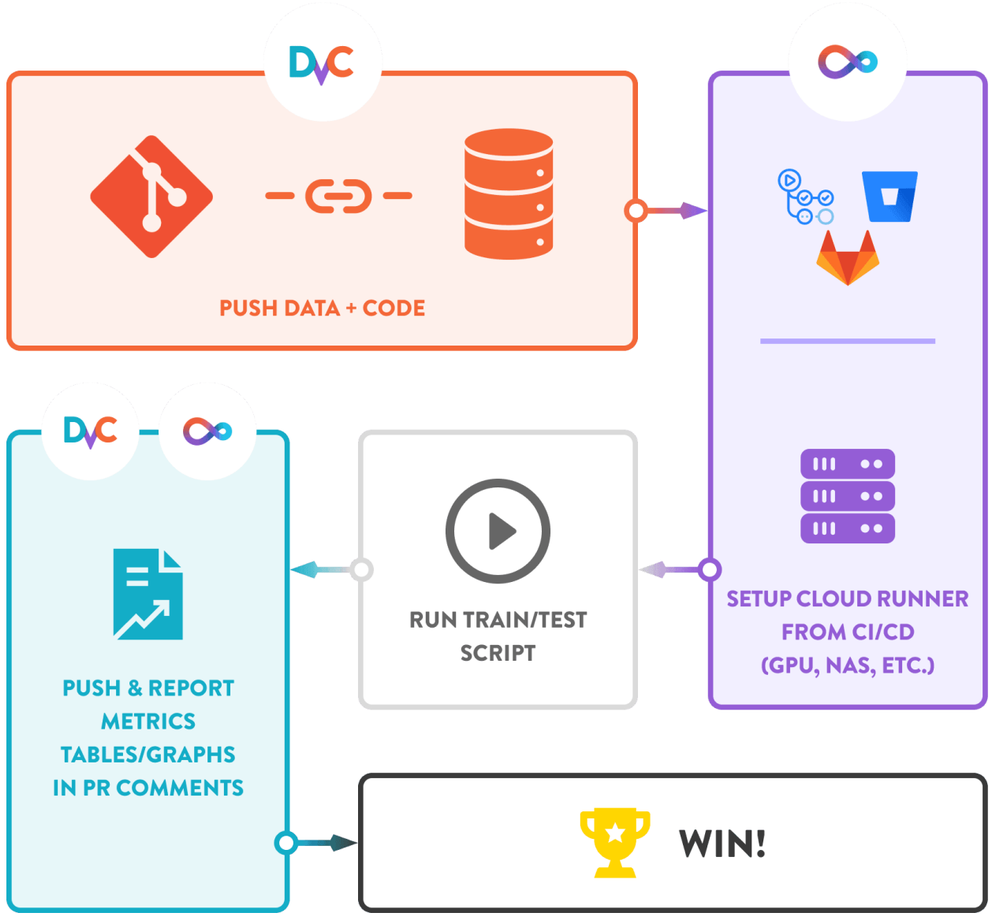


[1] https://dvc.org/doc/command-reference/plots/diff

Experiment tracking

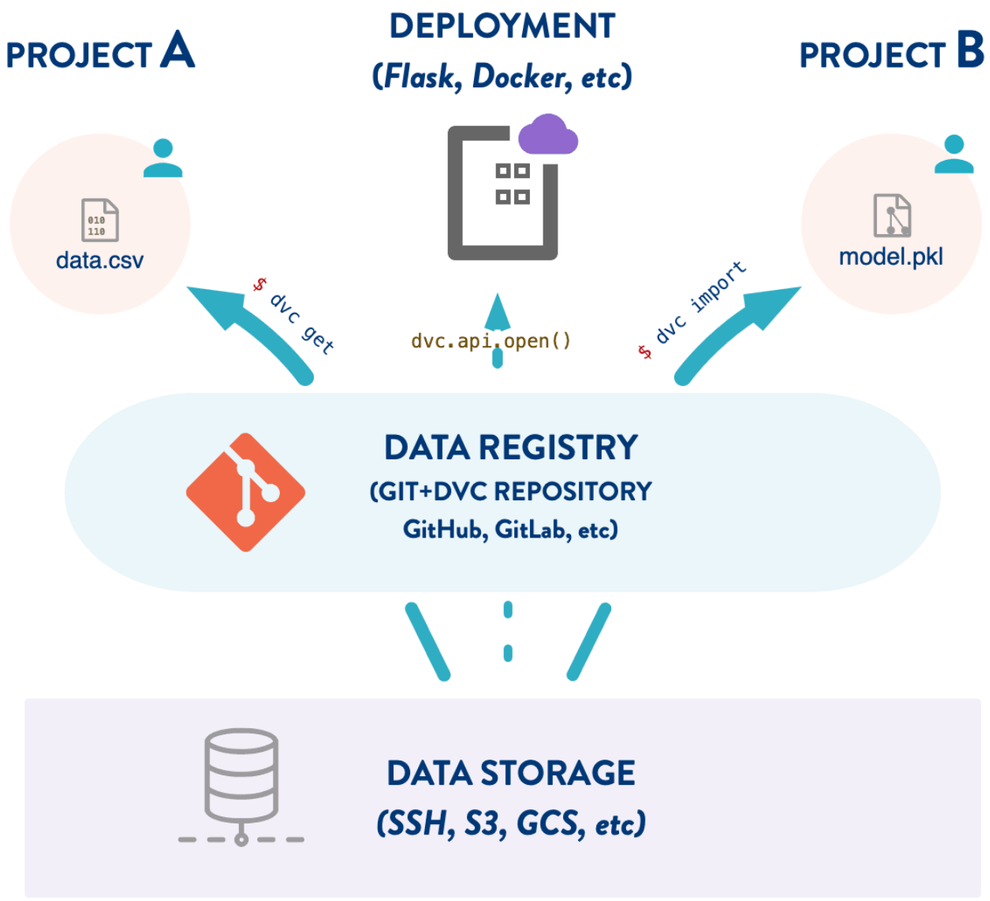
- Run experiment and log metrics
  - `dvc repro`
  - `dvc exp save`
- Alternatively, combine two steps `dvc exp run`
- Experiments are custom Git references
  - Prevent bloating up Git commits
  - Explicit saves can be made with `dvc exp save`
- Visualize using `dvc exp show`

CI/CD for Machine Learning



[1] Picture credits: https://dvc.org/doc/use-cases/ci-cd-for-machine-learning

Data registry



[1] Picture credits: https://dvc.org/doc/use-cases/data-registry

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