

Visualize Metrics & Plots with DVC and Studio

Lesson 5

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

- ◆ ML experiment issues & requirements
- ◆ Metrics tracking with DVC
- ◆ Visualize metrics and plots with DVC
- ◆ Visualize metrics and compare experiments with Studio





ML Experiment Issues & Requirements

Experiment Management



- ◇ Provide reproducibility
- ◇ Pipeline automation
- ◇ Metrics & artifacts tracking
- ◇ Create, run & organize experiments
 - Configuration management
 - Search & compare
 - Saving & sharing views of experiment dashboard
 - Documentation & reports
- ◇ Model lifecycle management
- ◇ Team collaboration



Metrics Tracking with DVC

dvc.yaml: setup metrics and plots

```
stages:  
train:  
  cmd: python train.py --config=params.yaml  
  deps:  
  - features.csv  
  outs:  
  - model.pkl  
  metrics:  
  - metrics.json:  
    cache: false  
  plots:  
  - auc.json:  
    cache: false
```

**Add metrics/plots files
in dvc.yaml**

A light blue rounded rectangular callout box with the text "Add metrics/plots files in dvc.yaml". A line extends from the bottom of the box, turning left and then down to point at the "metrics:" and "plots:" sections of the code block on the left.

dvc.yaml: setup metrics and plots

```
stages:  
train:  
  cmd: python train.py --config=params.yaml  
  deps:  
  - features.csv  
  outs:  
  - model.pkl  
  metrics:  
  - metrics.json:  
    cache: false  
  plots:  
  - auc.json:  
    cache: false
```

**Set cache to False to
keep file in Git history**

Compare experiments: **dvc metrics show**



run command

```
$ dvc metrics show
```

output

```
metrics.json:
{
  "f1_score": 0.7861833464670345,
  "confusion_matrix": {
    "classes": ["setosa", "versicolor", "virginica"],
    "matrix":
      [[23, 0, 0],
       [0, 8, 0],
       [0, 11, 18]]
  }
}
```

**A metrics file
specified in **dvc.yaml****

Compare experiments: **dvc metrics diff**



run command

```
$ dvc metrics diff
```

output

Path	Metric	Value	Change
metrics.json	AUC	0.9671	0.0028
metrics.json	TP	531	4

Show changes in
metrics



Live code example

Metrics Tracking with DVC



Plots and graphics with DVC

Compare experiments: dvc plots show



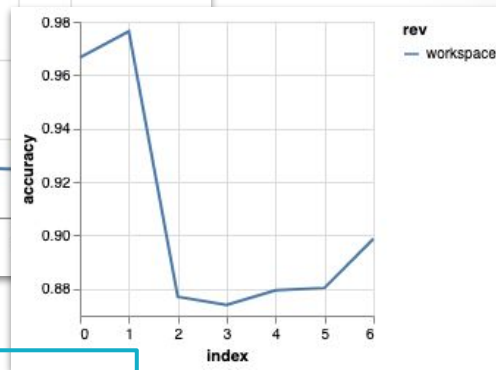
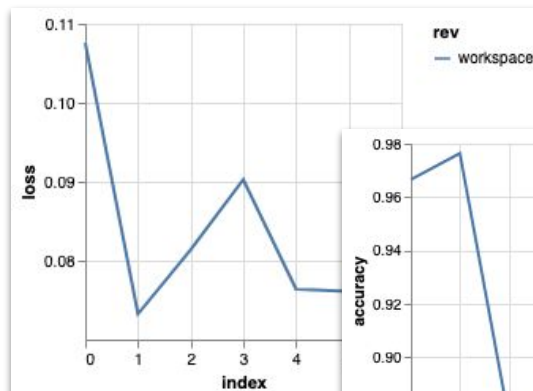
output

```
epoch,accuracy,loss,val_accuracy,val_loss
```

```
0,0.9418667,0.19958884770199656,0.9679,0.10217399864746257
1,0.9763333,0.07896138601688048,0.9768,0.07310650711813942
2,0.98375,0.05241111190887168,0.9788,0.06665669009438716
3,0.98801666,0.03681169906261687,0.9781,0.06697812260198989
4,0.99111664,0.027362171787042946,0.978,0.07385754839298315
5,0.9932333,0.02069501801203781,0.9771,0.08009233058886166
6,0.9945,0.017702101902437668,0.9803,0.07830339228538505
7,0.9954,0.01396906608727198,0.9802,0.07247738889862157
```

run command

```
$ dvc plots show logs.csv
```

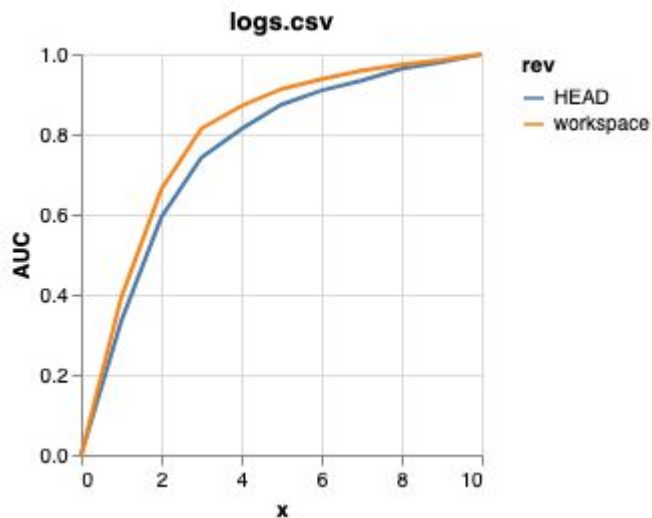


Use the `-y` option to change the field to plot

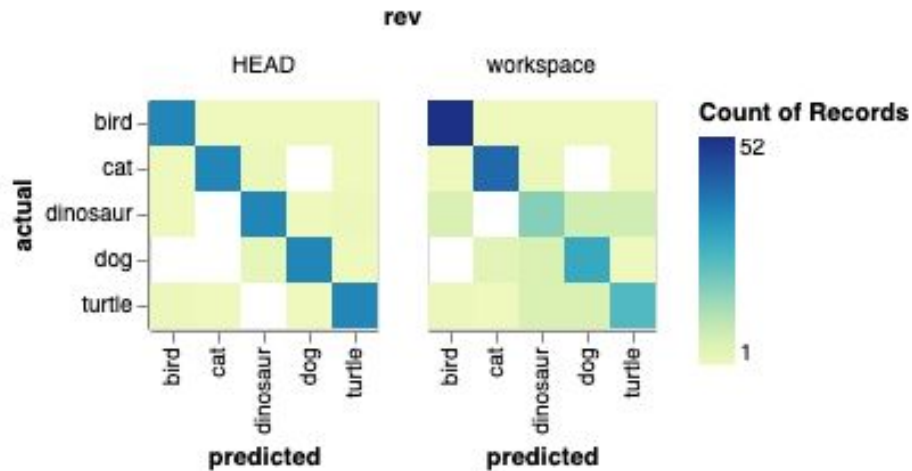
Compare experiments: **dvc plots diff**



Linear plot diff example



Confusion matrix diff example



Add and modify plot templates



DVC project root folder

.dvc

cache/

plots/

confusion.json

default.json

scatter.json

smooth.json

tmp/

...

```
{
  "$schema":
    "https://vega.github.io/schema/vega-lite/v4.json",
  "data": {
    "values": "<DVC_METRIC_DATA>"
  },
  "title": "<DVC_METRIC_TITLE>",
  "mark": "rect",
  "width": 500,
  "height": 500,
  "encoding": {
    ....
  }
}
```

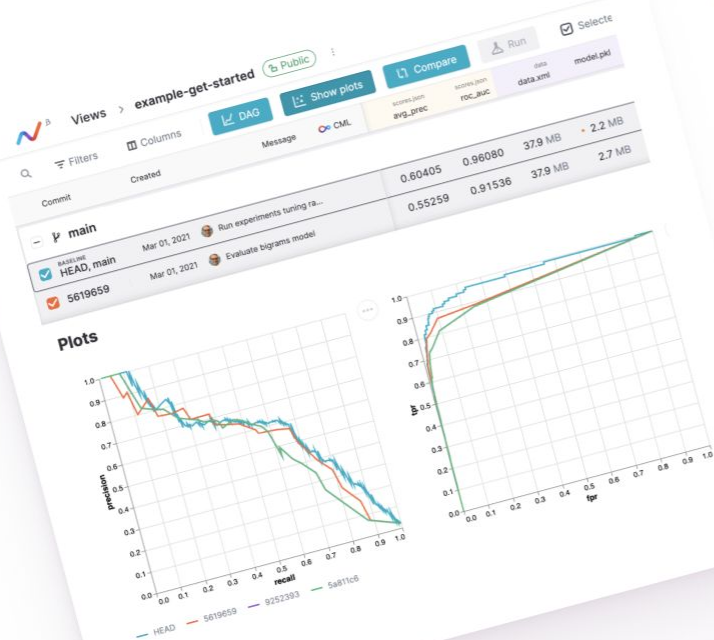


Live code example

Plots and graphics with DVC



Metrics Tracking and Plots with Studio



Metrics need to be shareable, accessible

Visualize, track, and share ML models across your team

Studio: experiments dashboard



Personal ▾ Views

Find a view or repo

+ Add a view

Talk to an expert

mnist_project
Updated 3 days ago
tapadpt/mnist_project

Metrics	main	hidden-units-128	high-dropout
accuracy	0.90610	0.00000	-0.00400
loss	0.25934	0.00000	+0.01263

example-get-started
tapadpt/example-get-started

Metrics	master	high-num-heads
avg_prec	0.60405	0.00000
roc_auc	0.96080	0.00000

yolov5
2 issues Updated 2 months ago
iterative/yolov5

Metrics	dvc	IR	C6
anchor_t	4.00000		
box	0.05000		
cls	0.50000		

fashion_mnist
Updated 28 days ago
tapadpt/fashion_mnist

Metrics	main
accuracy	0.91010
loss	0.24840

Connect to
Git repository and
create a "View"

Make views public

Studio: experiments table



Experiment
filters

Display
options

Column
filters

Views > example-get-started Public

Filters 1 Columns Show plots Compare Run

Selected only Trends Delta mode

Clear all Branch

Commit

master

BASELINE HEAD, m...

10-bigr...

9-bigr...

8-evalu...

7-ml-pi...

6-prepa...

5-sourc...

4-impor...

Metrics Files Parameters

Search

Selected 3 of 7

params.yaml

featureize

max_features

ngrams

prepare

seed

split

train

min_split

n_est

seed

12 of 12 commits

0.60405	0.96080	37.9 MB	64	100
0.55259	0.91536	37.9 MB	2	50
0.52048	0.90320	37.9 MB	2	50
0.52048	0.90320	37.9 MB	2	50
-	-	37.9 MB	2	50
-	-	37.9 MB	2	50
-	-	37.9 MB	-	-

Trends

All time

master try-large-dataset

avg_prec

Time

Studio: experiments and metrics tracking



Views > example-get-started Public

Search Filters Columns Show plots Compare Run

Selected only Trends Delta mode

Commit	Created	Message	CML	avg_prec	roc_auc	data.xml
try-large-dataset		inherited from master	View PR			
try-lar...	Jun 02, 2021	Try 100K dataset (4x data)		0.67038	0.96693	152.1 MB
master						
BASELINE HEAD, m...	May 29, 2021	Run experiments tuning ra...		0.60405	0.96080	37.9 MB
10-bigr...	May 28, 2021	Evaluate bigrams model		0.55259	0.91536	37.9 MB
9-bigra...	May 27, 2021	Reproduce model using bi...		0.52048	0.90320	37.9 MB
8-evalu...	May 26, 2021	Create evaluation stage		0.52048	0.90320	37.9 MB
7-ml-pi...	May 24, 2021	Create ML pipeline stages		-	-	37.9 MB
6-prepa...	May 23, 2021	Create data preparation st...		-	-	37.9 MB
5-sourc...	May 22, 2021	Add source code files to re...		-	-	37.9 MB
4-impor...	May 21, 2021	Import raw data (overwrite)		-	-	37.9 MB

changes

Open diff on GitHub

HEAD, master, 11-random-forest-experiments, ...
10-bigrams-experiment, bigrams-experiment

Show diff for all data points (including hidden)

Metrics

Name	HEAD, mast...	10-bigrams...
scores.json:avg_prec	0.60405	0.55259
scores.json:roc_auc	0.96080	0.91536

Parameters

Name	HEAD, mast...	10-bigrams...
...eaturize.max_features	3000	1500

Files

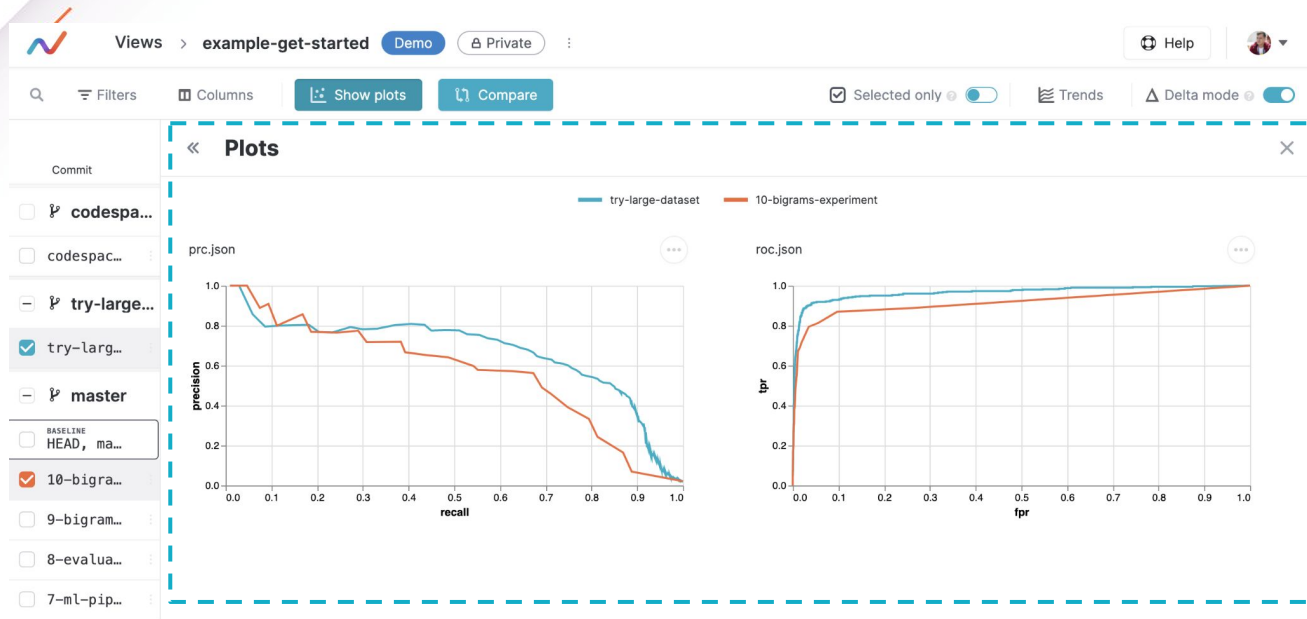
Name	HEAD, mast...	10-bigrams...
data/features	12.7 MB	10.9 MB

List of experiments

Set metric goals

Track changes

Studio: show plots



Show plots for metrics differences

Studio: track params and data changes



Commit				scores.json		data				p	
Created	↓	Message	CML	avg_prec	roc_auc	data.xml	features	model.pkl	max_features	feature	
<input type="checkbox"/> try-large-dataset inherited from master View PR											
<input type="checkbox"/> try-la...	Jun 01, 2021	Try 100K dataset (4x data)		0.67038	0.96693	• 152.1 MB	• 51.1 MB	• 8.6 MB	3000		
<input type="checkbox"/> master											
<input type="checkbox"/> BASELINE HEAD, ...	May 28, 2021	Run experiments tuning ra...		0.60405	0.96080	37.9 MB	• 12.7 MB	• 2.2 MB	3000		
<input type="checkbox"/> 10-big...	May 27, 2021	Evaluate bigrams model		0.55259	0.91536	37.9 MB	10.9 MB	2.7 MB	1500		
<input type="checkbox"/> 9-bigr...	May 26, 2021	Reproduce model using bi...		0.52048	0.90320	37.9 MB	• 10.9 MB	• 2.7 MB	1500		



Live code example

Metrics Tracking and Plots with DVC Studio



What have we learned?

What have we learned?



1. Requirements for ML experiment management
2. How to setup metrics and plots with DVC
3. How to visualize metrics and plots with DVC and DVC Studio





Links



Data Science blueprint

<https://data-science-blueprint.readthedocs.io/en/latest/presentation/schema.html>