

# Visualize Metrics & Plots with DVC and Studio

Lesson 5

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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



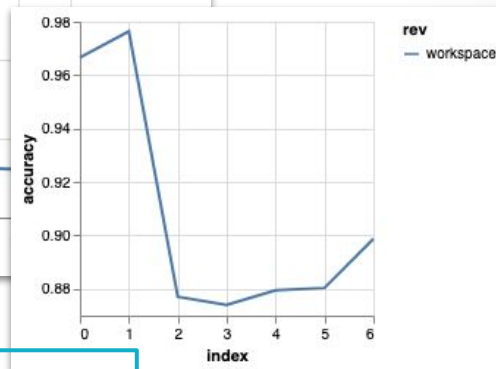
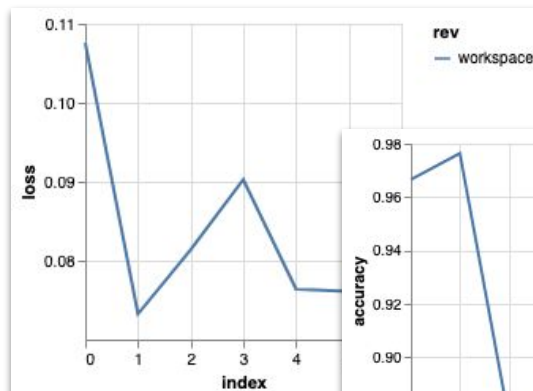
# output

```
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
```

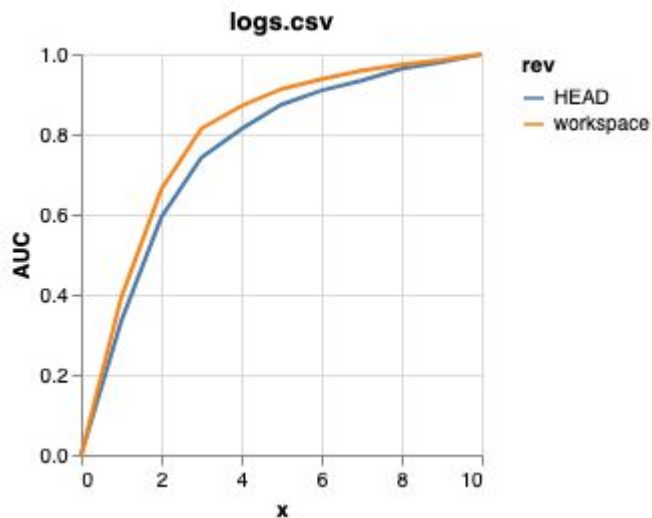


Use the `-y` option to change the field to plot

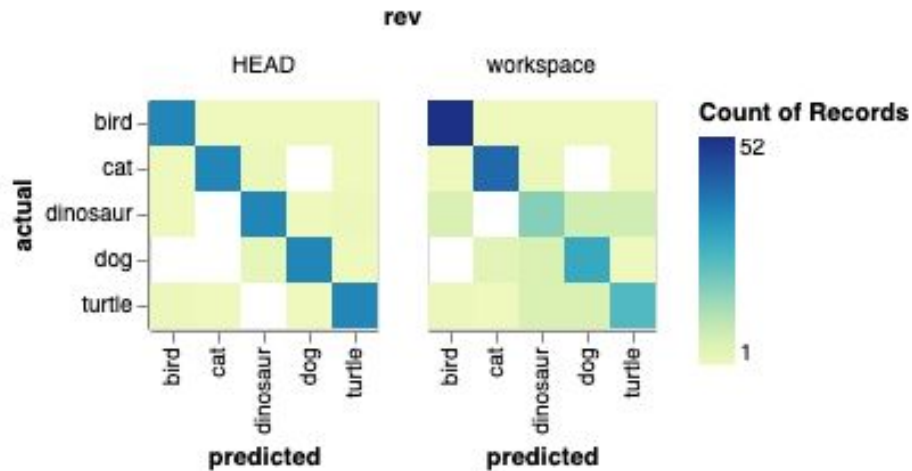
# Compare experiments: dvc plots diff



# 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": {
    ....
  }
}
```



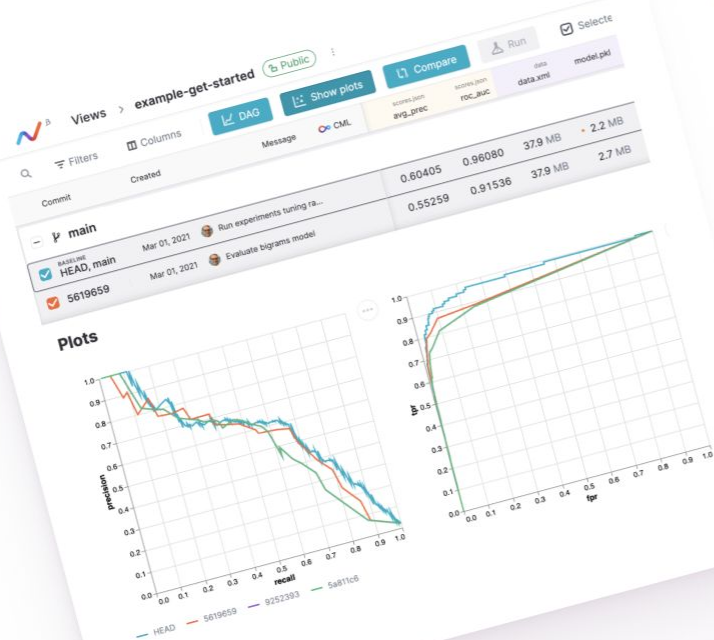
**Live code example**

# 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

tapadpti/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**

tapadpti/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

tapadpti/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

scores.json		data		params.yaml	
avg_prec	roc_auc	data.xml	min_split	n_est	seed
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	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						
BASLINE 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

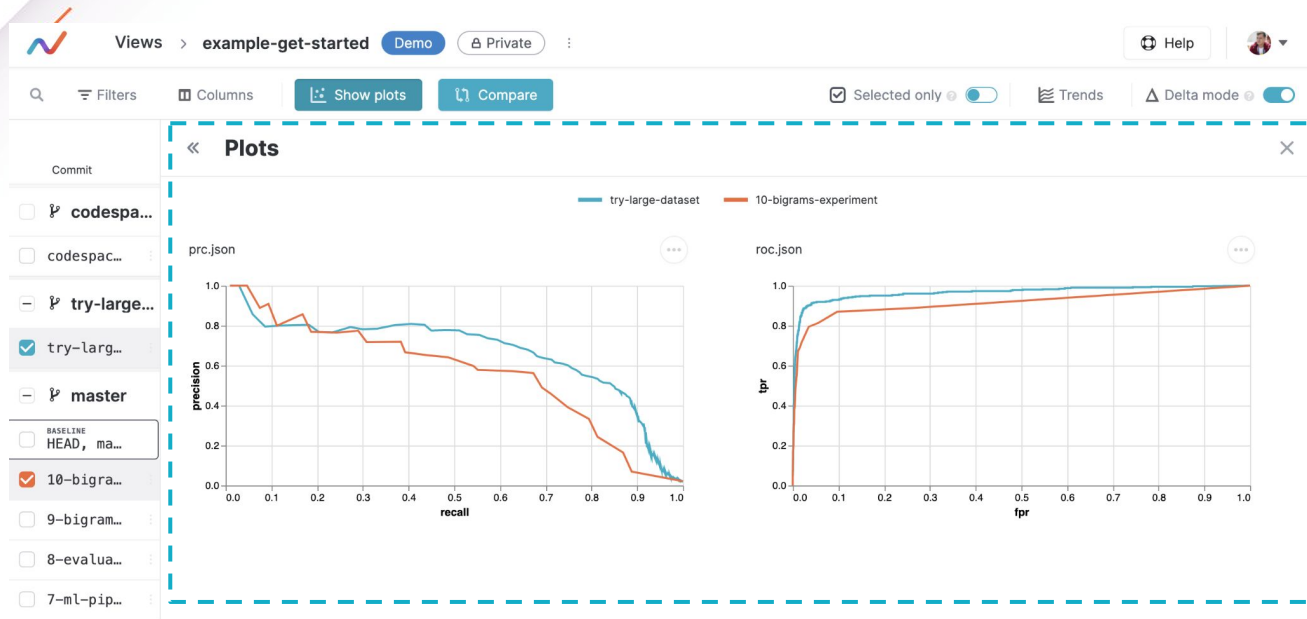
Name	HEAD, mast...	10-bigrams...
data/features	12.7 MB	10.9 MB

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"/> <b>try-large-dataset</b> inherited from master <a href="#">View PR</a>											
<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"/> <b>master</b>											
<input type="checkbox"/> <b>BASLINE HEAD, ...</b>	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>