MLflow with R

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Overview

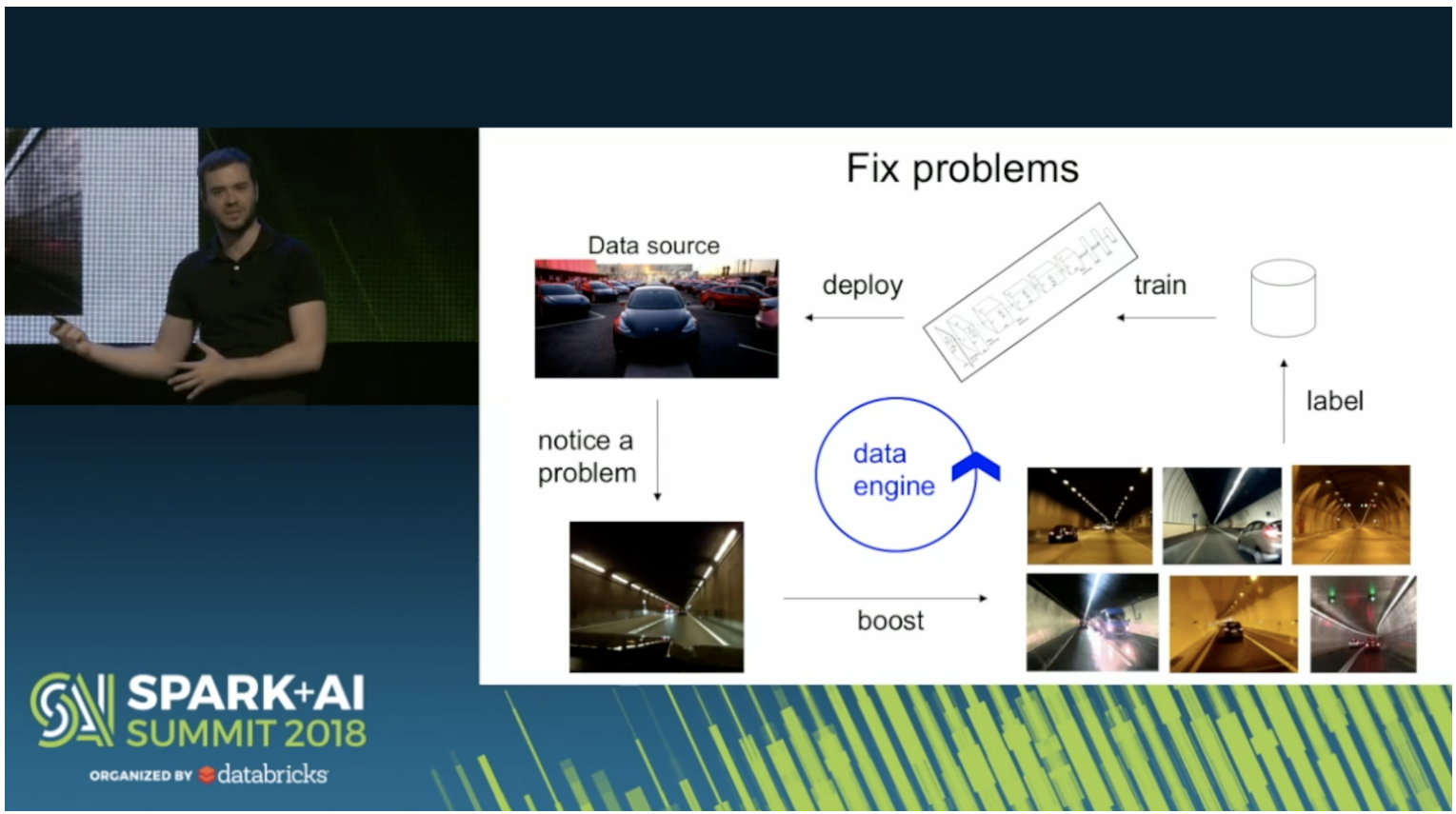
- What is MLflow?
- MLflow with R

What is MLflow?

Background

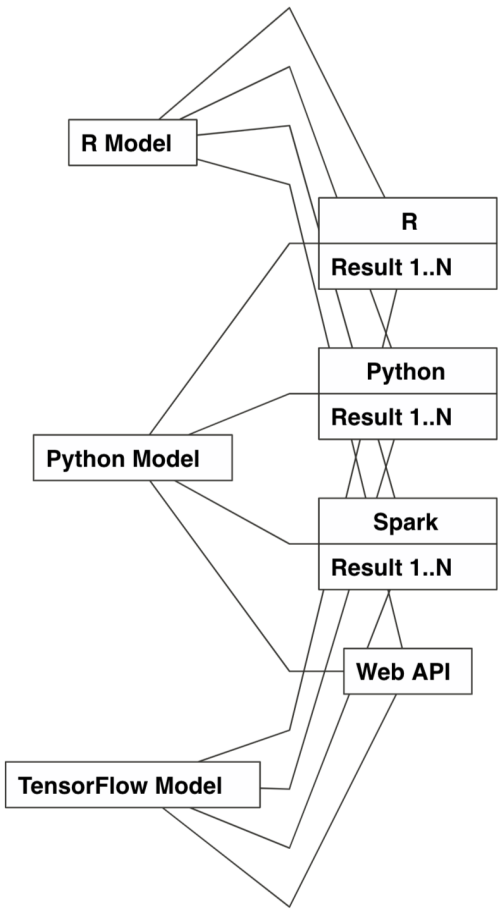
Spark Summit from Andrej Karpathy at Tesla

The toolchain for the (software) 2.0 tack does not exist.



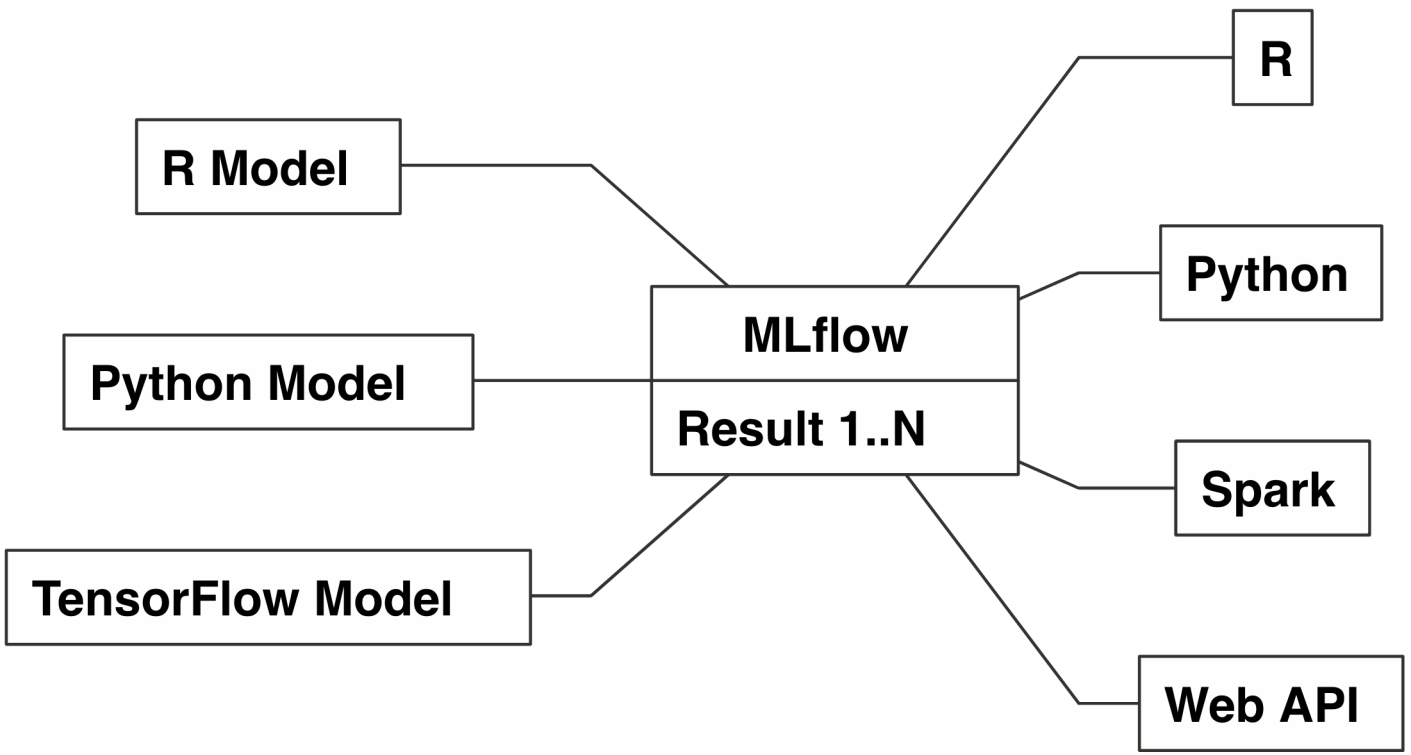
Challenge

Different models need to be run across many runtimes each producing many results.



Solution

MLflow can run models across runtimes tracking their results.



MLflow

“Helps teams manage their machine learning lifecycle.”

- **Tracking** : Track experiments to record and compare params and results.
- **Projects** : Reuse and reproduce code to share or transfer to production.
- **Models** : Manage and deploy models from across libraries and platforms.

MLflow with R

Principles

- Parity with Python API.
- Designed for the R user.

Installing

Install Anaconda or miniconda.

```
install.packages("mlflow")
mlflow::mlflow_install()
```

Tracking

Tracking - Implicit

Implicit MLflow run:

```r
library(mlflow)

# Log a parameter (key-value pair)
mlflow_log_param("param1", 5)

# Log a metric; metrics can be updated throughout the run
mlflow_log_metric("foo", 1)
mlflow_log_metric("foo", 2)
mlflow_log_metric("foo", 3)

# Log an artifact (output file)
writeLines("Hello world!", "output.txt")
mlflow_log_artifact("output.txt")
```

Run terminates when the R session finishes or by running:

```r
mlflow_end_run()
```

Useful when sourcing files.

Tracking - Explicit

Explicit MLflow run:

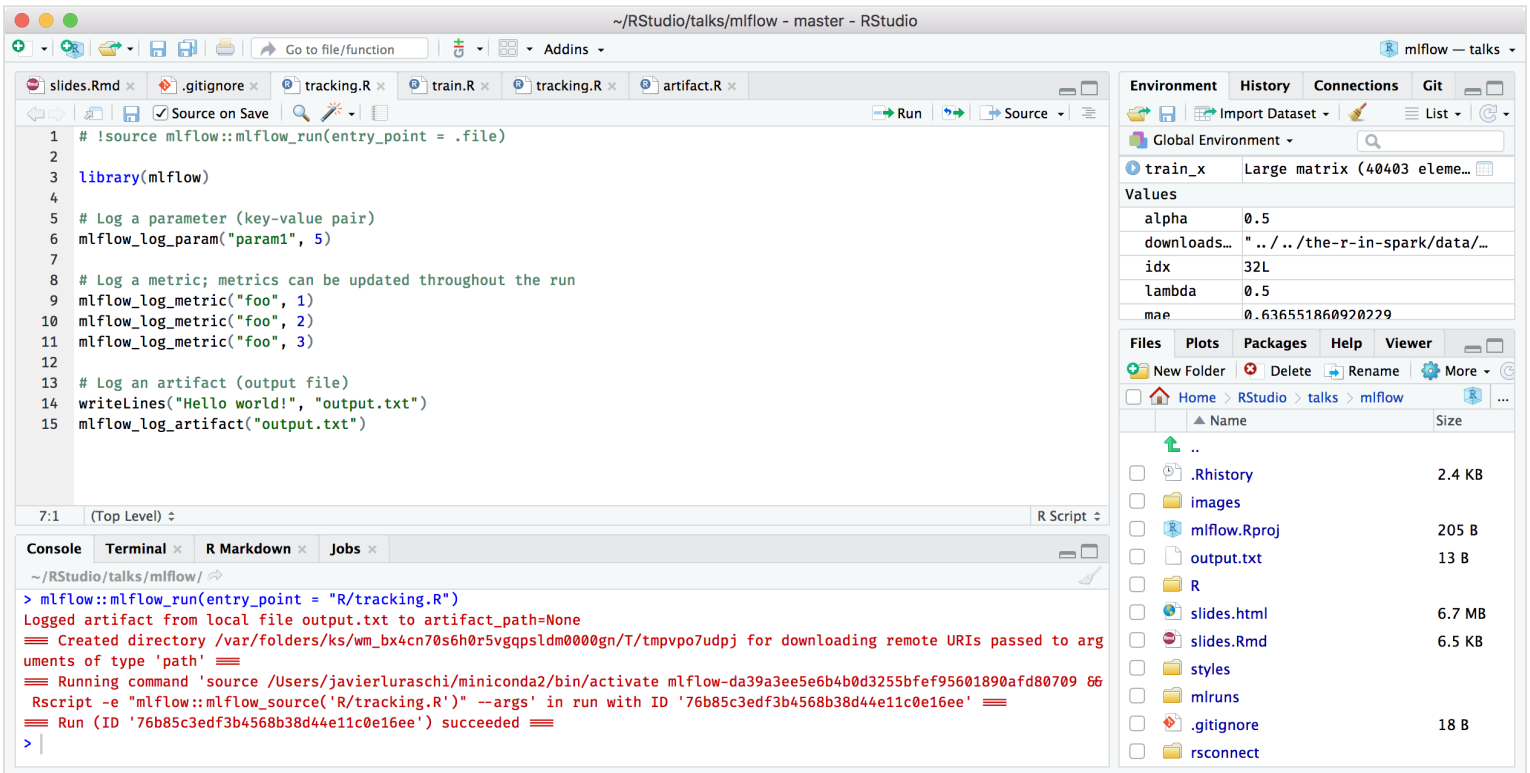
```
library(mlflow)

with(mlflow_start_run(), {
  # Log a parameter (key-value pair)
  mlflow_log_param("param1", 5)

  # Log a metric; metrics can be updated throughout the run
  mlflow_log_metric("foo", 1)
  mlflow_log_metric("foo", 2)
  mlflow_log_metric("foo", 3)

  # Log an artifact (output file)
  writeLines("Hello world!", "output.txt")
  mlflow_log_artifact("output.txt")
})
```

Tracking - Sources

```
mlflow_run("R/tracking.R")
```

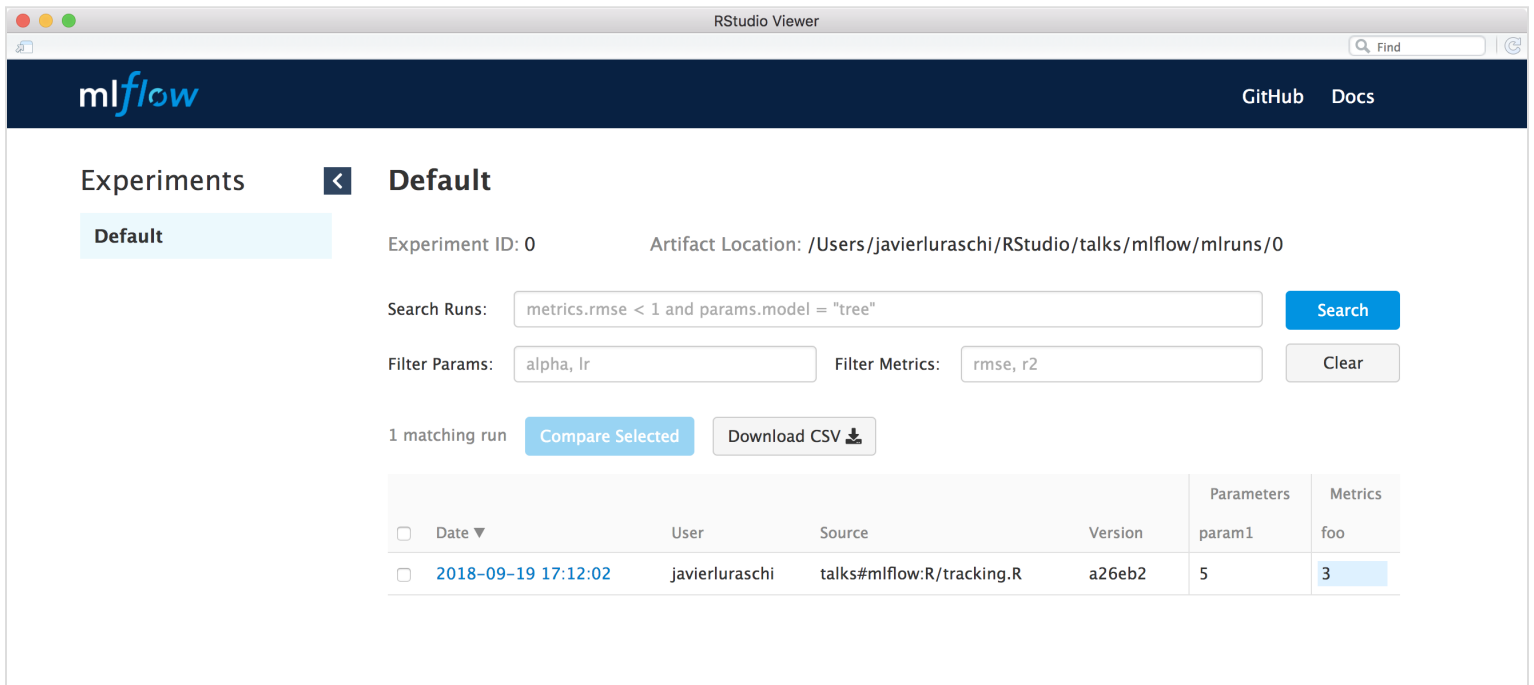
Or adding the following to `tracking.R` in RStudio 1.2:

```
# !source mlflow::mlflow_run(entry_point = .file)
```



Tracking - UI

```
mlflow_ui()
```



Projects

Projects - Snapshots

Create dependencies snapshot:

```
mlflow_snapshot()
```

Then restore snapshot:

```
mlflow_restore_snapshot()
```

Projects - Consuming R from R

```
mlflow_run(
  "train.R",
  "https://github.com/rstudio/mlflow-example",
  param_list = list(alpha = 0.2)
)
```

```
Elasticnet model (alpha=0.2, lambda=0.5):
  RMSE: 0.827574750159859
  MAE: 0.632070002076146
  R2: 0.227227498131926
```

Projects - Consuming Python from R

```
mlflow_run(
  uri = "https://github.com/mlflow/mlflow-example",
  param_list = list(alpha = 0.2)
)
```

```
Elasticnet model (alpha=0.200000, l1_ratio=0.100000):
  RMSE: 0.7836984021909766
  MAE: 0.6142020452688988
  R2: 0.20673590971167466
```

Projects - Consuming R from Bash

Or from bash:

```
mlflow run --entry-point train.R https://github.com/rstudio/mlflow-example
```

```
Elasticnet model (alpha=0.5, lambda=0.5):
  RMSE: 0.828684594922867
  MAE: 0.627503954965052
  R2: 0.19208126758775
```

Models

R Models - Saving from R

```r
mlflow_save_model(model)
```

Generic functions can be serialized with `carrier::crate`:

```r
model <- lm(mpg ~ . -mpg, mtcars)

mlflow_save_model(
  crate(~ stats::predict(model, .x), model)
)
```

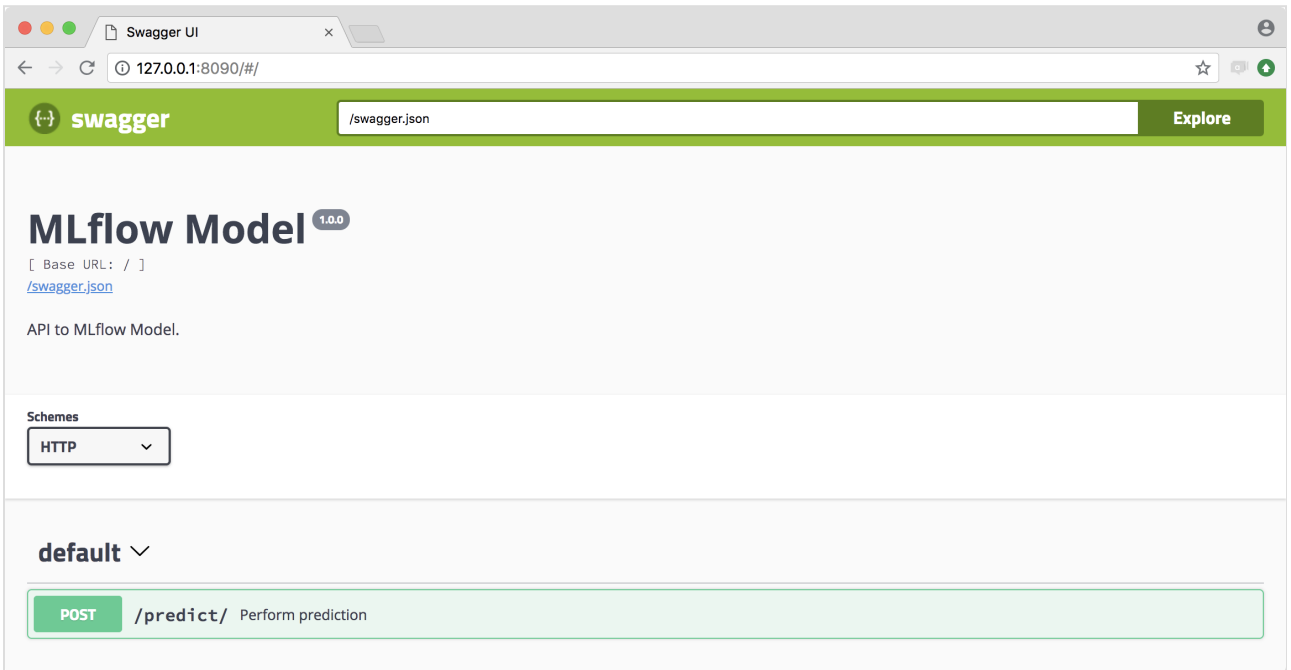
Models - Predictions from R

```
mlflow_rfunc_predict(
  "model",
  data = data.frame(cyl = 2, disp = 160, hp = 110, drat = 3.9, wt = 2.62,
                    qsec = 16.46, vs = 0, am = 1, gear = 4, carb = 4)
)
```

```
       1
23.04527
```

Models - Serving from R

```
mlflow_rfunc_serve("model")
```




```
mlflow rfunc serve model-path model
```

```
curl -X POST "http://127.0.0.1:8090/predict/" -H "accept: application/json" -H "Content-Type:
  application/json" -d
  '[{"cyl":2,"disp":160,"hp":110,"drat":3.9,"wt":2.62,"qsec":16.46,"vs":0,"am":1,"gear":4,"carb":
```

Models - Predict form Bash

Or from bash,

```
mlflow rfunc predic --model-path model --input-path data.csv
```

Keras Models - Saving

However, `mlflow_save_model()` can be extended by packages:

```
library(keras)

cars <- scale(mtcars)
model <- keras_model_sequential() %>%
  layer_dense(units = 8, activation = "relu", input_shape = ncol(mtcars) - 1) %>%
  layer_dense(units = 4, activation = "relu") %>%
  layer_dense(units = 1, activation = "relu") %>%
  compile(
    loss = "mse",
    optimizer = optimizer_rmsprop(),
    metrics = "mean_absolute_error"
  )

fit(model, cars[,-1], cars[,1], epochs = 10)
mlflow_save_model(model, "keras")
```

Keras Models - Prediction

```
mlflow_rfunc_predict(
  "keras",
  data = data.frame(cyl = 1, disp = 1, hp = 1, drat = 1, wt = 1,
                    qsec = 1, vs = 1, am = 1, gear = 1, carb = -1)
)
```

```
          [,1]
[1,] 0.02378437
```

Keras Models - Serving

```
mlflow_rfunc_serve("keras")
```

```
[{"cyl":1,"disp":1,"hp":1,"drat":1,"wt":1,"qsec":1,"vs":1,"am":1,"gear":1,"carb":-1}]
```

```
{"predictions": [[0.0238]]}
```

Models - Prediction in Spark

```
library(sparklyr)
sc ← spark_connect(master = "local")
mtcars_tbl ← sdf_copy_to(sc, mtcars)
```

```
model ← mlflow_load_model("model")
```

```
mtcars_tbl %>% spark_apply(function(x, model) model(x), context = model)
```

```
# Source: spark<?> [?? x 1]
   result
 *  <dbl>
 1   22.6
 2   22.1
 3   26.3
 4   21.2
 5   17.7
```

Thanks!

Resources

mlflow.org

github.com/mlflow/mlflow

rpubs.com/jluraschi/mlflow-rseattle

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