

# Model Deployment, Model Versioning, Working Environments (Dev -> Staging -> Prod)

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# model deployment

## what happens after you've built your model?

*Often, data scientists end their model development process after they have achieved an acceptable accuracy and are able to produce a graph for a presentation, and "ta-da! Mission Accomplished."*



sometimes, this happens...



# Or, this happens...

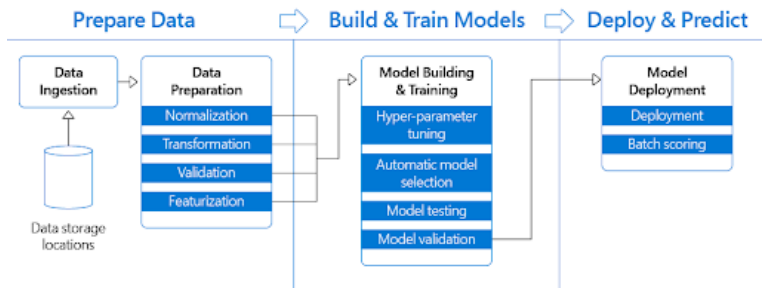
```
In [8]: ml_model.say_something()
```

```
I am all alone  
I was never deployed :(  
Was my F1 score not that great?
```

# what is model deployment?

Model deployment is the method by which you integrate a machine learning model into an existing production environment to make practical business decisions based on data. It is one of the last stages in the machine learning life cycle and can be one of the most cumbersome.

# ML Lifecycle

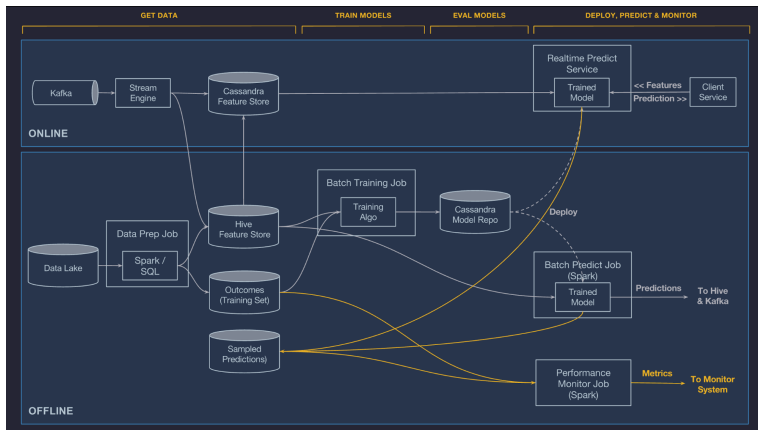


# types of model deployment

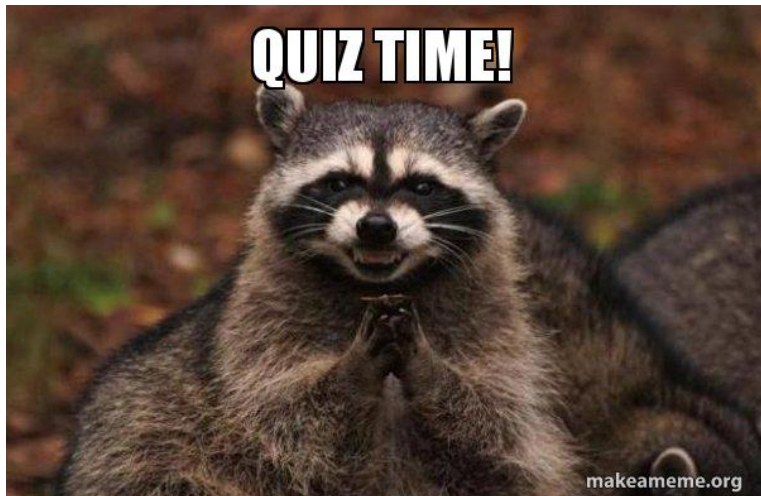
- ▶ batch (offline inference)
  - ▶ looser time constraint but makes many more predictions
  - ▶ saves predictions to data storage (relational database or NoSQL database)
  - ▶ automated and usually triggered by a batch data ingestion or typically generated on some recurring schedule (e.g. hourly, daily)
- ▶ real-time (online inference)
  - ▶ return single predictions in less than a second
  - ▶ allows us to make predictions for any new data e.g. generating recommendations for new users upon signing up
  - ▶ model object often containerized using Docker to preserve ML environment
  - ▶ exposed through a REST API



# ML Pipeline



# Pop Quiz!!!



# what is a container?

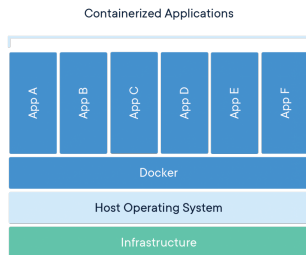


# what is a container in cloud computing?

A container is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another. A Docker container image is a:

- ▶ lightweight
- ▶ standalone
- ▶ executable package of software

that includes everything needed to run an application: code, runtime, system tools, system libraries and settings.



# model versioning

# recap: workflow principles in a Data Science Shop

## a) **reproducibility**

- ▶ anyone should be able to arrive to your **same results**

## b) **portability**

- ▶ anyone should be able to **pick up where you left off** on any machine

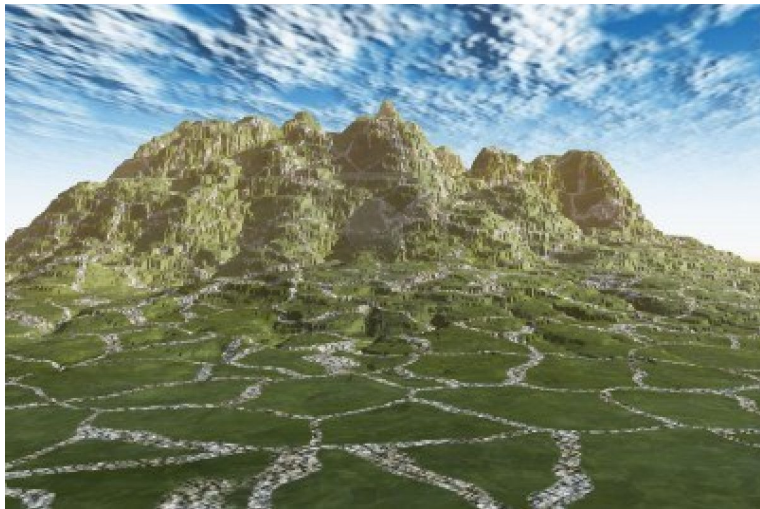
## c) **scalability**

- ▶ your project should also work for **larger data sets** and/or be on the path of **automation**

# what is model versioning?

Machine learning is about rapid experimentation and iteration, and without keeping track of your modeling history you won't be able to learn much. Versioning lets you keep track of all of your models, how well they've done, and what hyperparameters you used to get there.

many paths to the top





# what should be versioned?

- ▶ environment and infrastructure variables
- ▶ code
- ▶ libraries/packages version
- ▶ data used for training
- ▶ data used for validation
- ▶ other parameters used in model development

# Model Tracker Example

Model		Code (architecture)	Dataset	VERSION			Data (testing)	RESULTS	
				Data (training)	Data (validation)	Other Parameters		Accuracy	% False Positives
Model	1	Alpha	pets	1.0	1.0	1.0	1.0	80%	10%
Model	1.1	Alpha	pets	1.1	1.0	1.0	1.0	75%	12%
Model	1.2	Alpha	pets	1.2	1.0	1.0	1.0	85%	8%
Model	1.3	Alpha	pets	1.2	1.1	1.0	1.0	85%	9%
Model	1.4	Alpha	pets	1.2	1.1	1.1	1.0	86%	6%
Model	1.5	Beta	pets	1.2	1.1	1.1	1.0	90%	6%
Model	1.6	Inception	pets	1.2	1.1	1.1	1.0	84%	10%
Model	1.7	Beta	pets	1.2	1.1	1.2	1.0	91%	5%

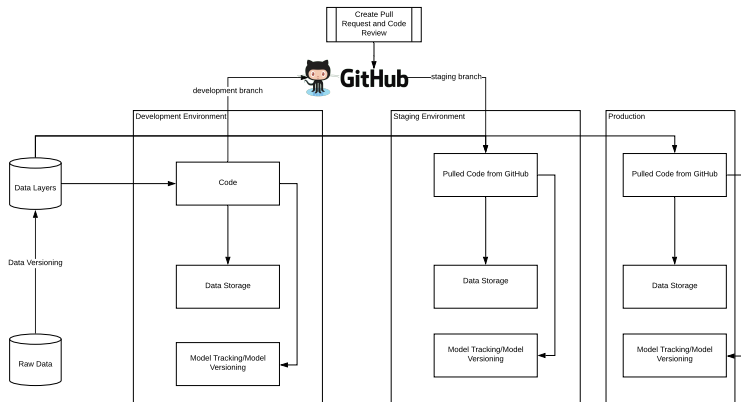
# ML Model Tracking and Versioning DEMO

# why is it important?

- ▶ finding the best model
- ▶ failure tolerance
- ▶ movement between various working environments
- ▶ debug effectively
- ▶ provides transparency about what produced the model
- ▶ allows for faster experimentation

# working environments

# Working Environments



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