Google Cloud

TensorFlow Transform

Lak Lakshmanan

Learn how to...

Learn how to...

Implement feature preprocessing and feature creation using tf.transform

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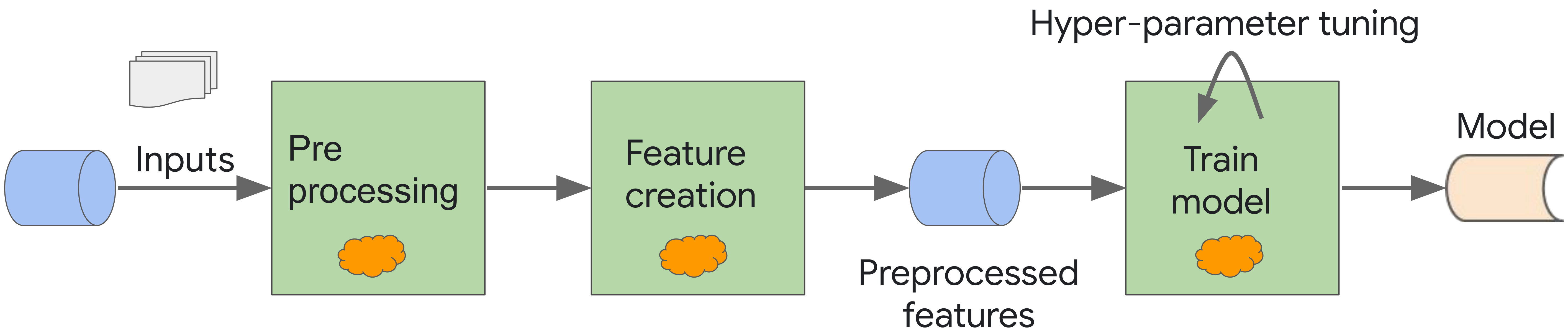
Carry out feature processing efficiently, at scale and on streaming data

Recall that there are three possible places to do feature engineering, each of which has its pros and cons



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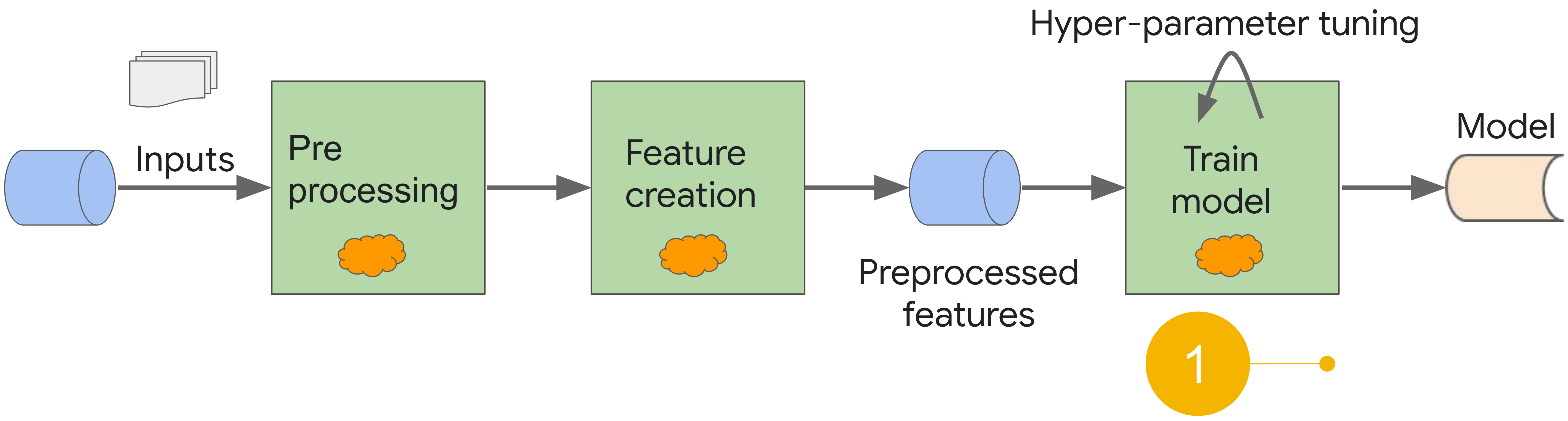

TensorFlow*

*efficient

*tf methods only

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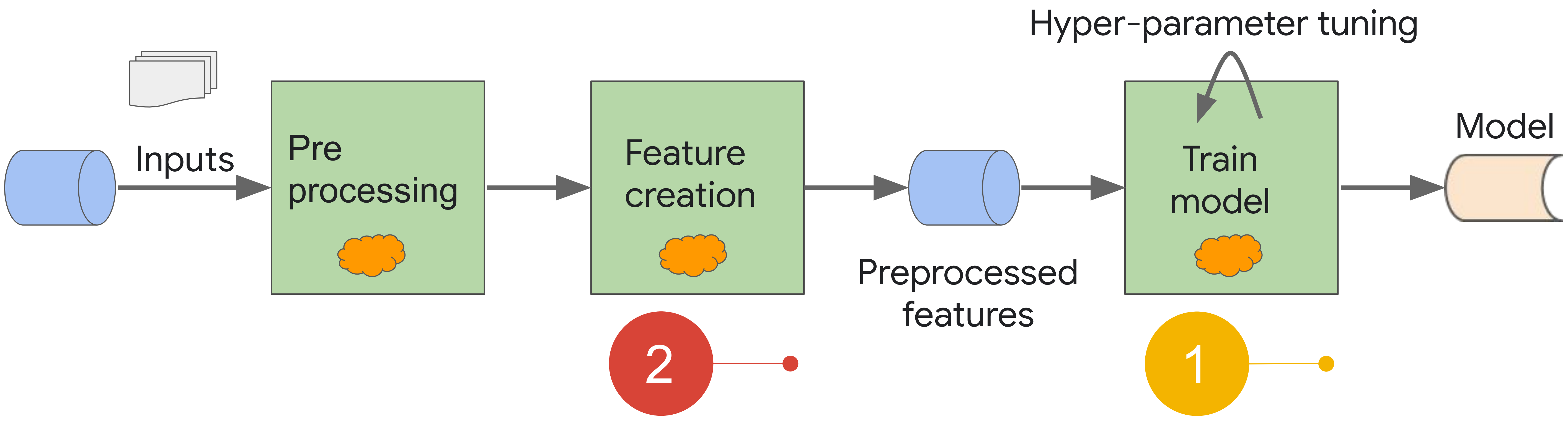

Beam*

*in a pipeline

*Python/Java code

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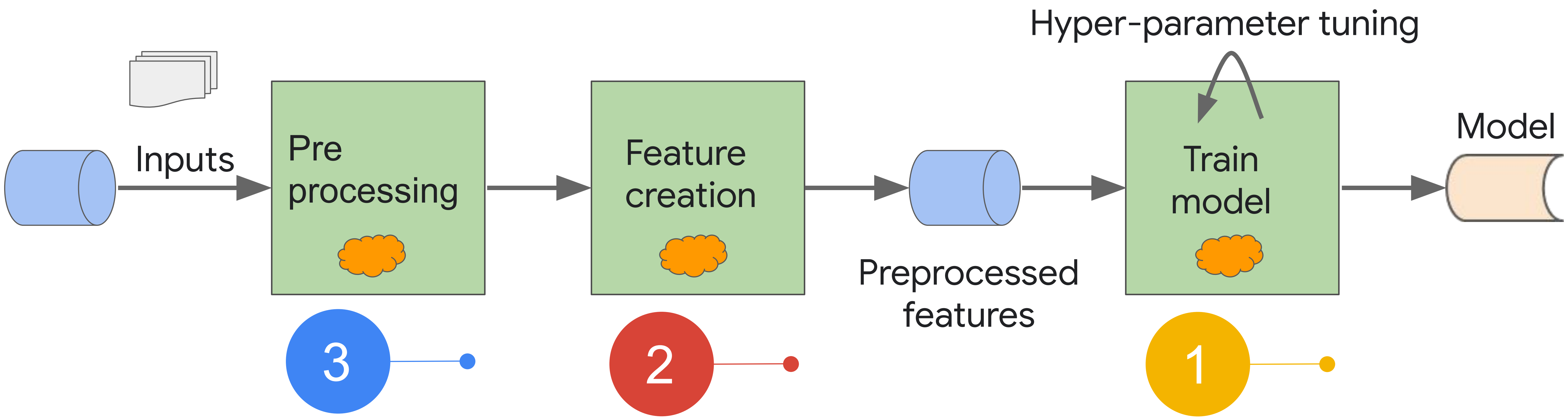

tf.transform*
*efficient
*tf methods only
*aggregates

Beam*
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*Python/Java code
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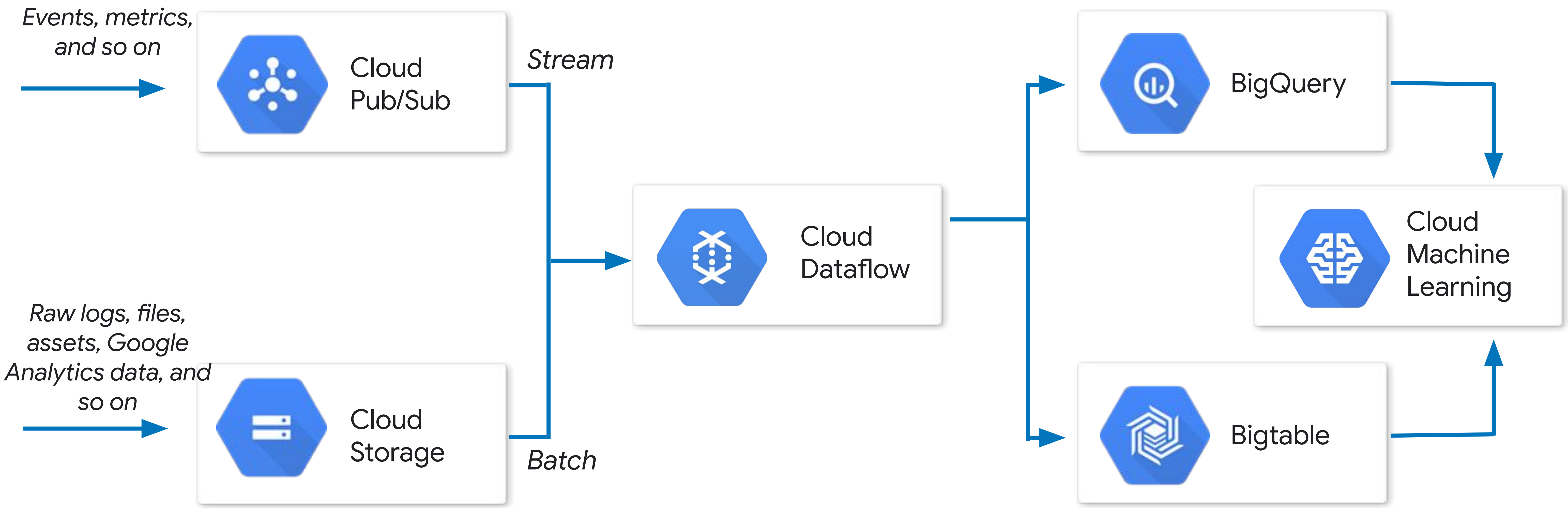
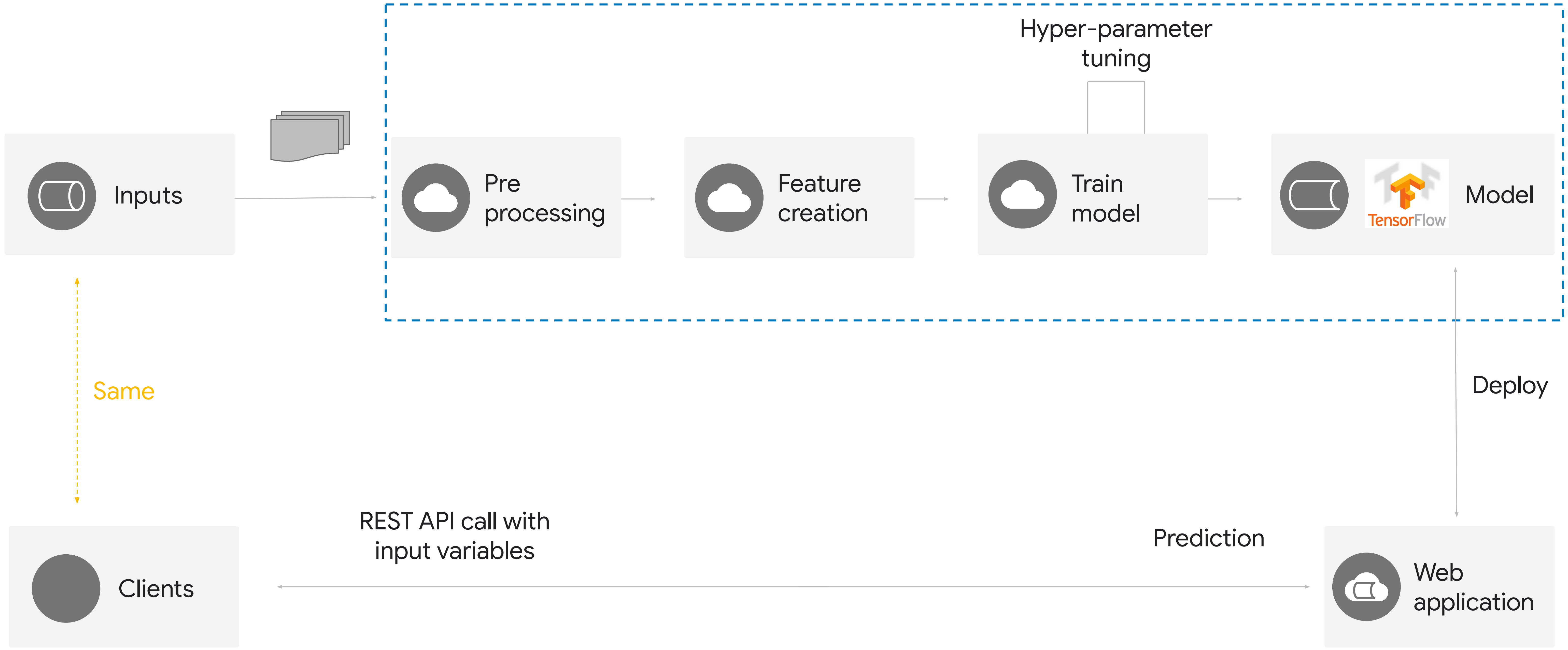
Dataflow preprocessing works in the context of a pipeline



TensorFlow is good for on-demand, on-the-fly processing



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Beam and TensorFlow

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Scale inputs by the min & max

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Find min/max value of a numeric feature	Scale inputs by the min & max
Find all the unique values of a categorical feature	One-hot encode inputs based on set of unique values

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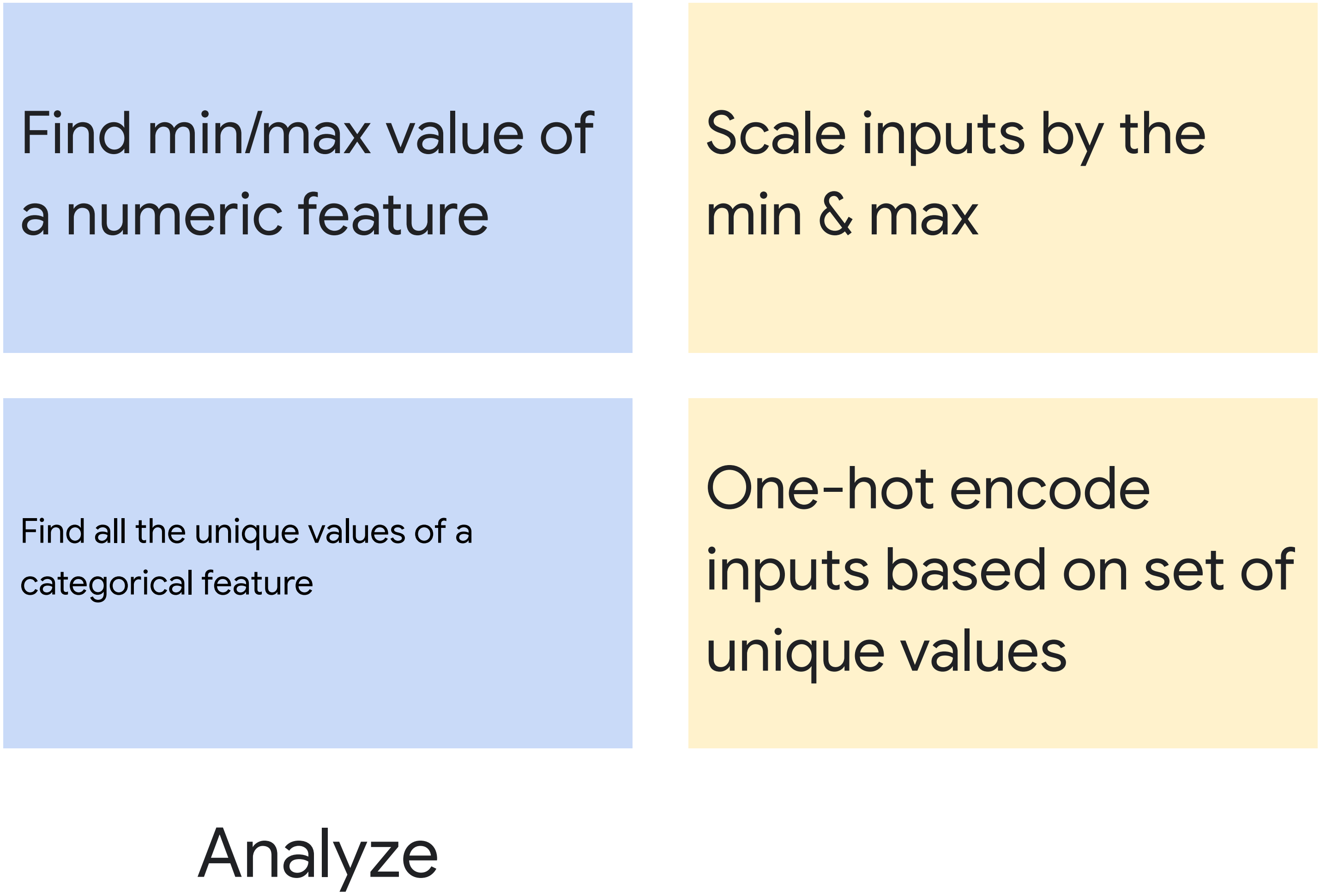

Find min/max value of a numeric feature

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One-hot encode inputs based on set of unique values

Analyze

tf.transform is a hybrid of Beam and TensorFlow

Analyze	Transform
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Analyze	Transform
Beam	TensorFlow

tf.transform provides two PTransforms

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`AnalyzeAndTransformDataset`

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`TransformDataset`

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The underlying transformations are executed in TensorFlow at prediction time

tf.transform has two phases

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Analysis phase (compute min/max/vocab etc. using Beam)

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Analysis phase (compute min/max/vocab etc. using Beam)

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- Executed in TensorFlow during prediction

- Executed in Beam to create training/evaluation datasets

First, set up the schema of the training dataset

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raw_data_schema = {
    colname : dataset_schema.ColumnSchema(tf.string, ...)
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      colname : dataset_schema.ColumnSchema(tf.float32, ...)
        for colname in 'fare_amount,pickuplon, … ,dropofflat'.split(',')
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TensorFlow type for input column

float32

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})
raw_data_metadata =
    dataset_metadata.DatasetMetadata(dataset_schema.Schema(raw_data_schema))
```

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raw_data_schema.update({                                    float32
      colname : dataset_schema.ColumnSchema(tf.float32, ...)
        for colname in 'fare_amount,pickuplon, … ,dropofflat'.split(',')
})
raw_data_metadata =   Use the schema to create metadata “template”
    dataset_metadata.DatasetMetadata(dataset_schema.Schema(raw_data_schema))
```

Next, run the analyze-and-transform PTransform on training dataset to get back preprocessed training data and the transform function

```
raw_data = (p
     | beam.io.Read(beam.io.BigQuerySource(query=myquery, use_standard_sql=True))
     | beam.Filter(is_valid))


transformed_dataset, transform_fn = ((raw_data, raw_data_metadata)
      | beam_impl.AnalyzeAndTransformDataset(preprocess))
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1. Read in data as usual for Beam

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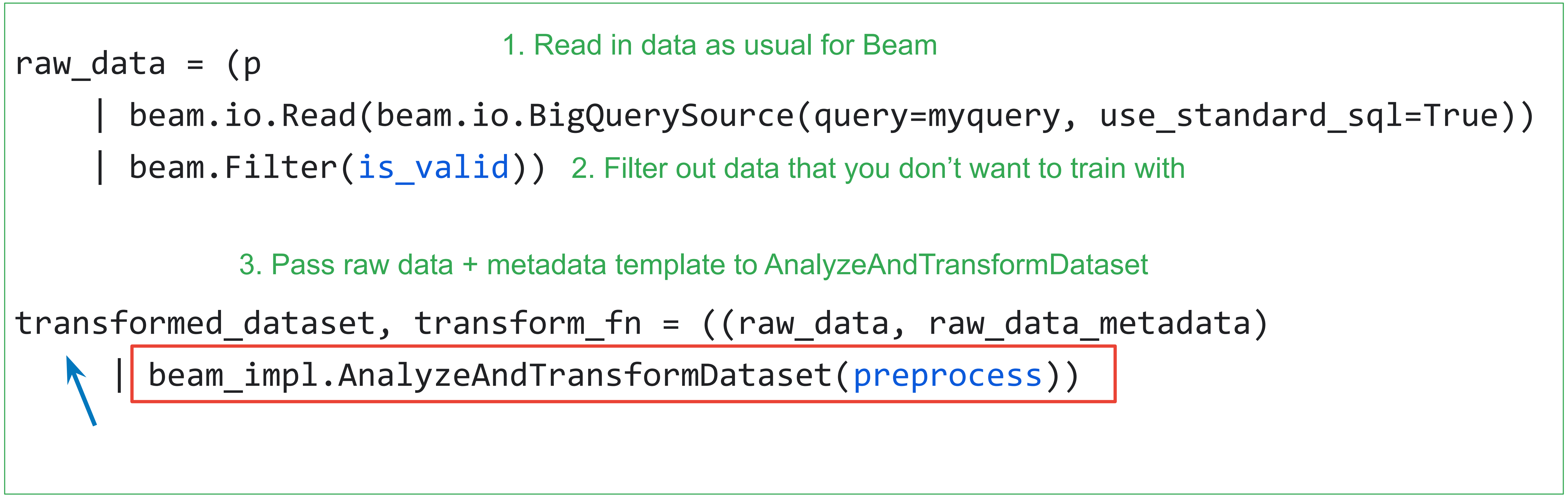

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3. Pass raw data + metadata template to AnalyzeAndTransformDataset

```
transformed_dataset, transform_fn = ((raw_data, raw_data_metadata)
      | beam_impl.AnalyzeAndTransformDataset(preprocess))
```

4. Get back transformed dataset and a reusable transform function

Write out the preprocessed training data into TFRecords, the most efficient format for TensorFlow

```
transformed_data |
   tfrecordio.WriteToTFRecord(
     os.path.join(OUTPUT_DIR,'train'),

     coder=ExampleProtoCoder(
            transformed_metadata.schema)
   )
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Write out the preprocessed training data into TFRecords, the most efficient format for TensorFlow

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The filenames will be like train-0003-of0015

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     coder=ExampleProtoCoder(
            transformed_metadata.schema)
   )
```

Note that we use the transformed metadata schema here

The preprocessing function is restricted to TensorFlow functions

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The things you do in preprocess() will get added to the TensorFlow graph, and be executed in TensorFlow during serving

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   result = {}
```

Create features from the input tensors and put into “results” dict

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def preprocess(inputs):

  result = {}   Create features from the input tensors and put into “results” dict

  result['fare_amount'] = inputs['fare_amount'] Pass through
```

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def preprocess(inputs):

   result = {}   Create features from the input tensors and put into “results” dict

   result['fare_amount'] = inputs['fare_amount'] Pass through

   result['dayofweek'] = tft.string_to_int(inputs['dayofweek']) vocabulary
```

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   return result
```

Analyze and Transform happens on the training dataset

```
transformed_dataset, transform_fn =
((raw_data, raw_data_metadata)
     |
beam_impl.AnalyzeAndTransformDataset(
                  preprocess))
```

Writing out the eval dataset is similar, except that we reuse the transform function computed from the training data

```
raw_test_data = (p
        | beam.io.Read(beam.io.BigQuerySource(...)
        | 'eval_filter' >> beam.Filter(is_valid))
transformed_test_dataset = (((raw_test_data, raw_data_metadata), transform_fn)
        | beam_impl.TransformDataset())
```

Writing out the eval dataset is similar, except that we reuse the transform function computed from the training data

```
raw_test_data = (p
        | beam.io.Read(beam.io.BigQuerySource(...)
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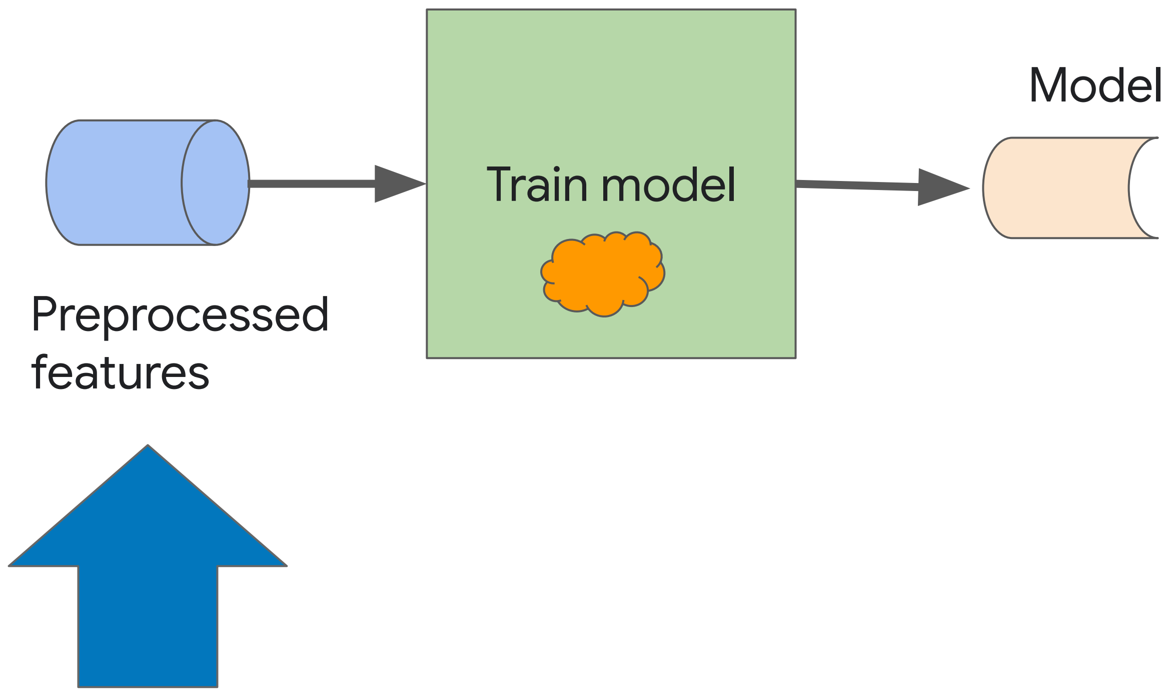
transformed_test_dataset = (((raw_test_data, raw_data_metadata), transform_fn)
        | beam_impl.TransformDataset())

transformed_test_data, _ = transformed_test_dataset
_ = transformed_test_data | tfrecordio.WriteToTFRecord(
          os.path.join(OUTPUT_DIR, 'eval'),
          coder=example_proto_coder.ExampleProtoCoder(
              transformed_metadata.schema))
```

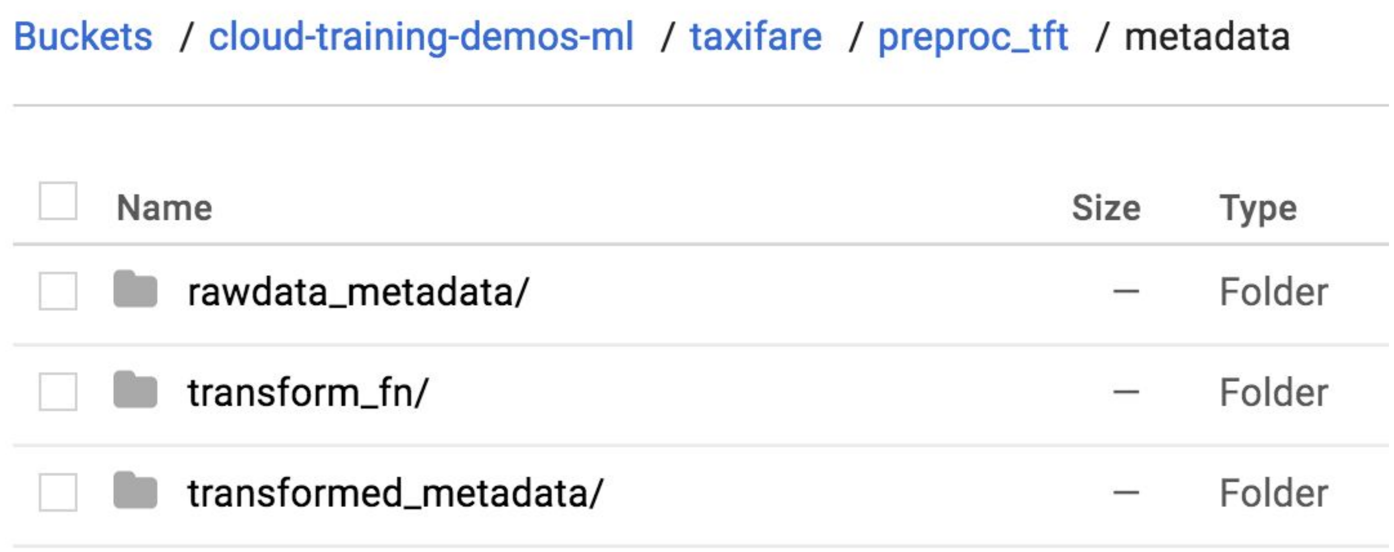
For training and evaluation, we created preprocessed features using Beam



Created by
AnalyzeAndTransformDataset
Or by TransformDataset

For serving, we need to write out the transformation metadata

```
_ = transform_fn |
  transform_fn_io.WriteTransformFn(
     os.path.join(OUTPUT_DIR,
'metadata')))
```



Buckets / cloud-training-demos-ml / taxifare / preproc_tft / metadata

□	Name	Size	Type
□	rawdata_metadata/	–	Folder
□	transform_fn/	–	Folder
□	transformed_metadata/	–	Folder

Change input function to read preprocessed features

```
def read_dataset(args, mode):
   if mode == tf.estimator.ModeKeys.TRAIN:
       input_paths = args['train_data_paths']
   else:
       input_paths = args['eval_data_paths']
   transformed_metadata = metadata_io.read_metadata(
             os.path.join(args['metadata_path'], 'transformed_metadata'))
   return input_fn_maker.build_training_input_fn(
         metadata = transformed_metadata,
         file_pattern = (
             input_paths[0] if len(input_paths) == 1 else input_paths),
        ...)
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Reading transformed features

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Reading transformed features

The serving input function accepts the raw data

```
def make_serving_input_fn(args):
   raw_metadata = metadata_io.read_metadata(
       os.path.join(args['metadata_path'], 'rawdata_metadata'))
   transform_savedmodel_dir = (
       os.path.join(args['metadata_path'], 'transform_fn'))
   return input_fn_maker.build_parsing_transforming_serving_input_receiver_fn(
     raw_metadata,
     transform_savedmodel_dir,
     exclude_raw_keys = [LABEL_COLUMN])
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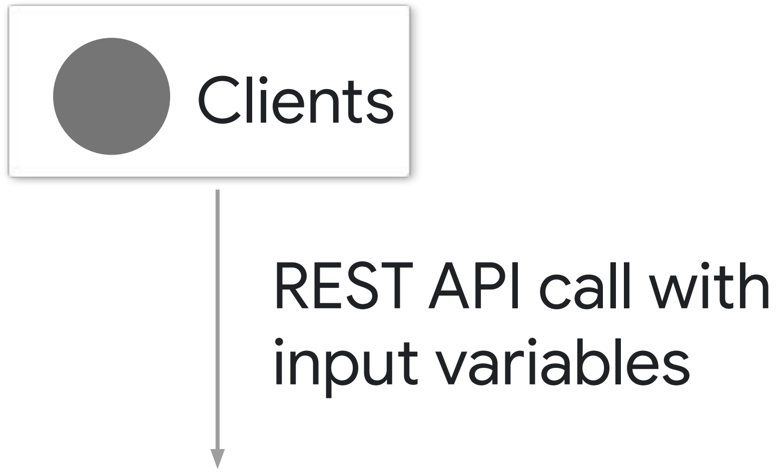

Clients

REST API call with input variables

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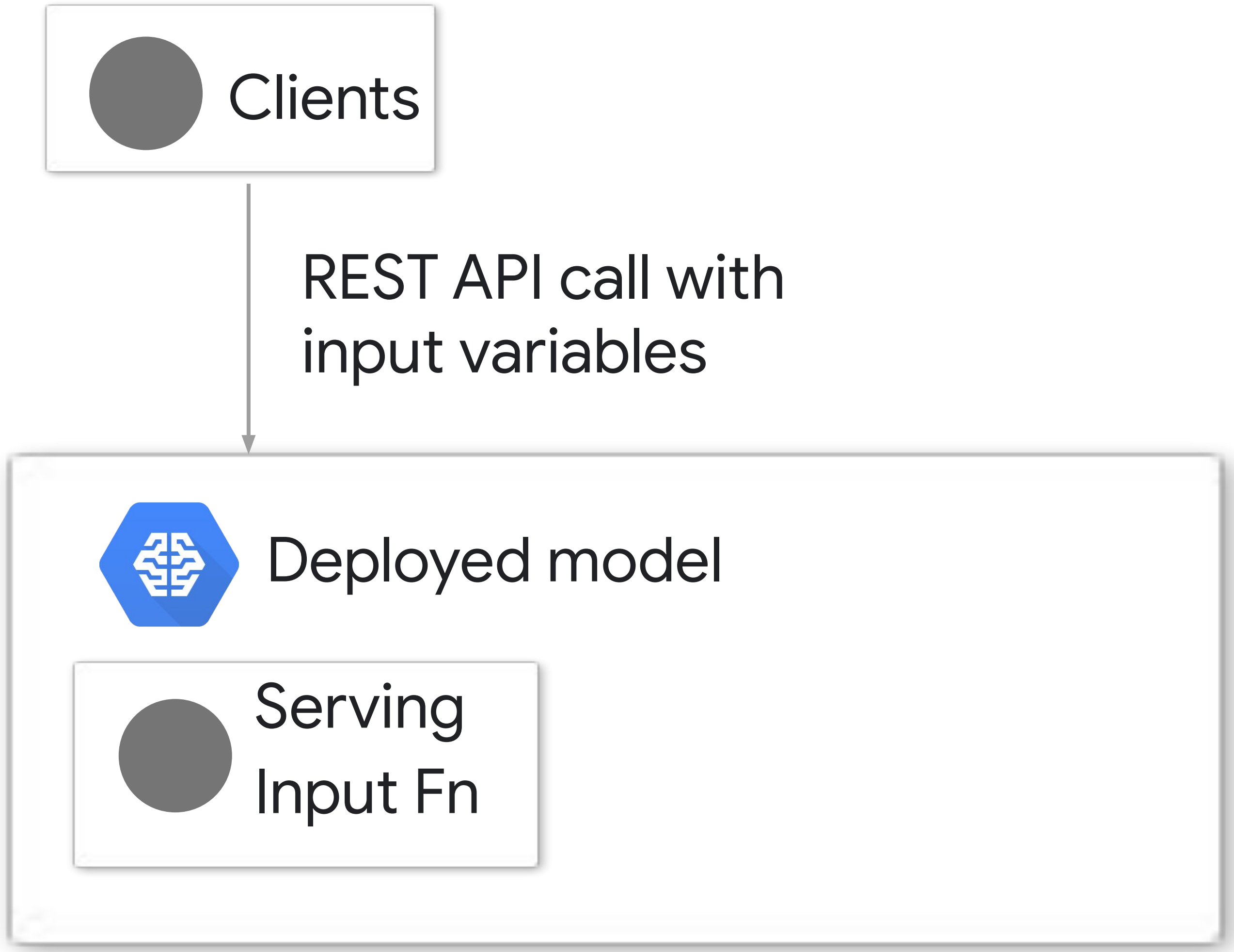

Clients

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Deployed model

Serving Input Fn

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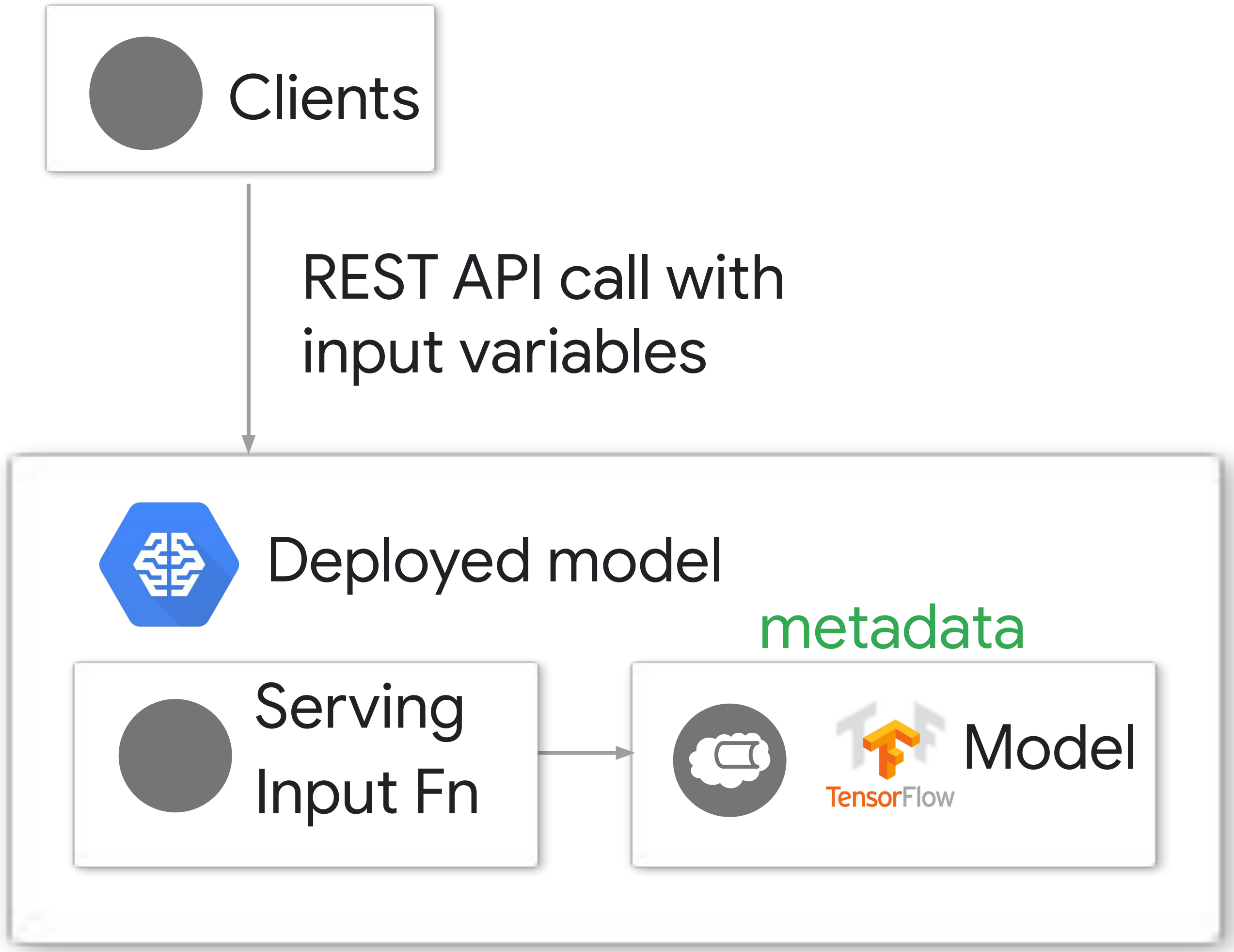

Clients

REST API call with input variables

Deployed model

metadata

Serving Input Fn

Model

Lab

Exploring tf.transform

Look at tftransform.ipynb

cloud.google.com