Intermediate Track: Implementing a complex ML pipeline Session 1

Dr. Kerry Donny-Clark

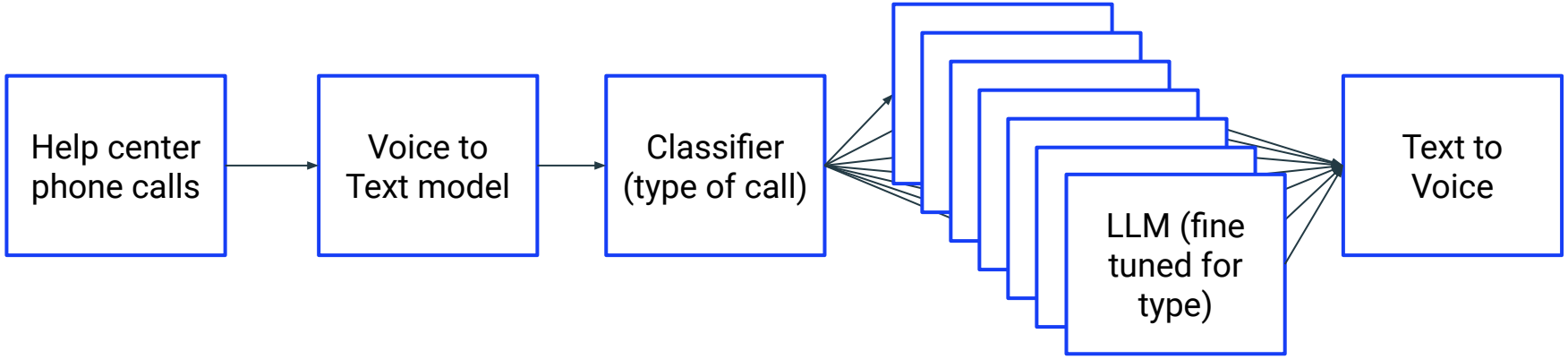
Welcome to Beam College Intermediate Track: Implementing a complex ML pipeline

Hi, I’m Kerry.

Implementing a complex ML pipeline: Overview

1. **Intro to ML in Beam: RunInference and Model Handlers**
2. Choosing Models and how to adapt a model to Beam
3. High level view of the pipeline
4. Deep dive into our example pipeline, Part I
5. Deep dive into our example pipeline Part II
6. Expanding the pipeline to real life use cases

Welcome to Beam College Intermediate Track: Implementing a complex ML pipeline



RunInference

```
class MyComplicatedPridctionStuff(beam.DoFn):
    def setup():
    #Code for loading once
    ...

    def process(self, element):
        #Use model handle to call
        ...
        #Handle errors, do nice error logging
        ...
        #Output useful metrics from the process
        ...
        TODO Oh wait! I need to batch stuff first ...
```

RunInference

```
with beam.Pipeline(options=pipeline_options)  as p:
    (p
    | beam.io.fileio.MatchFiles( gs://my_bucket/images*)
    | beam.io.fileio.ReadMatches()
    | beam.ml.inference.RunInference(model_handler
          .with_preprocess_fn(lambda x: preprocess(x))
          .with_postprocess_fn(lambda x: post_process(x)))
    ...
```

ModelHandlers

```
with beam.Pipeline(options=pipeline_options)  as p:
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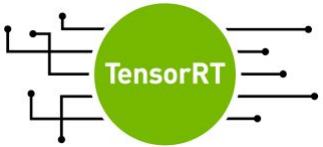
    ...
```

ModelHandlers

PytorchModelHandler**Tensor**

ModelHandlers



ModelHandlers

```
pipeline_handler = HuggingFacePipelineModelHandler(
    task="automatic-speech-recognition",
    model="openai/whisper-small",
    min_batch_size=2,
    load_pipeline_args={'chunk_length_s':30, 'device':'cuda:0'},
    large_model=True)
```

Learn More

Code:

https://github.com/apache/beam/tree/master/sdks/python/apache_beam/ml

RunInference and **ModelHandler** base classes are in **base.py**

Notebooks and examples:

https://github.com/apache/beam/tree/master/sdks/python/apache_beam/examples/inference

https://github.com/apache/beam/tree/master/examples/notebooks/beam-ml

Notebooks can be imported into Google Colab!

Next Session

Choosing Models and how to adapt a model to Beam

Thank you!

Intermediate Track: Implementing a complex ML pipeline Session 2

Dr. Kerry Donny-Clark

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RunInference

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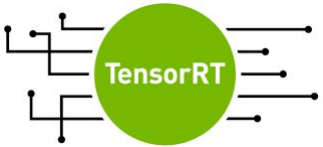
          .with_preprocess_fn(lambda x: preprocess(x))
          .with_postprocess_fn(lambda x: post_process(x)))
    ...
```

Choosing a model

- Function
- Size
- Framework
- Support in Beam

ModelHandlers



Model Zoos

Model Zoos

HuggingFace
    HuggingFaceModelHandler
    HuggingFacePipelineModelHandler

TensorflowHub
    TFModelHandlerTensor(
        model_uri=CLASSIFIER_URL)

ModelHandlers: Text Example

1. Pick a Model
    a. https://huggingface.co/stevhliu/my_awesome_eli5_mlm_model
2. Choose your model handler
    a. HuggingFaceModelHandler
3. Add preprocessing and/or postprocessing
    a. Encoding, decoding

ModelHandlers: Text Example

Warning! **RunInference** returns a **PredictionResult**:

```
class PredictionResult(NamedTuple('PredictionResult',
                                  [('example', _INPUT_TYPE),
                                   ('inference', _OUTPUT_TYPE),
                                   ('model_id', Optional[str])]))
```

What you usually want is in '**result.inference**'.

ModelHandlers: Text Example

Let's Go To Colab!
https://colab.sandbox.google.com/github/apache/beam/blob/master/examples/notebooks/beam-ml/run_inference_huggingface.ipynb

Next Session

High level overview of a complex ML pipeline

Thank you!

Intermediate Track: Implementing a complex ML pipeline Session 3

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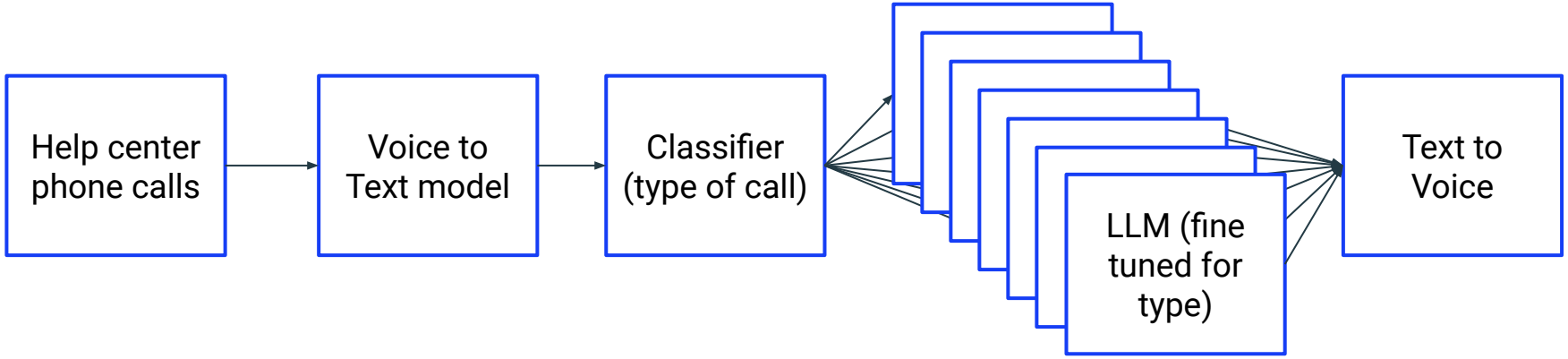
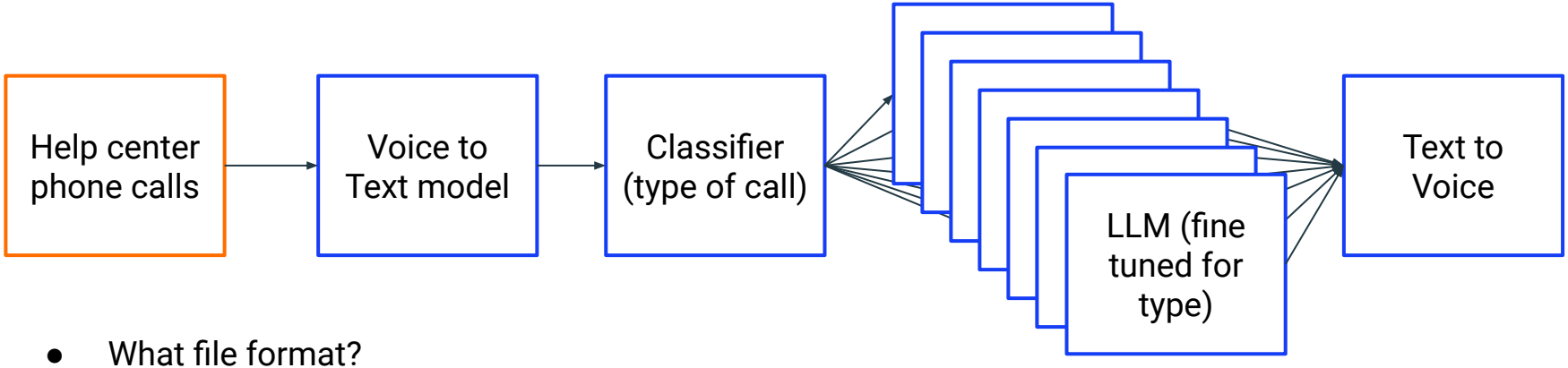
Our Pipeline

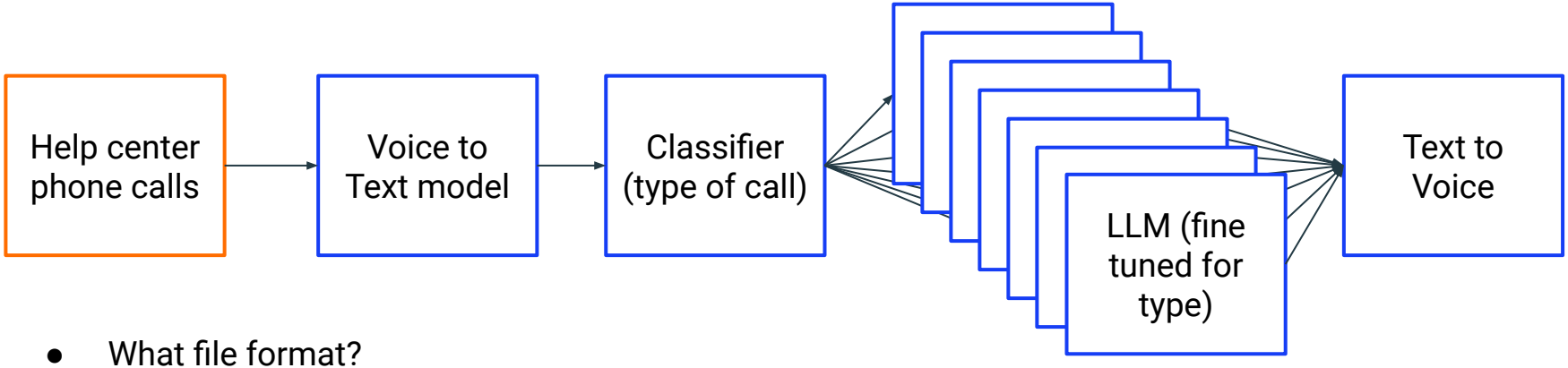


Our Pipeline



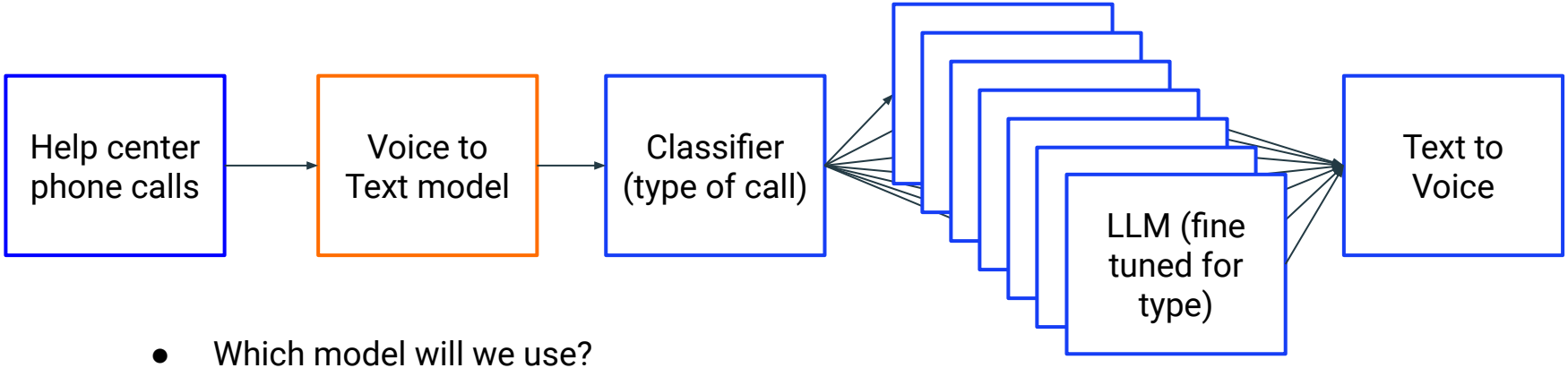
- What file format?
- Where are they stored?
- How long are the audio clips?

Our Pipeline



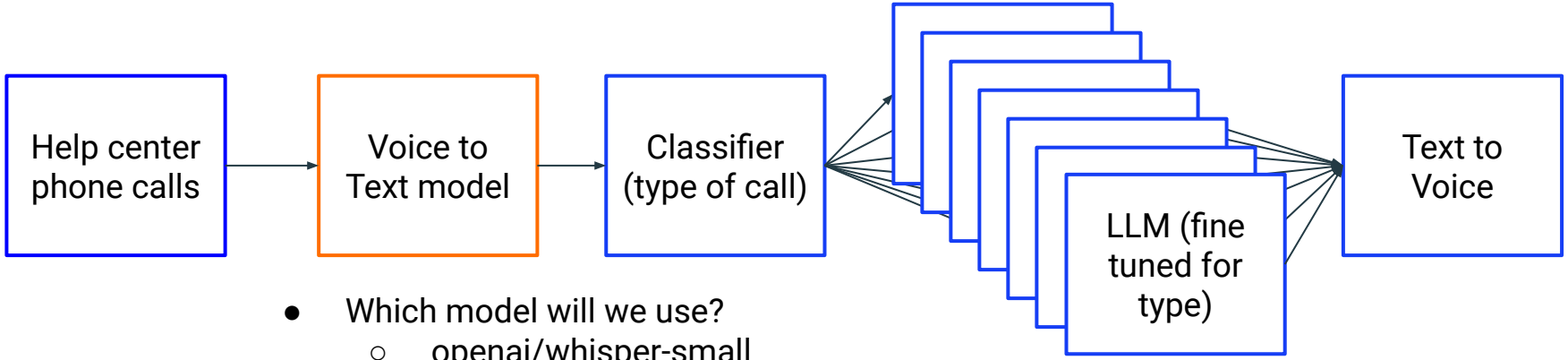
- What file format?
  - .wav
- Where are they stored?
  - GCS bucket
- How long are the audio clips?
  - 1-2 minutes

Our Pipeline



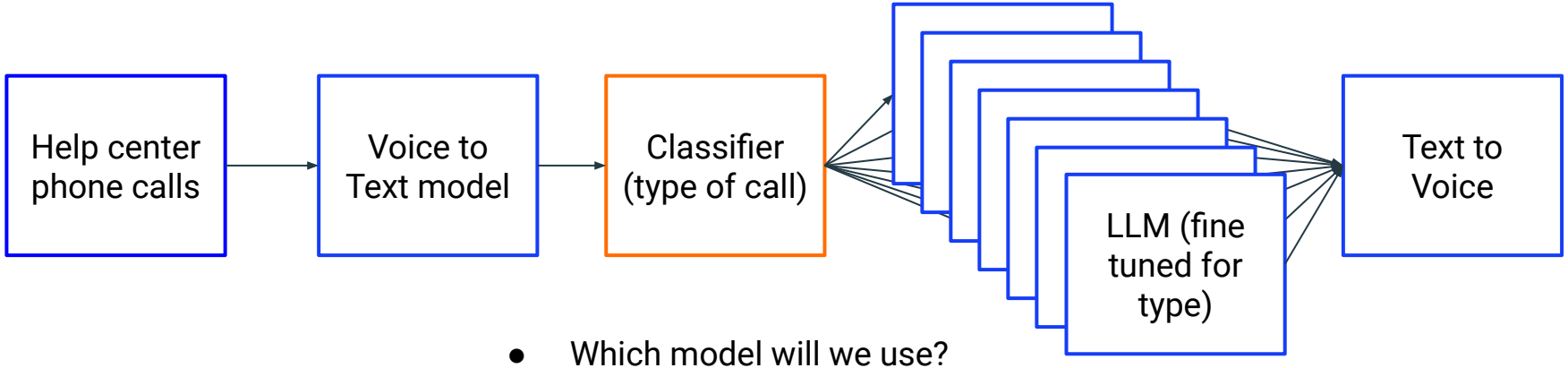
- Which model will we use?
- Where will we get the model?
- What framework?
- Which model handler?
- How we will preprocess the data?

Our Pipeline



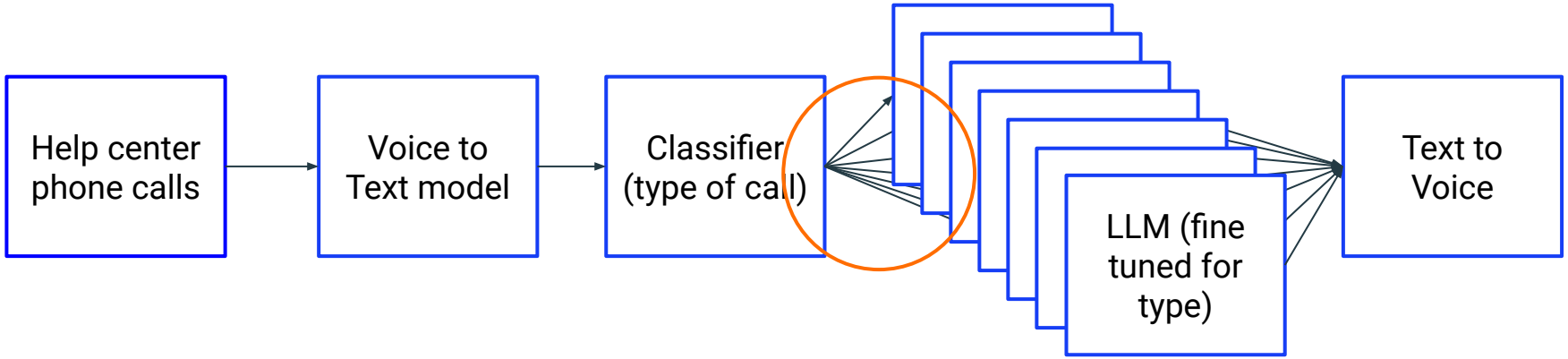
- Which model will we use?
  - openai/whisper-small
- Where will we get the model?
  - HuggingFace
- What framework?
  - pytorch
- Which model handler?
  - HuggingFacePipelineModelHandler
- How we will preprocess the data?
  - HuggingFace Pipelines will do it automatically

Our Pipeline



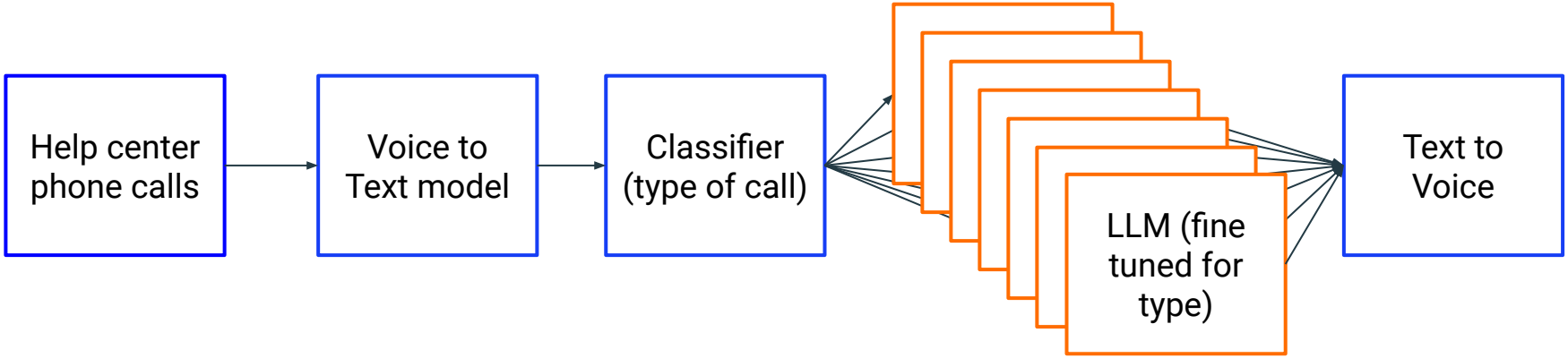
- Which model will we use?
  - XGBoost classifier
- Where will we get the model?
  - We will train it
- What framework?
  - XGBoost
- Which model handler?
  - XGBoostModelHandlerPandas

Our Pipeline



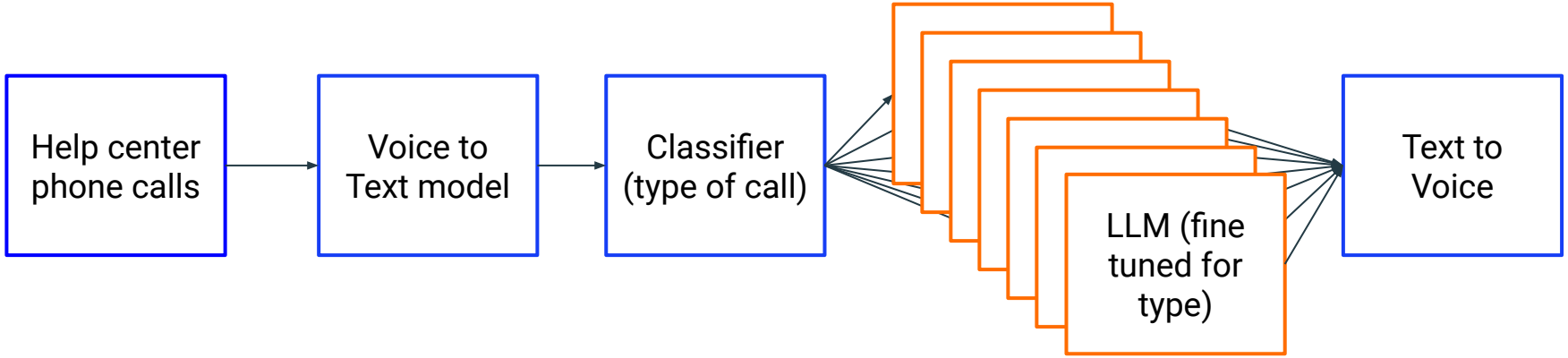
- How do we match class to model?
  - Use a KeyedModelHandler
  - https://cloud.google.com/dataflow/docs/notebooks/per_key_models

Our Pipeline



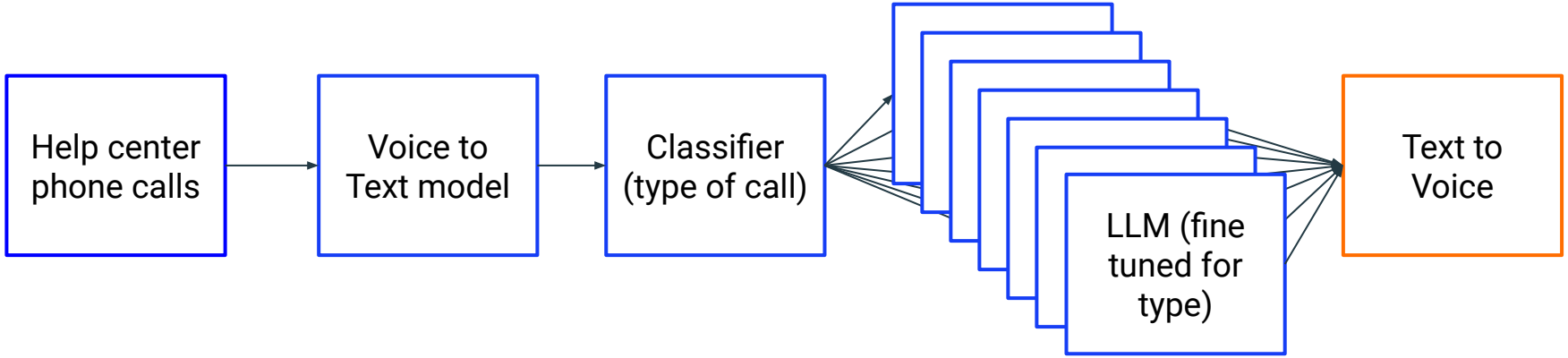
- Which models will we use?
- Where will we get the model?
- What framework?
- Which model handler?

Our Pipeline



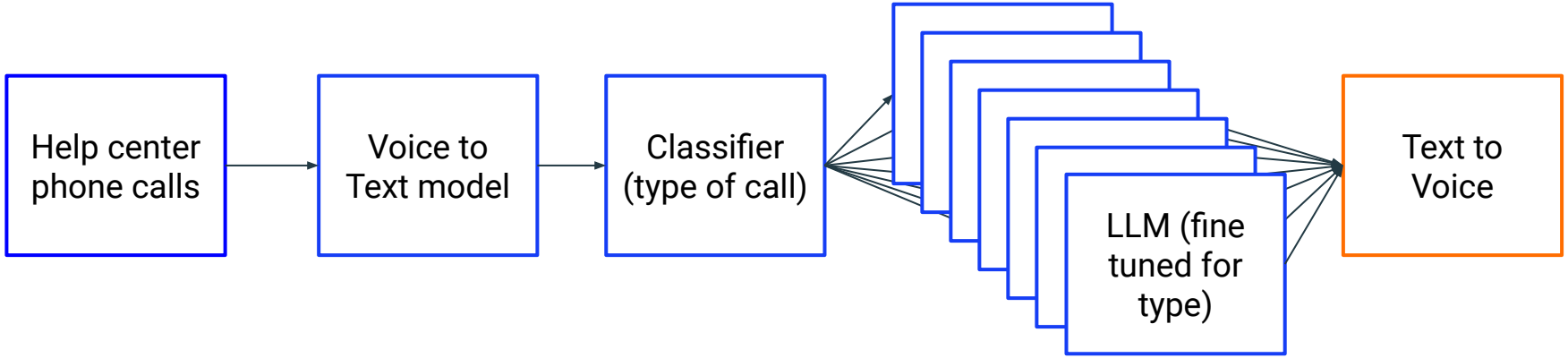
- Which models will we use?
  - Small LLMs: GPT2, Bert, etc
- Where will we get the model?
  - HuggingFace
- What framework?
  - PyTorch
- Which model handler?
  - HuggingFaceModelHandler

Our Pipeline



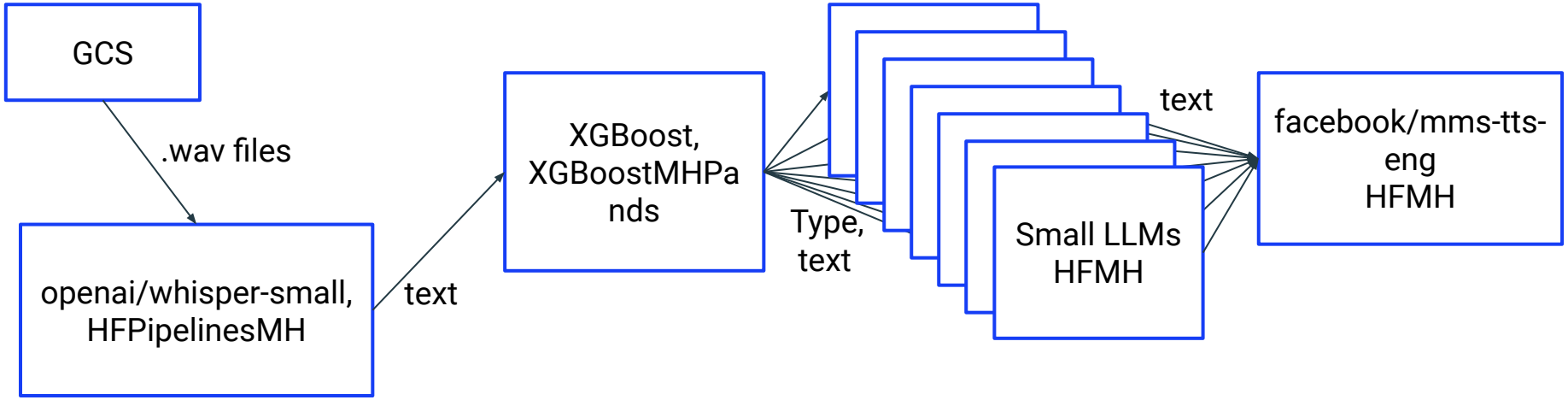
- Which model will we use?
- Where will we get the model?
- What framework?
- Which model handler?

Our Pipeline



- Which model will we use?
  - facebook/mms-tts-eng
- Where will we get the model?
  - HuggingFace
- What framework?
  - PyTorch
- Which model handler?
  - HuggingFaceModelHandler

Our Pipeline, detail view



HF = HuggingFace
MH= ModelHandler

Links

- Speech to Text: https://huggingface.co/openai/whisper-small
- XGBoost: https://xgboost.readthedocs.io/en/stable/
  - Beam notebook: https://github.com/apache/beam/blob/master/examples/notebooks/beam-ml/run_inference_xgboost.ipynb
- Text to Speech: https://huggingface.co/facebook/mms-tts-eng
- Beam KeyedModelHandler notebook: https://cloud.google.com/dataflow/docs/notebooks/per_key_models

Next Session

Deep dive into our example pipeline, Part I

DataflowWorkerAcceleratorTypes

Thank you!

Intermediate Track: Implementing a complex ML pipeline Session 4

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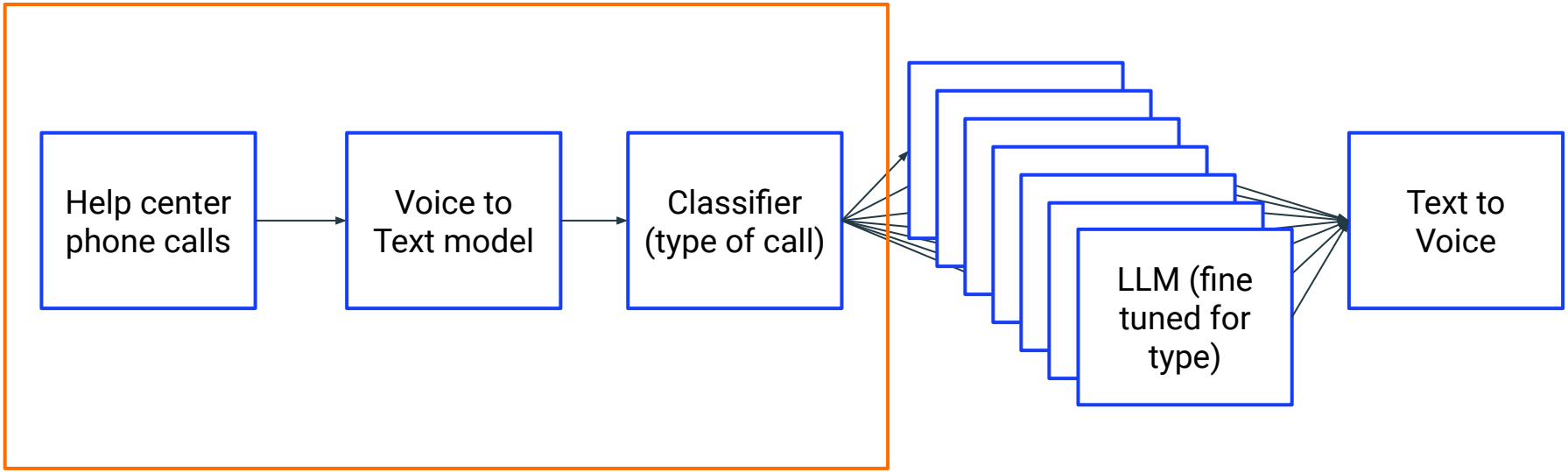
Our Pipeline
We will cover the first half



To Colab!

Next Session

Deep dive into our example pipeline, Part II

DataflowWorkerAcceleratorTypes

Thank you!

Intermediate Track: Implementing a complex ML pipeline Session 5

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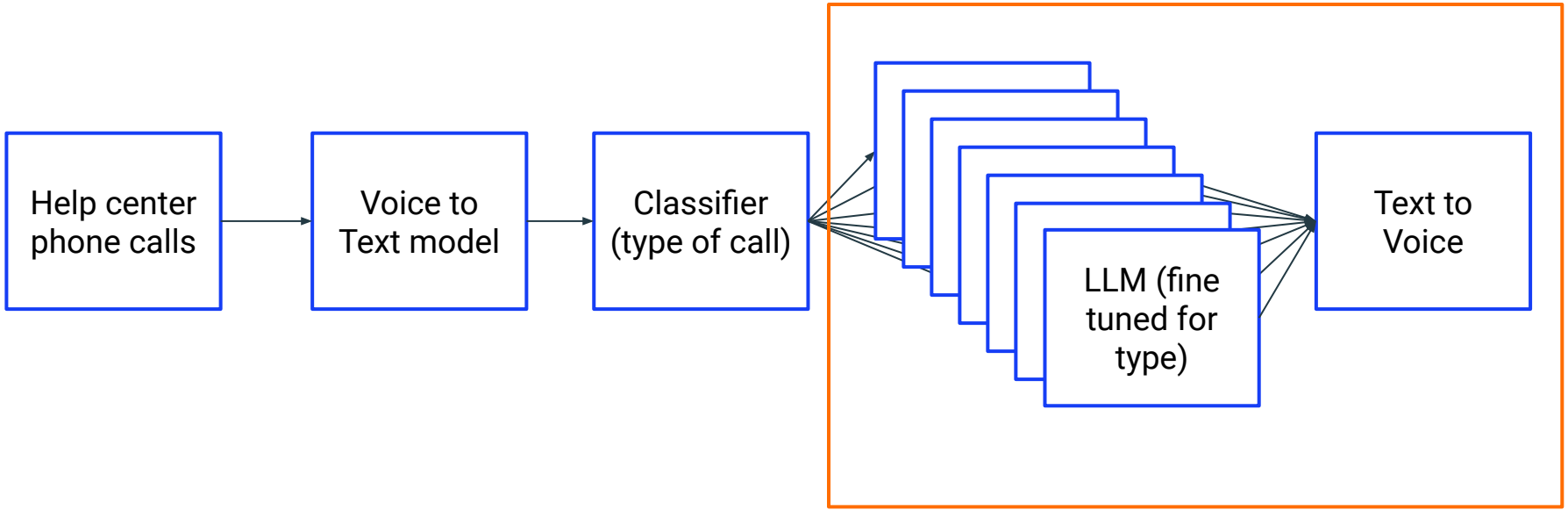
Our Pipeline
We will cover the second half



To Colab!

Next Session

Expanding the pipeline to real life use cases

DataflowWorkerAcceleratorTypes

Thank you!

Intermediate Track: Implementing a complex ML pipeline Session 6

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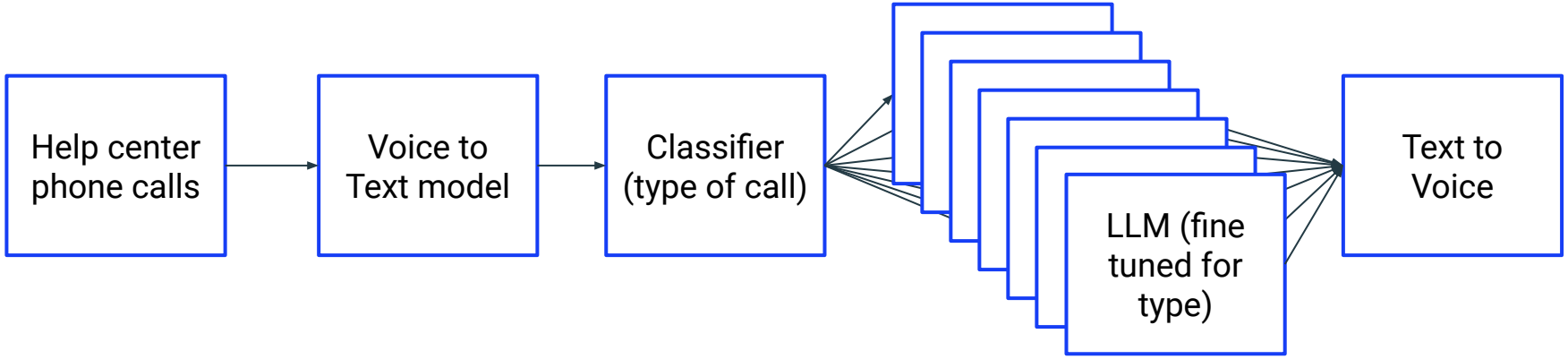
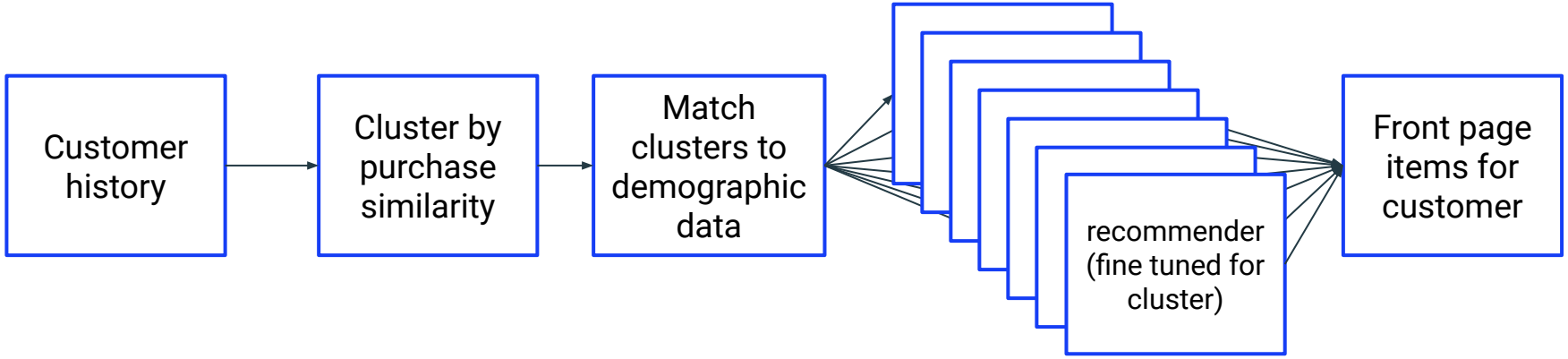
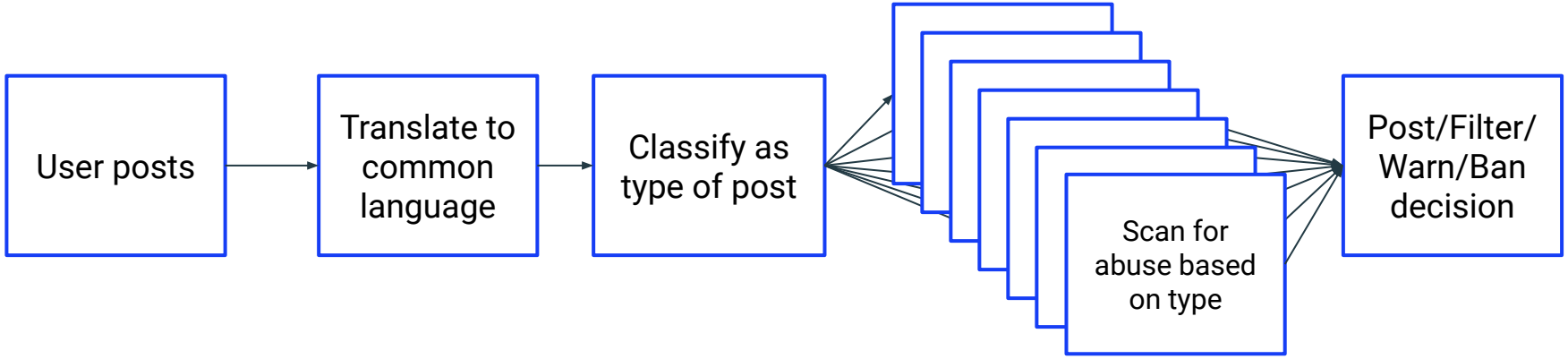
Our Pipeline



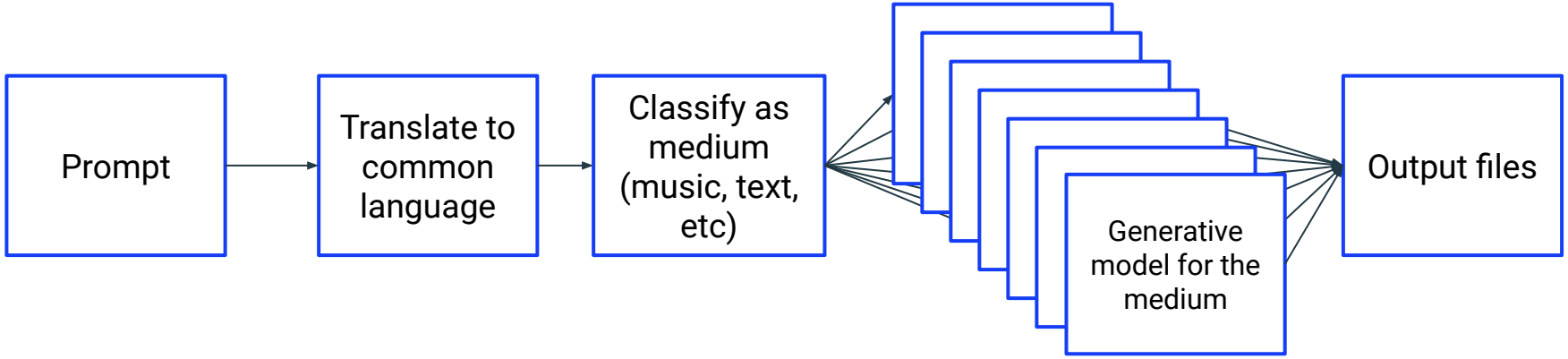
Same Pipeline, different business problem



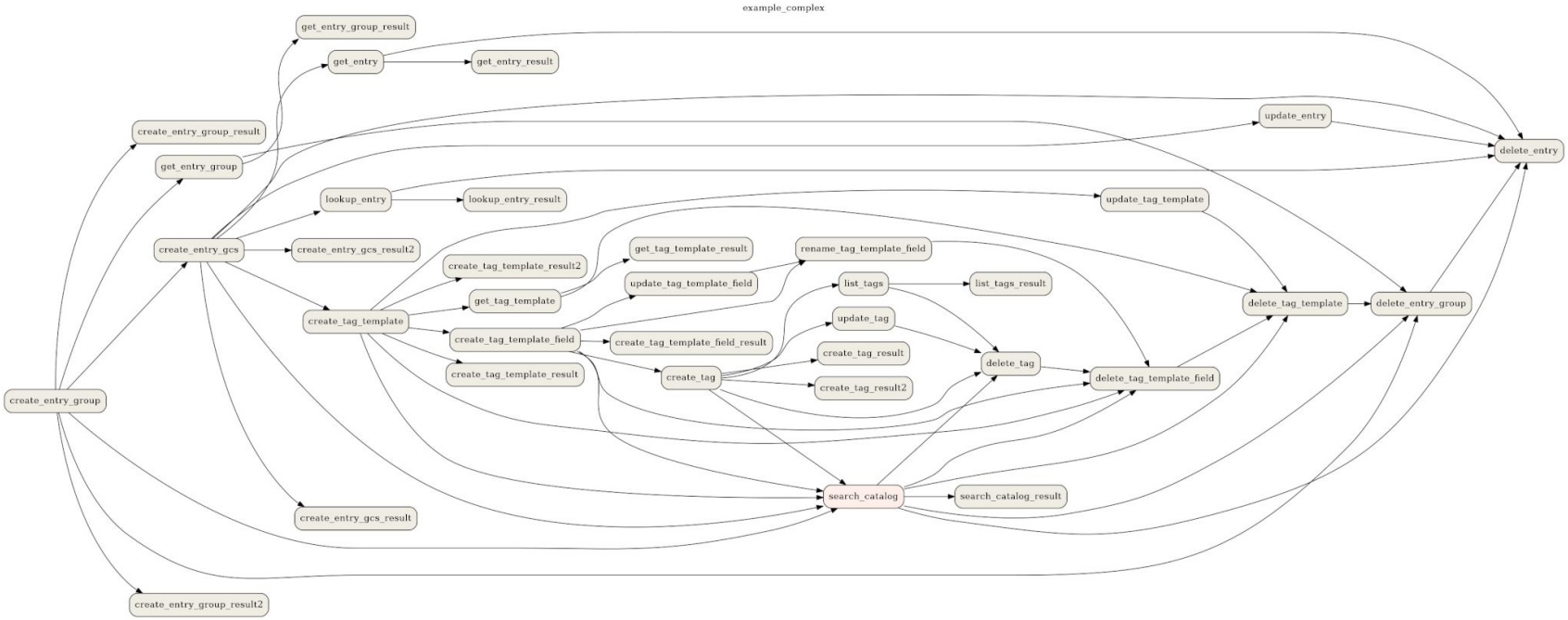
Same Pipeline, different business problem



Same Pipeline, different business problem



And of course it can get crazier



Source: Apache Software Foundation

DataflowWorkerAcceleratorTypes

Thank you!