BEAM
SUMMIT

Auto model refresh in RunInference

Name: Anand Inguva
Company: Google
Contact: anandinguva@google.com

BEAM SUMMIT
NYC 2023

Agenda

- RunInference
- Automatic model refresh in RunInference

RunInference

- RunInference is a simple to use PTransform that can be used for the task of ML Inference.
- **RunInference** helps users to avoid writing boilerplate code with the help of **ModelHandler**
  - ModelHandler - Framework specific modules which are required to configure parameters for the model.
  - Pytorch, Tensorflow, Sklearn, XGboost, Onnx and TensorRT are supported. Many more to come.

RunInference

- **RunInference** streamlines model loading, batching, and error handling for invalid inputs, while also calculating metrics like model loading latency and inference latency, and managing model sharing across threads in a process.

```
with beam.Pipeline(options=pipeline_options) as p:
    (p
    | beam.io.fileio.MatchFiles(gs://my_bucket/images*)
    | beam.io.fileio.ReadMatches()
    | beam.Map(preprocess_image)
    | beam.ml.inference.RunInference(model_handler)
```

How to update RunInference ML model in a running beam pipeline?

Current process to update models

- RunInference pipelines uses a specific models for predictions
- Updating the model requires stopping the pipeline, changing the model path, and restarting the pipeline.

Issues with current process

- The pipeline interruption can lead to service downtime.
- The model update process is manual, leading to potential human error.

Introduce automatic model refresh

- Enables model updating without stopping the pipeline.
- The feature is automated, reducing the chance of errors.

How Automatic Model Refresh works?

- Uses Beam's side inputs to fetch the latest model path.
- RunInference accepts a side input which should be a Singleton.

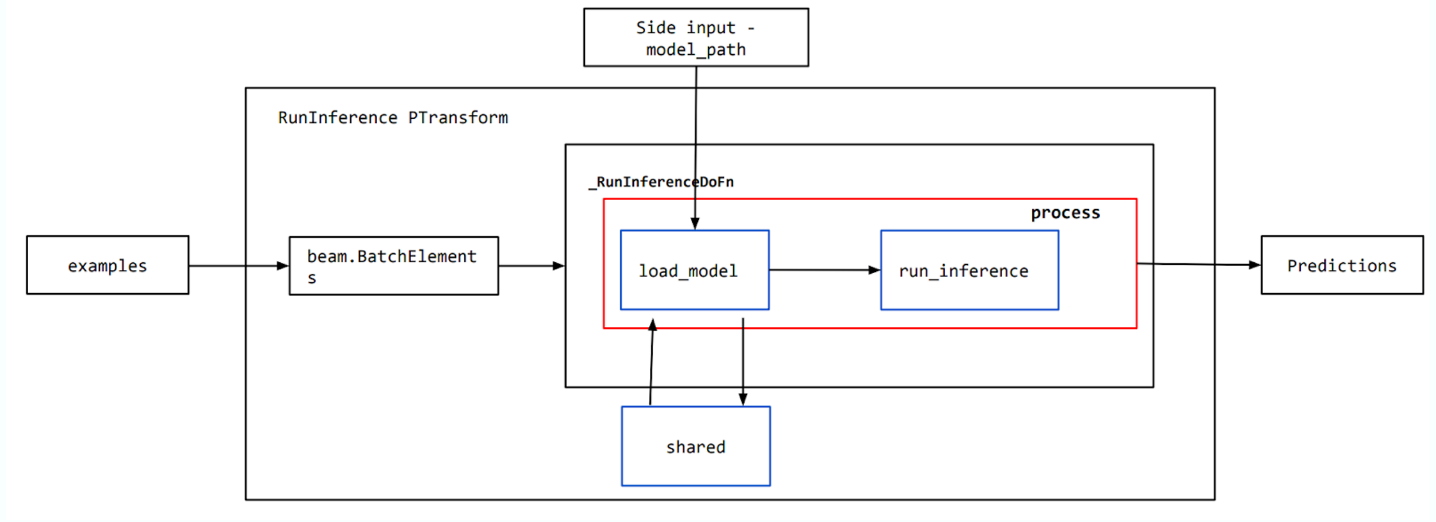
Side inputs

- Accessible from a DoFn
  - Elements that can determined during runtime.
- Side inputs can be used as a caching layer.
  - Store the model metadata such as model path, model id etc.

Reference to side inputs:

https://beam.apache.org/documentation/programming-guide/#side-inputs

Side inputs in RunInference



ModelMetaData

- RunInference expects that the side input passed has
  - PColl elements are wrapped around ModelMetaData
  - PColl view is Singleton

```
class ModelMetadata(NamedTuple):
  model_id: str
  model_name: str
```

- `model_id`: URI or path to the ML model.
- `model_name`: a prefix to the metrics namespace to differentiate between the models.

Modes - Automatic model refresh

Watch mode

- You watch a directory for model updates.
- You can use Apache Beam provided patterns such as **`WatchFilePattern`**.

Event mode

- Use Pub/Sub to send model updates to the RunInference.

WatchFilePattern - A pattern of watch mode

- Watches a directory for a matching `file_pattern`.
- Specify `interval` in seconds to check for the matching `file_pattern`.
- Follows slowly updating side input pattern.
- Newly updated matching file name should unique.

```
with beam.Pipeline(options=pipeline_options) as p:
watch_file_pattern = (p | WatchFilePattern(file_pattern=<your_glob_pattern>)
    (p
    | beam.io.fileio.MatchFiles(gs://my_bucket/images*)
    | beam.io.fileio.ReadMatches()
    | beam.Map(preprocess_image)
    | beam.ml.inference.RunInference(
                               model_handler, model_metadata_pcoll=watch_file_pattern)
```

ReadFromPubSub - A pattern of Event mode

- Example: Use **`ReadFromPubSub`** to get the latest model path.
- Make sure the side input PCollection has a Singleton View.

```
with beam.Pipeline() as p:
   event_model_side_input = (
    p
    | "ReadFromPubSub">> ReadFromPubSub(topic=<your_topic>)
    | "ConvertToModelMetaData" >> beam.Map(
                                               lambda x: ModelMetaData(model_id=x,
                         model_name=get_unique_name(model_name))
      (p
         | beam.io.fileio.MatchFiles(gs://my_bucket/images*)
         | beam.io.fileio.ReadMatches()
         | beam.Map(preprocess_image)
         | beam.ml.inference.RunInference(
                           model_handler,
                          model_metadata_pcoll= event_model_side_input)
```

Output of RunInference

- **`PredictionResult`** - A NamedTuple
  - example
  - inference
  - **`model_id:`** used to differentiate between different models.

Summary

- Use automatic model refresh to update your models in a streaming pipeline.
- WatchMode and EventMode
- Use beam provided patterns such as WatchFilePattern.

NAMES

QUESTIONS?

Gmail: anandinguva98@gmail.com, anandinguva@google.com.
Linkedin: https://www.linkedin.com/in/anand-inguva-5689a1128/