Dataflow for Beginners

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BEAM SUMMIT

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Agenda

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02 Beam Yaml Pipeline Structure and Examples
03 Basic Transforms Examples
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06 Job Builder Ease-of-Use Features
07 Customizing Data Movement Jobs
08 Data Processing Patterns (Filter, Map, SQL, Error Handling)
09 Working with YAML in the Job Builder (Export, Import, Yaml Editor)

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01

Beam Yaml Introduction, Positioning, and Advantages

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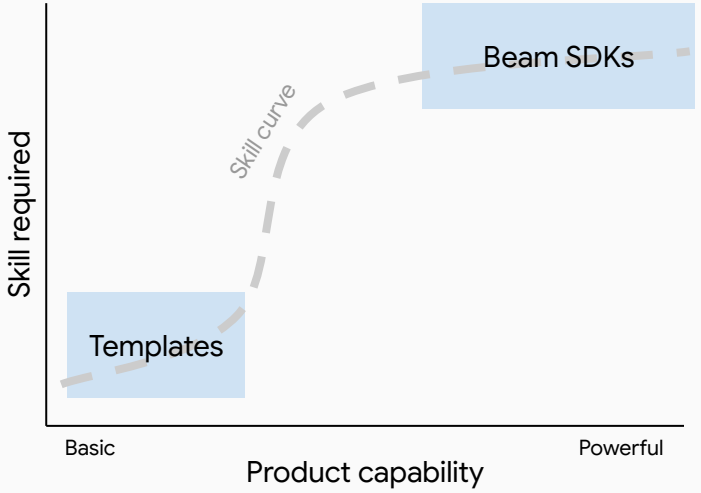
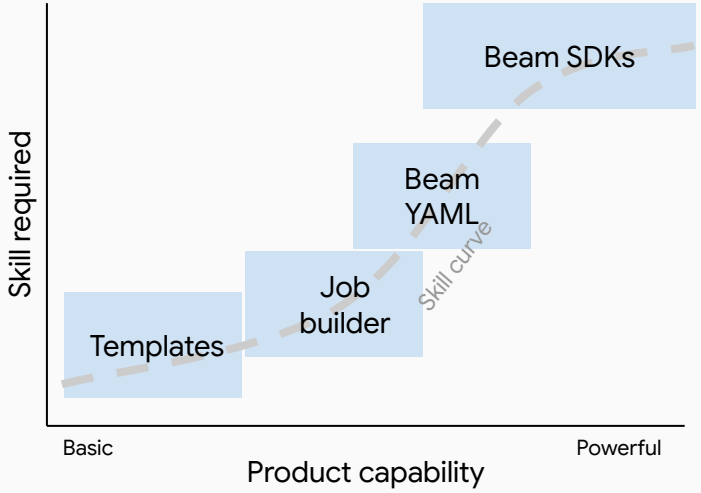
Current Beam/Dataflow State

- Python, Golang, Java, etc. SDK's to give users a choice of language
  - Still requires programming language knowledge and Beam model experience
- Dataflow Templates
  - Only works if someone has written a pipeline that exactly matches your use case
  - Even the smallest tweaks typically require as much knowledge as writing a pipeline from scratch.

YAML helps fill a missing gap between Templates and Beam SDKs





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Core Goals of Beam YAML Design

- Schema-first design (i.e. structured data via Beam Row)
  - But allow for schemaless
- Deliver main Beam functionality
  - IO's, Windowing, Turnkey transforms, etc.
- Robust error handling on a per-transform basis
- Easy syntax with syntactic sugar where possible
- Built-in transforms and IO's can be executed using Java or Python interchangeably
  - Affinity heuristic will optimize pipeline for specific SDK
- Provide Google-provided Dataflow Template for running YAML pipelines
  - Users will be able to submit YAML jobs directly to Dataflow
- Allow for code translation for getting started with Beam

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02

Beam Yaml Pipeline Structure and Examples

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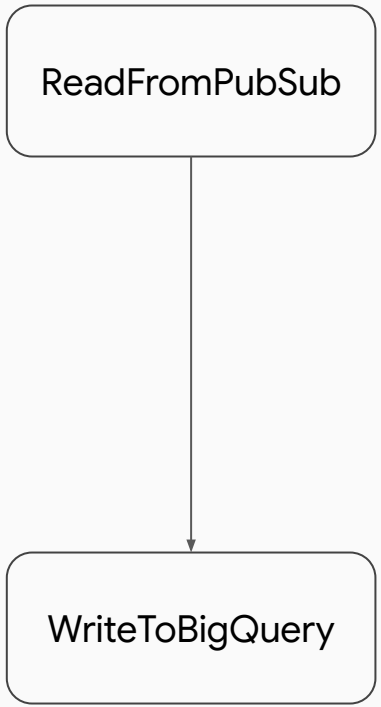
Basic Read-Write YAML Pipeline

```yaml
pipeline:
  type: chain

  source:
    type: ReadFromPubSub
    config:
      subscription: ...
      schema: ...

  sink:
    type: WriteToBigQuery
    config:
      table: ...
```



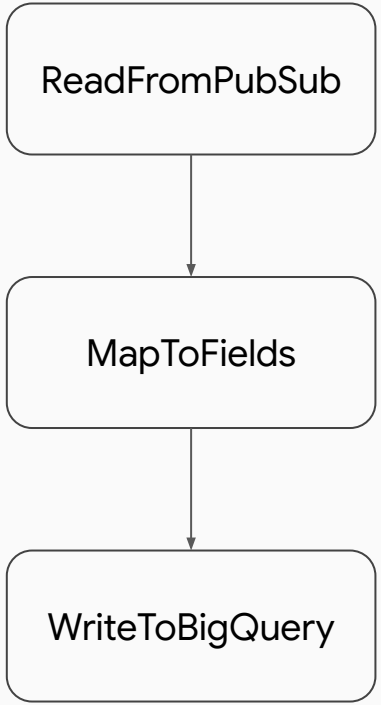
Add a Transformation

```yaml
pipeline:
  type: chain

  source:
    type: ReadFromPubSub
    config:
      subscription: ...
      schema: ...

  transforms:
  - type: MapToFields
    config:
      language: python
      fields:
        name: "name.upper()"
        age: "age + 20"

  sink:
    type: WriteToBigQuery
    config:
      table: ...
```



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Many transforms can be chained

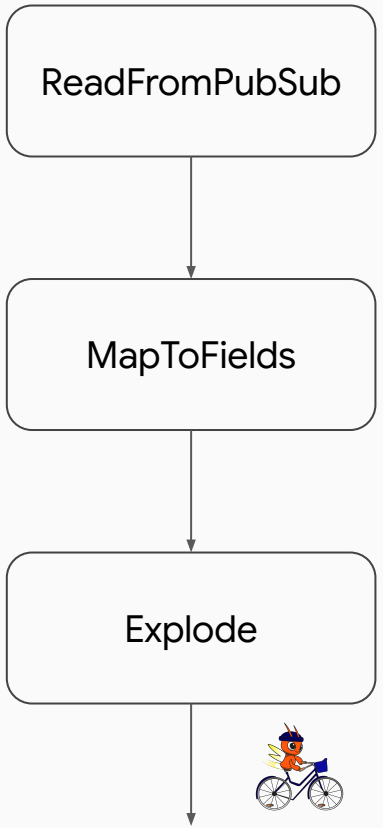
```yaml
pipeline:
  type: chain

  transforms:
  - type: ReadFromPubSub
    config:
      subscription: ...
      schema: ...

  - type: MapToFields
    config:
      language: python
      fields:
        name: "name.upper()"
        age: "age + 20"

  - type: Explode
    config:
      fields: [pets]

  ...
```



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Pipelines need not be linear

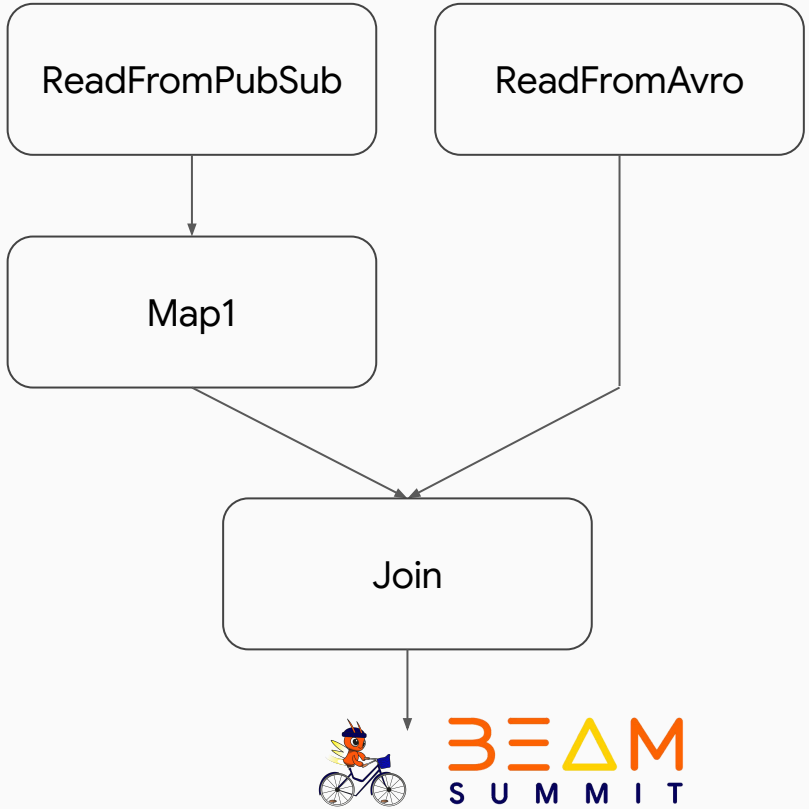
```
pipeline:
  transforms:
  - type: ReadFromPubSub
    config: ...

  - type: MapToFields
    name: Map1
    input: ReadFromPubSub
    config: ...

  - type: ReadFromAvro
    config:
      path: "gs://..."

  - type: Join
    input:
      left: MapToFields
      right: ReadFromAvro
    config:
      ...

  ...
```



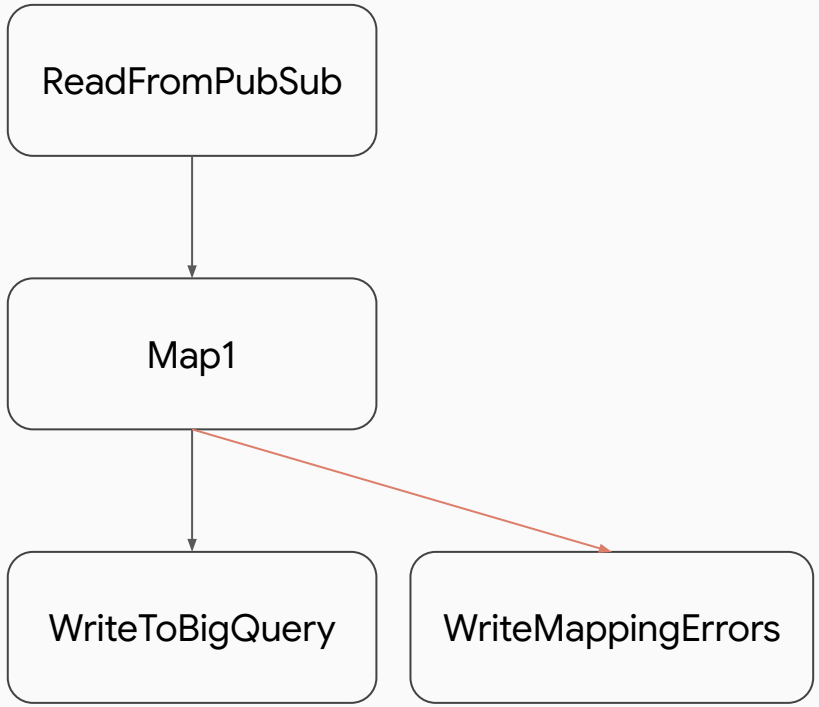
Sophisticated error handling

```
pipeline:
  transforms:
  - type: ReadFromPubSub
    config: ...

  - type: MapToFields
    name: Map1
    input: ReadFromPubSub
    config:
      ...
      error_handling:
        output: errors

  - type: WriteToBigQuery
    input: Map1
    config: ...

  - type: WriteToJson
    name: WriteMappingErrors
    input: MapToFields.errors
    config:
      path: "/path/to/errors.json"
```



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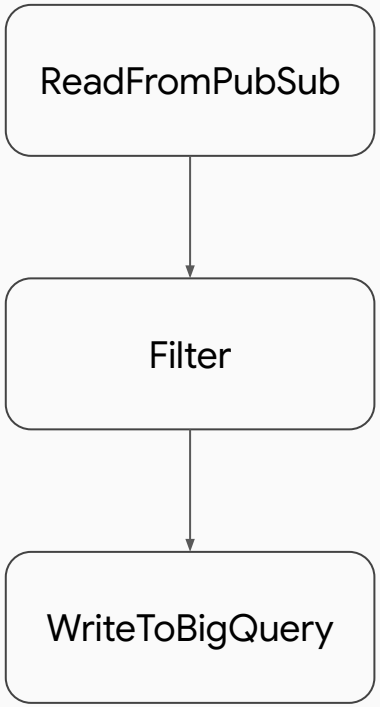
Built-in Jinja2 templatization

```yaml
pipeline:
  type: chain

  source:
    type: ReadFromPubSub
    config:
      subscription: ...
      schema: ...

  transforms:
  - type: Filter
    config:
      language: python
      keep: "age > {{threshold}}"

  sink:
    type: WriteToBigQuery
    config:
      table: "{{table_prefix}}-{{threshold}}"
```



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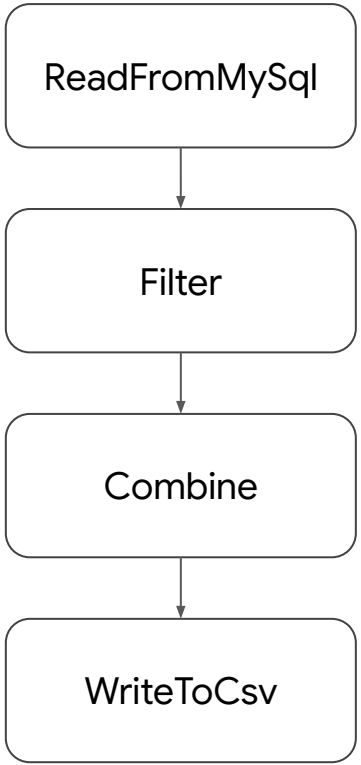
Example pipeline

```yaml
pipeline:
  type: chain
  transforms:
    - type: ReadFromMySql
      config:
        url: jdbc:mysql://host:port/database
        table: transactions
        username: 'username'
        password: 'password'
    - type: Filter
      config:
        language: python
        keep: category == "Electronics"
    - type: Combine
      name: CountNumberSold
      config:
        group_by: product_name
        combine:
          num_sold:
            value: product_name
            fn: count
    - type: WriteToCsv
      config:
        path: electronics.csv
```



Beam YAML Transforms - IO and others

- ReadFrom/WriteToAvro
- ReadFrom/WriteToCsv
- ReadFrom/WriteToJson
- ReadFrom/WriteToParquet
- ReadFrom/WriteToMySql
- ReadFrom/WriteToBigQuery
- ReadFrom/WriteToPubSub
- ReadFrom/WriteToKafka
- . . .
- Full list at https://beam.apache.org/releases/yamldoc/current/

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Beam YAML Transforms - IO and others

- Utility
  - Create
  - Flatten
  - WindowInto
  - LogForTesting
  - AssertEqual
- Mapping
  - MapToFields
  - Explode
  - Filter
  - Partition
- Aggregation
  - Combine
- ML
  - MLTransform
  - Enrichment
  - RunInference
- Other
  - Sql
  - Join
- . . .
- Full list at https://beam.apache.org/releases/yamldoc/current/

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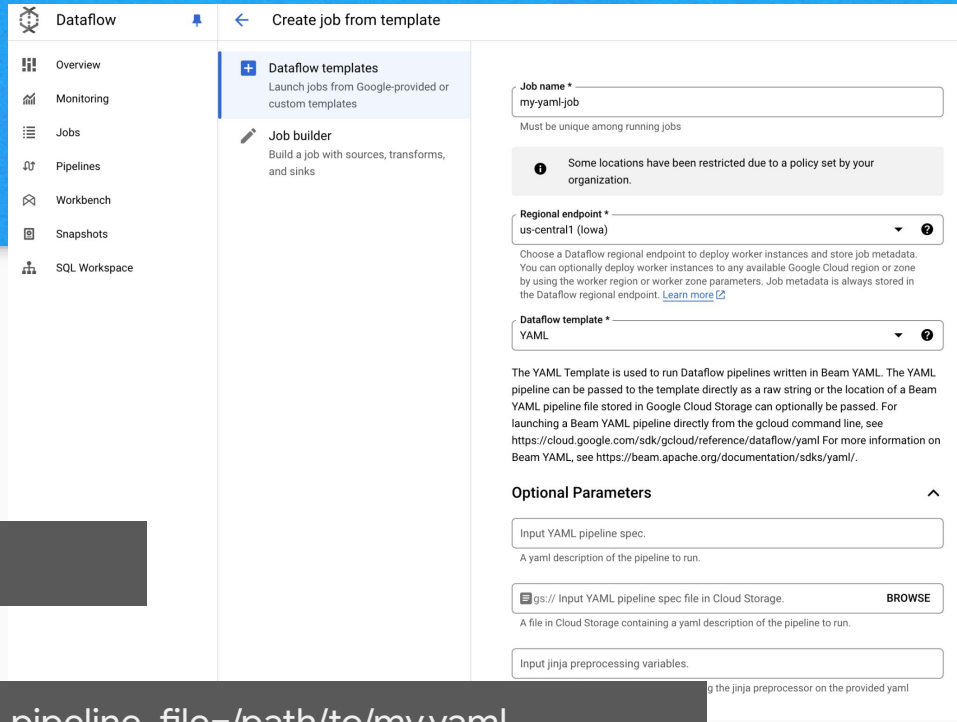
Running Beam YAML



Beam YAML jobs can be launched

- From the template UI
- Via the gcloud tool via Dataflow

```
$ gcloud dataflow yaml run /path/to/my.yaml
```

- Locally

```
$ python -m apache_beam.yaml.main --yaml_pipeline_file=/path/to/my.yaml
```

Can set runner using --runner or in YAML options block

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Basic Transforms Examples

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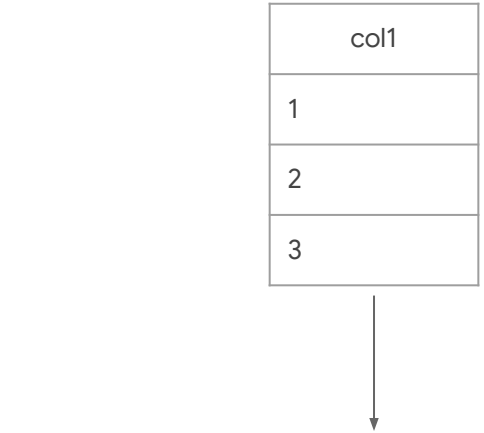
Mapping Transforms

- MapToFields
  - Map the input collection to a schema where each field can be defined by a UDF (user-defined function)
    - Expressions (Generic/Python/Java/SQL/JS*)
    - Callables (Python/Java/JS*)
    - File (Python/Java/JS*)
- Filter
  - Filter records in a collection given a predicate
    - Same expression, callable, file capabilities as MapToFields
- Explode
  - Produce elements for each iterable field specified
    - {name='a', iter=[1, 2, 3]} ⟶ {name='a', iter=1}, {name='a', iter=2}, and {name='a', iter=3}
- Partition
  - Split input collection into multiple output collections based on condition
- AssignTimestamps
  - Mark field in collection as Timestamp - useful for streaming pipeline with embedded timestamps

* JavaScript support is experimental

Generic MapToFields

```yaml
- type: MapToFields
  name: RenameAndMapCustomFields
  input: ReadFromCsv
  config:
    fields:
      new_col: col1
      int_literal: 389
      float_literal: 1.90216
      str_literal: '"example"'
```



col1
1
2
3

new_col	int_literal	float_literal	str_literal
1	389	1.90216	"example"
2	389	1.90216	"example"
3	389	1.90216	"example"

MapToFields

```
- type: MapToFields
  name: RenameAndMapCustomFields
  input: ReadFromCsv
  config:
    language: python
    fields:
      myNewStr:
        expression: "myOldStr"
      myNewNum:
        callable: "lambda row: row.myOldNum * 2"
      myNewName:
        path: "udf.py"
        name: "to_uppercase"
```

myOldNum	myOldStr	myOldName
1	“a”	“John”
2	“b”	“Jane”
3	“c”	“Apache Beam”

myNewNum	myNewStr	myNewName
2	“a”	“JOHN”
4	“b”	“JANE”
6	“c”	“APACHE BEAM”

MapToFields Callable

```
- type: MapToFields
  name: RenameAndMapCustomFields
  input: ReadFromCsv
  config:
    language: python
    fields:
      json_str:
        callable: |
          import json
          def process(row):
            json_str = json.dumps(row._asdict())
            return json_str
```

col1	col2	col3
1	“a”	“John”
2	“b”	“Jane”
3	“c”	“Apache Beam”

json_str
'{"col1": 1, "col2": "a", "col3": "John"}'
'{"col1": 2, "col2": "b", "col3": "Jane"}'
'{"col1": 3, "col2": "c", "col3": "Apache Beam"}'

MapToFields Output Types

```yaml
- type: MapToFields
  name: RenameAndMapCustomFields
  input: ReadFromCsv
  config:
    language: python
    fields:
      json_str: # -------> Any
        callable: |
          import json
          def process(row):
            json_str = json.dumps(row._asdict())
            return json_str
- type: SomeJavaTransform
  config:
    ...
```

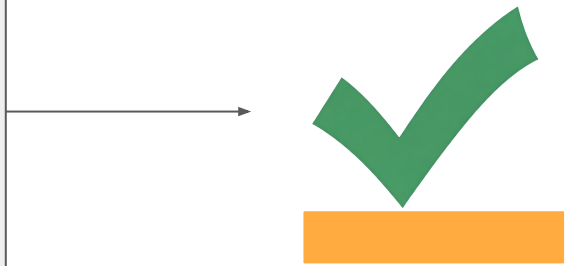


```
java.lang.IllegalArgumentException:
Failed to decode Schema due to an error
decoding Field proto:

name: "json_str"
type {
  nullable: true
  logical_type {
    urn: "beam:logical:pythonsdk_any:v1"
  }
}
```

MapToFields Output Types

```yaml
- type: MapToFields
  name: RenameAndMapCustomFields
  input: ReadFromCsv
  config:
    language: python
    fields:
      json_str:
        callable: |
          import json
          def process(row):
            json_str = json.dumps(row._asdict())
            return json_str
        output_type: string # -------> String
- type: SomeJavaTransform
  config:
    ...
```



MapToFields Create Schema

```
- type: MapToFields
  name: RenameAndMapCustomFields
  input: ReadFromCsv
  config:
    language: python
    fields:
      col1:
        callable: 'lambda row: row.col1'
        output_type: integer
      col2:
        callable: 'lambda row: row.col2'
        output_type: string
      col3:
        callable: 'lambda row: row.col3'
        output_type: string
```

col1	col2	col3
1	“a”	“John”
2	“b”	“Jane”
3	“c”	“Apache Beam”

col1	col2	col3
1	“a”	“John”
2	“b”	“Jane”
3	“c”	“Apache Beam”

MapToFields Java

```yaml
- type: MapToFields
  name: RenameAndMapCustomFields
  input: ReadFromCsv
  config:
    language: java
    fields:
      myNewStr:
        expression: "myOldStr"
      myNewNum:
        callable: |
          import org.apache.beam.sdk.values.Row;
          import java.util.function.Function;
          public class MyFunction implements Function<Row, String> {
            public String apply(Row row) {
              return row.getString("myOldNum") * 2;
            }
          }
      myNewName:
        path: "udf.java"
        name: "to_uppercase"
```

myOldNum	myOldStr	myOldName
1	“a”	“John”
2	“b”	“Jane”
3	“c”	“Apache Beam”

myNewNum	myNewStr	myNewName
2	“a”	“JOHN”
4	“b”	“JANE”
6	“c”	“APACHE BEAM”

MapToFields SQL

```
SELECT
  `timestamp`,
  UPPER(myOldName) AS myNewName,
  "myOldNum + 1" AS myNewNum
FROM PCOLLECTION;
```

```
- type: MapToFields
  name: RenameAndMapCustomFields
  input: ReadFromCsv
  config:
    language: sql
    fields:
      timestamp:
        expression: "`timestamp`"
      myNewNum:
        expression: "myOldNum + 1"
      myNewName:
        expression: "UPPER(myOldName)"
```

timestamp	myOldNum	myOldName
1	1	“John”
2	2	“Jane”
3	3	“Apache Beam”

timestamp	myNewNum	myNewName
1	2	“JOHN”
2	3	“JANE”
3	4	“APACHE BEAM”

Aggregation Transforms

- Combine
  - Aggregate the input collection according to a given aggregation method
    - Built-in
      - sum, max, min, all, any, mean, count, group, concat
    - Custom transform
      - Some function that implements `core.CombineFn`
  - Supports multiple languages - Python, SQL

Basic Combine

```yaml
- type: Combine
  config:
    group_by: col1
    combine:
      col2:
        value: col2
        fn:
          type: sum
      count:
        value: col1
        fn:
          type: count
```

col1	col2
'a'	1
'b'	2
'a'	3

col1	col2	count
'a'	4	2
'b'	2	1

Basic Combine

```
- type: Combine
  config:
    group_by: col1
    combine:
      col2:
        value: col2
        fn: sum
      count:
        value: col1
        fn: count
```

col1	col2
'a'	1
'b'	2
'a'	3

col1	col2	count
'a'	4	2
'b'	2	1

Basic Combine

```yaml
- type: Combine
  config:
    group_by: col1
    combine:
      col2: sum
      count:
        value: col1
        fn: count
```

col1	col2
'a'	1
'b'	2
'a'	3

col1	col2	count
'a'	4	2
'b'	2	1

SQL Combine

```yaml
- type: Combine
  config:
    language: sql
    group_by: id
    combine:
      num_values: "count(*)"
      total: "sum(col1)"
```

id	col1
1	1
2	2
1	3

id	num_values	total
1	2	4
2	1	2

Custom Combine Fn

```yaml
- type: Combine
  config:
    language: python
    group_by: id
    combine:
      top_two:
        value: "col1 + col2"
        fn:
          type: 'apache_beam.transforms.combiners.TopCombineFn'
          config:
            n: 2
```

id	col1	col2
1	1	5
2	2	6
1	3	7
1	4	8

id	top_two
1	[12,10]
2	[8]

A set of Beam's built-in CombineFn's can be found at
https://beam.apache.org/releases/pydoc/current/apache_beam.transforms.combiners.html

04

Advanced Topics (Providers, Inlining, Jinja, ML, Testing)

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Custom Transforms

Though we aim to provide a rich set of built-in transforms, invariable customers will want to provide their own custom transformations.

- We provide this extensibility via *Providers*
- Allows one to use the full expressivity of Beam SDKs
- Custom transforms can be authored and deployed in multiple ways
  - Inline
  - PyPi packages
  - Java jars
  - Maven/gradle targets
  - YAML
- Customers can use this to provide their own custom transforms, and their users can then reference and use them.

A tutorial on creating a custom Java provider can be found at https://github.com/Polber/beam-yaml-xlang

Provider Example (Java Jar)

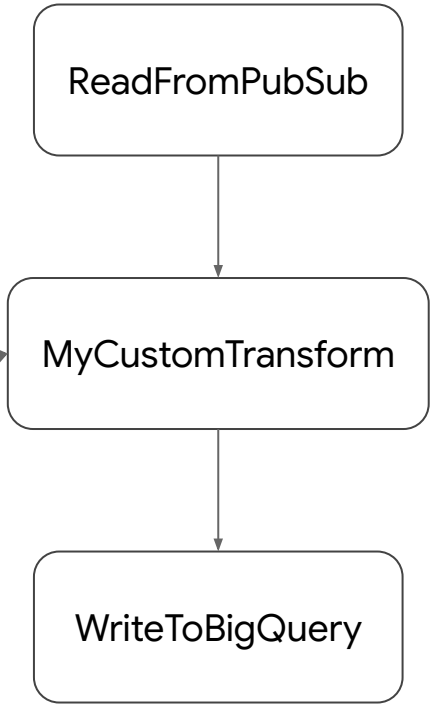
```yaml
pipeline:
  type: chain

  transforms:
  - type: ReadFromPubSub
    config: ...

  - type: MyCustomTransform
    config: ...

  - type: WriteToBigQuery
    config: ...

providers:
  - type: javaJar
    config:
      jar: "/path/or/url/to/myExpansionService.jar"
    transforms:
      MyCustomTransform: "urn:for:my:service"
```

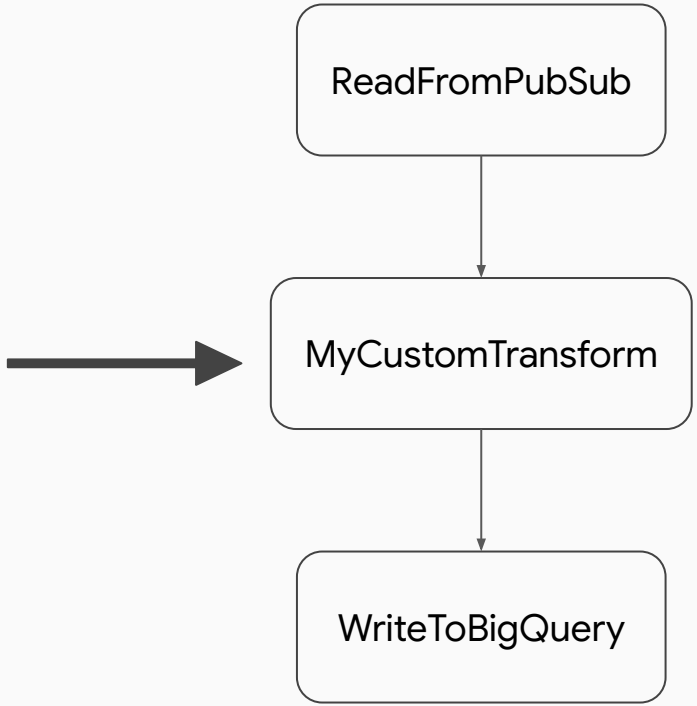


Provider Example (PyPi)

```
pipeline:
  type: chain

  transforms:
  - type: ReadFromPubSub
    config:
      subscription: ...
  - type: MyCustomTransform
    config:
      param: value
  - type: WriteToBigQuery
    config:
      table: ...

  providers:
  - type: pythonPackage
    config:
       packages:
            - my_pypi_package>=version
            - /path/to/local/package.zip
    transforms:
       MyCustomTransform: "pkg.subpkg.MyTransform"
```



Additional Custom Transforms

There are cases where the overhead of supplying a custom packaged provider is not worth the time investment or overhead. In those cases, Beam YAML provides a method for creating in-line Python transforms.

There are currently two ways to implement these in-line Python transforms

- Using PyTransform
- Leveraging the Providers framework (python Provider)

Best Practice:

- Output a Beam Row - outputting schema'd data helps integration with existing Beam YAML transforms

PyTransform

- Typically used to call some arbitrary Transform that is not specifically wrapped for Beam YAML
- This could be a transform built into Beam, or one packaged with the pipeline

```
- type: PyTransform
  config:
    constructor: apache_beam.pkg.module.SomeTransform
    args: [1, 'foo']
    kwargs:
       baz: 3
```

PyTransform __constructor__

```yaml
- type: PyTransform
  config:
    constructor: __constructor__
    kwargs:
      source: |
        class MyPTransform(beam.PTransform):
          def __init__(self, inc):
            self._inc = inc
          def expand(self, pcoll):
            return pcoll | beam.Map(lambda x: beam.Row(out=x.col2 + self._inc))

      inc: 10
```

col1	col2
1	4
2	5
3	6

out
14
15
16

PyTransform __callable__

```yaml
- type: PyTransform
  config:
    constructor: __callable__
    kwargs:
      source: |
        def my_ptransform(pcoll, inc):
          return pcoll | beam.Map(lambda x: beam.Row(out=x.col2 + inc))
      inc: 10
```

col1	col2
1	4
2	5
3	6

out
14
15
16

Python Provider

```yaml
pipeline:
  transforms:
    - ...
    - type: MyTransform
      input: ...
      config:
        inc: 10
    - ...

providers:
  - type: python
    config: {}
    transforms:
      MyTransform: |
        @beam.ptransform_fn
        def my_ptransform(pcoll, inc):
          return pcoll | beam.Map(lambda x: beam.Row(out=x.col2 + inc))
```

col1	col2
1	4
2	5
3	6

out
14
15
16

Jinja Templatization

There are many cases where a static YAML file, or components, may be cumbersome to share, negating the benefit of YAML being easy to share across teams.

- Sensitive information embedded (SPII)
- Different teams/users need minor variations (though possibly clearly defined subsets of use-cases)
- Copy/paste-ing YAML blocks can be disorganized and difficult to maintain across an organization
- etc.

Jinja Templatization

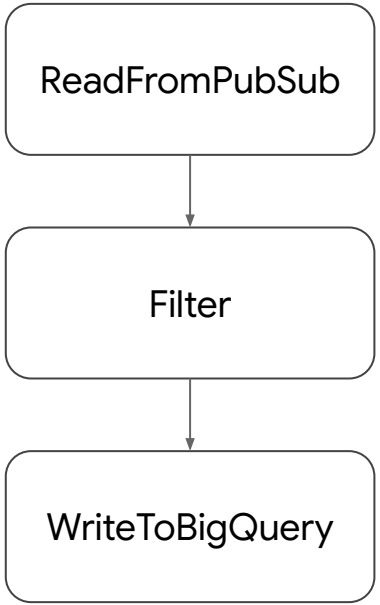
Jinja framework provides standardized method for creating template YAML pipelines

- Inject variables, such as SPII, when running the pipeline, rather than embedding
- Allows for dynamic construction of pipeline graphs based on runtime parameters
- Import central-hosted YAML blocks/files

More information on Jinja syntax can be found at https://jinja.palletsprojects.com/en/3.1.x/templates/#

Variable injection

```yaml
pipeline:
  type: chain
  transforms:
    - type: ReadFromPubSub
      config:
        subscription: ...
        format: ...
        schema: ...
    - type: Filter
      config:
        language: python
        keep: "age > {{threshold}}"
    - type: WriteToBigQuery
      config:
        table: "my_project.my_dataset.my_table_staging"
```

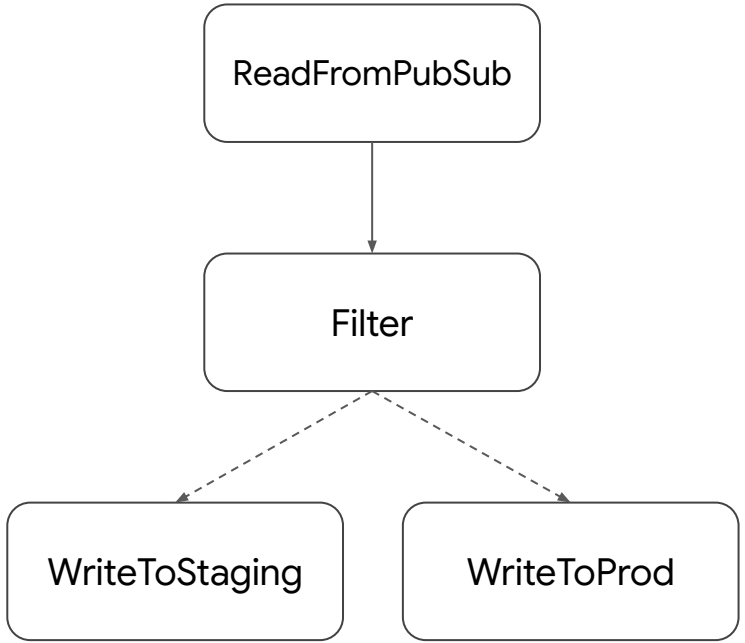



```
python -m apache_beam.yaml.main --yaml_pipeline_file=pipeline.yaml    --jinja_variables='{"threshold": "5"}'
```

Dynamic graph construction

```
pipeline:
  type: chain
  transforms:
    - type: ReadFromPubSub
      config:
        subscription: ...
        format: ...
        schema: ...
    - type: Filter
      config:
        language: python
        keep: "age > {{threshold}}"

{% if use_staging == "true" %}
    - type: WriteToBigQuery
      name: WriteToStaging
      config:
        table: "my_project.my_dataset.my_table_staging"
{% else %}
    - type: WriteToBigQuery
      name: WriteToProd
      config:
        table: "my_project.my_dataset.my_table"
{% endif %}
```



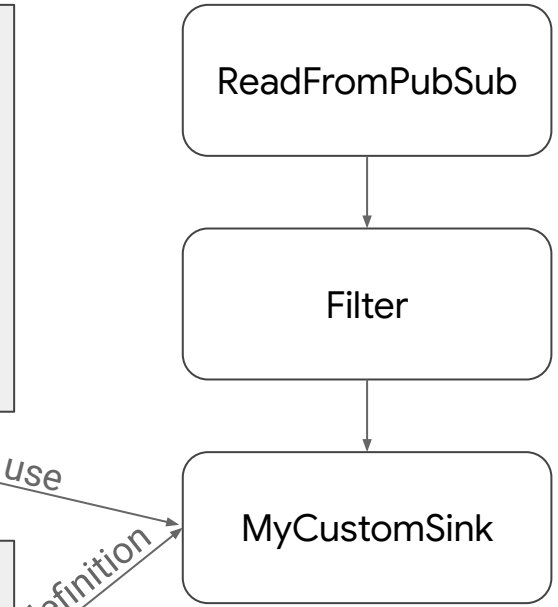

```
python -m apache_beam.yaml.main --yaml_pipeline_file=pipeline.yaml    --jinja_variables='{"threshold": "5", "use_staging": "true"}'
```

Easily share transforms catalogs

```
{% include 'gs://my-bucket/path/to/providers.yaml' %}
pipeline:
  type: chain
  transforms:
    - type: ReadFromPubSub
      config:
        subscription: ...
        format: ...
        schema: ...
    - type: Filter
      config:
        language: python
        keep: "age > {{threshold}}"
    - type: MyCustomSink
      config:
        ...
```

providers.yaml

```
providers:
  - type: pythonPackage
    config:
       packages:
           - my_pypi_package>=version
           - /path/to/local/package.zip
    transforms:
       MyCustomSink: "pkg.subpkg.PTransformClassOrCallable"
```



ML - RunInference

A transform that takes the input rows, containing examples (or features), for use on an ML model. The transform then appends the inferences (or predictions) for those examples to the input row.

```
pipelines:
 - pipeline:
    type: chain
    transforms:
     - type: Create
       config:
         elements:
           - question: "What is a car?"
           - question: "Where is the Eiffel Tower located?"
     - type: RunInference
       config:
         model_handler:
           type: "VertexAIModelHandlerJSON"
           config:
             endpoint_id: 9157860935048626176
             project: "apache-beam-testing"
             location: "us-central1"
             preprocess:
               callable: 'lambda x: {"prompt": x.question}'
             private: false
```

```
[Row(inference=PredictionResult(example={'prompt': 'What is a car?'}, inference={'content': 'A car is a wheeled, self-propelled motor vehicle used for transportation. Cars are typically powered by an internal combustion engine, although some are powered by electric motors. Cars can be used for personal transportation, commercial transportation, or both.', 'citationMetadata': {'citations': []}...
```

BEAM SUMMIT

ML - MLTransform

Use MLTransform to apply common machine learning (ML) processing tasks on keyed data.

```
pipelines:
 # MLTransform with write_artifact_location
 - pipeline:
    type: chain
    transforms:
      - type: Create
        config:
          elements:
            - {num: 0, text: 'To be or not to be'}
            - {num: 2, text: 'I think, therefore I am'}
            - {num: 5, text: 'The only thing we have to fear is fear itself'}
            - {num: 8, text: 'Be the change you wish to see in the world'}
      - type: MLTransform
        config:
          write_artifact_location: "{TEMP_DIR}"
          transforms:
            - type: ScaleTo01
              config:
                columns: [num]
            - type: ScaleByMinMax
              config:
                columns: [num]
                min_value: 0
                max_value: 100
      - type: MapToFields
        config:
          language: python
          fields:
            num_scaled:
              callable: 'lambda x: x.num[0]'
      - type: AssertEqual
        config:
          elements:
            - {num_scaled: 0.0}
            - {num_scaled: 25.0}
            - {num_scaled: 62.5}
            - {num_scaled: 100.0}
  options:
    yaml_experimental_features: ['ML']
```

BEAM SUMMIT

Testing - example pipeline

```
pipeline:
  transforms:
  - type: ReadFromText
    name: Read from GCS
    config:
      path:
gs://dataflow-samples/shakespeare/kinglear.txt
  - type: MapToFields
    name: Split words
    config:
      language: python
      fields:
        word:
          callable: |
            import re
            def all_words(row):
              return re.findall(r'[a-z]+', row.line.lower())
        value: 1
    input: Read from GCS
- type: Explode
    name: Explode word arrays
    config:
      fields: [word]
    input: Split words
...
```

```
...
- type: Combine
    name: Count words
    config:
      group_by: [word]
      combine:
        value: sum
    input: Explode word arrays
  - type: MapToFields
    name: Format output
    config:
      language: python
      fields:
        output: "word + ': ' + str(value)"
    input: Count words
  - type: WriteToText
    name: Write to GCS
    config:
      path: gs://bucket/counts.txt
    input: Format output

tests: []
```

BEAM SUMMIT

Testing - testing section and execution

Testing section:

```
tests:
- name: MyRegressionTest
  mock_outputs:
    - name: Read from GCS
      elements:
        - line: "Nothing can come of nothing"
  expected_inputs:
    - name: Write to GCS
      elements:
        - output: 'nothing: 2'
        - output: 'can: 1'
        - output: 'come: 1'
        - output: 'of: 1'
```

Execution:

```
$ python -m apache_beam.yaml.main --yaml_pipeline_file=wordcount.yaml --tests
```

BEAM SUMMIT

More Information

- Beam YAML docs:
  - https://beam.apache.org/documentation/sdks/yaml/
- Creating a custom Beam Java transform for Beam YAML:
  - https://github.com/Polber/beam-yaml-xlang
- Beam YAML blog:
  - https://beam.apache.org/blog/beam-yaml-release/
- Beam YAML examples catalog (including use-case from slides)
  - https://github.com/apache/beam/tree/master/sdks/python/apache_beam/yaml/examples
- Beam YAML Getting Started Notebook:
  - https://colab.sandbox.google.com/github/apache/beam/blob/master/examples/notebooks/get-started/try-apache-beam-yaml.ipynb

05

JobBuilder Introduction and Relationship to Beam YAML

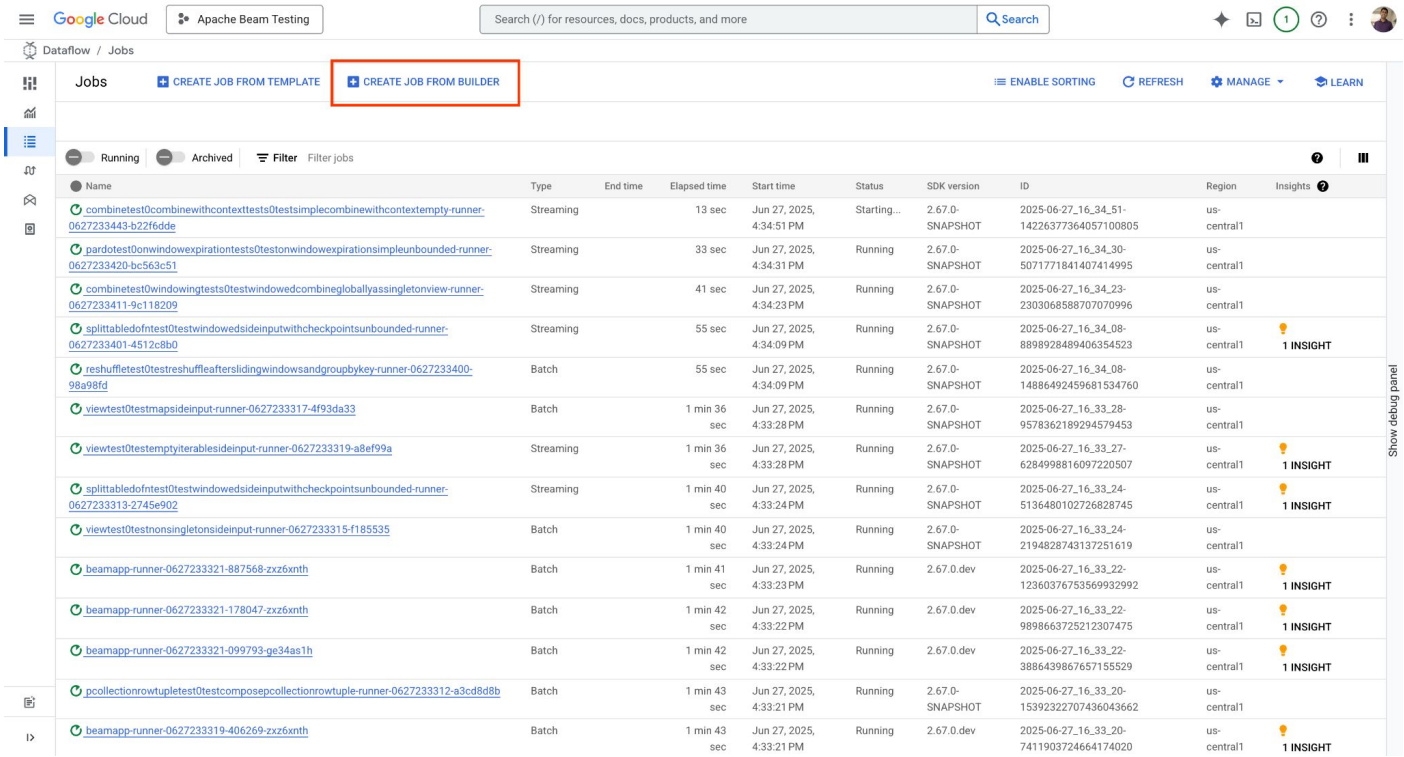
Chamikara Jayalath

BEAM SUMMIT

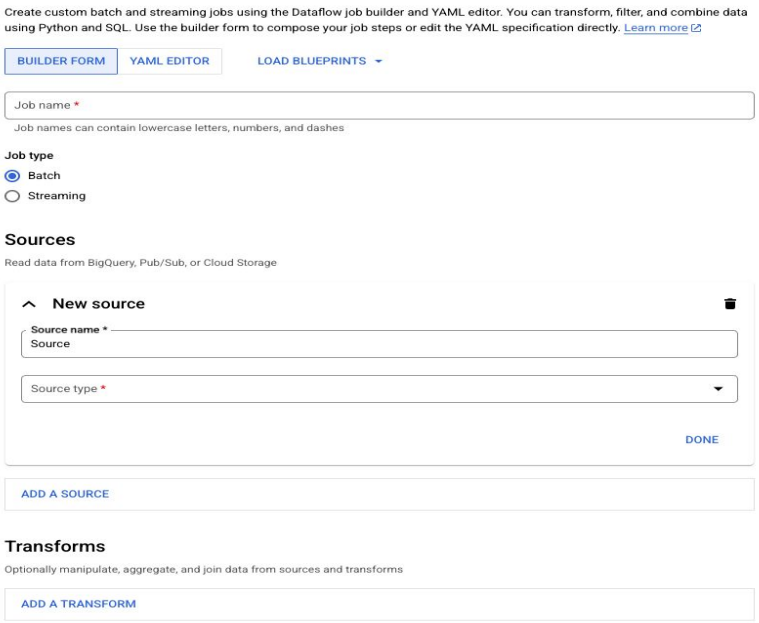
What is the Dataflow Job Builder?

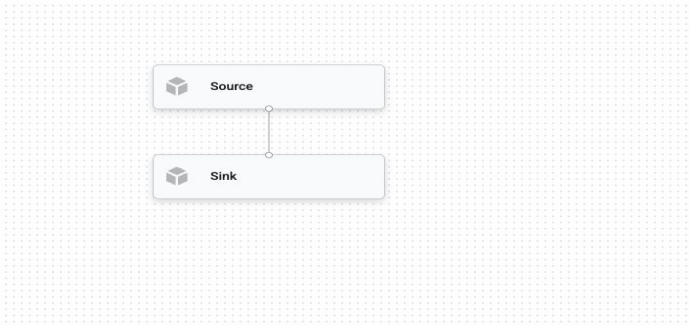
- A visual UI for building and running Dataflow pipelines
- Backed by Beam YAML
- Allows saving your pipeline in GCS and loading them back.
- Includes a set of pre-defined pipelines (blueprints)

What is the Dataflow Job Builder?



What is the Dataflow Job Builder?





Why use Dataflow Job Builder ?

- No need to download or install a Beam SDK.
- Visual editing in the UI can be much simpler than building the pipeline programmatically.
- Transforms can be configured using the UI.
- Enough customization to work for many pipelines.
- Jobs can be validated and launched via the UI.

New source

Source name *

Source

Source type *

- Pub/Sub Topic
- Pub/Sub Subscription
- BigQuery Table
- CSV from Cloud Storage
- JSON from Cloud Storage
- Text files from Cloud Storage
- YAML Source
- JDBC

Tra

Optic

ADD A TRANSFORM

New source

Source name *

Source

Source type *

CSV from Cloud Storage

gs:// CSV location * BROWSE

The location of your CSV file(s) in Cloud Storage. You can use wildcards to specify multiple files. Learn more

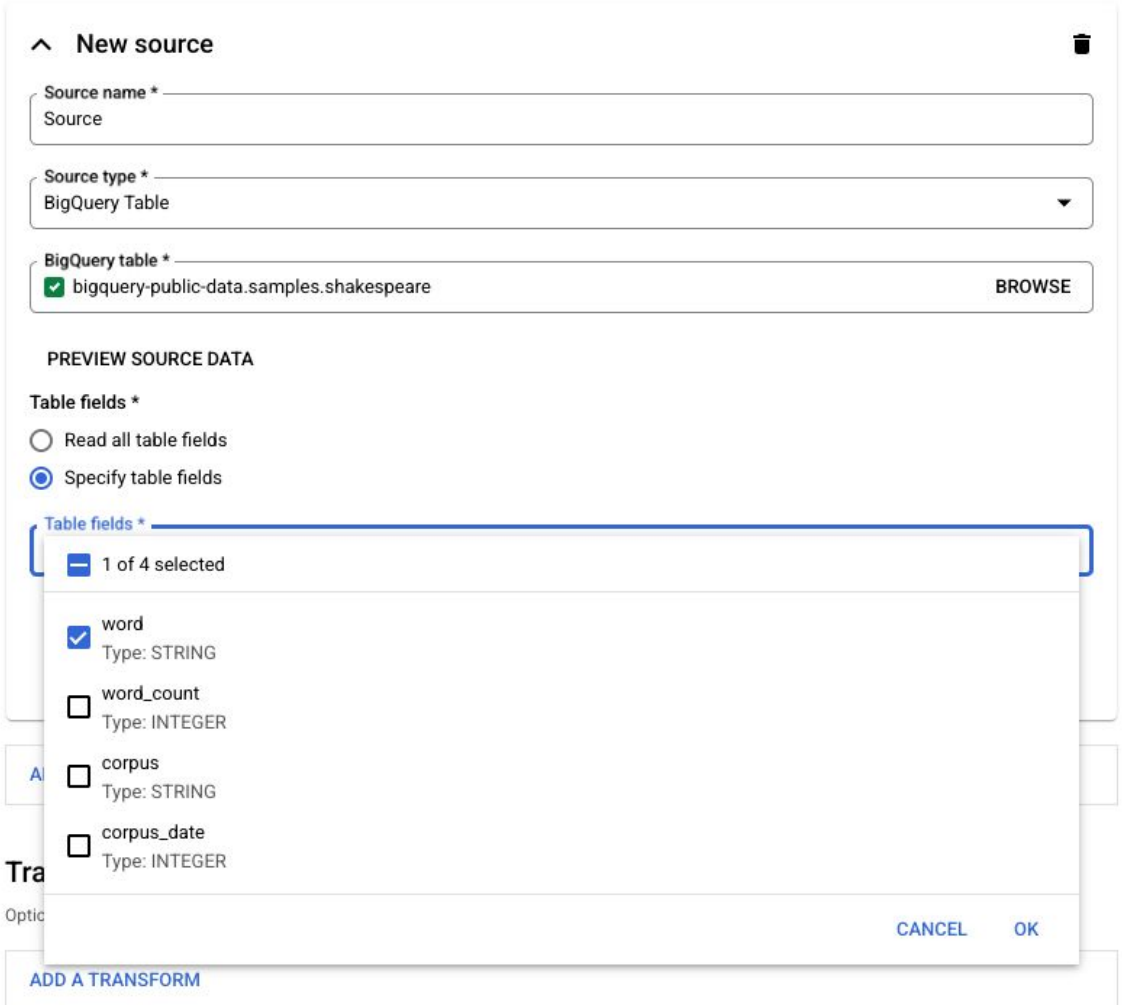
PREVIEW SOURCE DATA

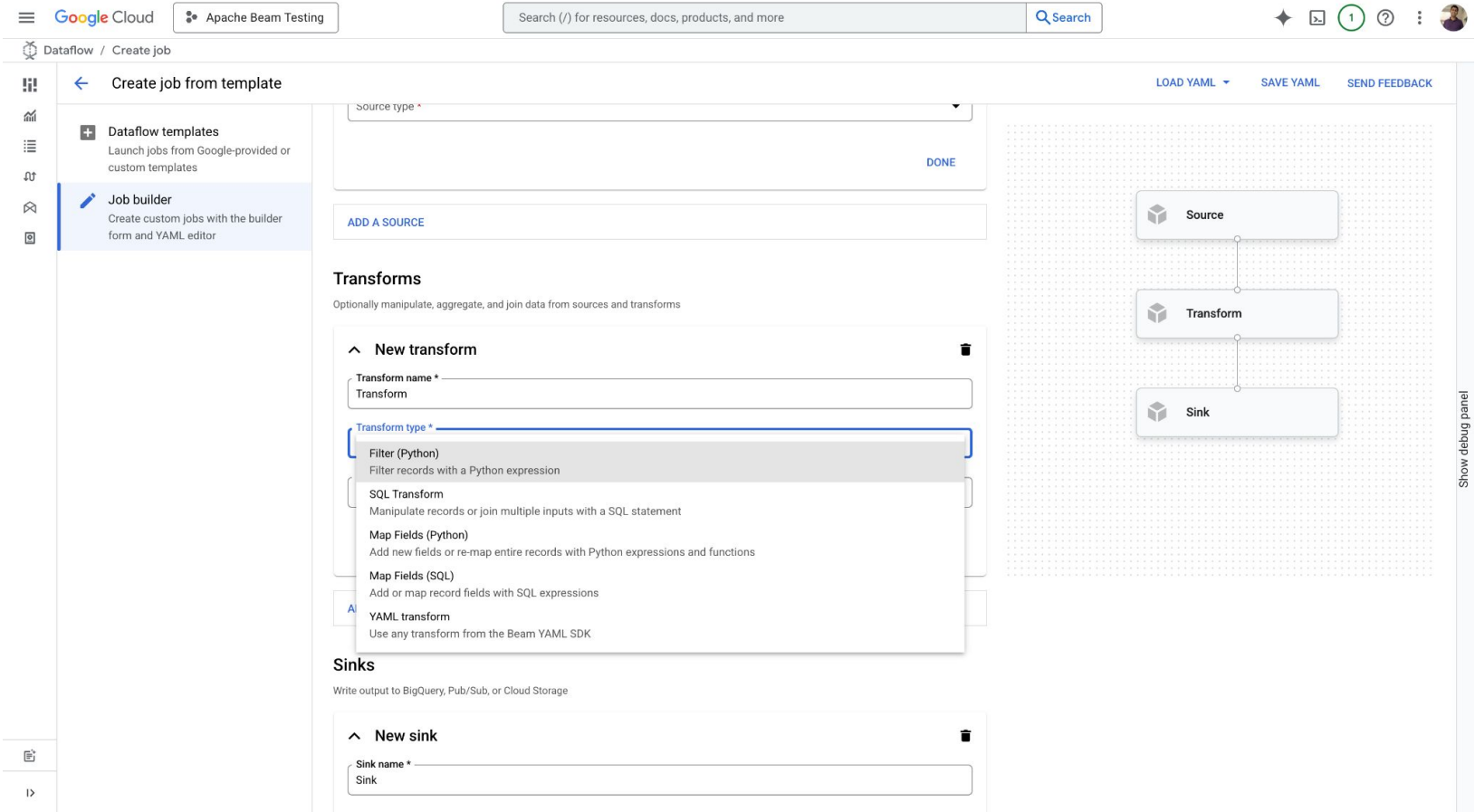
CSV delimiter character

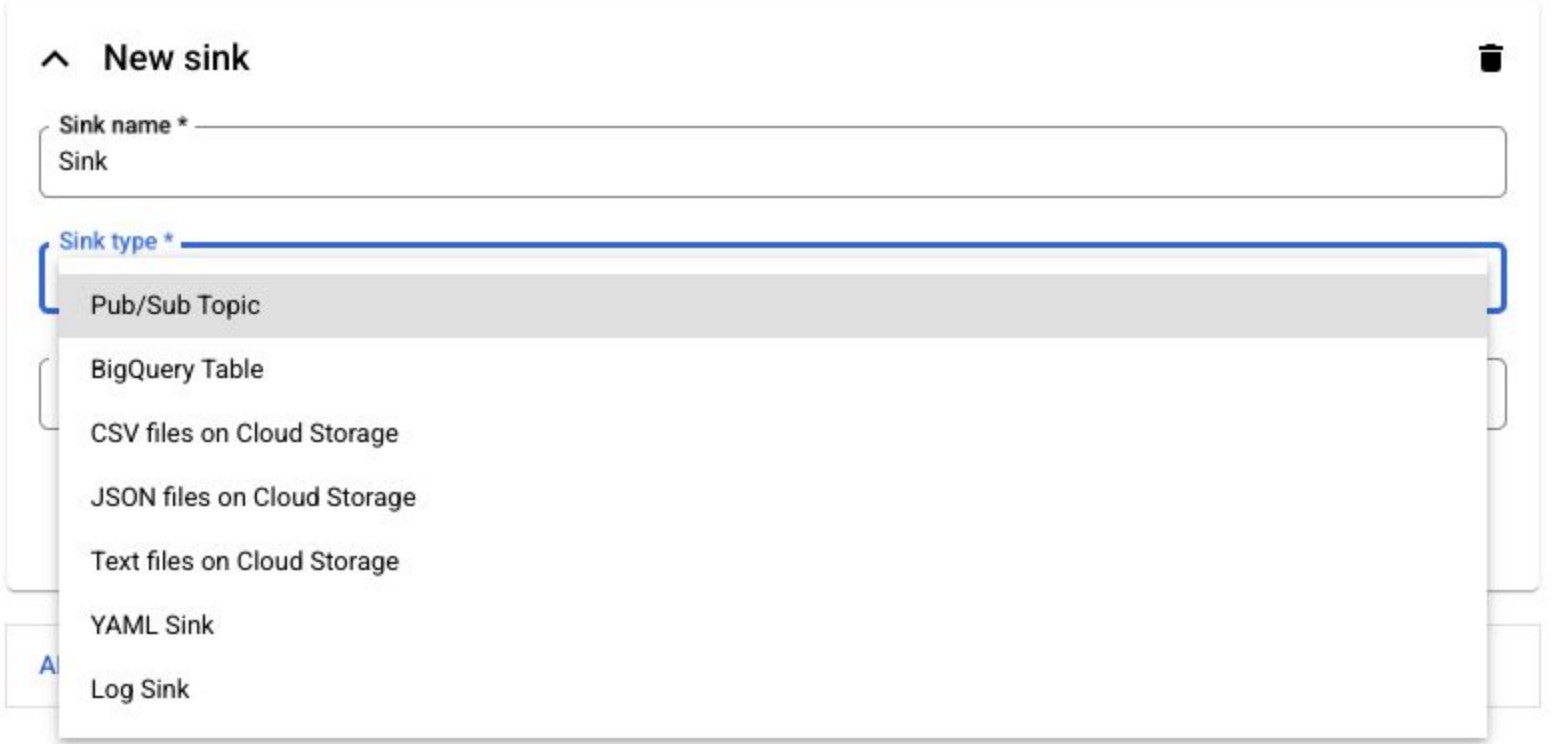
Comma

Character used to parse CSV fields

DONE


New source
Source name *
Source
Source type *
BigQuery Table
BigQuery table *
bigquery-public-data.samples.shakespeare
BROWSE
PREVIEW SOURCE DATA
Table fields *
Read all table fields
Specify table fields
Table fields *
1 of 4 selected
word
Type: STRING
word_count
Type: INTEGER
corpus
Type: STRING
corpus_date
Type: INTEGER
CANCEL
OK
ADD A TRANSFORM


Google Cloud
Apache Beam Testing
Search (/) for resources, docs, products, and more
Search
Dataflow / Create job
Create job from template
LOAD YAML
SAVE YAML
SEND FEEDBACK
Dataflow templates
Launch jobs from Google-provided or custom templates
Job builder
Create custom jobs with the builder form and YAML editor
Source type *
DONE
ADD A SOURCE
Transforms
Optionally manipulate, aggregate, and join data from sources and transforms
New transform
Transform name *
Transform
Transform type *
Filter (Python)
Filter records with a Python expression
SQL Transform
Manipulate records or join multiple inputs with a SQL statement
Map Fields (Python)
Add new fields or re-map entire records with Python expressions and functions
Map Fields (SQL)
Add or map record fields with SQL expressions
YAML transform
Use any transform from the Beam YAML SDK
Sinks
Write output to BigQuery, Pub/Sub, or Cloud Storage
New sink
Sink name *
Sink
Source
Transform
Sink
Show debug panel


New sink
Sink name *
Sink
Sink type *
Pub/Sub Topic
BigQuery Table
CSV files on Cloud Storage
JSON files on Cloud Storage
Text files on Cloud Storage
YAML Sink
Log Sink

06

Job Builder Ease-of-Use Features

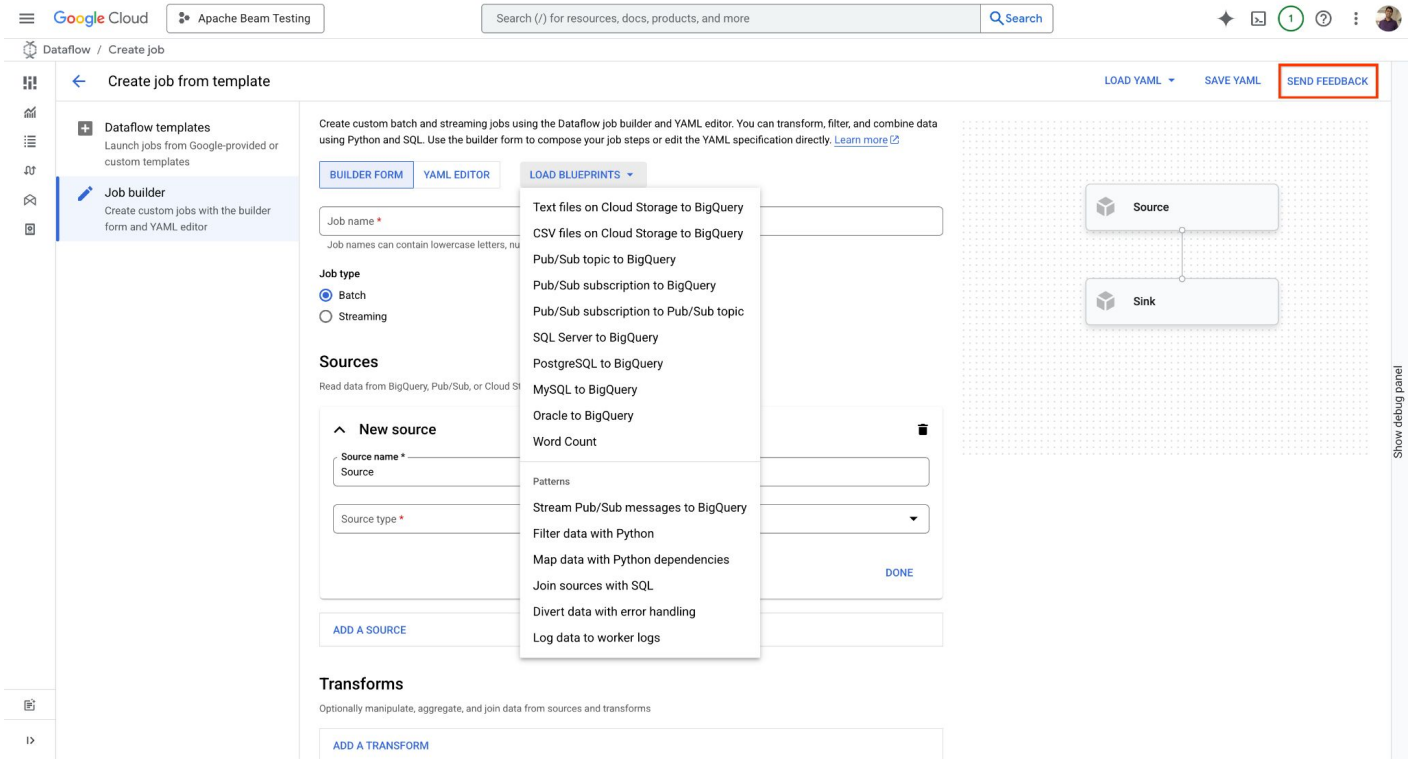
Chamikara Jayalath

BEAM SUMMIT

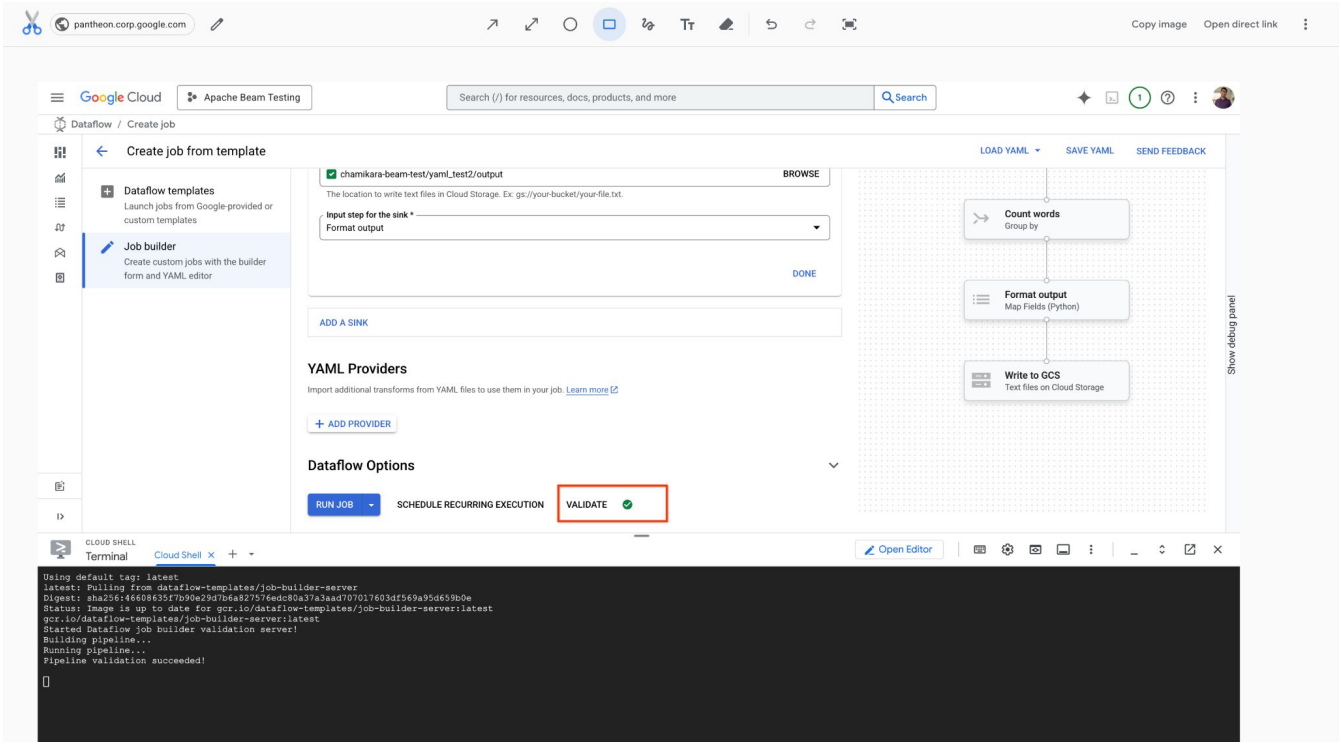
Blueprints

- Includes widely used pipelines that are already built for you
- Just load and run
- You can customize and save in GCS if needed

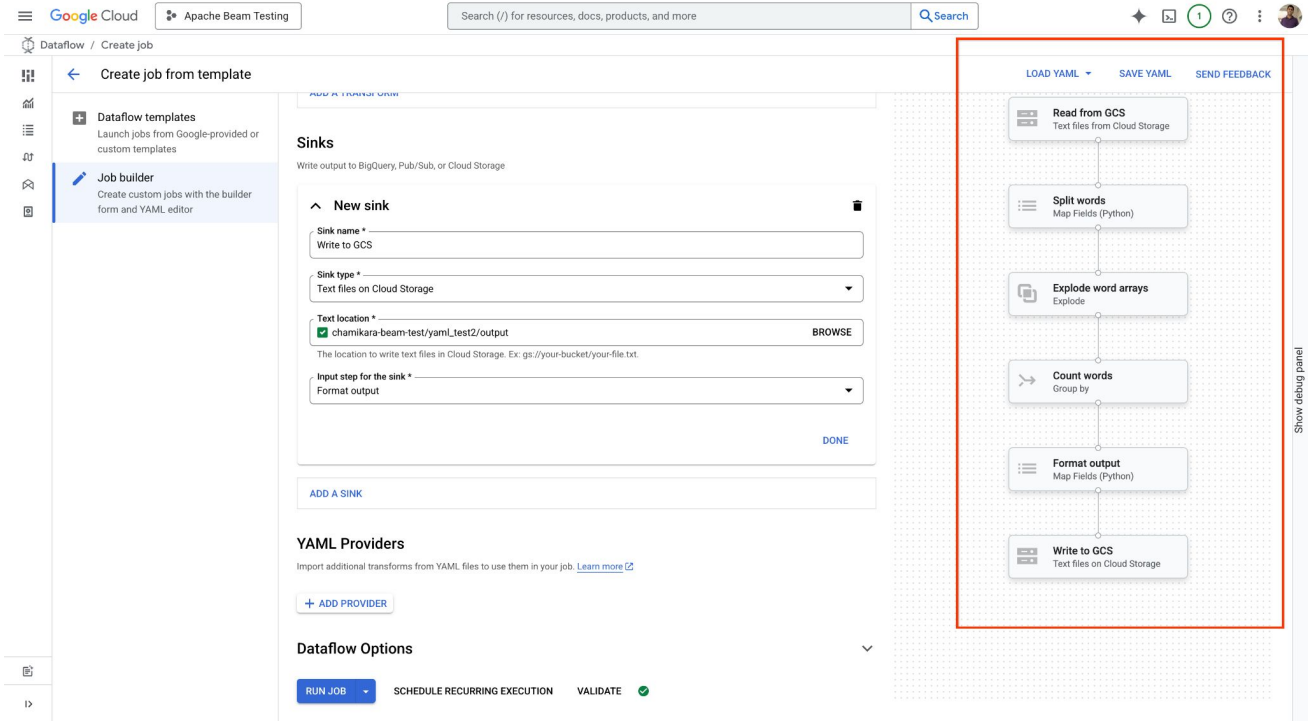
Blueprints


Google Cloud
Apache Beam Testing
Search (/) for resources, docs, products, and more
Search
Dataflow / Create job
Create job from template
LOAD YAML
SAVE YAML
SEND FEEDBACK
Dataflow templates
Launch jobs from Google-provided or custom templates
Job builder
Create custom jobs with the builder form and YAML editor
Create custom batch and streaming jobs using the Dataflow job builder and YAML editor. You can transform, filter, and combine data using Python and SQL. Use the builder form to compose your job steps or edit the YAML specification directly. Learn more
BUILDER FORM
YAML EDITOR
LOAD BLUEPRINTS
Job name *
Job names can contain lowercase letters, nu
Job type
Batch
Streaming
Text files on Cloud Storage to BigQuery
CSV files on Cloud Storage to BigQuery
Pub/Sub topic to BigQuery
Pub/Sub subscription to BigQuery
Pub/Sub subscription to Pub/Sub topic
SQL Server to BigQuery
PostgreSQL to BigQuery
MySQL to BigQuery
Oracle to BigQuery
Word Count
Patterns
Stream Pub/Sub messages to BigQuery
Filter data with Python
Map data with Python dependencies
Join sources with SQL
Divert data with error handling
Log data to worker logs
Source
Sink
Sources
Read data from BigQuery, Pub/Sub, or Cloud St
New source
Source name *
Source
Source type *
DONE
ADD A SOURCE
Transforms
Optionally manipulate, aggregate, and join data from sources and transforms
ADD A TRANSFORM
Show debug panel

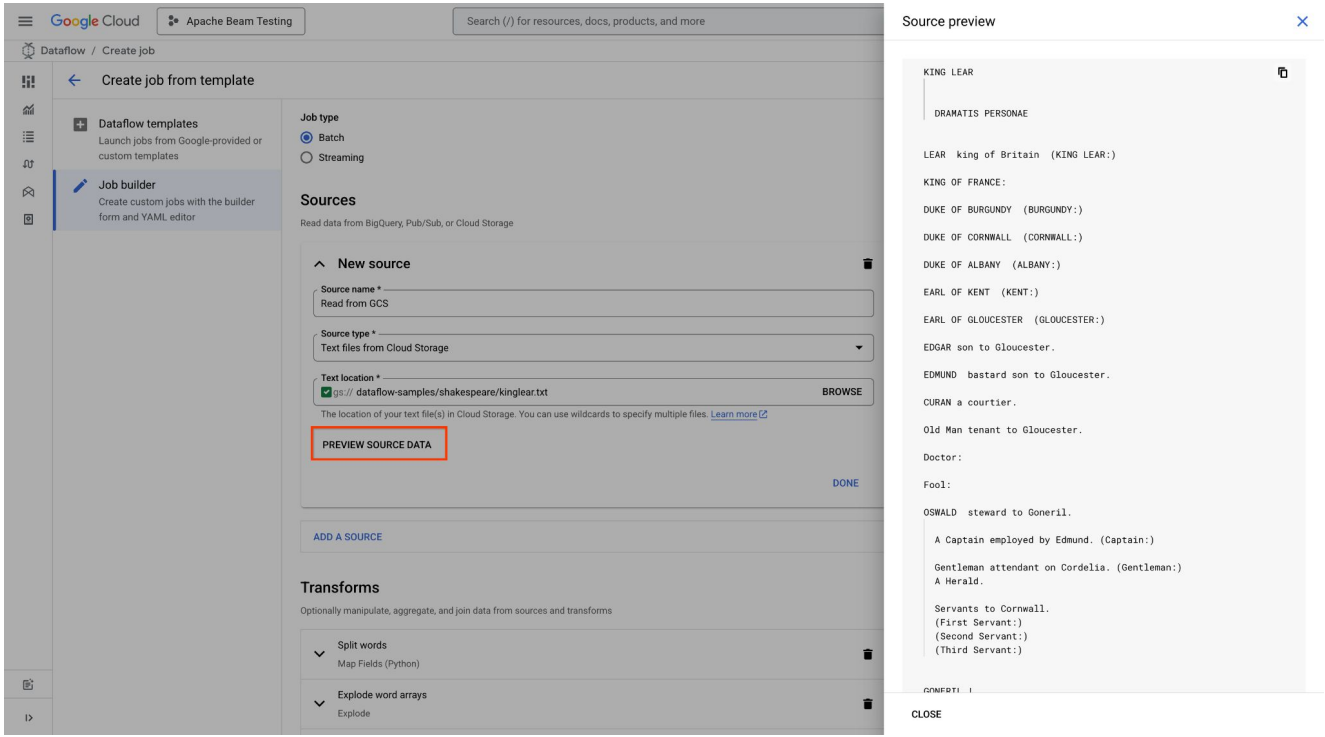
Validate pipelines



Dynamic Job Graph



Preview Source Data



07

Customizing Data Movement Jobs

Chamikara Jayalath

BEAM SUMMIT

Traditional Dataflow Templates

- Great to move data from source A to sink B.
- Pipeline is fixed.
- Modifying the pipeline is high effort.
  - Requires defining a new template.
  - Requires defining a new container.
  - Requires configuring the new template.

Data Movement to ETL

- But ETL jobs usually require customizing the data (transform) before writing them back.
- Can be a custom transform and/or a custom config.
- So high effort to use traditional templates here.

Job Builder for ETL jobs

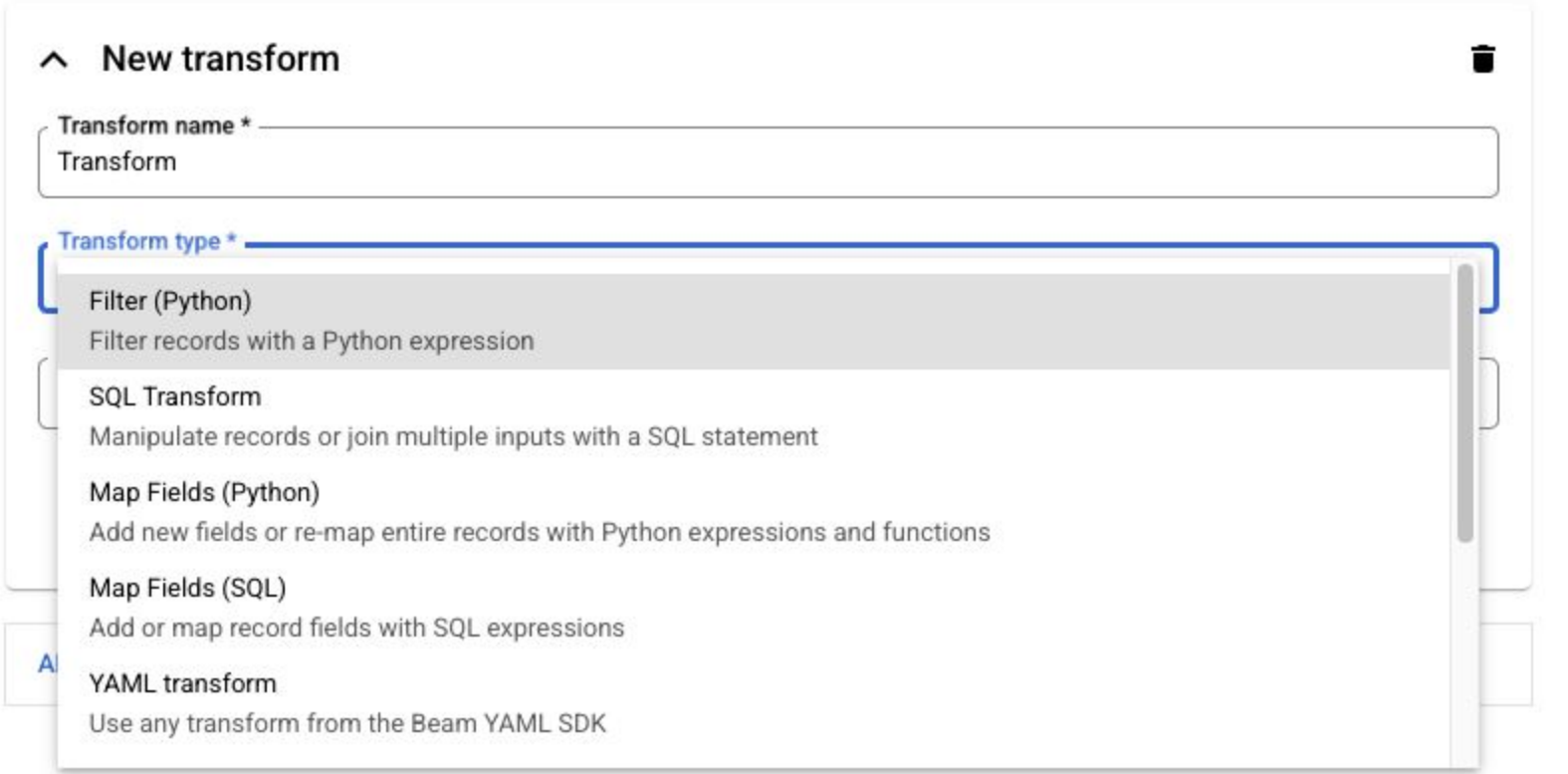
- Much easier to to customize existing blueprints.
- Much easier to define new pipelines.
- Much easier to define new transforms.
- Predefined transforms for mapping, filtering, combining, etc.

08

Data Processing Patterns (Filter, Map, SQL, Error Handling)

Chamikara Jayalath

BEAM SUMMIT


New transform
Transform name *
Transform
Transform type *
Filter (Python)
Filter records with a Python expression
SQL Transform
Manipulate records or join multiple inputs with a SQL statement
Map Fields (Python)
Add new fields or re-map entire records with Python expressions and functions
Map Fields (SQL)
Add or map record fields with SQL expressions
YAML transform
Use any transform from the Beam YAML SDK


New transform
Transform name *
Transform
Transform type *
Filter (Python)
Python filter expression *
Records that do not match the expression will be filtered out
Handle errors
Route records that throw exceptions when processed to a separate step output. This output m
transform or sink.
Input step for the transform *
Python filter expressions can filter records by performing checks against the record's fields. For example:
myField == 'value'
myField > 0 and myField < 10
myField != False
DONE

New transform

Transform name *
Transform

Transform type *
Map Fields (Python)

Preserve existing fields
Append new fields to the record. If unchecked, existing fields are dropped.

Mapped fields

ADD A FIELD

Dropped fields

+ ADD A FIELD

Python dependencies

Add PyPI packages as dependencies to make them available to import in callables.

+ ADD A DEPENDENCY

Handle errors
Route records that throw exceptions when processed to a separate step output. This output must be consumed by a downstream transform or sink.

Input step for the transform *
Source

DONE

New field

Field name *
year

Callable
If checked, the field value must be a Python function rather than a simple expression

Python callable
Python function that defines the field value

Press Option+F1 for Accessibility Options.

```
1  import roman
2  def convert(row):
3    return roman.toRoman(row.year)
```

DONE

ADD A FIELD

Python dependencies

Add PyPI packages as dependencies to make them available to import in callables.

Dependency 1 *
roman>=4.2

The requirement specifier with an optional version specifier

+ ADD A DEPENDENCY

Edit transform

Transform name *
Join

Transform type *
SQL Transform

Input steps for the transform *
Taxi ride data and Zone lookup data

Input aliases
If a single input is selected, it can be referenced in the query as PCOLLECTION. If multiple inputs are selected, aliases for each input will appear above the query editor.

Taxi ride data: input0 | Zone lookup data: input1

Press Option+F1 for Accessibility Options.

```
1  SELECT * FROM input0
2  JOIN input1 ON input0.PULocationID = input1.LocationID
```

A Beam Calcite SQL query to be run over one or more inputs

DONE

Create job from template

LOAD YAML | SAVE YAML | SEND FEEDBACK

- **Dataflow templates**
  Launch jobs from Google-provided or custom templates
- **Job builder**
  Create custom jobs with the builder form and YAML editor

New transform

Transform name *
Format output

Transform type *
Map Fields (Python)

Preserve existing fields
Append new fields to the record. If unchecked, existing fields are dropped.

Mapped fields

output

ADD A FIELD

Python dependencies

Add PyPI packages as dependencies to make them available to import in callables.

+ ADD A DEPENDENCY

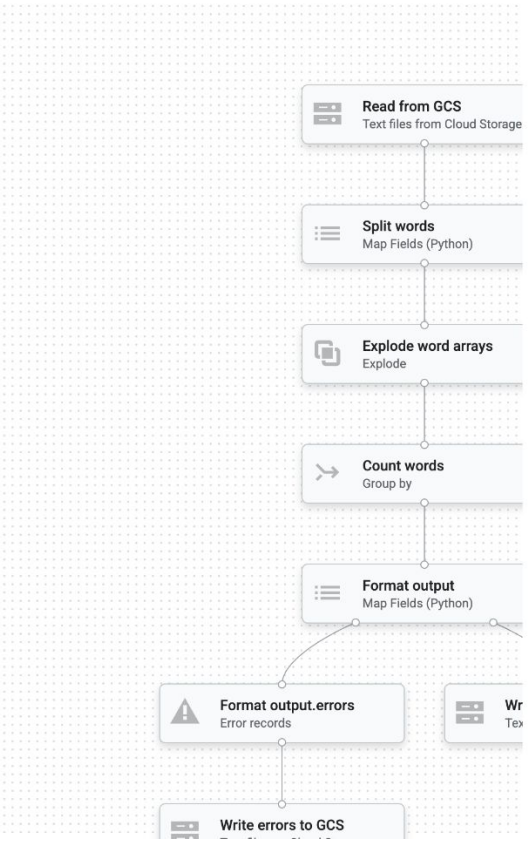
Handle errors
Route records that throw exceptions when processed to a separate step output. This output must be consumed by a downstream transform or sink.

Input step for the transform *
Count words

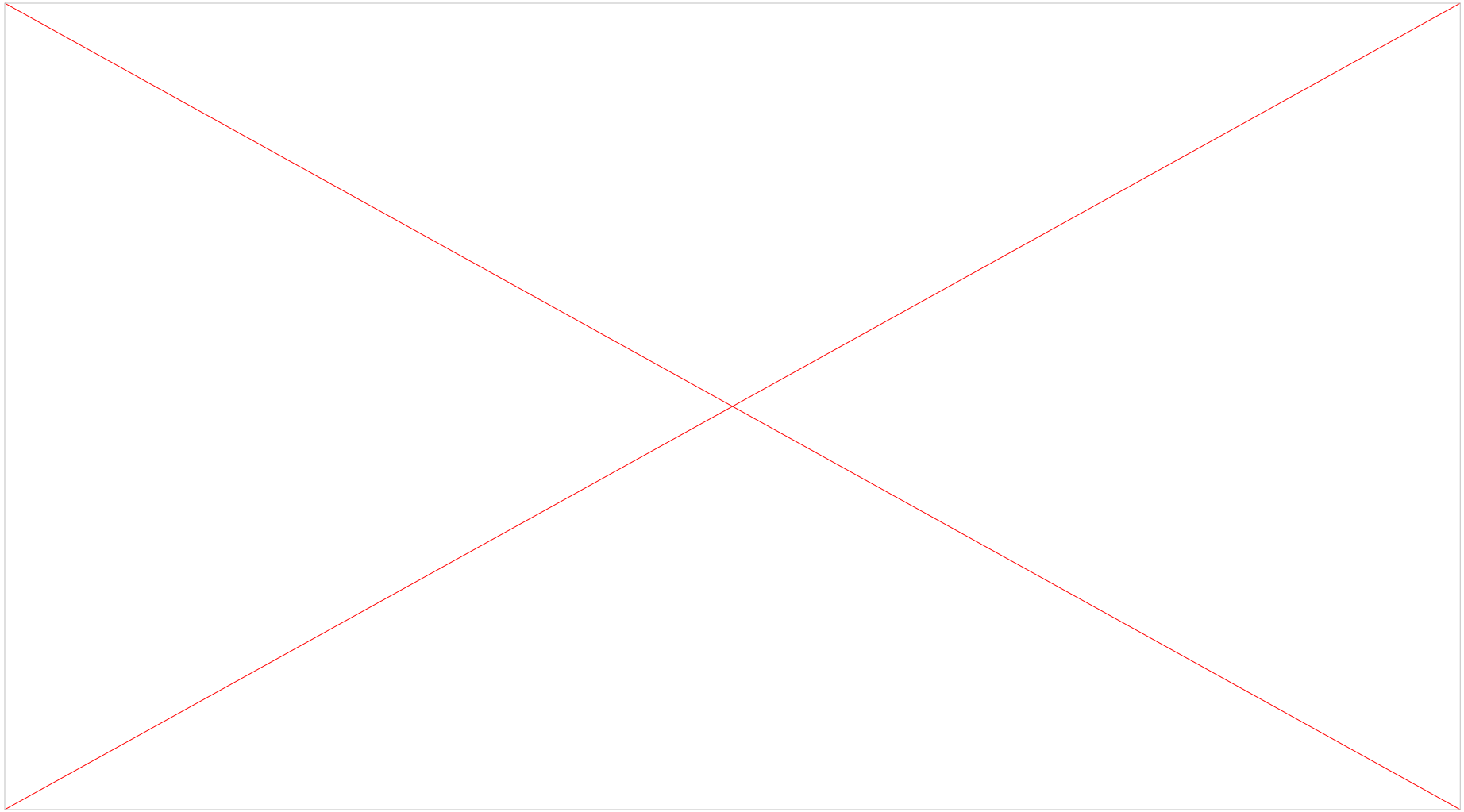
DONE

ADD A TRANSFORM

Sinks



Show debug panel



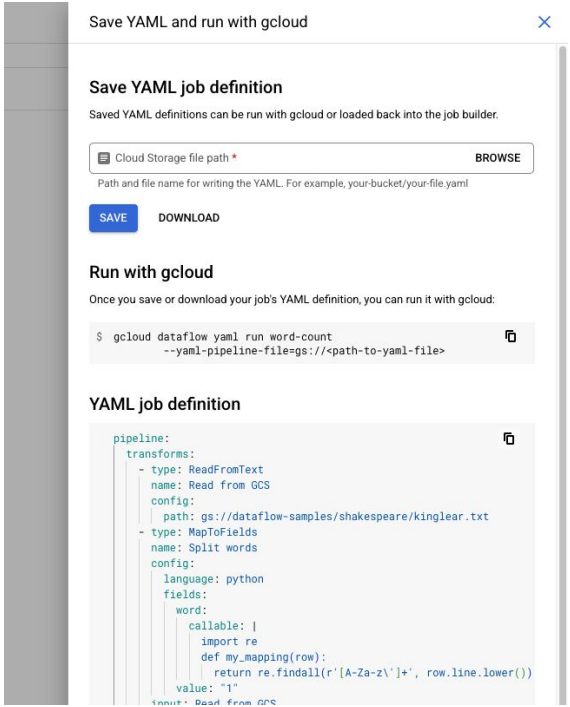
09

Working with YAML in the Job Builder (Export, Import, Yaml Editor)

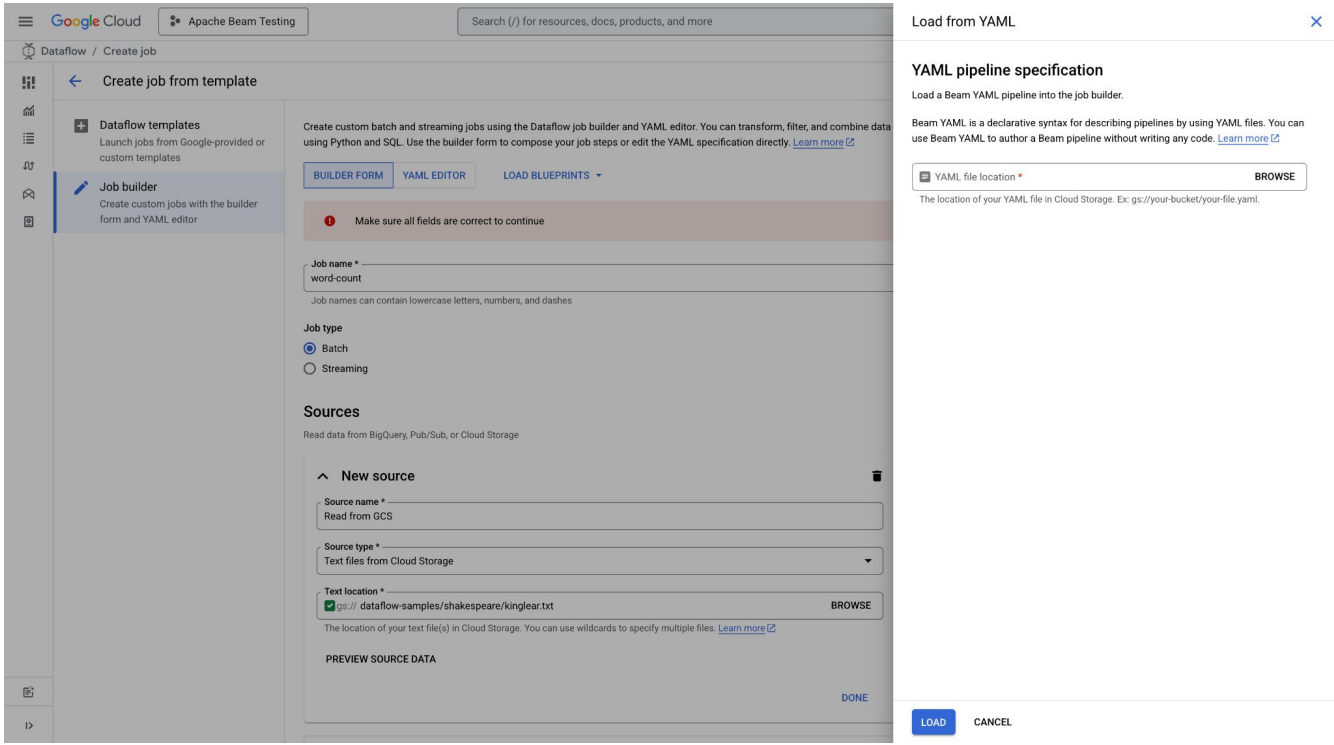
Chamikara Jayalath

BEAM SUMMIT

Working with YAML



Working with YAML



Working with YAML

Create custom batch and streaming jobs using the Dataflow job builder and YAML editor. You can transform, filter, and combine data using Python and SQL. Use the builder form to compose your job steps or edit the YAML specification directly. Learn more

BUILDER FORM | YAML EDITOR | LOAD BLUEPRINTS

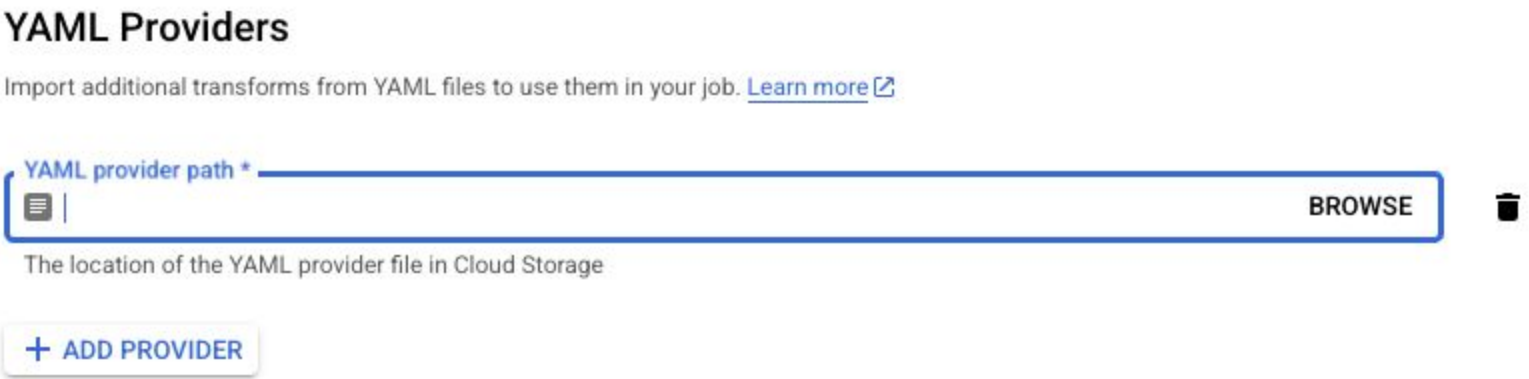
Job name *
word-count

Job names can contain lowercase letters, numbers, and dashes

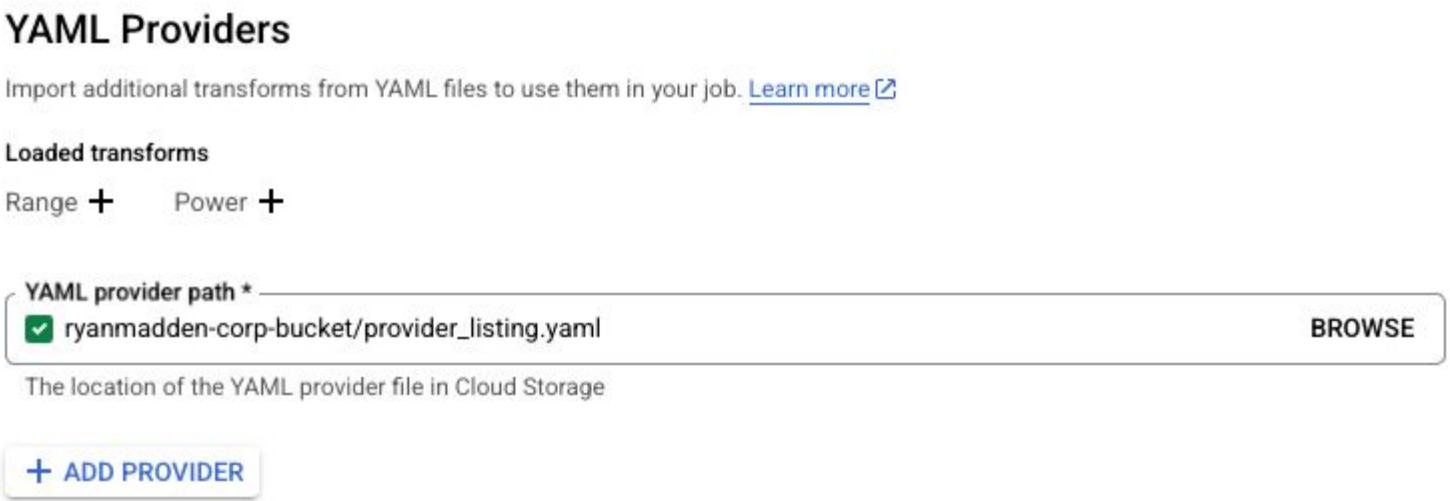
Press Option+F1 for Accessibility Options.

```yaml
pipeline:
  transforms:
    - type: ReadFromText
      name: Read from GCS
      config:
        path: gs://dataflow-samples/shakespeare/kinglear.txt
    - type: MapToFields
      name: Split words
      config:
        language: python
        fields:
          word:
            callable: |
              import re
              def my_mapping(row):
                return re.findall(r'[A-Za-z\']+', row.line.lower())
          value: "1"
      input: Read from GCS
    - type: Explode
      name: Explode word arrays
      config:
        fields: [word]
      input: Split words
    - type: Combine
```

YAML Providers



YAML Providers



Dataflow Day Schedule (07/10)

		Speaker	Role	Topic
	Before 9:00			Onramp signup and getting settled
9:00	9:05	Wei Hsia	Developer Advocate	Agenda, objective, and kickoff
9:05	9:35	Mehran Nazir	Product Manager	Dataflow's current and future state
9:35	10:35	Riju Kallivalappil	Software Engineer	Dataflow: Life of a batch pipeline (and best practices)
10:35	10:50			Morning Break
10:50	11:50	Tom Stepp	Software Engineer	Dataflow: Life of a streaming piepline (and best practices)
11:50	12:50	Danny McCormick	Software Engineer	Dataflow ML and Turnkey transforms
		Valentyn Tymofieiev	Software Engineer	
13:00	14:00			Lunch
14:00	14:30	Valeria Sanchez	Cloud Technical Solutions Engineer, Big Data	Dataflow and Google Cloud Customer Care
		Varnikaa Gupta	Technical Solutions Specialist, Google Cloud	
14:30	15:00	Ian Mburu	Solutions Consultant	Common I/Os and how to use them with Dataflow
15:00	16:00			Q&A

Venue: 75 9th Avenue, New York, NY 10011 (2nd floor of the Chelsea Market building)

Thank you!

Questions?

Please reach out with any questions!

Emails:
chamikara@google.com

derrickaw@google.com