CS 327E Class 5

February 25, 2019

No Quiz Today

Milestone 4 Feedback

Did you run into any major obstacles with the assignment?

A. My group had problems identifying entity types.
B. My group had problems decomposing large tables.
C. A and B.
D. My group did **not** face any major obstacles.

Beam/Dataflow Setup

https://github.com/cs327e-spring2019/snippets/wiki/Beam-Dataflow-Setup-Guide

Beam/Dataflow Setup Outcome

Did you successfully complete your setup?

A. Yes, the Wordcount jobs ran without errors.
B. No, I got stuck during the setup and need help.
C. I’m still setting things up and need more time to finish.

Dataflow Concepts

- A system for processing arbitrary computations on large amounts of data
- Can process batch data and streaming data using the same code
- Uses Apache Beam, an open-source programming model
- Designed to be very scalable, millions of QPS

Apache Beam Concepts

- A model for describing data and data processing operations:
  - `Pipeline`: a data processing task from start to finish
  - `PCollection`: a collection of data elements
  - `Transform`: a data transformation operation
- SDKs for Java, Python and Go
- Executed in the cloud on Dataflow, Spark, Flink, etc.
- Executed locally with Direct Runner for dev/testing

Beam Pipeline

- `Pipeline` = A directed acyclic graph where the nodes are the `Transforms` and the edges are the `PCollections`
- General Structure of a `Pipeline`:
  - Reads one or more data sources as input `PCollections`
  - Applies one or more `Transforms` on the `PCollections`
  - Outputs resulting `PCollection` as one or more data sinks
- Executed as a single unit
- Run in batch or streaming mode

PCollection

- `PCollection` = A collection of data elements
- Elements can be of any type (String, Int, Array, etc.)
- `PCollections` are distributed across machines
- `PCollections` are immutable
- Created from a data source or a `Transform`
- Written to a data sink or passed to another `Transform`

Transform Types

- Element-wise:
    - maps 1 input to (1, 0, many) outputs
    - Examples: `ParDo`, `Map`, `FlatMap`
- Aggregation:
    - reduces many inputs to (1, fewer) outputs
    - Examples: `GroupByKey, CoGroupByKey`
- Composite: combines element-wise and aggregation
    - `GroupByKey -> ParDo`

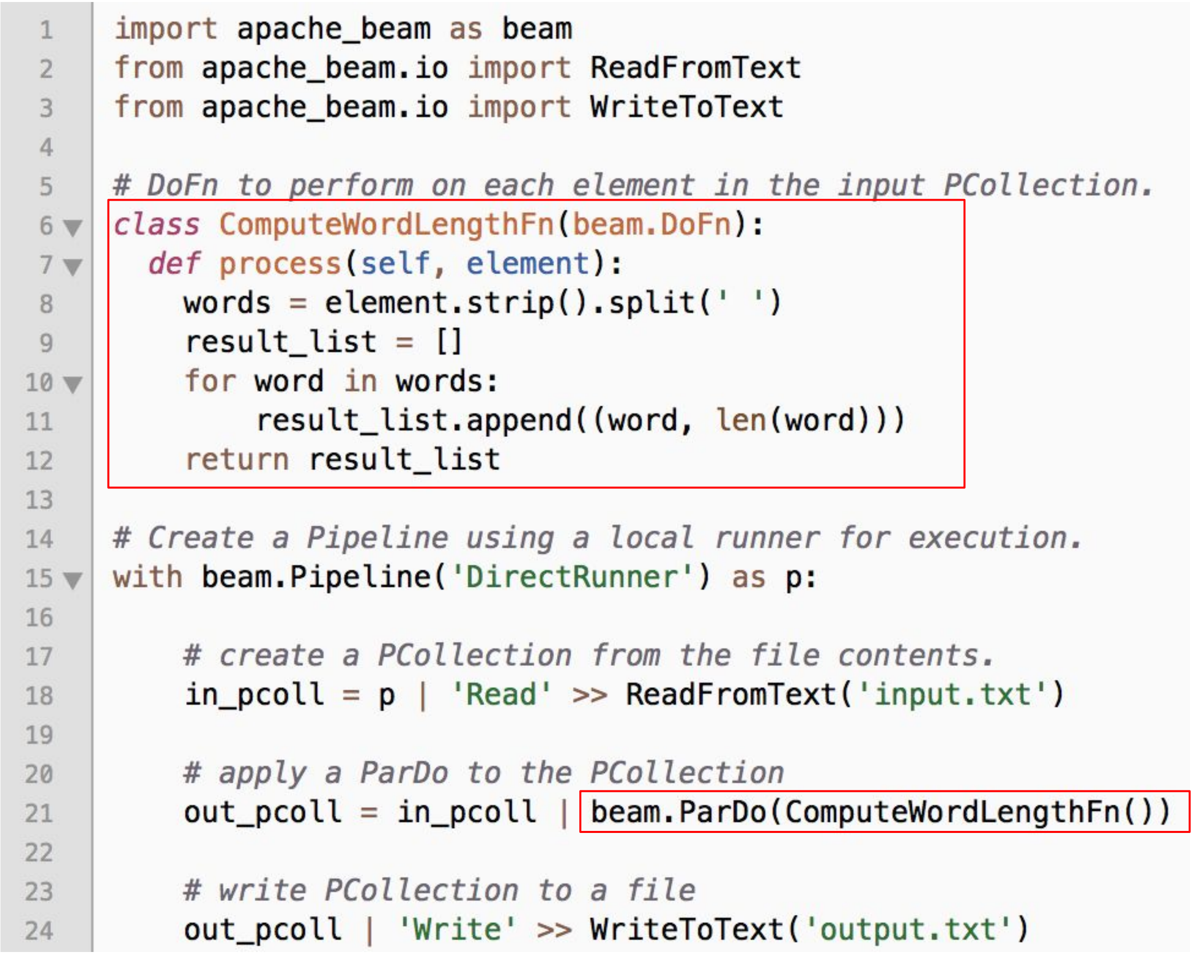
Transform Properties

- Serializable
- Parallelizable
- Idempotent

`ParDo`

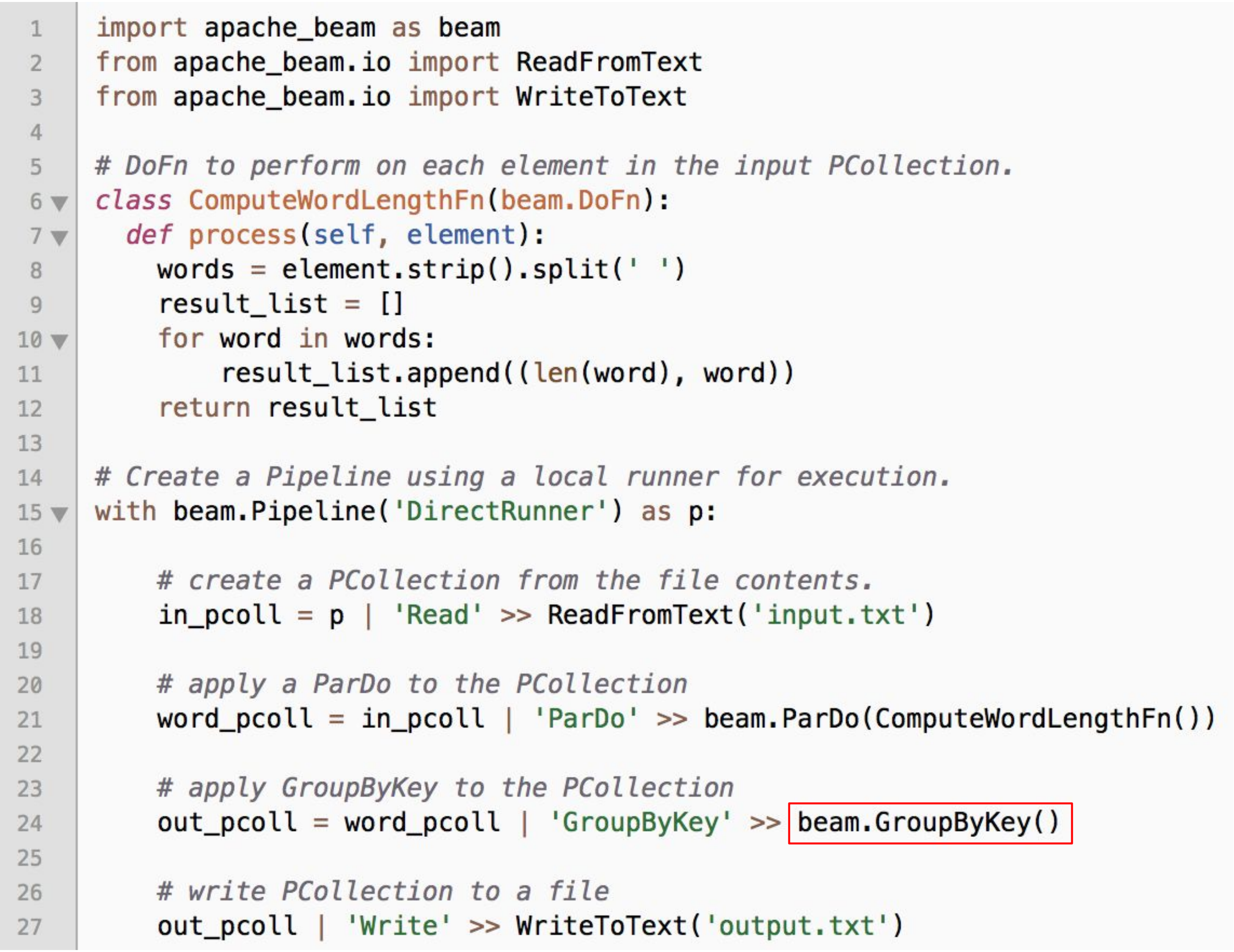
- `ParDo` = “Parallel Do”
- Maps 1 input to (1, 0, many) outputs
- Takes as input a `PCollection`
- Applies the user-defined `ParDo` to the input `PCollection`
- Outputs results as a new `PCollection`
- Typical usage: filtering, formatting, extracting parts of data, performing computations on data elements

Hello World Example



```python
import apache_beam as beam
from apache_beam.io import ReadFromText
from apache_beam.io import WriteToText

# DoFn to perform on each element in the input PCollection.
class ComputeWordLengthFn(beam.DoFn):
  def process(self, element):
    words = element.strip().split(' ')
    result_list = []
    for word in words:
        result_list.append((word, len(word)))
    return result_list

# Create a Pipeline using a local runner for execution.
with beam.Pipeline('DirectRunner') as p:

    # create a PCollection from the file contents.
    in_pcoll = p | 'Read' >> ReadFromText('input.txt')

    # apply a ParDo to the PCollection
    out_pcoll = in_pcoll | beam.ParDo(ComputeWordLengthFn())

    # write PCollection to a file
    out_pcoll | 'Write' >> WriteToText('output.txt')
```

Hello World Example



```python
import apache_beam as beam
from apache_beam.io import ReadFromText
from apache_beam.io import WriteToText

# DoFn to perform on each element in the input PCollection.
class ComputeWordLengthFn(beam.DoFn):
  def process(self, element):
    words = element.strip().split(' ')
    result_list = []
    for word in words:
        result_list.append((len(word), word))
    return result_list

# Create a Pipeline using a local runner for execution.
with beam.Pipeline('DirectRunner') as p:

    # create a PCollection from the file contents.
    in_pcoll = p | 'Read' >> ReadFromText('input.txt')

    # apply a ParDo to the PCollection
    word_pcoll = in_pcoll | 'ParDo' >> beam.ParDo(ComputeWordLengthFn())

    # apply GroupByKey to the PCollection
    out_pcoll = word_pcoll | 'GroupByKey' >> beam.GroupByKey()

    # write PCollection to a file
    out_pcoll | 'Write' >> WriteToText('output.txt')
```

Hands-on Exercises

```
git clone https://github.com/cs327e-spring2019/snippets.git
```

Best Practices:

1. Know basic UNIX commands (e.g. `ls`, `cp`, `mv`, `rm`, etc.)
2. Start with some initial working code. See snippets repo for samples.
3. Test and debug **each** new line of code.
4. Write temporary and final `PCollections` to log files.
5. Test and debug **end-to-end** pipeline locally before running on Dataflow.
6. If you get stuck, go to OHs. If you can’t make OHs, make an appointment with one of the TAs.
7. Start assignments **early**. The Beam Python documentation is sparse and learning Beam requires *patience*, *perseverance*, and *experimentation*.

Milestone 5

1) Requirements: assignment sheet

2) Design issues: sign-up sheet

3) Beam setup problems: sign-up sheet