Lecture 4: MapReduce (continue)

COSC 526: Introduction to Data Mining

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Today Outline

- More about MR: portable and efficient implementations
- Text manipulation
- Introduction in XSEDE Jetstream
- Overview of Spark core concepts
- Create SparkContext and Resilient distributed datasets (RDDs)
- Run parallel operations on RDDs
- Live chat

One problems, many solutions

WordCount++: A solution

```
1: class Mapper
2:     method Map(string t, integer r)
3:         Emit(string t, integer r)

1: class Reducer
2:     method Reduce(string t, integers [r_1, r_2, ...])
3:         sum ← 0
4:         cnt ← 0
5:         for all integer r ∈ integers [r_1, r_2, ...] do
6:             sum ← sum + r
7:             cnt ← cnt + 1
8:         r_avg ← sum/cnt
9:         Emit(string t, integer r_avg)
```

Is this an efficient solution?

```
1: class Mapper
2:     method Map(string t, integer r)
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```

A more efficient solution?

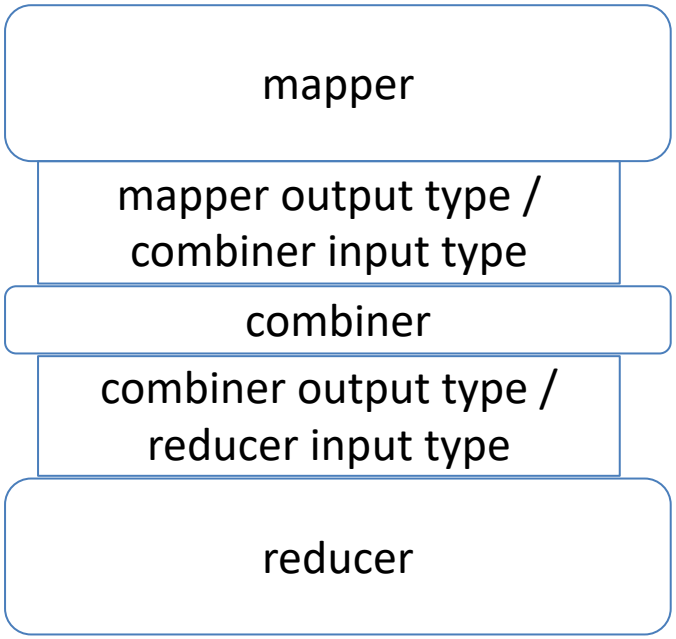
```
1: class Mapper
2:     method Map(string t, integer r)
3:         Emit(string t, integer r)

1: class Combiner
2:     method Combine(string t, integers [r_1, r_2, ...])
3:         sum ← 0
4:         cnt ← 0
5:         for all integer r ∈ integers [r_1, r_2, ...] do
6:             sum ← sum + r
7:             cnt ← cnt + 1
8:         Emit(string t, pair (sum, cnt))

1: class Reducer
2:     method Reduce(string t, pairs [(s_1, c_1), (s_2, c_2) ...])
3:         sum ← 0
4:         cnt ← 0
5:         for all pair (s, c) ∈ pairs [(s_1, c_1), (s_2, c_2) ...] do
6:             sum ← sum + s
7:             cnt ← cnt + c
8:         r_avg ← sum/cnt
9:         Emit(string t, integer r_avg)
```

Combiners Constraints and Portability

- Combiners in, for example, Apache Hadoop cannot change the correctness of the MapReduce algorithm
- Combiners must have same input and output key-value types



mapper output type
==
combiner input type
==
combiner output type
==
reducer input type

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Does the solution meet the constraints?

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2:     method Reduce(string t, pairs [(s_1, c_1), (s_2, c_2) ...])
```

Mismatch between combiner input key-value type and output key-value type violates the MapReduce programming model!!!

A portable and efficient solution

```
1: class Mapper
2:     method Map(string t, integer r)
3:         Emit(string t, pair (r, 1))

1: class Combiner
2:     method Combine(string t, pairs [(s1, c1), (s2, c2) ...])
3:         sum ← 0
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5:         for all pair (s, c) ∈ pairs [(s1, c1), (s2, c2) ...] do
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```

Assignment 4

Assignment 4

- Goal: Continue building our expertise with Jupyter and Python
  - Sequential manipulation of a classical in literature
  - Visualization of statistics
- Deadline: **Friday**, ***Feb 19 - 8AM ET***

Assignment 4: Text manipulation

- Given a literature classic such as the “The Count of Monte Cristo”
- Problem 1: Analyze the text for word length frequency
- Problem 2: Analyze the text for letter frequency
- Problem 3: Count the positional frequencies of each letter (first, interior, and last)
- Problem 4: Visualize your findings in histograms (one for each one of Problems 1-3)
  - One code is give to you, write the other two codes
- Repeat with a different manuscript
  - Run your code with e.g., a manuscript written in a different language or an old manuscript

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