

## Big data: architectures and data analytics

## Multiple inputs

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## Multiple inputs

- In some applications data are read from two or more datasets
  - The datasets could have different formats
- Hadoop allows reading data from multiple inputs (multiple datasets) with different formats
  - One different mapper for each input dataset must be specified
  - However, the key-value pairs emitted by the mappers must be consistent

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## Multiple inputs

- Example of a use case
  - Input data collected from different sensors
  - All sensors measure the same "measure"
  - But sensors developed by different vendors use a different data format to store the gathered data/measurements

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## Multiple inputs

- In the driver
  - Use the `addInputPath` method of the `MultipleInputs` class multiple times to
    - Add one input path at a time
    - Specify the input format class
    - Specify the Mapper class associated with the specified input path

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## Multiple inputs

- E.g.,
 

```
MultipleInputs.addInputPath(job, new Path(args[1]),
TextInputFormat.class, Mapper1.class);
MultipleInputs.addInputPath(job, new Path(args[2]),
TextInputFormat.class, Mapper2.class);
```

  - Specify two input paths (`args[1]` and `args[2]`)
  - The data of both paths are read by using the `TextInputFormat` class
  - The `Mapper1` class is the class used to manage the input key-value pairs associated with the first path
  - The `Mapper2` class is used to manage the input key-value pairs associated with the second path

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## Multiple outputs

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## Multiple outputs

- In some applications it could be useful to store the output key-value pairs of a MapReduce application in different files
  - Each file contains a specific subset of the emitted key-value pairs (based on some rules)
    - Usually this approach is useful for splitting and filtering operations
  - Each file name has a prefix that is used to specify the "content" of the file
- All the files are stored in one single output directory
  - i.e., there are no multiple output directories, but only multiple output files

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## Multiple outputs

- Hadoop allows specifying the prefix of the output files
  - The standard prefix is "part-" (see the content of the output directory of some of the previous applications)
  - The `MultipleOutputs` class is used to specify the prefixes of the output files
    - One different prefix for each "type" of output file
    - There will be one output file of each type for each reducer (mapper the job a map-only job)

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## Multiple outputs - Driver

- Use the method `MultipleOutputs.addNamedOutput` multiple times in the Driver to specify the prefixes of the output files
- The method has 4 parameter
  - The job object
  - The "name/prefix" of `MultipleOutputs`
  - The `OutputFormat` class
  - The key output data type class
  - The value output data type class
- Call this method one time for each "output file type"

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## Multiple outputs - Driver

- E.g.,
 

```
MultipleOutputs.addNamedOutput(job,
"hightemp", TextOutputFormat.class, Text.class,
NullWritable.class);
MultipleOutputs.addNamedOutput(job,
"normaltemp", TextOutputFormat.class,
Text.class, NullWritable.class);
```
- This example defines two types of output files
  - The first type of output files while have the prefix "hightemp"
  - The second type of output files while have the prefix "normaltemp"

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## Multiple outputs – Map-only example

- Define a private `MultipleOutputs` variable in the mapper if the job is a map-only job (in the reducer otherwise)
  - E.g.,
    - `private MultipleOutputs<Text, NullWritable> mos = null;`
- Create an instance of the `MultipleOutputs` class in the setup method of the mapper (or in the reducer)
  - E.g.,
    - `mos = new MultipleOutputs<Text, NullWritable>(context);`

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## Multiple outputs – Map-only example

- Use the write method of the MultipleOutputs object in the map method (or in the reduce method) to write the key-value pairs in the file of interest
  - E.g.,
    - `mos.write("hightemp", value, NullWritable.get());`
      - This example writes the current key-value pair in a file with the prefix "hightemp-"
    - `mos.write("normaltemp", value, NullWritable.get());`
      - This example writes the current key-value pair in a file with the prefix "normaltemp-"

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## Multiple outputs – Map-only example

- Close the MultipleOutputs object in the cleanup method of the mapper (or of the reducer)
  - E.g.,
    - `mos.close();`

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