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# **mrjob Documentation**

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**mrjob lets you write MapReduce jobs in Python 2.6+/3.3+ and run them on several platforms.** You can:

- Write multi-step MapReduce jobs in pure Python
- Test on your local machine
- Run on a Hadoop cluster
- Run in the cloud using [Amazon Elastic MapReduce \(EMR\)](#)
- Run in the cloud using [Google Cloud Dataproc \(Dataproc\)](#)
- Easily run [Spark](#) jobs on EMR or your own Hadoop cluster

mrjob is licensed under the [Apache License, Version 2.0](#).

To get started, install with `pip`:

```
pip install mrjob
```

and begin reading the tutorial below.



## Why mrjob?

### Overview

mrjob is the easiest route to writing Python programs that run on Hadoop. If you use mrjob, you'll be able to test your code locally without installing Hadoop or run it on a cluster of your choice.

Additionally, mrjob has extensive integration with Amazon Elastic MapReduce. Once you're set up, it's as easy to run your job in the cloud as it is to run it on your laptop.

Here are a number of features of mrjob that make writing MapReduce jobs easier:

- Keep all MapReduce code for one job in a single class
- Easily upload and install code and data dependencies at runtime
- Switch input and output formats with a single line of code
- Automatically download and parse error logs for Python tracebacks
- Put command line filters before or after your Python code

If you don't want to be a Hadoop expert but need the computing power of MapReduce, mrjob might be just the thing for you.

### Why use mrjob instead of X?

Where X is any other library that helps Hadoop and Python interface with each other.

1. mrjob has more documentation than any other framework or library we are aware of. If you're reading this, it's probably your first contact with the library, which means you are in a great position to [provide valuable feedback about our documentation](#). Let us know if anything is unclear or hard to understand.
2. mrjob lets you run your code without Hadoop at all. Other frameworks require a Hadoop instance to function at all. If you use mrjob, you'll be able to write proper tests for your MapReduce code.
3. mrjob provides a consistent interface across every environment it supports. No matter whether you're running locally, in the cloud, or on your own cluster, your Python code doesn't change at all.
4. mrjob handles much of the machinery of getting code and data to and from the cluster your job runs on. You don't need a series of scripts to install dependencies or upload files.

5. mrjob makes debugging much easier. Locally, it can run a simple MapReduce implementation in-process, so you get a traceback in your console instead of in an obscure log file. On a cluster or on Elastic MapReduce, it parses error logs for Python tracebacks and other likely causes of failure.
6. mrjob automatically serializes and deserializes data going into and coming out of each task so you don't need to constantly `json.loads()` and `json.dumps()`.

## Why use X instead of mrjob?

The flip side to mrjob's ease of use is that it doesn't give you the same level of access to Hadoop APIs that Dumbo and Pydoop do. It's simplified a great deal. But that hasn't stopped several companies, including Yelp, from using it for day-to-day heavy lifting. For common (and many uncommon) cases, the abstractions help rather than hinder.

Other libraries can be faster if you use typedbytes. There have been several attempts at integrating it with mrjob, and it may land eventually, but it doesn't exist yet.

## Fundamentals

### Installation

Install with pip:

```
pip install mrjob
```

or from a [git](#) clone of the [source code](#):

```
python setup.py test && python setup.py install
```

### Writing your first job

Open a file called `mr_word_count.py` and type this into it:

```
from mrjob.job import MRJob

class MRWordFrequencyCount(MRJob):

    def mapper(self, _, line):
        yield "chars", len(line)
        yield "words", len(line.split())
        yield "lines", 1

    def reducer(self, key, values):
        yield key, sum(values)

if __name__ == '__main__':
    MRWordFrequencyCount.run()
```

Now go back to the command line, find your favorite body of text (such mrjob's `README.rst`, or even your new file `mr_word_count.py`), and try this:

```
$ python mr_word_count.py my_file.txt
```



You should see something like this:

```
"chars" 3654
"lines" 123
"words" 417
```

Congratulations! You’ve just written and run your first program with mrjob.

## What’s happening

A job is defined by a class that inherits from `MRJob`. This class contains methods that define the *steps* of your job.

A “step” consists of a mapper, a combiner, and a reducer. All of those are optional, though you must have at least one. So you could have a step that’s just a mapper, or just a combiner and a reducer.

When you only have one step, all you have to do is write methods called `mapper()`, `combiner()`, and `reducer()`.

The `mapper()` method takes a key and a value as args (in this case, the key is ignored and a single line of text input is the value) and yields as many key-value pairs as it likes. The `reduce()` method takes a key and an iterator of values and also yields as many key-value pairs as it likes. (In this case, it sums the values for each key, which represent the numbers of characters, words, and lines in the input.)

**Warning:** Forgetting the following information will result in confusion.

The final required component of a job file is these two lines at the end of the file, **every time**:

```
if __name__ == '__main__':
    MRWordCounter.run() # where MRWordCounter is your job class
```

These lines pass control over the command line arguments and execution to mrjob. **Without them, your job will not work.** For more information, see *Hadoop Streaming and mrjob* and *Why can’t I put the job class and run code in the same file?*.

## Running your job different ways

The most basic way to run your job is on the command line:

```
$ python my_job.py input.txt
```

By default, output will be written to stdout.

You can pass input via stdin, but be aware that mrjob will just dump it to a file first:

```
$ python my_job.py < input.txt
```

You can pass multiple input files, mixed with stdin (using the `-` character):

```
$ python my_job.py input1.txt input2.txt - < input3.txt
```

By default, mrjob will run your job in a single Python process. This provides the friendliest debugging experience, but it’s not exactly distributed computing!

You change the way the job is run with the `-r/--runner` option. You can use `-r inline` (the default), `-r local`, `-r hadoop`, or `-r emr`.

To run your job in multiple subprocesses with a few Hadoop features simulated, use `-r local`.

To run it on your Hadoop cluster, use `-r hadoop`.

If you have Dataproc configured (see [Dataproc Quickstart](#)), you can run it there with `-r dataproc`.

Your input files can come from HDFS if you're using Hadoop, or GCS if you're using Dataproc:

```
$ python my_job.py -r dataproc gcs://my-inputs/input.txt
$ python my_job.py -r hadoop hdfs://my_home/input.txt
```

If you have Elastic MapReduce configured (see [Elastic MapReduce Quickstart](#)), you can run it there with `-r emr`.

Your input files can come from HDFS if you're using Hadoop, or S3 if you're using EMR:

```
$ python my_job.py -r emr s3://my-inputs/input.txt
$ python my_job.py -r hadoop hdfs://my_home/input.txt
```

If your code spans multiple files, see [Uploading your source tree](#).

## Writing your second job

Most of the time, you'll need more than one step in your job. To define multiple steps, override `steps()` to return a list of `MRSteps`.

Here's a job that finds the most commonly used word in the input:

```
from mrjob.job import MRJob
from mrjob.step import MRStep
import re

WORD_RE = re.compile(r"[\w']+")

class MRMostUsedWord(MRJob):

    def steps(self):
        return [
            MRStep(mapper=self.mapper_get_words,
                  combiner=self.combiner_count_words,
                  reducer=self.reducer_count_words),
            MRStep(reducer=self.reducer_find_max_word)
        ]

    def mapper_get_words(self, _, line):
        # yield each word in the line
        for word in WORD_RE.findall(line):
            yield (word.lower(), 1)

    def combiner_count_words(self, word, counts):
        # optimization: sum the words we've seen so far
        yield (word, sum(counts))

    def reducer_count_words(self, word, counts):
        # send all (num_occurrences, word) pairs to the same reducer.
        # num_occurrences is so we can easily use Python's max() function.
        yield None, (sum(counts), word)

    # discard the key; it is just None
    def reducer_find_max_word(self, _, word_count_pairs):
        # each item of word_count_pairs is (count, word),
        # so yielding one results in key=counts, value=word
        yield max(word_count_pairs)
```

```
if __name__ == '__main__':
    MRMostUsedWord.run()
```

## Configuration

mrjob has an overflowing cornucopia of configuration options. You'll want to specify some on the command line, some in a config file.

You can put a config file at `/etc/mrjob.conf`, `~/.mrjob.conf`, or `./mrjob.conf` for mrjob to find it without passing it via `--conf-path`.

Config files are interpreted as YAML if you have the `yaml` module installed. Otherwise, they are interpreted as JSON.

See [Config file format and location](#) for in-depth information. Here is an example file:

```
runners:
  emr:
    aws-region: us-west-1
    python_archives:
      - a_library_I_use_on_emr.tar.gz
  inline:
    local_tmp_dir: $HOME/.tmp
```

## Concepts

### MapReduce and Apache Hadoop

*This section uses text from Apache's [MapReduce Tutorial](#).*

MapReduce is a way of writing programs designed for processing vast amounts of data, and a system for running those programs in a distributed and fault-tolerant way. [Apache Hadoop](#) is one such system designed primarily to run Java code.

A MapReduce job usually splits the input data-set into independent chunks which are processed by the map tasks in a completely parallel manner. The framework sorts the outputs of the maps, which are then input to the reduce tasks. Typically both the input and the output of the job are stored in a file system shared by all processing nodes. The framework takes care of scheduling tasks, monitoring them, and re-executing the failed tasks.

The MapReduce framework consists of a single master “job tracker” (Hadoop 1) or “resource manager” (Hadoop 2) and a number of worker nodes. The master is responsible for scheduling the jobs’ component tasks on the worker nodes and re-executing the failed tasks. The worker nodes execute the tasks as directed by the master.

As the job author, you write *map*, *combine*, and *reduce* functions that are submitted to the job tracker for execution.

A *mapper* takes a single key and value as input, and returns zero or more (key, value) pairs. The pairs from all map outputs of a single step are grouped by key.

A *combiner* takes a key and a subset of the values for that key as input and returns zero or more (key, value) pairs. Combiners are optimizations that run immediately after each mapper and can be used to decrease total data transfer. Combiners should be idempotent (produce the same output if run multiple times in the job pipeline).

A *reducer* takes a key and the complete set of values for that key in the current step, and returns zero or more arbitrary (key, value) pairs as output.

After the reducer has run, if there are more steps, the individual results are arbitrarily assigned to mappers for further processing. If there are no more steps, the results are sorted and made available for reading.

## An example

Consider a program that counts how many times words occur in a document. Here is some input:

```
The wheels on the bus go round and round,  
round and round, round and round  
The wheels on the bus go round and round,  
all through the town.
```

The inputs to the mapper will be `(None, "one line of text")`. (The key is `None` because the input is just raw text.)

The mapper converts the line to lowercase, removes punctuation, splits it on whitespace, and outputs `(word, 1)` for each item.

```
mapper input: (None, "The wheels on the bus go round and round,")  
mapper output:  
    "the", 1  
    "wheels", 1  
    "on", 1  
    "the", 1  
    "bus", 1  
    "go", 1  
    "round", 1  
    "and", 1  
    "round", 1
```

Each call to the combiner gets a word as the key and a list of 1s as the value. It sums the 1s and outputs the original key and the sum.

```
combiner input: ("the", [1, 1])  
combiner output:  
    "the", 2
```

The reducer is identical to the combiner; for each key, it simply outputs the original key and the sum of the values.

```
reducer input: ("round", [2, 4, 2])  
reducer output:  
    "round", 8
```

The final output is collected:

```
"all", 1  
"and", 4  
"bus", 2  
"go", 2  
"on", 2  
"round", 8  
"the", 5  
"through", 1  
"town", 1  
"wheels", 2
```

Your algorithm may require several repetitions of this process.

## Hadoop Streaming and mrjob

**Note:** If this is your first exposure to MapReduce or Hadoop, you may want to skip this section and come back later. Feel free to stick with it if you feel adventurous.

Although Hadoop is primarily designed to work with Java code, it supports other languages via *Hadoop Streaming*. This jar opens a subprocess to your code, sends it input via stdin, and gathers results via stdout.

In most cases, the input to a Hadoop Streaming job is a set of newline-delimited files. Each line of input is passed to your mapper, which outputs key-value pairs expressed as two strings separated by a tab and ending with a newline, like this:

```
key1\tvalue1\nkey2\tvalue2\n
```

Hadoop then sorts the output lines by key (the line up to the first tab character) and passes the sorted lines to the appropriate combiners or reducers.

mrjob is a framework that assists you in submitting your job to the Hadoop job tracker and in running each individual step under Hadoop Streaming.

## How your program is run

Depending on the way your script is invoked on the command line, it will behave in different ways. You'll only ever use one of these; the rest are for mrjob and Hadoop Streaming to use.

When you run with no arguments or with `--runner`, you invoke mrjob's machinery for running your job or submitting it to the cluster. We'll call it *Process 1* to disambiguate it later. Your mappers and reducers are not called in this process at all <sup>1</sup>.

```
$ python my_job.py -r hadoop input.txt # run process 1
```

Within Process 1, mrjob will need to determine what the *steps* of your project are. It does so by launching another subprocess of your job, this time with the `--steps` argument, which we'll call Process 2:

```
$ python my_job.py --steps # run process 2
[{"mapper": {"type": "script"},
 "reducer": {"type": "script"},
 "combiner": {"type": "script"},
 "type": "streaming"}]
```

mrjob now has all the information it needs to send the job to Hadoop <sup>2</sup>. It does so. (At this time, please wave your hands in the air to represent magic.)

mrjob has told Hadoop something like this:

- Run a step with Hadoop Streaming.
- The command for the mapper is `python my_job.py --step-num=0 --mapper`.
- The command for the combiner is `python my_job.py --step-num=0 --combiner`.
- The command for the reducer is `python my_job.py --step-num=0 --reducer`.

When Hadoop distributes tasks among the task nodes, Hadoop Streaming will use the appropriate command to process the data it is given. (We did not assign numbers to the above commands because there might be anywhere from 1 to 10,000 processes running on Hadoop.)

You should now have a pretty good idea of the different environments in which your job is run.

<sup>1</sup> Unless you're using the `inline` runner, which is a special case for debugging.

<sup>2</sup> Or run the job locally.

## Writing jobs

This guide covers everything you need to know to write your job. You'll probably need to flip between this guide and [Runners](#) to find all the information you need.

### Defining steps

Your job will be defined in a file to be executed on your machine as a Python script, as well as on a Hadoop cluster as an individual map, combine, or reduce task. (See [How your program is run](#) for more on that.)

All dependencies must either be contained within the file, available on the task nodes, or uploaded to the cluster by mrjob when your job is submitted. ([Runners](#) explains how to do those things.)

The following two sections are more reference-oriented versions of [Writing your first job](#) and [Writing your second job](#).

### Single-step jobs

The simplest way to write a one-step job is to subclass *MRJob* and override a few methods:

```
from mrjob.job import MRJob
import re

WORD_RE = re.compile(r"[\w']+")

class MRWordFreqCount(MRJob):

    def mapper(self, _, line):
        for word in WORD_RE.findall(line):
            yield word.lower(), 1

    def combiner(self, word, counts):
        yield word, sum(counts)

    def reducer(self, word, counts):
        yield word, sum(counts)

if __name__ == '__main__':
    MRWordFreqCount.run()
```

(See [Writing your first job](#) for an explanation of this example.)

Here are all the methods you can override to write a one-step job. We'll explain them over the course of this document.

- `mapper()`
- `combiner()`
- `reducer()`
- `mapper_init()`
- `combiner_init()`
- `reducer_init()`
- `mapper_final()`

- `combiner_final()`
- `reducer_final()`
- `mapper_cmd()`
- `combiner_cmd()`
- `reducer_cmd()`
- `mapper_pre_filter()`
- `combiner_pre_filter()`
- `reducer_pre_filter()`

## Multi-step jobs

To define multiple steps, override `steps()` to return a list of `MRSteps`:

```
from mrjob.job import MRJob
from mrjob.step import MRStep
import re

WORD_RE = re.compile(r"[\w']+")

class MRMostUsedWord(MRJob):

    def mapper_get_words(self, _, line):
        # yield each word in the line
        for word in WORD_RE.findall(line):
            yield (word.lower(), 1)

    def combiner_count_words(self, word, counts):
        # sum the words we've seen so far
        yield (word, sum(counts))

    def reducer_count_words(self, word, counts):
        # send all (num_occurrences, word) pairs to the same reducer.
        # num_occurrences is so we can easily use Python's max() function.
        yield None, (sum(counts), word)

    # discard the key; it is just None
    def reducer_find_max_word(self, _, word_count_pairs):
        # each item of word_count_pairs is (count, word),
        # so yielding one results in key=counts, value=word
        yield max(word_count_pairs)

    def steps(self):
        return [
            MRStep(mapper=self.mapper_get_words,
                  combiner=self.combiner_count_words,
                  reducer=self.reducer_count_words),
            MRStep(reducer=self.reducer_find_max_word)
        ]

if __name__ == '__main__':
    MRMostUsedWord.run()
```

(This example is explained further in [Protocols](#).)

The keyword arguments accepted by `MRStep` are the same as the *method names listed in the previous section*, plus a `jobconf` argument which takes a dictionary of jobconf arguments to pass to Hadoop.

---

**Note:** If this is your first time learning about mrjob, you should skip down to [Protocols](#) and finish this section later.

---

## Setup and teardown of tasks

Remember from *How your program is run* that your script is invoked once per task by Hadoop Streaming. It starts your script, feeds it stdin, reads its stdout, and closes it. mrjob lets you write methods to run at the beginning and end of this process: the `*_init()` and `*_final()` methods:

- `mapper_init()`
- `combiner_init()`
- `reducer_init()`
- `mapper_final()`
- `combiner_final()`
- `reducer_final()`

(And the corresponding keyword arguments to `MRStep`.)

If you need to load some kind of support file, like a `sqlite3` database, or perhaps create a temporary file, you can use these methods to do so. (See [File options](#) for an example.)

`*_init()` and `*_final()` methods can yield values just like normal tasks. Here is our word frequency count example rewritten to use these methods:

```
from mrjob.job import MRJob
from mrjob.step import MRStep

class MRWordFreqCount(MRJob):

    def init_get_words(self):
        self.words = {}

    def get_words(self, _, line):
        for word in WORD_RE.findall(line):
            word = word.lower()
            self.words.setdefault(word, 0)
            self.words[word] = self.words[word] + 1

    def final_get_words(self):
        for word, val in self.words.iteritems():
            yield word, val

    def sum_words(self, word, counts):
        yield word, sum(counts)

    def steps(self):
        return [MRStep(mapper_init=self.init_get_words,
                        mapper=self.get_words,
                        mapper_final=self.final_get_words,
                        combiner=self.sum_words,
                        reducer=self.sum_words)]
```



In this version, instead of yielding one line per word, the mapper keeps an internal count of word occurrences across all lines this mapper has seen so far. The mapper itself yields nothing. When Hadoop Streaming stops sending data to the map task, mrjob calls `final_get_words()`. That function emits the totals for this task, which is a much smaller set of output lines than the mapper would have output.

The optimization above is similar to using *combiners*, demonstrated in *Multi-step jobs*. It is usually clearer to use a combiner rather than a custom data structure, and Hadoop may run combiners in more places than just the ends of tasks.

*Defining command line options* has a partial example that shows how to load a `sqlite3` database using `mapper_init()`.

## Shell commands as steps

You can forego scripts entirely for a step by specifying it as a shell command. To do so, use `mapper_cmd`, `combiner_cmd`, or `reducer_cmd` as arguments to `MRStep`, or override the methods of the same names on `MRJob`. (See `mapper_cmd()`, `combiner_cmd()`, and `reducer_cmd()`.)

**Warning:** The default inline runner does not support `*_cmd()`. If you want to test locally, use the `local` runner (`-r local`).

You may mix command and script steps at will. This job will count the number of lines containing the string “kitty”:

```
from mrjob.job import job

class KittyJob(MRJob):

    OUTPUT_PROTOCOL = JSONValueProtocol

    def mapper_cmd(self):
        return "grep kitty"

    def reducer(self, key, values):
        yield None, sum(1 for _ in values)

if __name__ == '__main__':
    KittyJob().run()
```

Step commands are run without a shell. But if you’d like to use shell features such as pipes, you can use `mrjob.util.bash_wrap()` to wrap your command in a call to `bash`.

```
from mrjob.util import bash_wrap

class DemoJob(MRJob):

    def mapper_cmd(self):
        return bash_wrap("grep 'blah blah' | wc -l")
```

**Note:** You may not use `*_cmd()` with any other options for a task such as `*_filter()`, `*_init()`, `*_final()`, or a regular mapper/combiner/reducer function.

**Note:** You might see an opportunity here to write your MapReduce code in whatever language you please. If that appeals to you, check out [upload\\_files](#) for another piece of the puzzle.

## Filtering task input with shell commands

You can specify a command to filter a task’s input before it reaches your task using the `mapper_pre_filter` and `reducer_pre_filter` arguments to `MRStep`, or override the methods of the same names on `MRJob`. Doing so will cause mrjob to pipe input through that command before it reaches your mapper.

**Warning:** The default inline runner does not support `*_pre_filter()`. If you want to test locally, use the `local runner (-r local)`.

Here’s a job that tests filters using `grep`:

```
from mrjob.job import MRJob
from mrjob.protocol import JSONValueProtocol
from mrjob.step import MRStep

class KittiesJob(MRJob):

    OUTPUT_PROTOCOL = JSONValueProtocol

    def test_for_kitty(self, _, value):
        yield None, 0 # make sure we have some output
        if 'kitty' not in value:
            yield None, 1

    def sum_missing_kitties(self, _, values):
        yield None, sum(values)

    def steps(self):
        return [
            MRStep(mapper_pre_filter='grep "kitty"',
                  mapper=self.test_for_kitty,
                  reducer=self.sum_missing_kitties)]

if __name__ == '__main__':
    KittiesJob().run()
```

The output of the job should always be 0, since every line that gets to `test_for_kitty()` is filtered by `grep` to have “kitty” in it.

Filter commands are run without a shell. But if you’d like to use shell features such as pipes, you can use `mrjob.util.bash_wrap()` to wrap your command in a call to `bash`. See *Filtering task input with shell commands* for an example of `mrjob.util.bash_wrap()`.

## Protocols

mrjob assumes that all data is newline-delimited bytes. It automatically serializes and deserializes these bytes using *protocols*. Each job has an *input protocol*, an *output protocol*, and an *internal protocol*.

A protocol has a `read()` method and a `write()` method. The `read()` method converts bytes to pairs of Python objects representing the keys and values. The `write()` method converts a pair of Python objects back to bytes.

The *input protocol* is used to read the bytes sent to the first mapper (or reducer, if your first step doesn’t use a mapper). The *output protocol* is used to write the output of the last step to bytes written to the output file. The *internal protocol* converts the output of one step to the input of the next if the job has more than one step.

You can specify which protocols your job uses like this:

```
class MyMRJob(mrjob.job.MRJob):

    # these are the defaults
    INPUT_PROTOCOL = mrjob.protocol.RawValueProtocol
    INTERNAL_PROTOCOL = mrjob.protocol.JSONProtocol
    OUTPUT_PROTOCOL = mrjob.protocol.JSONProtocol
```

The default input protocol is *RawValueProtocol*, which just reads in a line as a `str`. (The line won't have a trailing newline character because *MRJob* strips it.) So by default, the first step in your job sees `(None, line)` for each line of input<sup>3</sup>.

The default output and internal protocols are both *JSONProtocol*<sup>4</sup>, which reads and writes JSON strings separated by a tab character. (By default, Hadoop Streaming uses the tab character to separate keys and values within one line when it sorts your data.)

If your head hurts a bit, think of it this way: use *RawValueProtocol* when you want to read or write lines of raw text. Use *JSONProtocol* when you want to read or write key-value pairs where the key and value are JSON-encoded bytes.

---

**Note:** Hadoop Streaming does not understand JSON, or mrjob protocols. It simply groups lines by doing a string comparison on whatever comes before the first tab character.

---

See *mrjob.protocol* for the full list of protocols built-in to mrjob.

## Data flow walkthrough by example

Let's revisit our example from *Multi-step jobs*. It has two steps and takes a plain text file as input.

```
class MRMostUsedWord(MRJob):

    def steps(self):
        return [
            MRStep(mapper=self.mapper_get_words,
                  combiner=self.combiner_count_words,
                  reducer=self.reducer_count_words),
            MRStep(reducer=self.reducer_find_max_word)
        ]
```

The first step starts with `mapper_get_words()`:

```
def mapper_get_words(self, _, line):
    # yield each word in the line
    for word in WORD_RE.findall(line):
        yield (word.lower(), 1)
```

Since the input protocol is *RawValueProtocol*, the key will always be `None` and the value will be the text of the line.

The function discards the key and yields `(word, 1)` for each word in the line. Since the internal protocol is *JSONProtocol*, each component of the output is serialized to JSON. The serialized components are written to stdout separated by a tab character and ending in a newline character, like this:

---

<sup>3</sup> Experienced Pythonistas might notice that a `str` is a bytestring on Python 2, but Unicode on Python 3. That's right! *RawValueProtocol* is an alias for one of two different protocols depending on your Python version.

<sup>4</sup> *JSONProtocol* is an alias for one of four different implementations; we try to use the (much faster) `ujson` library if it is available, and if not, `rapidjson` or `simplejson` before falling back to the built-in `json` implementation.

```
"mrjob" 1
"is"     1
"a"      1
"python" 1
```

The next two parts of the step are the combiner and reducer:

```
def combiner_count_words(self, word, counts):
    # sum the words we've seen so far
    yield (word, sum(counts))

def reducer_count_words(self, word, counts):
    # send all (num_occurrences, word) pairs to the same reducer.
    # num_occurrences is so we can easily use Python's max() function.
    yield None, (sum(counts), word)
```

In both cases, bytes are deserialized into `(word, counts)` by *JSONProtocol*, and the output is serialized as JSON in the same way (because both are followed by another step). It looks just like the first mapper output, but the results are summed:

```
"mrjob" 31
"is"     2
"a"      2
"Python" 1
```

The final step is just a reducer:

```
# discard the key; it is just None
def reducer_find_max_word(self, _, word_count_pairs):
    # each item of word_count_pairs is (count, word),
    # so yielding one results in key=counts, value=word
    yield max(word_count_pairs)
```

Since all input to this step has the same key (`None`), a single task will get all rows. Again, *JSONProtocol* will handle deserialization and produce the arguments to `reducer_find_max_word()`.

The output protocol is also *JSONProtocol*, so the final output will be:

```
31  "mrjob"
```

And we're done! But that's a bit ugly; there's no need to write the key out at all. Let's use *JSONValueProtocol* instead, so we only see the JSON-encoded value:

```
class MRMostUsedWord(MRJob):

    OUTPUT_PROTOCOL = JSONValueProtocol
```

Now we should have code that is identical to `examples/mr_most_used_word.py` in mrjob's source code. Let's try running it (`-q` prevents debug logging):

```
$ python mr_most_used_word.py README.txt -q
"mrjob"
```

Hooray!

## Specifying protocols for your job

Usually, you'll just want to set one or more of the class variables *INPUT\_PROTOCOL*, *INTERNAL\_PROTOCOL*, and *OUTPUT\_PROTOCOL*:

```
class BasicProtocolJob(MRJob):

    # get input as raw strings
    INPUT_PROTOCOL = RawValueProtocol
    # pass data internally with pickle
    INTERNAL_PROTOCOL = PickleProtocol
    # write output as JSON
    OUTPUT_PROTOCOL = JSONProtocol
```

If you need more complex behavior, you can override `input_protocol()`, `internal_protocol()`, or `output_protocol()` and return a protocol object instance. Here's an example that sneaks a peek at [Defining command line options](#):

```
class CommandLineProtocolJob(MRJob):

    def configure_options(self):
        super(CommandLineProtocolJob, self).configure_options()
        self.add_passthrough_option(
            '--output-format', default='raw', choices=['raw', 'json'],
            help="Specify the output format of the job")

    def output_protocol(self):
        if self.options.output_format == 'json':
            return JSONValueProtocol()
        elif self.options.output_format == 'raw':
            return RawValueProtocol()
```

Finally, if you need to use a completely different concept of protocol assignment, you can override `pick_protocols()`:

```
class WhatIsThisIDontEvenProtocolJob(MRJob):

    def pick_protocols(self, step_num, step_type):
        return random.choice([Protocololol, ROFLcol, Trolltocol, Locotorp])
```

## Writing custom protocols

A protocol is an object with methods `read(self, line)` and `write(self, key, value)`. The `read()` method takes a bytestring and returns a 2-tuple of decoded objects, and `write()` takes the key and value and returns bytes to be passed back to Hadoop Streaming or as output.

Protocols don't have to worry about adding or stripping newlines; this is handled automatically by *MRJob*.

Here is a simplified version of mrjob's JSON protocol:

```
import json

class JSONProtocol(object):

    def read(self, line):
        k_str, v_str = line.split('\t', 1)
        return json.loads(k_str), json.loads(v_str)

    def write(self, key, value):
        return '%s\t%s' % (json.dumps(key), json.dumps(value))
```

You can improve performance significantly by caching the serialization/deserialization results of keys. Look at the source code of `mrjob.protocol` for an example.

## Jar steps

You can run Java directly on Hadoop (bypassing Hadoop Streaming) by using `JarStep` instead of `MRStep()`.

For example, on EMR you can use a jar to run a script:

```
from mrjob.job import MRJob
from mrjob.step import JarStep

class ScriptyJarJob(MRJob):

    def steps(self):
        return [JarStep(
            jar='s3://elasticmapreduce/libs/script-runner/script-runner.jar',
            args=['s3://my_bucket/my_script.sh'])]
```

More interesting is combining `MRStep` and `JarStep` in the same job. Use `mrjob.step.INPUT` and `mrjob.step.OUTPUT` in `args` to stand for the input and output paths for that step. For example:

```
class NaiveBayesJob(MRJob):

    def steps(self):
        return [
            MRStep(mapper=self.mapper, reducer=self.reducer),
            JarStep(
                jar='elephant-driver.jar',
                args=['naive-bayes', INPUT, OUTPUT]
            )
        ]
```

`JarStep` has no concept of *Protocols*. If your jar reads input from a `MRStep`, or writes input read by another `MRStep`, it is up to those steps to read and write data in the format your jar expects.

If you are writing the jar yourself, the easiest solution is to have it read and write mrjob's default protocol (lines containing two JSONs, separated by a tab).

If you are using a third-party jar, you can set custom protocols for the steps before and after it by overriding `pick_protocols()`.

**Warning:** If the first step of your job is a `JarStep` and you pass in multiple input paths, mrjob will replace `INPUT` with the input paths joined together with a comma. Not all jars can handle this! Best practice in this case is to put all your input into a single directory and pass that as your input path.

## Defining command line options

Recall from *How your program is run* that your script is executed in several contexts: once for the initial invocation, and once for each task. If you just add an option to your job's option parser, that option's value won't be propagated to other runs of your script. Instead, you can use mrjob's option API: `add_passthrough_option()` and `add_file_option()`.

## Passthrough options

A *passthrough option* is an `optparse` option that mrjob is aware of. mrjob inspects the value of the option when you invoke your script <sup>5</sup> and reproduces that value when it invokes your script in other contexts. The command line-switchable protocol example from before uses this feature:

```
class CommandLineProtocolJob(MRJob):

    def configure_options(self):
        super(CommandLineProtocolJob, self).configure_options()
        self.add_passthrough_option(
            '--output-format', default='raw', choices=['raw', 'json'],
            help="Specify the output format of the job")

    def output_protocol(self):
        if self.options.output_format == 'json':
            return JSONValueProtocol()
        elif self.options.output_format == 'raw':
            return RawValueProtocol()
```

When you run your script with `--output-format=json`, mrjob detects that you passed `--output-format` on the command line. When your script is run in any other context, such as on Hadoop, it adds `--output-format=json` to its command string.

`add_passthrough_option()` takes the same arguments as `optparse.OptionParser.add_option()`. For more information, see the [optparse docs](#).

## Passing through existing options

Occasionally, it'll be useful for mappers, reducers, etc. to be able to see the value of other command-line options. For this, use `pass_through_option()` with the corresponding command-line switch.

For example, you might wish to fetch supporting data for your job from different locations, depending on whether your job is running on EMR or locally:

```
class MRRunnerAwareJob(MRJob):

    def configure_options(self):
        super(MRRunnerAwareJob, self).configure_options()

        self.pass_through_option('--runner')

    def mapper_init(self):
        if self.options.runner == 'emr':
            self.data = ... # load from S3
        else:
            self.data = ... # load from local FS
```

**Note:** Keep in mind that `self.options.runner` (and the values of most options) will be `None` unless the user explicitly set them with a command-line switch.

## File options

A *file option* is like a passthrough option, but:

<sup>5</sup> This is accomplished using crazy `optparse` hacks so you don't need to limit yourself to certain option types. However, your default values need to be compatible with `copy.deepcopy()`.

1. Its value must be a string or list of strings (action="store" or action="append"), where each string represents either a local path, or an HDFS or S3 path that will be accessible from the task nodes.
2. That file will be downloaded to each task's local directory and the value of the option will magically be changed to its path.

For example, if you had a map task that required a `sqlite3` database, you could do this:

```
class SqliteJob(MRJob):

    def configure_options(self):
        super(SqliteJob, self).configure_options()
        self.add_file_option('--database')

    def mapper_init(self):
        # make sqlite3 database available to mapper
        self.sqlite_conn = sqlite3.connect(self.options.database)
```

You could call it any of these ways, depending on where the file is:

```
$ python sqlite_job.py -r local --database=/etc/my_db.sqlite3
$ python sqlite_job.py -r hadoop --database=/etc/my_db.sqlite3
$ python sqlite_job.py -r hadoop --database=hdfs://my_dir/my_db.sqlite3
$ python sqlite_job.py -r emr --database=/etc/my_db.sqlite3
$ python sqlite_job.py -r emr --database=s3://my_bucket/my_db.sqlite3
```

In any of these cases, when your task runs, `my_db.sqlite3` will always be available in the task's working directory, and the value of `self.options.database` will always be set to its path.

See [Making files available to tasks](#) if you want to upload a file to your tasks' working directories without writing a custom command line option.

**Warning:** You **must** wait to read files until **after class initialization**. That means you should use the `*_init()` methods to read files. Trying to read files into class variables will not work.

## Custom option types

`optparse` allows you to add custom types and actions to your options (see [Extending optparse](#)), but doing so requires passing a custom `Option` object into the `OptionParser` constructor. `mrjob` creates its own `OptionParser` object, so if you want to use a custom `Option` class, you'll need to set the `OPTION_CLASS` attribute.

```
import optparse

import mrjob

class MyOption(optparse.Option):
    pass    # extend optparse as documented by the Python standard library

class MyJob(mrjob.job.MRJob):

    OPTION_CLASS = MyOption
```



## Counters

Hadoop lets you track *counters* that are aggregated over a step. A counter has a group, a name, and an integer value. Hadoop itself tracks a few counters automatically. mrjob prints your job's counters to the command line when your job finishes, and they are available to the runner object if you invoke it programmatically.

To increment a counter from anywhere in your job, use the `increment_counter()` method:

```
class MRCountingJob(MRJob):

    def mapper(self, _, value):
        self.increment_counter('group', 'counter_name', 1)
        yield _, value
```

At the end of your job, you'll get the counter's total value:

```
group:
  counter_name: 1
```

## Input and output formats

Input and output formats are Java classes that determine how your job interfaces with data on Hadoop's filesystem(s).

Suppose we wanted to write a word frequency count job that wrote output into a separate directory based on the first letter of the word counted (a/part-\*, b/part-\*, etc.). We could accomplish this by using the `MultipleValueOutputFormat` class from the Open Source project [nicknack](#).

First, we need to tell our job to use the custom output format by setting `HADOOP_OUTPUT_FORMAT` in our job class:

```
HADOOP_OUTPUT_FORMAT = 'nicknack.MultipleValueOutputFormat'
```

The output format class is part of a custom JAR, so we need to make sure that this JAR gets included in Hadoop's classpath. First [download](#) the jar to the same directory as your script, and add its name to `LIBJARS`:

```
LIBJARS = ['nicknack-1.0.0.jar']
```

(You can skip this step if you're using a format class that's built into Hadoop.)

Finally, output your data the way that your output format expects. `MultipleValueOutputFormat` expects the subdirectory name, followed by a tab, followed the actual line to write into the file.

First, we need to take direct control of how the job writes output by setting `OUTPUT_PROTOCOL` to `RawValueProtocol`:

```
OUTPUT_PROTOCOL = RawValueProtocol
```

Then we need to format the line accordingly. In this case, let's continue output our final data in the standard format (two JSONs separated by a tab):

```
def reducer(self, word, counts):
    total = sum(counts)
    yield None, '\t'.join([word[0], json.dumps(word), json.dumps(total)])
```

Done! Here's the full, working job (this is `mrjob.examples.mr_nick_nack`):

```
import json
import re

from mrjob.job import MRJob
from mrjob.protocol import RawValueProtocol
```

```
WORD_RE = re.compile(r"[A-Za-z]+")

class MRNickNack(MRJob):

    HADOOP_OUTPUT_FORMAT = 'nicknack.MultipleValueOutputFormat'

    LIBJARS = ['nicknack-1.0.0.jar']

    OUTPUT_PROTOCOL = RawValueProtocol

    def mapper(self, _, line):
        for word in WORD_RE.findall(line):
            yield (word.lower(), 1)

    def reducer(self, word, counts):
        total = sum(counts)
        yield None, '\t'.join([word[0], json.dumps(word), json.dumps(total)])

if __name__ == '__main__':
    MRNickNack.run()
```

Input formats work the same way; just set `HADOOP_INPUT_FORMAT`. (You usually won't need to set `INPUT_PROTOCOL` because it already defaults to `RawValueProtocol`.)

## Runners

While the `MRJob` class is the part of the framework that handles the execution of your code in a MapReduce context, the **runner** is the part that packages and submits your job to be run, and reporting the results back to you.

In most cases, you will interact with runners via the command line and configuration files. When you invoke mrjob via the command line, it reads your command line options (the `--runner` parameter) to determine which type of runner to create. Then it creates the runner, which reads your configuration files and command line args and starts your job running in whatever context you chose.

Most of the time, you won't have any reason to construct a runner directly. Instead you'll invoke your Python script on the command line and it will make a runner automatically, you'll call `mrjob run my_script` to have the mrjob command build a runner for your script (which may or may not be Python), or you'll write some sort of wrapper that calls `my_job.make_runner()`.

Internally, the general order of operations is:

- Get a runner by calling `make_runner()` on your job
- Call `run()` on your runner. This will:
  - Run your job with `--steps` to find out how many mappers/reducers to run
  - Copy your job and supporting files to Hadoop
  - Instruct Hadoop to run your job with the appropriate `--mapper`, `--combiner`, `--reducer`, and `--step-num` arguments

Each runner runs a single job once; if you want to run a job multiple times, make multiple runners.

Subclasses: `DataprocedureRunner`, `EMRJobRunner`, `HadoopJobRunner`, `InlineMRJobRunner`, `LocalMRJobRunner`

## Testing locally

To test the job locally, just run:

```
python your_mr_job_sub_class.py < log_file_or_whatever > output
```

The script will automatically invoke itself to run the various steps, using `InlineMRJobRunner` (`--runner=inline`). If you want to simulate Hadoop more closely, you can use `--runner=local`, which doesn't add your working directory to the `PYTHONPATH`, sets a few Hadoop environment variables, and uses multiple subprocesses for tasks.

You can also run individual steps:

```
# test 1st step mapper:
python your_mr_job_sub_class.py --mapper
# test 2nd step reducer (step numbers are 0-indexed):
python your_mr_job_sub_class.py --reducer --step-num=1
```

By default, we read from `stdin`, but you can also specify one or more input files. It automatically decompresses `.gz` and `.bz2` files:

```
python your_mr_job_sub_class.py log_01.gz log_02.bz2 log_03
```

See `mrjob.examples` for more examples.

## Running on your own Hadoop cluster

- Set up a hadoop cluster (see <http://hadoop.apache.org/common/docs/current/>)
- Run your job with `-r hadoop`:

```
python your_mr_job_sub_class.py -r hadoop < input > output
```

**Note:** You don't need to install `mrjob` or any other libraries on the nodes of your Hadoop cluster, but they *do* at least need a version of Python that's compatible with your job.

## Running on EMR

- Set up your Amazon account and credentials (see *Configuring AWS credentials*)
- Run your job with `-r emr`:

```
python your_mr_job_sub_class.py -r emr < input > output
```

## Running on Dataproc

- Set up your Google account and credentials (see *Configuring Google Cloud Platform (GCP) credentials*)
- Run your job with `-r dataproc`:

```
python your_mr_job_sub_class.py -r dataproc < input > output
```

**Note:** Dataproc support is new and has some *Limitations*.

## Configuration

Runners are configured by several methods:

- from `mrjob.conf` (see [Config file format and location](#))
- from the command line
- by re-defining `job_runner_kwargs()` etc in your `MRJob` (see [Job runner configuration](#))
- by instantiating the runner directly

In most cases, you should put all configuration in `mrjob.conf` and use the command line args or class variables to customize how individual jobs are run.

## Running your job programmatically

It is fairly common to write an organization-specific wrapper around mrjob. Use `make_runner()` to run an `MRJob` from another Python script. The context manager guarantees that all temporary files are cleaned up regardless of the success or failure of your job.

This pattern can also be used to write integration tests (see [Testing jobs](#)).

```
mr_job = MRWordCounter(args=['-r', 'emr'])
with mr_job.make_runner() as runner:
    runner.run()
    for line in runner.stream_output():
        key, value = mr_job.parse_output_line(line)
        ... # do something with the parsed output
```

You instantiate the `MRJob`, use a context manager to create the runner, run the job, iterate over the output lines, and use the job instance to parse each line with its output protocol.

Further reference:

- `make_runner()`
- `parse_output_line()`
- `stream_output()`
- `run()`

## Limitations

---

**Note:** You should pay attention to the next sentence.

---

**You cannot use the programmatic runner functionality in the same file as your job class.** As an example of what not to do, here is some code that does not work.

**Warning:** The code below shows you what **not** to do.

```
from mrjob.job import MRJob

class MyJob(MRJob):
    # (your job)

# no, stop, what are you doing?!?!
```

```
mr_job = MyJob(args=[args])
with mr_job.make_runner() as runner:
    runner.run()
# ... etc
```

If you try to do this, mrjob will give you an error message similar or identical to this one:

```
UsageError: make_runner() was called with --steps. This probably means you
    tried to use it from __main__, which doesn't work.
```

What you need to do instead is put your job in one file, and your run code in another. Here are two files that would correctly handle the above case.

```
# job.py
from mrjob.job import MRJob

class MyJob(MRJob):
    # (your job)

if __name__ == '__main__':
    MyJob.run()
```

```
# run.py
from job import MyJob
mr_job = MyJob(args=[args])
with mr_job.make_runner() as runner:
    runner.run()
# ... etc
```

### Why can't I put the job class and run code in the same file?

The file with the job class is sent to Hadoop to be run. Therefore, the job file cannot attempt to start the Hadoop job, or you would be recursively creating Hadoop jobs!

The code that runs the job should only run *outside* of the Hadoop context.

The `if __name__ == '__main__':` block is only run if you invoke the job file as a script. It is not run when imported. That's why you can import the job class to be run, but it can still be invoked as an executable.

## Counters

Counters may be read through the `counters()` method on the runner. The example below demonstrates the use of counters in a test case.

mr\_counting\_job.py

```
from mrjob.job import MRJob
from mrjob.step import MRStep

class MRCountingJob(MRJob):

    def steps(self):
        # 3 steps so we can check behavior of counters for multiple steps
        return [MRStep(self.mapper),
                MRStep(self.mapper),
                MRStep(self.mapper)]
```

```
def mapper(self, _, value):
    self.increment_counter('group', 'counter_name', 1)
    yield _, value

if __name__ == '__main__':
    MRCountingJob.run()
```

test\_counters.py

```
from io import BytesIO
from unittest import TestCase

from tests.mr_counting_job import MRCountingJob

class CounterTestCase(TestCase):

    def test_counters(self):
        stdin = BytesIO(b'foo\nbar\n')

        mr_job = MRCountingJob(['--no-conf', '-'])
        mr_job.sandbox(stdin=stdin)

        with mr_job.make_runner() as runner:
            runner.run()

            self.assertEqual(runner.counters(),
                             [{'group': {'counter_name': 2}},
                              {'group': {'counter_name': 2}},
                              {'group': {'counter_name': 2}}])
```

## Spark

### Why use mrjob with Spark?

mrjob augments [Spark](#)'s native Python support with the following features familiar to users of mrjob:

- automatically parse logs to explain errors and other Spark job failures
- automatic matching of Python version (see [python\\_bin](#))
- easily pass through environment variables (see [cmdenv](#))
- support for [libjars](#)
- passthrough and file options (see [Defining command line options](#))
- automatically upload input and other support files to HDFS or S3 (see [upload\\_files](#), [upload\\_archives](#), and [py\\_files](#))
- automatically set up Spark on EMR (see [bootstrap\\_spark](#))
- automatically making the mrjob library available to your job (see [bootstrap\\_mrjob](#))

## Writing your first Spark job

The simplest way to integrate mrjob with Spark is to add a `spark()` method to your `MRJob` class, and put your Spark code inside it.

Here’s how you’d implement a word frequency count job in Spark:

```
import re
from operator import add

from mrjob.job import MRJob

WORD_RE = re.compile(r"[\w']+")

class MRSparkWordcount(MRJob):

    def spark(self, input_path, output_path):
        # Spark may not be available where script is launched
        from pyspark import SparkContext

        sc = SparkContext(appName='mrjob Spark wordcount script')

        lines = sc.textFile(input_path)

        counts = (
            lines.flatMap(lambda line: WORD_RE.findall(line))
            .map(lambda word: (word, 1))
            .reduceByKey(add)

        counts.saveAsTextFile(output_path)

        sc.stop()

if __name__ == '__main__':
    MRSparkWordcount.run()
```

Since Spark already supports Python, mrjob takes care of setting up your cluster, passes in input and output paths, and otherwise gets out of the way. If you pass in multiple input paths, `input_path` will be these paths joined by a comma (SparkContext.textFile() will accept this).

Note that `pyspark` is imported *inside* the `spark()` method. This allows your job to run whether `pyspark` is installed locally or not.

The `spark()` method can be used to execute arbitrary code, so there’s nothing stopping you from using `SparkSession` instead of `SparkContext` in Spark 2, or writing a streaming-mode job rather than a batch one.

## Running on your own Hadoop cluster

Run your script with `-r hadoop`:

```
python your_mr_spark_job -r hadoop input_file1 input_file2 > output
```

There isn’t currently a “local” or “inline” mode that works independently from Spark, but you can use the `spark_master` option to run in Spark’s local mode:

```
python your_mr_spark_job -r hadoop --spark-master local input > output
```

The Hadoop runner always submits jobs to Spark in `client` mode, though you could change this using the `spark_args` option.

Also, note that if you set the Spark master to anything but `yarn` (the default), Spark will ignore archive files (see [upload\\_archives](#)).

## Running on EMR

Run your script with `-r emr`:

```
python your_mr_spark_job -r emr input_file1 input_file2 > output
```

The default EMR image should work fine for most Spark 1 jobs.

If you want to run on Spark 2, please set `image_version` to 5.0.0 or higher:

```
python your_mr_spark2_job -r emr --image-version 5.0.0 input > output
```

EMR introduced Spark support in AMI version 3.8.0, but it's not recommended to use the 3.x AMIs if you can avoid; they only support Python 2 and have trouble detecting when Spark jobs fail (instead silently producing no output).

The EMR runner always submits jobs to Spark in `cluster` mode, which it needs to access files on S3.

## Passing in libraries

Use `--py-file` to pass in `.zip` or `.egg` files full of Python code:

```
python your_mr_spark_job -r hadoop --py-file lib1.zip --py-file lib2.egg
```

Or set `py_files` in `mrjob.conf`.

## Command-line options

Command-line options (passthrough options, etc.) work exactly like they do with regular streaming jobs. See [Defining command line options](#).

## No setup scripts

Unlike with streaming jobs, you can't wrap Spark jobs in [setup scripts](#); once Spark starts operating on serialized data, it's operating in pure Python/Java and there's not a way to slip in a shell script.

If you're running in EMR, you can use [bootstrap scripts](#) to set up your environment when the cluster is created.

## Multi-step jobs

There generally isn't a need to define multiple Spark steps (Spark lets you map/reduce as many times as you want). However, it may sometimes be useful to pre- or post-process Spark data using a [streaming](#) or [jar](#) step.

This is accomplished by overriding your job's `steps()` method and using the `SparkStep` class:



```
def steps():
    return [
        MRStep(mapper=self.preprocessing_mapper),
        SparkStep(spark=self.spark),
    ]
```

## External Spark scripts

mrjob can also be used to launch external (non-mrjob) Spark scripts using the *SparkScriptStep* class, which specifies the path (or URI) of the script and its arguments.

As with *JarSteps*, you can interpolate input and output paths using *INPUT* and *OUTPUT* constants. For example, you could set your job's *steps()* method up like this:

```
def steps():
    return [
        SparkScriptStep(
            script=os.path.join(os.path.dirname(__file__), 'my_spark_script.py'),
            args=[INPUT, '-o', OUTPUT, '--other-switch'],
        ),
    ]
```

## Custom input and output formats

mrjob allows you to use input and output formats from custom JARs with Spark, just like you can *with streaming jobs*.

First [download your JAR](#) to the same directory as your job, and add it to your job class with the *LIBJARS* attribute:

```
LIBJARS = ['nicknack-1.0.0.jar']
```

Then use Spark's own capabilities to reference your input or output format, keeping in mind the data types they expect.

For example, nicknack's *MultipleValueOutputFormat* expects *<Text, Text>*, so if we wanted to integrate it with our wordcount example, we'd have to convert the count to a string:

```
def spark(self, input_path, output_path):
    from pyspark import SparkContext

    sc = SparkContext(appName='mrjob Spark wordcount script')

    lines = sc.textFile(input_path)

    counts = (
        lines.flatMap(lambda line: WORD_RE.findall(line))
        .map(lambda word: (word, 1))
        .reduceByKey(add))

    # MultipleValueOutputFormat expects Text, Text
    # w_c is (word, count)
    counts = counts.map(lambda w_c: (w_c[0], str(w_c[1])))

    counts.saveAsHadoopFile(output_path,
                           'nicknack.MultipleValueOutputFormat')

    sc.stop()
```

## Config file format and location

We look for `mrjob.conf` in these locations:

- The location specified by `MRJOB_CONF`
- `~/.mrjob.conf`
- `/etc/mrjob.conf`

You can specify one or more configuration files with the `--conf-path` flag. See [Options available to all runners](#) for more information.

The point of `mrjob.conf` is to let you set up things you want every job to have access to so that you don't have to think about it. For example:

- libraries and source code you want to be available for your jobs
- where temp directories and logs should go
- security credentials

`mrjob.conf` is just a **YAML**- or **JSON**-encoded dictionary containing default values to pass in to the constructors of the various runner classes. Here's a minimal `mrjob.conf`:

```
runners:
  emr:
    cmdenv:
      TZ: America/Los_Angeles
```

Now whenever you run `mr_your_script.py -r emr`, *EMRJobRunner* will automatically set `TZ` to `America/Los_Angeles` in your job's environment when it runs on EMR.

If you don't have the `yaml` module installed, you can use JSON in your `mrjob.conf` instead (JSON is a subset of YAML, so it'll still work once you install `yaml`). Here's how you'd render the above example in JSON:

```
{
  "runners": {
    "emr": {
      "cmdenv": {
        "TZ": "America/Los_Angeles"
      }
    }
  }
}
```

## Precedence and combining options

Options specified on the command-line take precedence over `mrjob.conf`. Usually this means simply overriding the option in `mrjob.conf`. However, we know that `cmdenv` contains environment variables, so we do the right thing. For example, if your `mrjob.conf` contained:

```
runners:
  emr:
    cmdenv:
      PATH: /usr/local/bin
      TZ: America/Los_Angeles
```

and you ran your job as:

```
mr_your_script.py -r emr --cmdenv TZ=Europe/Paris --cmdenv PATH=/usr/sbin
```

We’d automatically handle the `PATH` variables and your job’s environment would be:

```
{'TZ': 'Europe/Paris', 'PATH': '/usr/sbin:/usr/local/bin'}
```

What’s going on here is that `cmdenv` is associated with `combine_envs()`. Each option is associated with an appropriate combiner function that combines options in an appropriate way.

Combiner functions can also do useful things like expanding environment variables and globs in paths. For example, you could set:

```
runners:
  local:
    upload_files: &upload_files
    - $DATA_DIR/*.db
  hadoop:
    upload_files: *upload_files
  emr:
    upload_files: *upload_files
```

and every time you ran a job, every job in your `.db` file in `$DATA_DIR` would automatically be loaded into your job’s current working directory.

Also, if you specified additional files to upload with `--file`, those files would be uploaded in addition to the `.db` files, rather than instead of them.

See [Configuration quick reference](#) for the entire dizzying array of configurable options.

## Option data types

The same option may be specified multiple times and be one of several data types. For example, the AWS region may be specified in `mrjob.conf`, in the arguments to `EMRJobRunner`, and on the command line. These are the rules used to determine what value to use at runtime.

Values specified “later” refer to an option being specified at a higher priority. For example, a value in `mrjob.conf` is specified “earlier” than a value passed on the command line.

When there are multiple values, they are “combined with” a *combiner function*. The combiner function for each data type is listed in its description.

### Simple data types

When these are specified more than once, the last non-None value is used.

**String** Simple, unchanged string. Combined with `combine_values()`.

**Command** String containing all ASCII characters to be parsed with `shlex.split()`, or list of command + arguments. Combined with `combine_cmds()`.

**Path** Local path with `~` and environment variables (e.g. `$TMPDIR`) resolved. Combined with `combine_paths()`.

### List data types

The values of these options are specified as lists. When specified more than once, the lists are concatenated together.

**String list** List of *strings*. Combined with `combine_lists()`.

**Path list** List of *paths*. Combined with `combine_path_lists()`.

Changed in version 0.4.6: strings and non-sequence data types (e.g. numbers) are treated as single-item lists.

For example,

```
runners:
  emr:
    setup: /run/some/command with args
```

is equivalent to:

```
runners:
  emr:
    setup:
      - /run/some/command with args
```

## Dict data types

The values of these options are specified as dictionaries. When specified more than once, each has custom behavior described below.

**Plain dict** Values specified later override values specified earlier. Combined with `combine_dicts()`.

**Environment variable dict** Values specified later override values specified earlier, **except for those with keys ending in `PATH`**, in which values are concatenated and separated by a colon (`:`) rather than overwritten. The later value comes first.

For example, this config:

```
runners:
  emr:
    cmdenv:
      PATH: /usr/bin
```

when run with this command:

```
python my_job.py --cmdenv PATH=/usr/local/bin
```

will result in the following value of `cmdenv`:

```
/usr/local/bin:/usr/bin
```

The function that handles this is `combine_envs()`.

**The one exception** to this behavior is in the `local` runner, which uses the local system separator (on Windows `;`, on everything else still `:`) instead of always using `:`. In local mode, the function that combines config values is `combine_local_envs()`.

## Using multiple config files

If you have several standard configurations, you may want to have several config files “inherit” from a base config file. For example, you may have one set of AWS credentials, but two code bases and default instance sizes. To accomplish this, use the `include` option:

`~/mrjob.very-large.conf:`

```
include: ~/.mrjob.base.conf
runners:
  emr:
```

```
num_core_instances: 20
core_instance_type: m1.xlarge
```

~/mrjob.very-small.conf:

```
include: $HOME/.mrjob.base.conf
runners:
  emr:
    num_core_instances: 2
    core_instance_type: m1.small
```

~/mrjob.base.conf:

```
runners:
  emr:
    aws_access_key_id: HADOOPHADOOPBOBADOOP
    aws_secret_access_key: MEMIMOMADOOPBANANAFANAFOFADOOPHADOOP
    region: us-west-1
```

Options that are lists, commands, dictionaries, etc. combine the same way they do between the config files and the command line (with combiner functions).

You can use `$ENVIRONMENT_VARIABLES` and `~/file_in_your_home_dir` inside `include`.

You can inherit from multiple config files by passing `include` a list instead of a string. Files on the right will have precedence over files on the left. To continue the above examples, this config:

~/mrjob.everything.conf

```
include:
- ~/mrjob.very-small.conf
- ~/mrjob.very-large.conf
```

will be equivalent to this one:

~/mrjob.everything-2.conf

```
runners:
  emr:
    aws_access_key_id: HADOOPHADOOPBOBADOOP
    aws_secret_access_key: MEMIMOMADOOPBANANAFANAFOFADOOPHADOOP
    core_instance_type: m1.xlarge
    num_core_instances: 20
    region: us-west-1
```

In this case, `~/mrjob.very-large.conf` has taken precedence over `~/mrjob.very-small.conf`.

## Relative includes

Changed in version 0.4.6: `Relative include`: paths are relative to the real (after resolving symlinks) path of the including conf file.

For example, you could do this:

~/mrjob/base.conf:

```
runners:
  ...
```

~/mrjob/default.conf:

```
include: base.conf
```

You could then load your configs via a symlink `~/.mrjob.conf` to `~/.mrjob/default.conf` and `~/.mrjob/base.conf` would still be included (even though it's not in the same directory as the symlink).

## Clearing configs

Sometimes, you just want to override a list-type config (e.g. `setup`) or a `*PATH` environment variable, rather than having mrjob cleverly concatenate it with previous configs.

You can do this in YAML config files by tagging the values you want to take precedence with the `!clear` tag.

For example:

`~/.mrjob.base.conf`

```
runners:
  emr:
    aws_access_key_id: HADOOPHADOOPBOBADOOP
    aws_secret_access_key: MEMIMOMADOOPBANANAFANAFOFADOOPHADOOP
    cmdenv:
      PATH: /this/nice/path
      PYTHONPATH: /here/be/serpents
      USER: dave
    setup:
      - /run/this/command
```

`~/.mrjob.conf`

```
include: ~/.mrjob.base.conf
runners:
  emr:
    cmdenv:
      PATH: !clear /this/even/better/path/yay
      PYTHONPATH: !clear
    setup: !clear
      - /run/this/other/command
```

is equivalent to:

```
runners:
  emr:
    aws_access_key_id: HADOOPHADOOPBOBADOOP
    aws_secret_access_key: MEMIMOMADOOPBANANAFANAFOFADOOPHADOOP
    cmdenv:
      PATH: /this/even/better/path/yay
      USER: dave
    setup:
      - /run/this/other/command
```

If you specify multiple config files (e.g. `-c ~/.mrjob.base.conf -c ~/.mrjob.conf`), a `!clear` in a later file will override earlier files. `include:` is really just another way to prepend to the list of config files to load.

If you find it more readable, you may put the `!clear` tag *before* the key you want to clear. For example,

```
runners:
  emr:
    !clear setup:
      - /run/this/other/command
```

is equivalent to:

```
runners:
  emr:
    setup: !clear
    - /run/this/other/command
```

**!clear** tags in lists are ignored. You cannot currently clear an entire set of configs (e.g. `runners: emr: !clear ...` does not work).

## Options available to all runners

The format of each item in this document is:

**mrjob\_conf\_option\_name** (**--command-line-option-name**) [option\_type] **Default:** default value

Description of option behavior

Options that take multiple values can be passed multiple times on the command line. All options can be passed as keyword arguments to the runner if initialized programmatically.

## Making files available to tasks

Most jobs have dependencies of some sort - Python packages, Debian packages, data files, etc. This section covers options available to all runners that mrjob uses to upload files to your job's execution environments. See [File options](#) if you want to write your own command line options related to file uploading.

**Warning:** You **must** wait to read files until **after class initialization**. That means you should use the `*_init()` methods to read files. Trying to read files into class variables will not work.

**bootstrap\_mrjob** (**--bootstrap-mrjob**, **--no-bootstrap-mrjob**) [boolean] **Default:** (automatic)

Should we automatically zip up the mrjob library and install it when we run job? By default, we do unless `interpreter` is set.

Set this to `False` if you've already installed mrjob on your Hadoop cluster or install it by some other method. mrjob used to be bootstrapped as a tarball.

**py\_files** (**--py-file**) [*path list*] **Default:** []

List of `.egg` or `.zip` files to add to your job's `PYTHONPATH`.

This is based on a Spark feature, but it works just as well with streaming jobs.

New in version 0.5.7.

**python\_archives** (**--python-archive**) [*path list*] **Default:** []

Same as `upload_archives`, except they get added to the job's `PYTHONPATH`.

Deprecated since version 0.5.7: Try `py_files` with a `.zip` or `.egg` file instead. If you must use an archive, see [Uploading your source tree](#).

**upload\_archives** (**--archive**) [*path list*] **Default:** []

A list of archives (e.g. tarballs) to unpack in the local directory of the `mr_job` script when it runs. You can set the name in the job's working directory we unpack into by appending `#nameinworkingdir` to the path; otherwise we just use the name of the archive file (e.g. `foo.tar.gz` is unpacked to the directory `foo.tar.gz/`, and `foo.tar.gz#stuff` is unpacked to the directory `stuff/`).

Changed in version 0.5.7: This works with Spark as well.

**upload\_dirs** (**--dir**) [*path list*] **Default:** []

A list of directories to copy to the local directory of the `mr_job` script when it runs (mrjob does this by tarballing the directory and submitting the tarball to Hadoop as an archive).

You can set the name in the job's working directory of the directory we copy by appending `#nameinworkingdir` to the path; otherwise we just use its name.

This works with Spark as well.

New in version 0.5.8.

**upload\_files** (**--file**) [*path list*] **Default:** []

Files to copy to the local directory of the `mr_job` script when it runs. You can set the name of the file in the job's working directory by appending `#nameinworkingdir` to the path; otherwise we just use the name of the file.

In the config file:

```
upload_files:
- file_1.txt
- file_2.sqlite
```

On the command line:

```
--file file_1.txt --file file_2.sqlite
```

Changed in version 0.5.7: This works with Spark as well.

## Temp files and cleanup

**cleanup** (**--cleanup**) [*string*] **Default:** 'ALL'

List of which kinds of directories to delete when a job succeeds. Valid choices are:

- **'ALL'**: delete logs and local and remote temp files; stop cluster if on EMR and the job is not done when cleanup is run.
- **'CLUSTER'**: terminate EMR cluster if job not done when cleanup is run
- **'JOB'**: stop job if not done when cleanup runs (temporarily disabled)
- **'LOCAL\_TMP'**: delete local temp files only
- **'LOGS'**: delete logs only
- **'NONE'**: delete nothing
- **'REMOTE\_TMP'**: delete remote temp files only
- **'TMP'**: delete local and remote temp files, but not logs

In the config file:

```
cleanup: [LOGS, JOB]
```

On the command line:

```
--cleanup=LOGS, JOB
```

Changed in version 0.5.0: Options ending in `TMP` used to end in `SCRATCH`



**cleanup\_on\_failure** (**--cleanup-on-failure**) [*string*] **Default:** 'NONE'

Which kinds of directories to clean up when a job fails. Valid choices are the same as **cleanup**.

**local\_tmp\_dir** [*path*] **Default:** value of `tempfile.gettempdir()`

Alternate local temp directory.

There isn't a command-line switch for this option; just set TMPDIR or any other environment variable respected by `tempfile.gettempdir()`.

Changed in version 0.5.0: This option used to be named `base_tmp_dir`.

**output\_dir** (**--output-dir**) [*string*] **Default:** (automatic)

An empty/non-existent directory where Hadoop streaming should put the final output from the job. If you don't specify an output directory, we'll output into a subdirectory of this job's temporary directory. You can control this from the command line with `--output-dir`. This option cannot be set from configuration files. If used with the `hadoop` runner, this path does not need to be fully qualified with `hdfs://` URIs because it's understood that it has to be on HDFS.

**no\_output** (**--no-output**) [boolean] **Default:** False

Don't stream output to STDOUT after job completion. This is often used in conjunction with `--output-dir` to store output only in HDFS or S3.

**step\_output\_dir** (**--step-output-dir**) [*string*] **Default:** (automatic)

For a multi-step job, where to put output from job steps other than the last one. Each step's output will go into a numbered subdirectory of this one (0000/, 0001/, etc.)

This option can be useful for debugging. By default, intermediate output goes into HDFS, which is fastest but not easily accessible on EMR or Dataproc.

This option currently does nothing on local and inline runners.

## Job execution context

**cmdenv** (**--cmdenv**) [*environment variable dict*] **Default:** {}

Dictionary of environment variables to pass to the job inside Hadoop streaming.

In the config file:

```
cmdenv:
  PYTHONPATH: $HOME/stuff
  TZ: America/Los_Angeles
```

On the command line:

```
--cmdenv PYTHONPATH=$HOME/stuff,TZ=America/Los_Angeles
```

Changed in version 0.5.7: This works with Spark too. In client mode (`hadoop` runner), these environment variables are passed directly to **spark-submit**.

**interpreter** (**--interpreter**) [*string*] **Default:** None

Non-Python command to launch your script with (e.g. 'ruby'). This will also be used to query the script about steps unless you set `steps_interpreter`.

If you want to use an alternate Python command to run the job, use `python_bin`.

This takes precedence over `python_bin` and `steps_python_bin`.

**python\_bin** (**--python-bin**) [*command*] **Default:** (automatic)

Name/path of alternate Python binary for wrapper scripts and mappers/reducers (e.g. `'python -v'`).

If you're on Python 3, this always defaults to `'python3'`.

If you're on Python 2, this defaults to `'python'`, except on EMR, where it will be either `'python2.6'` or `'python2.7'`.

Generally, *EMRJobRunner* just matches whichever minor version of Python 2 you're running. However, if you're on a (deprecated) 2.x AMI, it'll instead default to `'python2.6'` on AMI version 2.4.2 and earlier (because Python 2.7 is unavailable) and `'python2.7'` on later 2.x AMI versions (because they have **pip-2.7** but not **pip-2.6**).

This option also affects which Python binary is used for file locking in *setup* scripts, so it might be useful to set even if you're using a non-Python *interpreter*. It's also used by *EMRJobRunner* to compile mrjob after bootstrapping it (see *bootstrap\_mrjob*).

Unlike *interpreter*, this does not affect the binary used to query the job about its steps (use *steps\_python\_bin*).

**setup** (**--setup**) [*string list*] **Default:** []

A list of lines of shell script to run before each task (mapper/reducer).

This option is complex and powerful; the best way to get started is to read the *Job Environment Setup Cookbook*.

Using this option replaces your task with a shell “wrapper” script that executes the setup commands, and then executes the task as the last line of the script. This means that environment variables set by hadoop (e.g. `$mapred_job_id`) are available to setup commands, and that you can pass environment variables to the task (e.g. `$PYTHONPATH`) using `export`.

We use file locking around the setup commands (not the task) to ensure that multiple tasks running on the same node won't run them simultaneously (it's safe to run `make`). Before running the task, we `cd` back to the original working directory.

In addition, passing expressions like `path#name` will cause *path* to be automatically uploaded to the task's working directory with the filename *name*, marked as executable, and interpolated into the script by its absolute path on the machine running the script.

*path* may also be a URI, and `~` and environment variables within *path* will be resolved based on the local environment. *name* is optional.

You can indicate that an archive should be unarchived into a directory by putting a `/` after *name* (e.g. `foo.tar.gz#foo/`).

You can indicate that a directory should be copied into the job's working directory by putting a `/` after *path* (e.g. `src-tree/#`). You may optionally put a `/` after *name* as well (e.g. `cd src-tree/#/subdir`).

New in version 0.5.8: support for directories (above)

For more details of parsing, see *parse\_setup\_cmd()*.

**setup\_cmds** (**--setup-cmd**) [*string list*] **Default:** []

Deprecated since version 0.4.2.

A list of commands to run before each mapper/reducer step. Basically *setup* without automatic file uploading/interpolation. Can also take commands as lists of arguments.

**setup\_scripts** (**--setup-script**) [*path list*] **Default:** []

Deprecated since version 0.4.2.

Files that will be copied into the local working directory and then run.

Pass `'path/to/script#'` to *setup* instead.

**sh\_bin** (**--sh-bin**) [*command*] **Default:** `sh -ex` (with exceptions below)

Name/path of alternate shell binary to use for `setup` and `bootstrap`. Needs to be backwards compatible with Bourne Shell (e.g. `'sh'`, `'bash'`, `'zsh'`).

This is also used to wrap mappers, reducers, etc. that require piping one command into another (see e.g. `mapper_pre_filter()`).

On Dataproc and EMR, this defaults to `/bin/sh -ex`.

Changed in version 0.5.9: Starting with EMR AMI 5.2.0, `sh -e` is broken, so we emulate the `-e` switch by using `/bin/sh -x` as our shell, and prepending `set -e` to any shell script generated by mrjob. `set -e` is not prepended if you set `sh_bin` yourself; you could add it with `setup`.

**steps\_interpreter** (**--steps-interpreter**) [*command*] **Default:** current Python interpreter

Alternate (non-Python) command to use to query the job about its steps. Usually it's good enough to set `interpreter`.

If you want to use an alternate Python command to get the job's steps, use `steps_python_bin`.

This takes precedence over `steps_python_bin`.

**steps\_python\_bin** (**--steps-python-bin**) [*command*] **Default:** (current Python interpreter)

Name/path of alternate python binary to use to query the job about its steps. Rarely needed. If not set, we use `sys.executable` (the current Python interpreter).

**task\_python\_bin** (**--task-python-bin**) [*command*] **Default:** same as `python_bin`

Name/path of alternate python binary to run the job (invoking it with `--mapper`, `--spark` or anything other than `--steps`).

In most cases, you're better off setting `python_bin`, which this defaults to. This option exists mostly to support running tasks inside Docker while using a normal Python binary in setup wrapper scripts.

**strict\_protocols** (**--strict-protocols**, **--no-strict-protocols**) [boolean] **Default:** `True`

If you set this to false, when jobs encounter unencodable input or output, they'll increment a counter rather than simply raising an exception.

**Warning:** Non-strict protocols are going away in v0.6.0. There is no limit on how much data on-strict protocols can silently swallow (potentially *all* of it). If you have a problem caused by character encoding in log files, consider using `TextValueProtocol` instead.

## Other

**conf\_paths** (**-c**, **--conf-path**, **--no-conf**) [*path list*] **Default:** see `find_mrjob_conf()`

List of paths to configuration files. This option cannot be used in configuration files, because that would cause a universe-ending causality paradox. Use `--no-conf` on the command line or `conf_paths=[]` to force mrjob to load no configuration files at all. If no config path flags are given, mrjob will look for one in the locations specified in *Config file format and location*.

Config path flags can be used multiple times to combine config files, much like the **include** config file directive. Using `--no-conf` will cause mrjob to ignore all preceding config path flags.

For example, this line will cause mrjob to combine settings from `left.conf` and `right.conf`:

```
python my_job.py -c left.conf -c right.conf
```

This line will cause mrjob to read no config file at all:

```
python my_job.py --no-conf
```

This line will cause mrjob to read only `right.conf`, because `--no-conf` nullifies `-c left.conf`:

```
python my_job.py -c left.conf --no-conf -c right.conf
```

## Options ignored by the local and inline runners

These options are ignored because they require a real instance of Hadoop:

- `hadoop_input_format`
- `hadoop_output_format`
- `libjars`
- `partitioner`

## Options ignored by the inline runner

These options are ignored because the `inline` runner does not invoke the job as a subprocess:

- `bootstrap_mrjob`
- `python_bin`
- `setup`
- `setup_cmds`
- `setup_scripts`
- `steps_python_bin`

## Hadoop-related options

Since mrjob is geared toward Hadoop, there are a few Hadoop-specific options. However, due to the difference between the different runners, the Hadoop platform, and Elastic MapReduce, they are not all available for all runners.

## Options specific to the local and inline runners

**hadoop\_version** (`--hadoop-version`) [*string*] **Default:** None

Set the version of Hadoop to simulate (this currently only matters for `jobconf`).

If you don't set this, the `local` and `inline` runners will run in a version-agnostic mode, where anytime the runner sets a simulated jobconf variable, it'll use *every* possible name for it (e.g. `user.name` and `mapreduce.job.user.name`).

## Options available to local, hadoop, and emr runners

These options are both used by Hadoop and simulated by the `local` and `inline` runners to some degree.

**jobconf** (**--jobconf**) [*dict*] **Default:** {}

-D args to pass to hadoop streaming. This should be a map from property name to value. Equivalent to passing `['-D', 'KEY1=VALUE1', '-D', 'KEY2=VALUE2', ...]` to `hadoop_extra_args`

## Options available to hadoop and emr runners

**hadoop\_extra\_args** (**--hadoop-arg**) [*string list*] **Default:** []

Extra arguments to pass to hadoop streaming.

**hadoop\_streaming\_jar** (**--hadoop-streaming-jar**) [*string*] **Default:** (automatic)

Path to a custom hadoop streaming jar.

On EMR, this can be either a local path or a URI (`s3://...`). If you want to use a jar at a path on the master node, use a `file://` URI.

On Hadoop, mrjob tries its best to find your hadoop streaming jar, searching these directories (recursively) for a `.jar` file with `hadoop` followed by `streaming` in its name:

- `hadoop_home` (the deprecated runner option)
- `$HADOOP_PREFIX`
- `$HADOOP_HOME`
- `$HADOOP_INSTALL`
- `$HADOOP_MAPRED_HOME`
- the parent of the directory containing the Hadoop binary (see `hadoop_bin`), unless it's one of `/`, `/usr` or `/usr/local`
- `$HADOOP_*_HOME` (in alphabetical order by environment variable name)
- `/home/hadoop/contrib`
- `/usr/lib/hadoop-mapreduce`

(The last two paths allow the Hadoop runner to work out-of-the box inside EMR.)

**libjars** (**--libjar**) [*string list*] **Default:** []

List of paths of JARs to be passed to Hadoop with the `-libjar` switch.

~ and environment variables within paths will be resolved based on the local environment.

New in version 0.5.3.

**label** (**--label**) [*string*] **Default:** script's module name, or `no_script`

Alternate label for the job

**owner** (**--owner**) [*string*] **Default:** `getpass.getuser()`, or `no_user` if that fails

Who is running this job (if different from the current user)

**check\_input\_paths** (**--check-input-paths**, **--no-check-input-paths**) [boolean] **Default:** `True`

Option to skip the input path check. With `--no-check-input-paths`, input paths to the runner will be passed straight through, without checking if they exist.

New in version 0.4.1.

**spark\_args** (**--spark-arg**) [*string list*] **Default:** []

Extra arguments to pass to **spark-submit**.

New in version 0.5.7.

## Options available to hadoop runner only

**hadoop\_bin** (**--hadoop-bin**) [*command*] **Default:** (automatic)

Name/path of your **hadoop** binary (may include arguments).

mrjob tries its best to find **hadoop**, checking all of the following places for an executable file named **hadoop**:

- **hadoop\_home/bin** (deprecated)
- `$HADOOP_PREFIX/bin`
- `$HADOOP_HOME/bin`
- `$HADOOP_INSTALL/bin`
- `$HADOOP_INSTALL/hadoop/bin`
- `$PATH`
- `$HADOOP_*_HOME/bin` (in alphabetical order by environment variable name)

If all else fails, we just use **hadoop** and hope for the best.

**hadoop\_home** (**--hadoop-home**) [*path*] **Default:** None

Deprecated since version 0.5.0.

Hint about where to find the **hadoop** binary and streaming jar. In most cases, mrjob will now find these on its own. If not, set **hadoop\_bin** and/or **hadoop\_streaming\_jar** as needed.

**hadoop\_log\_dirs** (**--hadoop-log-dir**) [*path list*] **Default:** (automatic)

Where to look for Hadoop logs (to find counters and probable cause of job failure). These can be (local) paths or URIs (`hdfs:///...`).

If this is *not* set, mrjob will try its best to find the logs, searching in:

- `$HADOOP_LOG_DIR`
- `$YARN_LOG_DIR` (on YARN only)
- `hdfs:///tmp/hadoop-yarn/staging` (on YARN only)
- `<job output dir>/_logs` (usually this is on HDFS)
- `$HADOOP_PREFIX/logs`
- `$HADOOP_HOME/logs`
- `$HADOOP_INSTALL/logs`
- `$HADOOP_MAPRED_HOME/logs`
- `<dir containing hadoop bin>/logs` (see **hadoop\_bin**), unless the **hadoop** binary is in `/bin`, `/usr/bin`, or `/usr/local/bin`
- `$HADOOP_*_HOME/logs` (in alphabetical order by environment variable name)
- `/var/log/hadoop-yarn` (on YARN only)

- /mnt/var/log/hadoop-yarn (on YARN only)
- /var/log/hadoop
- /mnt/var/log/hadoop

New in version 0.5.0.

Changed in version 0.5.3: Added paths in /var/log and /mnt/var/log/hadoop-yarn

**hadoop\_tmp\_dir** (**--hadoop-tmp-dir**) [*path*] **Default:** tmp/mrjob

Scratch space on HDFS. This path does not need to be fully qualified with `hdfs://` URIs because it's understood that it has to be on HDFS.

Changed in version 0.5.0: This option used to be named `hdfs_scratch_dir`.

**spark\_master** (**--spark-master**) [*string*] **Default:** 'yarn'

Name or URL to pass to the `--master` argument of **spark-submit** (e.g. `spark://host:port`, `yarn`).

Note that archives (see [upload\\_archives](#)) only work when this is set to `yarn`.

**spark\_submit\_bin** (**--spark-submit-bin**) [*command*] **Default:** (automatic)

Name/path of your **spark-submit** binary (may include arguments).

mrjob tries its best to find **spark-submit**, checking all of the following places for an executable file named `spark-submit`:

- \$SPARK\_HOME/bin
- \$PATH
- /usr/lib/spark/bin
- /usr/local/spark/bin
- /usr/local/lib/spark/bin

If all else fails, we just use `spark-submit` and hope for the best.

New in version 0.5.7.

## Configuration quick reference

### Setting configuration options

You can set an option by:

- Passing it on the command line with the switch version (like `--some-option`)
- Passing it as a keyword argument to the runner constructor, if you are creating the runner programmatically
- Putting it in one of the included config files under a runner name, like this:

```
runners:
  local:
    python_bin: python2.7  # only used in local runner
  emr:
    python_bin: python2.6  # only used in Elastic MapReduce runner
```

See [Config file format and location](#) for information on where to put config files.

## Options that can't be set from mrjob.conf (all runners)

There are some options that it makes no sense to set in the config file.

These options can be set via command-line switches:

Config	Command line	Default	Type
<code>conf_paths</code>	<code>-c, --conf-path, --no-conf</code>	see <code>find_mrjob_conf()</code>	<i>path list</i>
<code>no_output</code>	<code>--no-output</code>	False	boolean
<code>output_dir</code>	<code>--output-dir</code>	(automatic)	<i>string</i>
<code>step_output_dir</code>	<code>--step-output-dir</code>	(automatic)	<i>string</i>

These options can be set by overriding attributes or methods in your job class:

Option	Attribute	Method	Default
<code>hadoop_input_format</code>	<code>HADOOP_INPUT_FORMAT</code>	<code>hadoop_input_format()</code>	None
<code>hadoop_output_format</code>	<code>HADOOP_OUTPUT_FORMAT</code>	<code>hadoop_output_format()</code>	None
<code>partitioner</code>	<code>PARTITIONER</code>	<code>partitioner()</code>	None

These options can be set by overriding your job's `configure_options()` to call the appropriate method:

Option	Method	Default
<code>extra_args</code>	<code>add_passthrough_option()</code>	<code>[]</code>
<code>file_upload_args</code>	<code>add_file_option()</code>	<code>[]</code>

All of the above can be passed as keyword arguments to `MRJobRunner.__init__()` (this is what makes them runner options), but you usually don't want to instantiate runners directly.

## Other options for all runners

These options can be passed to any runner without an error, though some runners may ignore some options. See the text after the table for specifics.



Config	Command line	Default	Type
<code>bootstrap</code>	<code>-bootstrap</code>	<code>[]</code>	<i>string list</i>
<code>bootstrap_mrjob</code>	<code>-bootstrap-mrjob</code> , <code>-no-bootstrap-mrjob</code>	(automatic)	boolean
<code>check_input_paths</code>	<code>-check-input-paths</code> , <code>-no-check-input-paths</code>	True	boolean
<code>cleanup</code>	<code>-cleanup</code>	'ALL'	<i>string</i>
<code>cleanup_on_failure</code>	<code>-cleanup-on-failure</code>	'NONE'	<i>string</i>
<code>cmdenv</code>	<code>-cmdenv</code>	<code>{ }</code>	<i>environment variable dict</i>
<code>hadoop_extra_args</code>	<code>-hadoop-arg</code>	<code>[]</code>	<i>string list</i>
<code>hadoop_streaming_jar</code>	<code>-hadoop-streaming-jar</code>	(automatic)	<i>string</i>
<code>interpreter</code>	<code>-interpreter</code>	None	<i>string</i>
<code>jobconf</code>	<code>-jobconf</code>	<code>{ }</code>	<i>dict</i>
<code>label</code>	<code>-label</code>	script's module name, or <code>no_script</code>	<i>string</i>
<code>libjars</code>	<code>-libjar</code>	<code>[]</code>	<i>string list</i>
<code>local_tmp_dir</code>		value of <code>tempfile.gettempdir()</code>	<i>path</i>
<code>owner</code>	<code>-owner</code>	<code>getpass.getuser()</code> , or <code>no_user</code> if that fails	<i>string</i>
<code>py_files</code>	<code>-py-file</code>	<code>[]</code>	<i>path list</i>
<code>python_archives</code>	<code>-python-archive</code>	<code>[]</code>	<i>path list</i>
<code>python_bin</code>	<code>-python-bin</code>	(automatic)	<i>command</i>
<code>setup</code>	<code>-setup</code>	<code>[]</code>	<i>string list</i>
<code>setup_cmds</code>	<code>-setup-cmd</code>	<code>[]</code>	<i>string list</i>
<code>setup_scripts</code>	<code>-setup-script</code>	<code>[]</code>	<i>path list</i>
<code>sh_bin</code>	<code>-sh-bin</code>	<b>sh -ex</b> (with exceptions below)	<i>command</i>
<code>spark_args</code>	<code>-spark-arg</code>	<code>[]</code>	<i>string list</i>
<code>steps_interpreter</code>	<code>-steps-interpreter</code>	current Python interpreter	<i>command</i>
<code>steps_python_bin</code>	<code>-steps-python-bin</code>	(current Python interpreter)	<i>command</i>
<code>strict_protocols</code>	<code>-strict-protocols</code> , <code>-no-strict-protocols</code>	True	boolean
<code>task_python_bin</code>	<code>-task-python-bin</code>	same as <code>python_bin</code>	<i>command</i>
<code>upload_archives</code>	<code>-archive</code>	<code>[]</code>	<i>path list</i>
<code>upload_dirs</code>	<code>-dir</code>	<code>[]</code>	<i>path list</i>
<code>upload_files</code>	<code>-file</code>	<code>[]</code>	<i>path list</i>

*LocalMRJobRunner* takes no additional options, but:

- `bootstrap_mrjob` is `False` by default
- `cmdenv` uses the local system path separator instead of `:` all the time (so `;` on Windows, no change elsewhere)
- `python_bin` defaults to the current Python interpreter

In addition, it ignores `hadoop_input_format`, `hadoop_output_format`, `hadoop_streaming_jar`, and `jobconf`

*InlineMRJobRunner* works like *LocalMRJobRunner*, only it also ignores `bootstrap_mrjob`, `cmdenv`, `python_bin`, `setup_cmds`, `setup_scripts`, `steps_python_bin`, `upload_archives`, and `upload_files`.

## Additional options for DataprocJobRunner

Config	Command line	Default	Type
bootstrap	<code>--bootstrap</code>	<code>[]</code>	<i>string list</i>
bootstrap_python	<code>--bootstrap-python</code> , <code>--no-bootstrap-python</code>	True	boolean
check_cluster_every	<code>--check-cluster-every</code>	10	<i>string</i>
cloud_fs_sync_secs	<code>--cloud-fs-sync-secs</code>	5.0	<i>string</i>
cloud_tmp_dir	<code>--cloud-tmp-dir</code>	(automatic)	<i>string</i>
cluster_id	<code>--cluster-id</code>	automatically create a cluster and use it	<i>string</i>
core_instance_type	<code>--core-instance-type</code>	value of <code>instance_type</code>	<i>string</i>
image_version	<code>--image-version</code>	1.0	<i>string</i>
instance_type	<code>--instance-type</code>	'n1-standard-1'	<i>string</i>
master_instance_type	<code>--master-instance-type</code>	'n1-standard-1'	<i>string</i>
num_core_instances	<code>--num-core-instances</code>	2	<i>string</i>
num_task_instances	<code>--num-task-instances</code>	0	<i>string</i>
region	<code>--region</code>	gcloud SDK default	<i>string</i>
task_instance_type	<code>--task-instance-type</code>	value of <code>instance_type</code>	<i>string</i>
zone	<code>--zone</code>	gcloud SDK default	<i>string</i>

## Additional options for EMRJobRunner

Config	Command line	Default	Type
additional_emr_info	<code>--additional-emr-info</code>	None	special
applications	<code>--application</code>	<code>[]</code>	<i>string list</i>
aws_access_key_id		None	<i>string</i>
aws_secret_access_key	<code>--aws-secret-access-key</code>	None	<i>string</i>
aws_session_token		None	<i>string</i>
bootstrap_actions	<code>--bootstrap-actions</code>	<code>[]</code>	<i>string list</i>
bootstrap_cmds	<code>--bootstrap-cmd</code>	<code>[]</code>	<i>string list</i>
bootstrap_files	<code>--bootstrap-file</code>	<code>[]</code>	<i>path list</i>
bootstrap_python	<code>--bootstrap-python</code> , <code>--no-bootstrap-python</code>	(automatic)	boolean
bootstrap_python_packages	<code>--bootstrap-python-package</code>	<code>[]</code>	<i>path list</i>
bootstrap_scripts	<code>--bootstrap-script</code>	<code>[]</code>	<i>path list</i>
bootstrap_spark	<code>--bootstrap-spark</code> , <code>--no-bootstrap-spark</code>	(automatic)	boolean
check_cluster_every	<code>--check-cluster-every</code>	30	<i>string</i>
cloud_fs_sync_secs	<code>--cloud_fs_sync_secs</code>	5.0	<i>string</i>
cloud_log_dir	<code>--cloud-log-dir</code>	append logs to <code>cloud_tmp_dir</code>	<i>string</i>
cloud_tmp_dir	<code>--cloud-tmp-dir</code>	(automatic)	<i>string</i>
cloud_upload_part_size	<code>--cloud-upload-part-size</code>	100	integer
cluster_id	<code>--cluster-id</code>	automatically create a cluster and use it	<i>string</i>
core_instance_bid_price	<code>--core-instance-bid-price</code>	None	<i>string</i>
core_instance_type	<code>--core-instance-type</code>	value of <code>instance_type</code>	<i>string</i>
ec2_key_pair	<code>--ec2-key-pair</code>	None	<i>string</i>
ec2_key_pair_file	<code>--ec2-key-pair-file</code>	None	<i>path</i>
emr_action_on_failure	<code>--emr-action-on-failure</code>	(automatic)	<i>string</i>
emr_api_params	<code>--emr-api-param</code> , <code>--no-emr-api-param</code>	<code>{ }</code>	<i>dict</i>

Continued on next page

Table 1.1 – continued from previous page

Config	Command line	Default	Type
emr_configurations	–emr-configuration	[ ]	list of dict
emr_endpoint	–emr-endpoint	infer from region	string
enable_emr_debugging	–enable-emr-debugging	False	boolean
hadoop_streaming_jar_on_emr	–hadoop-streaming-jar-on-emr	AWS default	string
hadoop_version	–hadoop-version	None	string
iam_endpoint	–iam-endpoint	(automatic)	string
iam_instance_profile	–iam-instance-profile	(automatic)	string
iam_service_role	–iam-service-role	(automatic)	string
image_version	–image-version	'4.8.2'	string
instance_type	–instance-type	(automatic)	string
master_instance_bid_price	–master-instance-bid-price	None	string
master_instance_type	–master-instance-type	(automatic)	string
max_hours_idle	–max-hours-idle	None	string
mins_to_end_of_hour	–mins-to-end-of-hour	5.0	string
num_core_instances	–num-core-instances	0	string
num_ec2_instances	–num-ec2-instances	1	string
num_task_instances	–num-task-instances	0	string
pool_clusters	–pool-clusters	False	string
pool_name	–pool-name	'default'	string
pool_wait_minutes	–pool-wait-minutes	0	string
region	–region	'us-west-2'	string
release_label	–release-label	None	string
s3_endpoint	–s3-endpoint	(automatic)	string
ssh_bin	–ssh-bin	'ssh'	command
ssh_bind_ports	–ssh-bind-ports	range(40001, 40841)	special
ssh_tunnel	–ssh-tunnel, –no-ssh-tunnel	False	boolean
ssh_tunnel_is_open	–ssh-tunnel-is-open	False	boolean
subnet	–subnet	None	string
tags	–tag	{ }	dict
task_instance_bid_price	–task-instance-bid-price	None	string
task_instance_type	–task-instance-type	value of core_instance_type	string
visible_to_all_users	–visible-to-all-users, –no-visible-to-all-users	True	boolean
zone	zone	AWS default	string

## Additional options for HadoopJobRunner

Config	Command line	Default	Type
hadoop_bin	–hadoop-bin	(automatic)	command
hadoop_home	–hadoop-home	None	path
hadoop_log_dirs	–hadoop-log-dir	(automatic)	path list
hadoop_tmp_dir	–hadoop-tmp-dir	tmp/mrjob	path
spark_master	–spark-master	'yarn'	string
spark_submit_bin	–spark-submit-bin	(automatic)	command

## Job Environment Setup Cookbook

Many jobs have significant external dependencies, both libraries and other source code.

Combining shell syntax with Hadoop's DistributedCache notation, mrjob's `setup` option provides a powerful, dynamic alternative to pre-installing your Hadoop dependencies on every node.

All our `mrjob.conf` examples below are for the `hadoop` runner, but these work equally well with the `emr` runner. Also, if you are using EMR, take a look at the [EMR Bootstrapping Cookbook](#).

---

**Note:** Setup scripts don't work with [Spark](#); try `py_files` instead.

---

## Uploading your source tree

---

**Note:** This relies on a feature that was added in 0.5.8. See below for how to do it in earlier versions.

---

mrjob can automatically tarball your source directory and include it in your job's working directory. We can use setup scripts to upload the directory and then add it to `PYTHONPATH`.

Run your job with:

```
--setup 'export PYTHONPATH=$PYTHONPATH:your-src-code/#'
```

The `/` before the `#` tells mrjob that `your-src-code` is a directory. You may optionally include a `/` after the `#` as well (e.g. `export PYTHONPATH=$PYTHONPATH:your-source-code/#/your-lib`).

If every job you run is going to want to use `your-src-code`, you can do this in your `mrjob.conf`:

```
runners:
  hadoop:
    setup:
      - export PYTHONPATH=$PYTHONPATH:your-src-code/#
```

## Uploading your source tree as an archive

If you're using an earlier version of Python, you'll have to build the tarball yourself:

```
tar -C your-src-code -f your-src-code.tar.gz -z -c .
```

Then, run your job with:

```
--setup 'export PYTHONPATH=$PYTHONPATH:your-src-code.tar.gz#/'
```

The `/` after the `#` (without one before it) is what tells mrjob that `your-src-code.tar.gz` is an archive that Hadoop should unpack.

To do the same thing in `mrjob.conf`:

```
runners:
  hadoop:
    setup:
      - export PYTHONPATH=$PYTHONPATH:your-src-code.tar.gz#/'
```

## Running a makefile inside your source dir

```
--setup 'cd your-src-dir.tar.gz#/' --setup 'make'
```

or, in `mrjob.conf`:

```
runners:
  hadoop:
    setup:
      - cd your-src-dir.tar.gz#
      - make
```

If Hadoop runs multiple tasks on the same node, your source dir will be shared between them. This is not a problem; mrjob automatically adds locking around setup commands to ensure that multiple copies of your setup script don't run simultaneously.

## Making data files available to your job

Best practice for one or a few files is to use passthrough options; see [add\\_passthrough\\_option\(\)](#).

You can also use [upload\\_files](#) to upload file(s) into a task's working directory (or [upload\\_archives](#) for tarballs and other archives).

If you're a [setup](#) purist, you can also do something like this:

```
--setup 'true your-file#desired-name'
```

since **true** has no effect and ignores its arguments.

## Using a virtualenv

What if you can't install the libraries you need on your Hadoop cluster?

You could do something like this in your `mrjob.conf`:

```
runners:
  hadoop:
    setup:
      - virtualenv venv
      - . venv/bin/activate
      - pip install mr3po
```

However, now the locking feature that protects **make** becomes a liability; each task on the same node has its own virtualenv, but one task has to finish setting up before the next can start.

The solution is to share the virtualenv between all tasks on the same machine, something like this:

```
runners:
  hadoop:
    setup:
      - VENV=/tmp/$mapreduce_job_id
      - if [ ! -e $VENV ]; then virtualenv $VENV; fi
      - . $VENV/bin/activate
      - pip install mr3po
```

With Hadoop 1, you'd want to use `$mapred_job_id` instead of `$mapreduce_job_id`.

## Other ways to use pip to install Python packages

If you have a lot of dependencies, best practice is to make a [pip requirements](#) file and use the `-r` switch:

```
--setup 'pip install -r path/to/requirements.txt#'
```

Note that `pip` can also install from tarballs (which is useful for custom-built packages):

```
--setup 'pip install $MY_PYTHON_PKGS/*.tar.gz#'
```

## Hadoop Cookbook

### Increasing the task timeout

**Warning:** Some EMR AMIs appear to not support setting parameters like `timeout` with `jobconf` at run time. Instead, you must use *Bootstrap-time configuration*.

If your mappers or reducers take a long time to process a single step, you may want to increase the amount of time Hadoop lets them run before failing them as timeouts.

You can do this with `jobconf`. For example, to set the timeout to one hour:

```
runners:
  hadoop: # also works for emr runner
  jobconf:
    mapreduce.task.timeout: 3600000
```

**Note:** If you're using Hadoop 1, which uses `mapred.task.timeout`, don't worry: this example still works because mrjob auto-converts your `jobconf` options between Hadoop versions.

### Writing compressed output

To save space, you can have Hadoop automatically save your job's output as compressed files. Here's how you tell it to bzip them:

```
runners:
  hadoop: # also works for emr runner
  jobconf:
    # "true" must be a string argument, not a boolean! (Issue #323)
    mapreduce.output.fileoutputformat.compress: "true"
    mapreduce.output.fileoutputformat.compress.codec: org.apache.hadoop.io.compress.BZip2Codec
```

**Note:** You could also gzip your files with `org.apache.hadoop.io.compress.GzipCodec`. Usually bzip is a better option, as `.bz2` files are splittable, and `.gz` files are not. For example, if you use `.gz` files as input, Hadoop has no choice but to create one mapper per `.gz` file.

## Testing jobs

mrjob can run jobs without the help of Hadoop. This isn't very efficient, but it's a great way to test a job before submitting it to a cluster.

## Inline runner

The inline runner (*InlineMRJobRunner*) is the default runner for mrjob (it's what's used when you run `python mr_your_job.py <input>` without any `-r` option). It runs your job in a single process so that you get faster feedback and simpler tracebacks.

## Multiple splits

The inline runner doesn't run mappers or reducers concurrently, but it does run at least two mappers and two reducers for each step. This can help catch bad assumptions about the MapReduce programming model.

For example, say we wanted to write a simple script that counted the number of lines of input:

```
from mrjob.job import MRJob

class MRCountLinesWrong(MRJob):

    def mapper_init(self):
        self.num_lines = 0

    def mapper(self, _, line):
        self.num_lines += 1

    def mapper_final(self):
        yield None, self.num_lines

if __name__ == '__main__':
    MRCountLinesWrong.run()
```

Looks good, but if we run it, we get more than one line count:

```
$ python -m mrjob.examples.mr_count_lines_wrong README.rst 2> /dev/null
null          77
null          60
```

Aha! Because there can be more than one mapper! It's fine to use *mapper\_final()* like this, but we need to reduce on a single key:

```
from mrjob.job import MRJob

class MRCountLinesRight(MRJob):

    def mapper_init(self):
        self.num_lines = 0

    def mapper(self, _, line):
        self.num_lines += 1

    def mapper_final(self):
        yield None, self.num_lines

    def reducer(self, key, values):
        yield key, sum(values)

if __name__ == '__main__':
    MRCountLinesRight.run()
```

```
$ python -m mrjob.examples.mr_count_lines_right README.rst 2> /dev/null
null          137
```

Thanks, inline runner!

## Isolated working directories

Just like Hadoop, the inline runner runs each mapper and reducer in its own (temporary) working directory. It *does* add the original working directory to `$PYTHONPATH` so it can still access your local source tree.

## Simulating jobconf

The inline runner simulates jobconf variables/properties set by Hadoop (and their Hadoop 1 equivalents):

- `mapreduce.job.cache.archives` (`mapred.cache.archives`)
- `mapreduce.job.cache.files` (`mapred.cache.files`)
- `mapreduce.job.cache.local.archives` (`mapred.cache.localArchives`)
- `mapreduce.job.cache.local.files` (`mapred.cache.localFiles`)
- `mapreduce.job.id` (`mapred.job.id`)
- `mapreduce.job.local.dir` (`job.local.dir`)
- `mapreduce.map.input.file` (`map.input.file`)
- `mapreduce.map.input.length` (`map.input.length`)
- `mapreduce.map.input.start` (`map.input.start`)
- `mapreduce.task.attempt.id` (`mapred.task.id`)
- `mapreduce.task.id` (`mapred.tip.id`)
- `mapreduce.task.ismap` (`mapred.task.is.map`)
- `mapreduce.task.output.dir` (`mapred.work.output.dir`)
- `mapreduce.task.partition` (`mapred.task.partition`)

You can use `jobconf_from_env()` to read these from your job's environment. For example:

```
from mrjob.compat import jobconf_from_env
from mrjob.job import MRJob

class MRCountLinesByFile(MRJob):

    def mapper(self, _, line):
        yield jobconf_from_env('mapreduce.map.input.file'), 1

    def reducer(self, path, ones):
        yield path, sum(ones)

if __name__ == '__main__':
    MRCountLinesByFile.run()
```

```
$ python -m mrjob.examples.mr_count_lines_by_file README.rst CHANGES.txt 2> /dev/null
"CHANGES.txt"          564
"README.rst"            137
```



If you only want to simulate jobconf variables from a single version of Hadoop (for more stringent testing), you can set `hadoop_version`.

## Setting number of mappers and reducers

Want more or less splits? You can tell the inline runner the same way you'd tell hadoop, with the `mapreduce.job.maps` and `mapreduce.job.reduces` [jobconf](#) options:

```
$ python -m mrjob.examples.mr_count_lines_wrong --jobconf mapreduce.job.maps=5 README.rst 2> /dev/null
null      24
null      33
null      38
null      30
null      12
```

## Local runner

The local runner (`LocalMRJobRunner`; run using `-r local`) supports the above features, but, unlike the inline runner, it uses subprocesses.

This means it can be used to test options that don't make sense in a single-process context, including:

- `python_bin`
- `setup`
- `steps_python_bin`

The local runner *does* run multiple subprocesses concurrently, but it's not really meant as a replacement for Hadoop; it's just for testing!

## Anatomy of a test case

So, you've gotten a job working. Great! Here's how you write a regression test so that future developers won't break it.

For this example we'll use a test of the `*_init()` methods from the mrjob test cases:

```
from mrjob.job import MRJob

class MRInitJob(MRJob):

    def __init__(self, *args, **kwargs):
        super(MRInitJob, self).__init__(*args, **kwargs)
        self.sum_amount = 0
        self.multiplier = 0
        self.combiner_multiplier = 1

    def mapper_init(self):
        self.sum_amount += 10

    def mapper(self, key, value):
        yield(None, self.sum_amount)

    def reducer_init(self):
        self.multiplier += 10
```

```
def reducer(self, key, values):
    yield(None, sum(values) * self.multiplier)

def combiner_init(self):
    self.combiner_multiplier = 2

def combiner(self, key, values):
    yield(None, sum(values) * self.combiner_multiplier)
```

Without using any mrjob features, we can write a simple test case to make sure our methods are behaving as expected:

```
from unittest import TestCase

class MRInitTestCase(TestCase):

    def test_mapper(self):
        j = MRInitJob()
        j.mapper_init()
        self.assertEqual(j.mapper(None, None).next(), (None, j.sum_amount))
```

To test the full job, you need to set up input, run the job, and check the collected output. The most straightforward way to provide input is to use the `sandbox()` method. Create a `BytesIO` object, populate it with data, initialize your job to read from stdin, and enable the sandbox with your `BytesIO` as stdin.

You'll probably also want to specify `--no-conf` so options from your local `mrjob.conf` don't pollute your testing environment.

This example reads from **stdin** (hence the `-` parameter):

```
from io import BytesIO

def test_init_funcs(self):
    num_inputs = 2
    stdin = BytesIO(b'x\n' * num_inputs)
    mr_job = MRInitJob(['--no-conf', '-'])
    mr_job.sandbox(stdin=stdin)
```

To run the job without leaving temp files on your system, use the `make_runner()` context manager. `make_runner()` creates the runner specified in the command line arguments and ensures that job cleanup is performed regardless of the success or failure of the job.

Run the job with `run()`. The output lines are available as a generator through `stream_output()` and can be interpreted through the job's output protocol with `parse_output_line()`. You may choose to collect these lines in a list and check the contents of the list.

**Warning:** Do not let your tests depend on the input lines being processed in a certain order. Both mrjob and Hadoop divide input non-deterministically.

```
results = []
with mr_job.make_runner() as runner:
    runner.run()
    for line in runner.stream_output():
        # Use the job's specified protocol to read the output
        key, value = mr_job.parse_output_line(line)
        results.append(value)

# these numbers should match if mapper_init, reducer_init, and
```

```
# combiner_init were called as expected
self.assertEqual(results[0], num_inputs * 10 * 10 * 2)
```

## Cloud Dataproc

### Dataproc Quickstart

#### Configuring Google Cloud Platform (GCP) credentials

Configuring your GCP credentials allows mrjob to run your jobs on Dataproc and use GCS.

- [Create a Google Cloud Platform account](#), see top-right
- [Learn about Google Cloud Platform “projects”](#)
- [Select or create a Cloud Platform Console project](#)
- [Enable billing for your project](#)
- Go to the [API Manager](#) and search for / enable the following APIs...
  - Google Cloud Storage
  - Google Cloud Storage JSON API
  - Google Cloud Dataproc API
- Under Credentials, **Create Credentials** and select **Service account key**. Then, select **New service account**, enter a Name and select **Key type** JSON.
- Install the [Google Cloud SDK](#)

[Dataproc Documentation](#)

[How GCP Default credentials work](#)

#### Running a Dataproc Job

Running a job on Dataproc is just like running it locally or on your own Hadoop cluster, with the following changes:

- The job and related files are uploaded to GCS before being run
- The job is run on Dataproc (of course)
- Output is written to GCS before mrjob streams it to stdout locally
- The Hadoop version is specified by the [Dataproc version](#)

This the output of this command should be identical to the output shown in [Fundamentals](#), but it should take much longer:

```
> python word_count.py -r dataproc README.txt
"chars" 3654
"lines" 123
"words" 417
```

## Sending Output to a Specific Place

If you'd rather have your output go to somewhere deterministic on GCS, which you probably do, use `--output-dir`:

```
> python word_count.py -r dataproc README.rst \
>   --output-dir=gs://my-bucket/wc_out/
```

It's also likely that since you know where your output is on GCS, you don't want output streamed back to your local machine. For that, use `-no-output`:

```
> python word_count.py -r dataproc README.rst \
>   --output-dir=gs://my-bucket/wc_out/ \
>   --no-output
```

There are many other ins and outs of effectively using mrjob with Dataproc. This is a strictly no-outs body of documentation!

## Choosing Type and Number of GCE Instances

When you create a cluster on Dataproc, you'll have the option of specifying a number and type of GCE instances, which are basically virtual machines. Each instance type has different memory, CPU, I/O and network characteristics, and costs a different amount of money. See [Machine Types](#) and [Pricing](#) for details.

Instances perform one of three roles:

- **Master:** There is always one master instance. It handles scheduling of tasks (i.e. mappers and reducers), but does not run them itself.
- **Worker:** You may have one or more worker instances. These run tasks and host HDFS.
- **Preemptible Worker:** You may have zero or more of these. These run tasks, but do *not* host HDFS. This is mostly useful because your cluster can lose task instances without killing your job (see [Preemptible VMs](#)).

By default, mrjob runs a single `n1-standard-1`, which is a cheap but not very powerful instance type. This can be quite adequate for testing your code on a small subset of your data, but otherwise give little advantage over running a job locally. To get more performance out of your job, you can either add more instances, use more powerful instances, or both.

Here are some things to consider when tuning your instance settings:

- Google Cloud bills you a 10-minute minimum even if your cluster only lasts for a few minutes (this is an artifact of the Google Cloud billing structure), so for many jobs that you run repeatedly, it is a good strategy to pick instance settings that make your job consistently run in a little less than 10 minutes.
- Your job will take much longer and may fail if any task (usually a reducer) runs out of memory and starts using swap. (You can verify this by using `vmstat`.) Restructuring your job is often the best solution, but if you can't, consider using a high-memory instance type.
- Larger instance types are usually a better deal if you have the workload to justify them. For example, a `n1-highcpu-8` costs about 6 times as much as an `n1-standard-1`, but it has about 8 times as much processing power (and more memory).

The basic way to control type and number of instances is with the `instance_type` and `num_core_instances` options, on the command line like this:

```
--instance-type n1-highcpu-8 --num-core-instances 4
```

or in `mrjob.conf`, like this:

```
runners:
  dataproc:
    instance_type: n1-highcpu-8
    num_core_instances: 4
```

In most cases, your master instance type doesn't need to be larger than `n1-standard-1` to schedule tasks. *instance\_type* only applies to instances that actually run tasks. (In this example, there are 1 `n1-standard-1` master instance, and 4 `n1-highcpu-8` worker instances.) You *will* need a larger master instance if you have a very large number of input files; in this case, use the [master\\_instance\\_type](#) option.

If you want to run preemptible instances, use the [task\\_instance\\_type](#) and [num\\_task\\_instances](#) options.

## Limitations

mrjob's Dataproc implementation is relatively new and does not yet have some features supported by other runners, including:

- fetching counters
- finding probable cause of errors
- running Java JARs as steps
- [libjars](#) support

## Dataproc runner options

All options from [Options available to all runners](#) and [Hadoop-related options](#) are available to Dataproc runner.

## Google credentials

See [Configuring Google Cloud Platform \(GCP\) credentials](#) for specific instructions about setting these options.

## Choosing/creating a cluster to join

**cluster\_id** (**--cluster-id**) [*string*] **Default:** automatically create a cluster and use it

The ID of a persistent Dataproc cluster to run jobs in. It's fine for other jobs to be using the cluster; we give our job's steps a unique ID.

## Cluster creation and configuration

**zone** (**--zone**) [*string*] **Default:** gcloud SDK default

Availability zone to run the job in

**region** (**--region**) [*string*] **Default:** gcloud SDK default

region to run Dataproc jobs on (e.g. `us-central-1`). Also used by mrjob to create temporary buckets if you don't set [cloud\\_tmp\\_dir](#) explicitly.

**image\_version** (**--image-version**) [*string*] **Default:** 1.0

Cloud Image to run Dataproc jobs on. See [the Dataproc docs on specifying the Dataproc version](#). for details.

## Bootstrapping

These options apply at *bootstrap time*, before the Hadoop cluster has started. Bootstrap time is a good time to install Debian packages or compile and install another Python binary.

**bootstrap** (**--bootstrap**) [*string list*] **Default:** []

A list of lines of shell script to run once on each node in your cluster, at bootstrap time.

Passing expressions like `path#name` will cause *path* to be automatically uploaded to the task's working directory with the filename *name*, marked as executable, and interpolated into the script by their absolute path on the machine running the script. *path* may also be a URI, and `~` and environment variables within *path* will be resolved based on the local environment. *name* is optional. For details of parsing, see `parse_setup_cmd()`.

Unlike with `setup`, archives are not supported (unpack them yourself).

Remember to put `sudo` before commands requiring root privileges!

**bootstrap\_python** (**--bootstrap-python**, **--no-bootstrap-python**) [boolean] **Default:** True

Attempt to install a compatible version of Python at bootstrap time, including `pip` and development libraries (so you can build Python packages written in C).

This is useful even in Python 2, which is installed by default, but without `pip` and development libraries.

## Monitoring the cluster

**check\_cluster\_every** (**--check-cluster-every**) [*string*] **Default:** 10

How often to check on the status of Dataproc jobs in seconds. If you set this too low, GCP will throttle you.

## Number and type of instances

**instance\_type** (**--instance-type**) [*string*] **Default:** 'n1-standard-1'

What sort of GCE instance(s) to use on the nodes that actually run tasks (see <https://cloud.google.com/compute/docs/machine-types>). When you run multiple instances (see `instance_type`), the master node is just coordinating the other nodes, so usually the default instance type (`n1-standard-1`) is fine, and using larger instances is wasteful.

**master\_instance\_type** (**--master-instance-type**) [*string*] **Default:** 'n1-standard-1'

like `instance_type`, but only for the master Hadoop node. This node hosts the task tracker and HDFS, and runs tasks if there are no other nodes. Usually you just want to use `instance_type`.

**core\_instance\_type** (**--core-instance-type**) [*string*] **Default:** value of `instance_type`

like `instance_type`, but only for worker Hadoop nodes; these nodes run tasks and host HDFS. Usually you just want to use `instance_type`.

**task\_instance\_type** (**--task-instance-type**) [*string*] **Default:** value of `instance_type`

like `instance_type`, but only for the task Hadoop nodes; these nodes run tasks but do not host HDFS. Usually you just want to use `instance_type`.

**num\_core\_instances** (**--num-core-instances**) [*string*] **Default:** 2

Number of worker instances to start up. These run your job and host HDFS.

**num\_task\_instances** (`--num-task-instances`) [*string*] **Default:** 0

Number of task instances to start up. These run your job but do not host HDFS. If you use this, you must set `num_core_instances`; Dataproc does not allow you to run task instances without core instances (because there's nowhere to host HDFS).

## FS paths and options

MRJob uses google-api-python-client to manipulate/access FS.

**cloud\_tmp\_dir** (`--cloud-tmp-dir`) [*string*] **Default:** (automatic)

GCS directory (URI ending in `/`) to use as temp space, e.g. `gs://yourbucket/tmp/`.

By default, mrjob looks for a bucket belong to you whose name starts with `mrjob-` and which matches [region](#). If it can't find one, it creates one with a random name. This option is then set to `tmp/` in this bucket (e.g. `gs://mrjob-01234567890abcdef/tmp/`).

**cloud\_fs\_sync\_secs** (`--cloud-fs-sync-secs`) [*string*] **Default:** 5.0

How long to wait for GCS to reach eventual consistency. This is typically less than a second, but the default is 5.0 to be safe.

# Elastic MapReduce

## Elastic MapReduce Quickstart

### Configuring AWS credentials

Configuring your AWS credentials allows mrjob to run your jobs on Elastic MapReduce and use S3.

- Create an [Amazon Web Services account](#)
- Go to [Security Credentials](#) in the login menu (upper right, third from the right), say yes, you want to proceed, click on **Access Keys**, and then **Create New Access Key**. Make sure to copy the secret access key, as there is no way to recover it after creation.

Now you can either set the environment variables `AWS_ACCESS_KEY_ID` and `AWS_SECRET_ACCESS_KEY`, or set `aws_access_key_id` and `aws_secret_access_key` in your `mrjob.conf` file like this:

```
runners:
  emr:
    aws_access_key_id: <your key ID>
    aws_secret_access_key: <your secret>
```

### Configuring SSH credentials

Configuring your SSH credentials lets mrjob open an SSH tunnel to your jobs' master nodes to view live progress, see the job tracker in your browser, and fetch error logs quickly.

- Go to <https://console.aws.amazon.com/ec2/home>
- Make sure the **Region** dropdown (upper right, second from the right) matches the region you want to run jobs in (usually "Oregon").
- Click on **Key Pairs** (left sidebar, under **Network & Security**)

- Click on **Create Key Pair** (top left).
- Name your key pair EMR (any name will work but that's what we're using in this example)
- Save `EMR.pem` wherever you like (`~/ .ssh` is a good place)
- Run `chmod og-rwx /path/to/EMR.pem` so that `ssh` will be happy
- Add the following entries to your `mrjob.conf`:

```
runners:
  emr:
    ec2_key_pair: EMR
    ec2_key_pair_file: /path/to/EMR.pem # ~/ and $ENV_VARS allowed here
    ssh_tunnel: true
```

## Running an EMR Job

Running a job on EMR is just like running it locally or on your own Hadoop cluster, with the following changes:

- The job and related files are uploaded to S3 before being run
- The job is run on EMR (of course)
- Output is written to S3 before mrjob streams it to stdout locally
- The Hadoop version is specified by the EMR AMI version

This the output of this command should be identical to the output shown in [Fundamentals](#), but it should take much longer:

```
> python word_count.py -r emr README.txt "chars" 3654 "lines" 123 "words" 417
```

## Sending Output to a Specific Place

If you'd rather have your output go to somewhere deterministic on S3, which you probably do, use `--output-dir`:

```
> python word_count.py -r emr README.rst \
> --output-dir=s3://my-bucket/wc_out/
```

It's also likely that since you know where your output is on S3, you don't want output streamed back to your local machine. For that, use `-no-output`:

```
> python word_count.py -r emr README.rst \
> --output-dir=s3://my-bucket/wc_out/ \
> --no-output
```

There are many other ins and outs of effectively using mrjob with EMR. See [Advanced EMR usage](#) for some of the ins, but the outs are left as an exercise for the reader. This is a strictly no-outs body of documentation!

## Choosing Type and Number of EC2 Instances

When you create a cluster on EMR, you'll have the option of specifying a number and type of EC2 instances, which are basically virtual machines. Each instance type has different memory, CPU, I/O and network characteristics, and costs a different amount of money. See [Instance Types](#) and [Pricing](#) for details.

Instances perform one of three roles:

- **Master:** There is always one master instance. It handles scheduling of tasks (i.e. mappers and reducers), but does not run them itself.



- **Core:** You may have one or more core instances. These run tasks and host HDFS.
- **Task:** You may have zero or more of these. These run tasks, but do *not* host HDFS. This is mostly useful because your cluster can lose task instances without killing your job (see *Spot Instances*).

There's a special case where your cluster *only* has a single master instance, in which case the master instance schedules tasks, runs them, and hosts HDFS.

By default, `mrjob` runs a single `m1.medium`, which is a cheap but not very powerful instance type. This can be quite adequate for testing your code on a small subset of your data, but otherwise give little advantage over running a job locally. To get more performance out of your job, you can either add more instances, use more powerful instances, or both.

Here are some things to consider when tuning your instance settings:

- Amazon bills you for the full hour even if your cluster only lasts for a few minutes (this is an artifact of the EC2 billing structure), so for many jobs that you run repeatedly, it is a good strategy to pick instance settings that make your job consistently run in a little less than an hour.
- Your job will take much longer and may fail if any task (usually a reducer) runs out of memory and starts using swap. (You can verify this by running `mrjob boss j-CLUSTERID vmstat` and then looking in `j-CLUSTERID/*/stdout`.) Restructuring your job is often the best solution, but if you can't, consider using a high-memory instance type.
- Larger instance types are usually a better deal if you have the workload to justify them. For example, a `c1.xlarge` costs about 6 times as much as an `m1.medium`, but it has about 8 times as much processing power (and more memory).

The basic way to control type and number of instances is with the `instance_type` and `num_core_instances` options, on the command line like this:

```
--instance-type c1.medium --num-core-instances 4
```

or in `mrjob.conf`, like this:

```
runners:
  emr:
    instance_type: c1.medium
    num_core_instances: 4
```

In most cases, your master instance type doesn't need to be larger than `m1.medium` to schedule tasks, so `instance_type` only applies to the 4 instances that actually run tasks. You *will* need a larger master instance if you have a very large number of input files; in this case, use the `master_instance_type` option.

The `num_task_instances` option can be used to run 1 or more task instances (these run tasks but don't host HDFS). There are also `core_instance_type` and `task_instance_type` options if you want to set these directly.

## EMR runner options

All options from [Options available to all runners](#) and [Hadoop-related options](#) are available to the emr runner.

### Amazon credentials

See [Configuring AWS credentials](#) and [Configuring SSH credentials](#) for specific instructions about setting these options.

**aws\_access\_key\_id** *[string]* **Default:** None

“Username” for Amazon web services.

There isn't a command-line switch for this option because credentials are supposed to be secret! Use the environment variable `AWS_ACCESS_KEY_ID` instead.

**aws\_secret\_access\_key** (`--aws-secret-access-key`) [*string*] **Default:** None

Your "password" on AWS.

There isn't a command-line switch for this option because credentials are supposed to be secret! Use the environment variable `AWS_SECRET_ACCESS_KEY` instead.

**aws\_session\_token** [*string*] **Default:** None

Temporary AWS session token, used along with `aws_access_key_id` and `aws_secret_access_key` when using temporary credentials.

There isn't a command-line switch for this option because credentials are supposed to be secret! Use the environment variable `AWS_SECURITY_TOKEN` instead.

Changed in version 0.5.10: this used to be called `aws_security_token`.

**ec2\_key\_pair** (`--ec2-key-pair`) [*string*] **Default:** None

name of the SSH key you set up for EMR.

**ec2\_key\_pair\_file** (`--ec2-key-pair-file`) [*path*] **Default:** None

path to file containing the SSH key for EMR

## Cluster creation and configuration

**additional\_emr\_info** (`--additional-emr-info`) [*special*] **Default:** None

Special parameters to select additional features, mostly to support beta EMR features. Pass a JSON string on the command line or use data structures in the config file (which is itself basically JSON).

**applications** (`--application`) [*string list*] **Default:** []

Additional applications to run on 4.x AMIs (e.g. 'Ganglia', 'Mahout', 'Spark').

You do not need to specify 'Hadoop'; mrjob will always include it automatically. In most cases it'll auto-detect when to include 'Spark' as well.

See [Applications](#) in the EMR docs for more details.

New in version 0.5.2.

Changed in version 0.5.9: This used to be called `emr_applications`.

**emr\_api\_params** (`--emr-api-param`, `--no-emr-api-param`) [*dict*] **Default:** {}

Additional raw parameters to pass directly to the EMR API when creating a cluster. This allows old versions of *mrjob* to access new API features. See [the API documentation for RunJobFlow](#) for the full list of options.

Option names and values are strings. On the command line, to set an option use `--emr-api-param KEY=VALUE`:

```
--emr-api-param Instances.Ec2SubnetId=someID
```

and to suppress a value that would normally be passed to the API, use `--no-emr-api-param`:

```
--no-emr-api-param VisibleToAllUsers
```

In the config file, `emr_api_params` is a dict; params can be suppressed by setting them to null:

```
runners:
  emr:
    emr_api_params:
      Instances.Ec2SubnetId: someID
      VisibleToAllUsers: null
```

New in version 0.4.3.

**emr\_configurations** (**--emr-configuration**) [list of dicts] **Default:** []

Configurations for 4.x AMIs. For example:

```
runners:
  emr:
    emr_configurations:
      - Classification: core-site
        Properties:
          hadoop.security.groups.cache.secs: 250
```

On the command line, configurations should be JSON-encoded:

```
--emr-configuration '{"Classification": "core-site", ...}'
```

See [Configuring Applications](#) in the EMR docs for more details.

New in version 0.5.3.

**emr\_endpoint** (**--emr-endpoint**) [*string*] **Default:** infer from [region](#)

Force mrjob to connect to EMR on this endpoint (e.g. `us-west-1.elasticmapreduce.amazonaws.com`).

Mostly exists as a workaround for network issues.

**hadoop\_streaming\_jar\_on\_emr** (**--hadoop-streaming-jar-on-emr**) [*string*] **Default:** AWS default

Deprecated since version 0.5.4: Prepend `file://` and pass that to `hadoop_streaming_jar` instead.

**iam\_endpoint** (**--iam-endpoint**) [*string*] **Default:** (automatic)

Force mrjob to connect to IAM on this endpoint (e.g. `iam.us-gov.amazonaws.com`).

Mostly exists as a workaround for network issues.

**iam\_instance\_profile** (**--iam-instance-profile**) [*string*] **Default:** (automatic)

Name of an IAM instance profile to use for EC2 clusters created by EMR. See <http://docs.aws.amazon.com/ElasticMapReduce/latest/DeveloperGuide/emr-iam-roles.html> for more details on using IAM with EMR.

New in version 0.4.3.

**iam\_service\_role** (**--iam-service-role**) [*string*] **Default:** (automatic)

Name of an IAM role for the EMR service to use. See <http://docs.aws.amazon.com/ElasticMapReduce/latest/DeveloperGuide/emr-iam-roles.html> for more details on using IAM with EMR.

New in version 0.4.4.

**image\_version** (**--image-version**) [*string*] **Default:** '4.8.2'

EMR AMI (Amazon Machine Image) version to use. This controls which Hadoop version(s) are available and which version of Python is installed, among other things; see [the AWS docs on specifying the AMI version](#). for details.

This works for 4.x AMIs as well; mrjob will just prepend `emr-` and use that as the [release\\_label](#).

Changed in version 0.5.4: This used to be called *ami\_version*.

Changed in version 0.5.7: Default used to be `'3.11.0'`.

**Warning:** The deprecated `ami_version` alias for this option is completely ignored by mrjob 0.5.4 (it works in later 0.5.x versions).

**Warning:** The 2.x series of AMIs is deprecated by Amazon and not recommended.

**Warning:** The 1.x series of AMIs is no longer supported because they use Python 2.5.

**max\_hours\_idle** (`--max-hours-idle`) [*string*] **Default:** None

If we create a persistent cluster, have it automatically terminate itself after it's been idle this many hours AND we're within `mins_to_end_of_hour` of an EC2 billing hour.

New in version 0.4.1.

**mins\_to\_end\_of\_hour** (`--mins-to-end-of-hour`) [*string*] **Default:** 5.0

If `max_hours_idle` is set, controls how close to the end of an EC2 billing hour the cluster can automatically terminate itself.

New in version 0.4.1.

**region** (`--region`) [*string*] **Default:** `'us-west-2'`

region to run EMR jobs on (e.g. `us-west-1`). Also used by mrjob to create temporary buckets if you don't set `cloud_tmp_dir` explicitly.

Changed in version 0.5.4: This option used to be named `aws_region`.

**release\_label** (`--release-label`) [*string*] **Default:** None

EMR Release to use (e.g. `emr-4.0.0`). This overrides `image_version`.

For more information about Release Labels, see [Differences Introduced in 4.x](#).

New in version 0.5.0.

**subnet** (`--subnet`) [*string*] **Default:** None

ID of Amazon VPC subnet to launch cluster in (e.g. `'subnet-12345678'`). If this is not set, or an empty string, cluster will be launched in the normal AWS cloud.

New in version 0.5.3.

**tags** (`--tag`) [*dict*] **Default:** `{ }`

Metadata tags to apply to the EMR cluster after its creation. See [Tagging Amazon EMR Clusters](#) for more information on applying metadata tags to EMR clusters.

Tag names and values are strings. On the command line, to set a tag use `--tag KEY=VALUE`:

```
--tag team=development
```

In the config file, `tags` is a dict:

```
runners:
  emr:
    tags:
      team: development
      project: mrjob
```

Changed in version 0.5.4: This option used to be named *emr\_tags*

New in version 0.4.5.

**visible\_to\_all\_users** (**--visible-to-all-users**, **--no-visible-to-all-users**) [boolean] **Default:** True

If true (the default) EMR clusters will be visible to all IAM users. Otherwise, the cluster will only be visible to the IAM user that created it.

**Warning:** You should almost certainly not set this to False if you are *Pooling Clusters* with other users; other users will not be able to reuse your clusters, and **mrjob terminate-idle-clusters** won't be able to shut them down when they become idle.

New in version 0.4.1.

**zone** (**zone**) [*string*] **Default:** AWS default

Availability zone to run the job in

Changed in version 0.5.4: This option used to be named *aws\_availability\_zone*

## Bootstrapping

These options apply at *bootstrap time*, before the Hadoop cluster has started. Bootstrap time is a good time to install Debian packages or compile and install another Python binary.

**bootstrap** (**--bootstrap**) [*string list*] **Default:** []

A list of lines of shell script to run once on each node in your cluster, at bootstrap time.

This option is complex and powerful; the best way to get started is to read the [EMR Bootstrapping Cookbook](#).

Passing expressions like `path#name` will cause *path* to be automatically uploaded to the task's working directory with the filename *name*, marked as executable, and interpolated into the script by their absolute path on the machine running the script.

*path* may also be a URI, and `~` and environment variables within *path* will be resolved based on the local environment. *name* is optional. For details of parsing, see `parse_setup_cmd()`.

Unlike with `setup`, archives are not supported (unpack them yourself).

Remember to put `sudo` before commands requiring root privileges!

**bootstrap\_actions** (**--bootstrap-actions**) [*string list*] **Default:** []

A list of raw bootstrap actions (essentially scripts) to run prior to any of the other bootstrap steps. Any arguments should be separated from the command by spaces (we use `shlex.split()`). If the action is on the local filesystem, we'll automatically upload it to S3.

This has little advantage over `bootstrap`; it is included in order to give direct access to the EMR API.

**bootstrap\_cmds** (**--bootstrap-cmd**) [*string list*] **Default:** []

Deprecated since version 0.4.2.

A list of commands to run at bootstrap time. Basically `bootstrap` without automatic file uploading/interpolation. Can also take commands as lists of arguments.

**bootstrap\_files** (**--bootstrap-file**) [*path list*] **Default:** []

Deprecated since version 0.4.2.

Files to download to the bootstrap working directory before running bootstrap commands. Use the `bootstrap` option's file auto-upload/interpolation feature instead.

**bootstrap\_python** (`--bootstrap-python`, `--no-bootstrap-python`) [boolean] **Default:** (automatic)

Attempt to install a compatible (major) version of Python at bootstrap time, including header files and `pip` (see *Installing Python packages with pip*).

In Python 2, this never does anything.

In Python 3, this runs `sudo yum install -y python34 python34-devel python34-pip` by default on AMIs prior to 4.6.0 (starting with AMI 4.6.0, Python 3 is pre-installed).

New in version 0.5.0.

Changed in version 0.5.4: no longer installs Python 3 on AMI version 4.6.0+ by default

**bootstrap\_spark** (`--bootstrap-spark`, `--no-bootstrap-spark`) [boolean] **Default:** (automatic)

Install Spark on the cluster. This works on AMI version 3.x and later.

By default, we automatically install Spark only if our job has Spark steps.

New in version 0.5.7.

In case you're curious, here's how mrjob determines you're using Spark:

- any *SparkStep* or *SparkScriptStep* in your job's steps (including implicitly through the *spark* method)
- "Spark" included in `applications` option
- any bootstrap action (see `bootstrap_actions`) ending in `/spark-install` (this is how you install Spark on 3.x AMIs)

**bootstrap\_python\_packages** (`--bootstrap-python-package`) [*path list*] **Default:** []

Deprecated since version 0.4.2.

Paths of python modules tarballs to install on EMR. Pass `sudo python_bin -m pip install path/to/package.tar.gz#` to `bootstrap` instead.

Also, please consider installing packages directly from PyPI instead ( `sudo python_bin -m pip install package1 package2`); PyPI is much, much more robust/production-ready than when this option was first created.

**bootstrap\_scripts** (`--bootstrap-script`) [*path list*] **Default:** []

Deprecated since version 0.4.2.

Scripts to upload and then run at bootstrap time. Pass `path/to/script# args` to `bootstrap` instead.

## Monitoring the cluster

**check\_cluster\_every** (`--check-cluster-every`) [*string*] **Default:** 30

How often to check on the status of EMR jobs in seconds. If you set this too low, AWS will throttle you.

Changed in version 0.5.4: This used to be called *check\_emr\_status\_every*

**enable\_emr\_debugging** (`--enable-emr-debugging`) [boolean] **Default:** False

store Hadoop logs in SimpleDB

## Number and type of instances

**instance\_type** (**--instance-type**) [*string*] **Default:** (automatic)

By default, mrjob picks the cheapest instance type that will work at all. This is usually `m1.medium`, with two exceptions:

- `m1.large` if you're running Spark (see [bootstrap\\_spark](#))
- `m1.small` if you're running on the (deprecated) 2.x AMIs

Once you've tested a job and want to run it at scale, it's usually a good idea to use instances larger than the default; see <http://aws.amazon.com/ec2/instance-types/> for options.

If you're running multiple nodes (see [num\\_core\\_instances](#)), this option *doesn't* apply to the master node because it's just coordinating tasks, not running them. Use [master\\_instance\\_type](#) instead.

Changed in version 0.5.6: Used to default to `m1.medium` in all cases.

Changed in version 0.5.4: This option used to be named `ec2_instance_type`.

**core\_instance\_type** (**--core-instance-type**) [*string*] **Default:** value of [instance\\_type](#)

like [instance\\_type](#), but only for the core Hadoop nodes; these nodes run tasks and host HDFS. Usually you just want to use [instance\\_type](#).

Changed in version 0.5.4: This replaces the `ec2_core_instance_type` and `ec2_slave_instance_type` options.

**core\_instance\_bid\_price** (**--core-instance-bid-price**) [*string*] **Default:** None

When specified and not "0", this creates the core Hadoop nodes as spot instances at this bid price. You usually only want to set bid price for task instances.

Changed in version 0.5.4: This option used to be named `ec2_core_instance_bid_price`.

**master\_instance\_type** (**--master-instance-type**) [*string*] **Default:** (automatic)

like [instance\\_type](#), but only for the master Hadoop node. This node hosts the task tracker/resource manager and HDFS, and runs tasks if there are no other nodes.

If you're running a single node (no [num\\_core\\_instances](#) or [num\\_task\\_instances](#)), this will default to the value of [instance\\_type](#).

Otherwise, defaults to `m1.medium` (exception: `m1.small` on the deprecated 2.x AMIs), which is usually adequate for all but the largest jobs.

Changed in version 0.5.4: This option used to be named `ec2_master_instance_type`.

**master\_instance\_bid\_price** (**--master-instance-bid-price**) [*string*] **Default:** None

When specified and not "0", this creates the master Hadoop node as a spot instance at this bid price. You usually only want to set bid price for task instances unless the master instance is your only instance.

Changed in version 0.5.4: This option used to be named `ec2_master_instance_bid_price`.

**task\_instance\_type** (**--task-instance-type**) [*string*] **Default:** value of [core\\_instance\\_type](#)

like [instance\\_type](#), but only for the task Hadoop nodes; these nodes run tasks but do not host HDFS. Usually you just want to use [instance\\_type](#).

Changed in version 0.5.4: This option used to be named `ec2_task_instance_type`.

**task\_instance\_bid\_price** (**--task-instance-bid-price**) [*string*] **Default:** None

When specified and not "0", this creates the master Hadoop node as a spot instance at this bid price. (You usually only want to set bid price for task instances.)

Changed in version 0.5.4: This option used to be named *ec2\_task\_instance\_bid\_price*.

**num\_core\_instances** (**--num-core-instances**) [*string*] **Default:** 0

Number of core instances to start up. These run your job and host HDFS. This is in addition to the single master instance.

Changed in version 0.5.4: This option used to be named *num\_ec2\_core\_instances*.

**num\_ec2\_instances** (**--num-ec2-instances**) [*string*] **Default:** 1

Total number of instances to start up; basically the number of core instance you want, plus 1 (there is always one master instance). Incompatible with [num\\_core\\_instances](#) and [num\\_task\\_instances](#).

Deprecated since version 0.5.4: Just subtract one and pass that to [num\\_core\\_instances](#).

**num\_task\_instances** (**--num-task-instances**) [*string*] **Default:** 0

Number of task instances to start up. These run your job but do not host HDFS. Incompatible with [num\\_ec2\\_instances](#). If you use this, you must set [num\\_core\\_instances](#); EMR does not allow you to run task instances without core instances (because there's nowhere to host HDFS).

Changed in version 0.5.4: This used to be called *num\_ec2\_task\_instances*.

## Choosing/creating a cluster to join

**cluster\_id** (**--cluster-id**) [*string*] **Default:** automatically create a cluster and use it

The ID of a persistent EMR cluster to run jobs in. It's fine for other jobs to be using the cluster; we give our job's steps a unique ID.

**emr\_action\_on\_failure** (**--emr-action-on-failure**) [*string*] **Default:** (automatic)

What happens if step of your job fails

- 'CANCEL\_AND\_WAIT' cancels all steps on the cluster
- 'CONTINUE' continues to the next step (useful when submitting several jobs to the same cluster)
- 'TERMINATE\_CLUSTER' shuts down the cluster entirely

The default is 'CANCEL\_AND\_WAIT' when using pooling (see [pool\\_clusters](#)) or an existing cluster (see [cluster\\_id](#)), and 'TERMINATE\_CLUSTER' otherwise.

New in version 0.4.3.

**pool\_name** (**--pool-name**) [*string*] **Default:** 'default'

Specify a pool name to join. Does not imply [pool\\_clusters](#).

**pool\_clusters** (**--pool-clusters**) [*string*] **Default:** False

Try to run the job on a *WAITING* pooled cluster with the same bootstrap configuration. Prefer the one with the most compute units. Use S3 to "lock" the cluster and ensure that the job is not scheduled behind another job. If no suitable cluster is *WAITING*, create a new pooled cluster.

**Warning:** Do not run this without either setting [max\\_hours\\_idle](#) (recommended) or putting **mrjob terminate-idle-clusters** in your crontab; clusters left idle can quickly become expensive!

Changed in version 0.5.4: Pooling now gracefully recovers from joining a cluster that was in the process of shutting down (see [max\\_hours\\_idle](#)).



**pool\_wait\_minutes** (**--pool-wait-minutes**) [*string*] **Default:** 0

If pooling is enabled and no cluster is available, retry finding a cluster every 30 seconds until this many minutes have passed, then start a new cluster instead of joining one.

## S3 paths and options

MRJob uses boto to manipulate/access S3.

**cloud\_log\_dir** (**--cloud-log-dir**) [*string*] **Default:** append logs to `cloud_tmp_dir`

Where on S3 to put logs, for example `s3://yourbucket/logs/`. Logs for your cluster will go into a subdirectory, e.g. `s3://yourbucket/logs/j-CLUSTERID/`.

Changed in version 0.5.4: This option used to be named `s3_log_uri`

**cloud\_tmp\_dir** (**--cloud-tmp-dir**) [*string*] **Default:** (automatic)

S3 directory (URI ending in `/`) to use as temp space, e.g. `s3://yourbucket/tmp/`.

By default, mrjob looks for a bucket belong to you whose name starts with `mrjob-` and which matches `region`. If it can't find one, it creates one with a random name. This option is then set to `tmp/` in this bucket (e.g. `s3://mrjob-01234567890abcdef/tmp/`).

Changed in version 0.5.4: This used to be called `s3_tmp_dir`.

Changed in version 0.5.0: This used to be called `s3_scratch_uri`.

**cloud\_fs\_sync\_secs** (**--cloud-fs-sync-secs**) [*string*] **Default:** 5.0

How long to wait for S3 to reach eventual consistency. This is typically less than a second (zero in U.S. West), but the default is 5.0 to be safe.

Changed in version 0.5.4: This used to be called `s3_sync_wait_time`

**cloud\_upload\_part\_size** (**--cloud-upload-part-size**) [*integer*] **Default:** 100

Upload files to S3 in parts no bigger than this many megabytes (technically, `mebibytes`). Default is 100 MiB, as recommended by Amazon. Set to 0 to disable multipart uploading entirely.

Currently, Amazon requires parts to be between 5 MiB and 5 GiB. mrjob does not enforce these limits.

Changed in version 0.5.4: This used to be called `s3_upload_part_size`.

**s3\_endpoint** (**--s3-endpoint**) [*string*] **Default:** (automatic)

Force mrjob to connect to S3 on this endpoint, rather than letting it choose the appropriate endpoint for each S3 bucket.

Mostly exists as a workaround for network issues.

**Warning:** If you set this to a region-specific endpoint (e.g. `'s3-us-west-1.amazonaws.com'`) mrjob will not be able to access buckets located in other regions.

## SSH access and tunneling

**ssh\_bin** (**--ssh-bin**) [*command*] **Default:** `'ssh'`

Path to the ssh binary; may include switches (e.g. `'ssh -v'` or `['ssh', '-v']`). Defaults to `ssh`

**ssh\_bind\_ports** (**--ssh-bind-ports**) [special] **Default:** `range(40001, 40841)`

A list of ports that are safe to listen on. The command line syntax looks like `2000[:2001][, 2003, 2005:2008, etc]`, where commas separate ranges and colons separate range endpoints.

**ssh\_tunnel** (**--ssh-tunnel, --no-ssh-tunnel**) [boolean] **Default:** `False`

If `True`, create an ssh tunnel to the job tracker/resource manager and listen on a randomly chosen port. This requires you to set `ec2_key_pair` and `ec2_key_pair_file`. See *Configuring SSH credentials* for detailed instructions.

Changed in version 0.5.0: This option used to be named `ssh_tunnel_to_job_tracker`.

**ssh\_tunnel\_is\_open** (**--ssh-tunnel-is-open**) [boolean] **Default:** `False`

if `True`, any host can connect to the job tracker through the SSH tunnel you open. Mostly useful if your browser is running on a different machine from your job runner.

## EMR Bootstrapping Cookbook

Bootstrapping allows you to run commands to customize EMR machines, at the time the cluster is created.

### When to use bootstrap, and when to use setup

You can use `bootstrap` and `setup` together.

Generally, you want to use `bootstrap` for things that are part of your general production environment, and `setup` for things that are specific to your particular job. This makes things work as expected if you are *Pooling Clusters*.

All these examples use `bootstrap`. Not saying it's a good idea, but all these examples will work with `setup` as well (yes, Hadoop tasks on EMR apparently have access to `sudo`).

### Installing Python packages with pip

The only tricky thing is making sure you install packages for the correct version of Python. Figure out which version of Python you'll be running on EMR (see `python_bin` for defaults).

- If it's Python 2.6, use `pip`
- If it's Python 2.7, use `pip-2.7`
- If it's Python 3, use `pip-3.4`

For example, to install `ujson` on Python 2.7:

```
runners:
  emr:
    bootstrap:
      - sudo pip-2.7 install ujson
```

See [PyPI](#) for a the full list of available Python packages.

You can also install packages from a `requirements` file:

```
runners:
  emr:
    bootstrap:
      - sudo pip-2.7 install -r /local/path/of/requirements.txt#
```

Or a tarball:

```
runners:
  emr:
    bootstrap:
      - sudo pip-2.7 install /local/path/of/tarball.tar.gz#
```

**Note:** If for some reason you must run on AMI version 2.4.2 or earlier (protip: don’t do that), see [below](#) for how to get **pip** working.

**Warning:** If you’re trying to run jobs on AMI version 3.0.0 (protip: don’t do that either) **pip** appears not to work due to out-of-date SSL certificate information.

## Installing System Packages

EMR gives you access to a variety of different Amazon Machine Images, or AMIs for short (see [image\\_version](#)).

### 3.x and 4.x AMIs

Starting with 3.0.0, EMR AMIs use Amazon Linux, which uses **yum** to install packages. For example, to install NumPy:

```
runners:
  emr:
    bootstrap:
      - sudo yum install -y python27-numpy
```

(Don’t forget the `-y`!)

Amazon Linux currently has few packages for Python 3 libraries; if you’re on Python 3, just *use pip*.

Here are the package lists for all the various versions of Amazon Linux used by EMR:

- [2015.09](#) (3.11.0 and 4.2.0-4.4.0)
- [2015.03](#) (3.7.0-3.10.0 and 4.0.0-4.1.0)
- [2014.09](#) (3.4.0-3.6.0)
- [2014.03](#) (3.1.0-3.3.2)
- [2013.09](#) (3.0.0-3.0.4)

**Note:** The package lists gloss over Python versions; wherever you see a package named `python-<lib name>`, you’ll want to install `python26-<lib name>` or `python27-<lib name>` instead.

### 2.x AMIs

The 2.x AMIs are based on a version of Debian that is so old it has been “archived,” which makes their package installer, **apt-get**, no longer work out-of-the-box. If you *must* use the 2.x AMIs, you can get **apt-get** working again by fixing `/etc/apt/sources.list` and running **apt-get update**. For example, to install **pip** for Python 2.6:

```
runners:
  emr:
    bootstrap:
      - sudo echo "deb http://archive.debian.org/debian/ squeeze main contrib non-free" > /etc/apt/sources.list
      - sudo apt-get update
      - sudo apt-get install -y python-pip
```

---

**Note:** **pip-2.7** is already installed by default on AMI version 2.4.3 and later.

---

See the [full list of Squeeze packages](#) for all the (very old versions of) software you can install.

## Installing Python from source

If you really must use a version of Python that's not available on EMR (e.g. Python 3.5 or a very specific patch version), you can download and compile Python from source.

---

**Note:** This adds an extra 5 to 10 minutes before the cluster can run your job.

---

Here's how you download and install a Python tarball:

```
runners:
  emr:
    bootstrap:
      - wget -S -T 10 -t 5 https://www.python.org/ftp/python/x.y.z/Python-x.y.z.tgz
      - tar xzf Python-x.y.z.tgz
      - cd Python-x.y.z; ./configure && make && sudo make install; cd ..
    bootstrap_python: false
    python_bin: /usr/local/bin/python
```

(Replace `x.y.z` with a specific version of Python.)

Python 3.4+ comes with **pip** by default, but earlier versions do not, so you'll want to tack on `get-pip.py`:

```
runners:
  emr:
    bootstrap:
      ...
      - wget -S -T 10 -t 5 https://bootstrap.pypa.io/get-pip.py
      - sudo /usr/local/bin/python get-pip.py
```

Also, **pip** will be installed in `/usr/local/bin`, which is not in the path for **sudo**, so use its full path:

```
runners:
  emr:
    bootstrap:
      ...
      - sudo /usr/local/bin/pip install ...
```

## Troubleshooting

Many things can go wrong in an EMR job, and the system's distributed nature can make it difficult to find the source of a problem. `mrjob` attempts to simplify the debugging process by automatically scanning logs for probable causes of failure.

In addition to looking at S3, `mrjob` can be configured to also use SSH to fetch error logs directly from the master and worker nodes. This can speed up debugging significantly (EMR only transfers logs to S3 every five minutes).

## Using persistent clusters

When troubleshooting a job, it can be convenient to use a persistent cluster to avoid having to wait for bootstrapping every run.

**Warning:** Make sure you either use the `--max-hours-idle` option or have `mrjob terminate-idle-clusters` in your crontab, or you will be billed for unused CPU time on any clusters you forget to terminate.

First, use the `mrjob create-cluster` to create a persistent cluster:

```
$ mrjob create-cluster --max-hours-idle 1
Using configs in /Users/davidmarin/.mrjob.conf
Using s3://mrjob-35cdec11663cb1cb/tmp/ as our temp dir on S3
Creating persistent cluster to run several jobs in...
Creating temp directory /var/folders/zv/jmtt5bxs6xl3kzt38470hcxm0000gn/T/no_script.davidmarin.20160324.231018.720057/fil
Copying local files to s3://mrjob-35cdec11663cb1cb/tmp/no_script.davidmarin.20160324.231018.720057/fil
j-3BYHP30KB81XE
```

Now you can use the cluster ID to start the troublesome job:

```
$ python mrjob/examples/mr_boom.py README.rst -r emr --cluster-id j-3BYHP30KB81XE
Using configs in /Users/davidmarin/.mrjob.conf
Using s3://mrjob-35cdec11663cb1cb/tmp/ as our temp dir on S3
Creating temp directory /var/folders/zv/jmtt5bxs6xl3kzt38470hcxm0000gn/T/mr_boom.davidmarin.20160324.231045.501027/fil
Copying local files to s3://mrjob-35cdec11663cb1cb/tmp/mr_boom.davidmarin.20160324.231045.501027/fil
Adding our job to existing cluster j-3BYHP30KB81XE
Waiting for step 1 of 1 (s-SGVW9B5LEXF5) to complete...
  PENDING (cluster is STARTING: Provisioning Amazon EC2 capacity)
  PENDING (cluster is STARTING: Provisioning Amazon EC2 capacity)
  PENDING (cluster is STARTING: Provisioning Amazon EC2 capacity)
  PENDING (cluster is STARTING: Provisioning Amazon EC2 capacity)
  PENDING (cluster is STARTING: Provisioning Amazon EC2 capacity)
  PENDING (cluster is BOOTSTRAPPING: Running bootstrap actions)
  PENDING (cluster is BOOTSTRAPPING: Running bootstrap actions)
  PENDING (cluster is BOOTSTRAPPING: Running bootstrap actions)
  PENDING (cluster is BOOTSTRAPPING: Running bootstrap actions)
  PENDING (cluster is BOOTSTRAPPING: Running bootstrap actions)
Opening ssh tunnel to resource manager...
Connect to resource manager at: http://localhost:40069/cluster
RUNNING for 9.2s
RUNNING for 42.3s
  0.0% complete
RUNNING for 72.6s
  5.0% complete
RUNNING for 102.9s
  5.0% complete
RUNNING for 133.4s
 100.0% complete
FAILED
Cluster j-3BYHP30KB81XE is WAITING: Cluster ready after last step failed.
Attempting to fetch counters from logs...
Looking for step log in /mnt/var/log/hadoop/steps/s-SGVW9B5LEXF5 on ec2-52-37-112-240.us-west-2.compute.amazonaws.com
Parsing step log: ssh://ec2-52-37-112-240.us-west-2.compute.amazonaws.com/mnt/var/log/hadoop/steps/s-SGVW9B5LEXF5
Counters: 9
  Job Counters
    Data-local map tasks=1
    Failed map tasks=4
```

```
    Launched map tasks=4
    Other local map tasks=3
    Total megabyte-seconds taken by all map tasks=58125312
    Total time spent by all map tasks (ms)=75684
    Total time spent by all maps in occupied slots (ms)=227052
    Total time spent by all reduces in occupied slots (ms)=0
    Total vcore-seconds taken by all map tasks=75684
Scanning logs for probable cause of failure...
Looking for task logs in /mnt/var/log/hadoop/userlogs/application_1458861299388_0001 on ec2-52-37-112-240.us-west-2.compute.amazonaws.com
    Parsing task syslog: ssh://ec2-52-37-112-240.us-west-2.compute.amazonaws.com/mnt/var/log/hadoop/userlogs/application_1458861299388_0001
    Parsing task stderr: ssh://ec2-52-37-112-240.us-west-2.compute.amazonaws.com/mnt/var/log/hadoop/userlogs/application_1458861299388_0001
Probable cause of failure:

PipeMapRed failed!
java.lang.RuntimeException: PipeMapRed.waitOutputThreads(): subprocess failed with code 1
    at org.apache.hadoop.streaming.PipeMapRed.waitOutputThreads(PipeMapRed.java:330)
    at org.apache.hadoop.streaming.PipeMapRed.mapRedFinished(PipeMapRed.java:543)
    at org.apache.hadoop.streaming.PipeMapper.close(PipeMapper.java:130)
    at org.apache.hadoop.mapred.MapRunner.run(MapRunner.java:81)
    at org.apache.hadoop.streaming.PipeMapRunner.run(PipeMapRunner.java:34)
    at org.apache.hadoop.mapred.MapTask.runOldMapper(MapTask.java:432)
    at org.apache.hadoop.mapred.MapTask.run(MapTask.java:343)
    at org.apache.hadoop.mapred.YarnChild$2.run(YarnChild.java:175)
    at java.security.AccessController.doPrivileged(Native Method)
    at javax.security.auth.Subject.doAs(Subject.java:415)
    at org.apache.hadoop.security.UserGroupInformation.doAs(UserGroupInformation.java:1548)
    at org.apache.hadoop.mapred.YarnChild.main(YarnChild.java:170)

(from lines 37-50 of ssh://ec2-52-37-112-240.us-west-2.compute.amazonaws.com/mnt/var/log/hadoop/userlogs/application_1458861299388_0001)

caused by:

Traceback (most recent call last):
  File "mr_boom.py", line 10, in <module>
    MRBoom.run()
  File "/usr/lib/python3.4/dist-packages/mrjob/job.py", line 430, in run
    mr_job.execute()
  File "/usr/lib/python3.4/dist-packages/mrjob/job.py", line 439, in execute
    self.run_mapper(self.options.step_num)
  File "/usr/lib/python3.4/dist-packages/mrjob/job.py", line 499, in run_mapper
    for out_key, out_value in mapper_init() or ():
  File "mr_boom.py", line 7, in mapper_init
    raise Exception('BOOM')
Exception: BOOM

(from lines 1-12 of ssh://ec2-52-37-112-240.us-west-2.compute.amazonaws.com/mnt/var/log/hadoop/userlogs/application_1458861299388_0001)

while reading input from s3://mrjob-35cdec11663cb1cb/tmp/mr_boom.davidmarin.20160324.231045.501027/f

Step 1 of 1 failed
Killing our SSH tunnel (pid 52847)
```

Now you can fix the bug and try again, without having to wait for a new cluster to bootstrap.

---

**Note:** mrjob *can* fetch logs from persistent jobs even without SSH set up, but it has to pause 10 minutes to wait for EMR to transfer logs to S3, which defeats the purpose of rapid iteration.

---

## Advanced EMR usage

### Reusing Clusters

It can take several minutes to create a cluster. To decrease wait time when running multiple jobs, you may find it convenient to reuse a single cluster.

mrjob includes a utility to create persistent clusters without running a job. For example, this command will create a cluster with 12 EC2 instances (1 master and 11 core), taking all other options from *mrjob.conf*:

```
$ mrjob create-cluster --num-core-instances=11 --max-hours-idle 1
...
j-CLUSTERID
```

You can then add jobs to the cluster with the `--emr-cluster-id` switch or the *emr\_cluster\_id* variable in *mrjob.conf* (see `EMRJobRunner.__init__()`):

```
$ python mr_my_job.py -r emr --emr-cluster-id=j-CLUSTERID input_file.txt > out
...
Adding our job to existing cluster j-CLUSTERID
...
```

Debugging will be difficult unless you complete SSH setup (see *Configuring SSH credentials*) since the logs will not be copied from the master node to S3 before either five minutes pass or the cluster terminates.

### Pooling Clusters

Manually creating clusters to reuse and specifying the cluster ID for every run can be tedious. In addition, it is not convenient to coordinate cluster use among multiple users.

To mitigate these problems, mrjob provides **cluster pools**. Rather than having to remember to start a cluster and copying its ID, simply pass `--pool-clusters` on the command line. The first time you do this, a new cluster will be created that does not terminate when the job completes. When you use `--pool-clusters` the next time, it will identify the cluster and add the job to it rather than creating a new one.

**Warning:** If you use cluster pools, either set `max_hours_idle` in your config file (recommended), or keep **mrjob terminate-idle-clusters** in your crontab. Otherwise you may forget to terminate your clusters and waste a lot of money.

Pooling is designed so that jobs run against the same *mrjob.conf* can share the same clusters. This means that the version of mrjob and bootstrap configuration. Other options that affect which cluster a job can join:

- `image_version/release_label`: must match
- `applications`: require *at least* these applications (extra ones okay)
- `emr_configurations`: must match
- `ec2_key_pair`: if specified, only join clusters with the same key pair
- `subnet`: only join clusters with the same EC2 subnet ID (or lack thereof)

Pooled jobs will also only use clusters with the same **pool name**, so you can use the `pool_name` option to partition your clusters into separate pools.

Pooling is flexible about instance type and number of instances; it will attempt to select the most powerful cluster available as long as the cluster's instances provide at least as much memory and at least as much CPU as your job requests. If there is a tie, it picks clusters that are closest to the end of a full hour, to minimize wasted instance hours.

mrjob's pooling won't add more than 1000 steps to a cluster, as the EMR API won't show more than this many steps. (For *very old AMIs* <<http://docs.aws.amazon.com/ElasticMapReduce/latest/DeveloperGuide/AddingStepstoJobFlow.html>> there is a stricter limit of 256 steps).

mrjob also uses an S3-based “locking” mechanism to prevent two jobs from simultaneously joining the same cluster. This is somewhat ugly but works in practice, and avoids mrjob depending on Amazon services other than EMR and S3.

**Warning:** If S3 eventual consistency takes longer than `cloud_fs_sync_secs`, then you may encounter race conditions when using pooling, e.g. two jobs claiming the same cluster at the same time, or the idle cluster killer shutting down your job before it has started to run. Regions with read-after-write consistency (i.e. every region except US Standard) should not experience these issues.

You can allow jobs to wait for an available cluster instead of immediately starting a new one by specifying a value for `-pool-wait-minutes`. mrjob will try to find a cluster every 30 seconds for `pool_wait_minutes`. If none is found during that time, mrjob will start a new one.

## Spot Instances

Amazon also has a spot market for EC2 instances. You can potentially save money by using the spot market. The catch is that if someone bids more for instances that you're using, they can be taken away from your cluster. If this happens, you aren't charged, but your job may fail.

You can specify spot market bid prices using the `core_instance_bid_price`, `master_instance_bid_price`, and `task_instance_bid_price` options to specify a price in US dollars. For example, on the command line:

```
--ec2-task-instance-bid-price 0.42
```

or in `mrjob.conf`:

```
runners:
  emr:
    task_instance_bid_price: '0.42'
```

(Note the quotes; bid prices are strings, not floats!)

Amazon has a pretty thorough explanation of why and when you'd want to use spot instances [here](#). The brief summary is that either you don't care if your job fails, in which case you want to purchase all your instances on the spot market, or you'd need your job to finish but you'd like to save time and money if you can, in which case you want to run task instances on the spot market and purchase master and core instances the regular way.

Cluster pooling interacts with bid prices more or less how you'd expect; a job will join a pool with spot instances only if it requested spot instances at the same price or lower.

## Custom Python packages

See *Installing Python packages with pip* and *Installing System Packages*.

## Bootstrap-time configuration

Some Hadoop options, such as the maximum number of running map tasks per node, must be set at bootstrap time and will not work with `-jobconf`. You must use Amazon's `configure-hadoop` script for this. For example, this limits the number of mappers and reducers to one per node:



```
--bootstrap-action="s3://elasticmapreduce/bootstrap-actions/configure-hadoop \
-m mapred.tasktracker.map.tasks.maximum=1 \
-m mapred.tasktracker.reduce.tasks.maximum=1"
```

**Note:** This doesn't work on AMI version 4.0.0 and later.

## Setting up Ganglia

[Ganglia](#) is a scalable distributed monitoring system for high-performance computing systems. You can enable it for your EMR cluster with Amazon's [install-ganglia](#) bootstrap action:

```
--bootstrap-action="s3://elasticmapreduce/bootstrap-actions/install-ganglia"
```

**Note:** This doesn't work on AMI version 4.0.0 and later.

## The `mrjob` command

The `mrjob` command has two purposes:

1. To provide easy access to EMR tools
2. To eventually let you run Hadoop Streaming jobs written in languages other than Python

The `mrjob` command comes with Python-version-specific aliases (e.g. `mrjob-3`, `mrjob-3.4`), in case you choose to install `mrjob` for multiple versions of Python.

## EMR tools

### `audit-emr-usage`

Audit EMR usage over the past 2 weeks, sorted by cluster name and user.

Usage:

```
mrjob audit-emr-usage > report
```

Options:

```
-h, --help            show this help message and exit
-c CONF_PATHS, --conf-path=CONF_PATHS
                        Path to alternate mrjob.conf file to read from
--no-conf             Don't load mrjob.conf even if it's available
--emr-endpoint=EMR_ENDPOINT
                        Force mrjob to connect to EMR on this endpoint (e.g.
                        us-west-1.elasticmapreduce.amazonaws.com). Default is
                        to infer this from region.
--max-days-ago=MAX_DAYS_AGO
                        Max number of days ago to look at jobs. By default, we
                        go back as far as EMR supports (currently about 2
                        months)
-q, --quiet           Don't print anything to stderr
--region=REGION       GCE/AWS region to run Dataproc/EMR jobs in.
--aws-region=REGION   Deprecated alias for --region
--s3-endpoint=S3_ENDPOINT
```

<code>-v, --verbose</code>	Force mrjob to connect to S3 on this endpoint (e.g. <code>s3-us-west-1.amazonaws.com</code> ). You usually shouldn't set this; by default mrjob will choose the correct endpoint for each S3 bucket based on its location. print more messages to stderr
----------------------------	---

## boss

Run a command on every node of a cluster. Store stdout and stderr for results in `OUTPUT_DIR`.

Usage:

<code>mrjob boss CLUSTER_ID [options] "command string"</code>
---

Options:

<code>-h, --help</code>	show this help message and exit
<code>-c CONF_PATHS, --conf-path=CONF_PATHS</code>	Path to alternate mrjob.conf file to read from
<code>--no-conf</code>	Don't load mrjob.conf even if it's available
<code>--ec2-key-pair-file=EC2_KEY_PAIR_FILE</code>	Path to file containing SSH key for EMR
<code>--emr-endpoint=EMR_ENDPOINT</code>	Force mrjob to connect to EMR on this endpoint (e.g. <code>us-west-1.elasticmapreduce.amazonaws.com</code> ). Default is to infer this from region.
<code>-o OUTPUT_DIR, --output-dir=OUTPUT_DIR</code>	Specify an output directory (default: <code>CLUSTER_ID</code> )
<code>-q, --quiet</code>	Don't print anything to stderr
<code>--region=REGION</code>	GCE/AWS region to run Dataproc/EMR jobs in.
<code>--aws-region=REGION</code>	Deprecated alias for <code>--region</code>
<code>--s3-endpoint=S3_ENDPOINT</code>	Force mrjob to connect to S3 on this endpoint (e.g. <code>s3-us-west-1.amazonaws.com</code> ). You usually shouldn't set this; by default mrjob will choose the correct endpoint for each S3 bucket based on its location.
<code>--ssh-bin=SSH_BIN</code>	Name/path of ssh binary. Arguments are allowed (e.g. <code>--ssh-bin 'ssh -v'</code> )
<code>-v, --verbose</code>	print more messages to stderr

## create-cluster

Create a persistent EMR cluster to run clusters in, and print its ID to stdout.

<b>Warning:</b> Do not run this without <code>mrjob terminate-idle-clusters</code> in your crontab; clusters left idle can quickly become expensive!
--

Usage:

<code>mrjob create-cluster</code>
-----------------------------------

Options:

<code>-h, --help</code>	show this help message and exit
<code>--additional-emr-info=ADDITIONAL_EMR_INFO</code>	A JSON string for selecting additional features on EMR

```

--application=APPLICATIONS
    Additional applications to run on 4.x AMIs (e.g.
    Ganglia, Mahout, Spark)
--bootstrap=BOOTSTRAP
    A shell command to set up libraries etc. before any
    steps (e.g. "sudo apt-get -qy install python3"). You
    may interpolate files available via URL or locally
    with Hadoop Distributed Cache syntax ("sudo yum
    install -y foo.rpm#")
--bootstrap-action=BOOTSTRAP_ACTIONS
    Raw bootstrap action scripts to run before any of the
    other bootstrap steps. You can use --bootstrap-action
    more than once. Local scripts will be automatically
    uploaded to S3. To add arguments, just use quotes:
    "foo.sh arg1 arg2"
--bootstrap-cmd=BOOTSTRAP_CMDS
    Commands to run on the master node to set up
    libraries, etc. You can use --bootstrap-cmd more than
    once. Use mrjob.conf to specify arguments as a list to
    be run directly.
--bootstrap-file=BOOTSTRAP_FILES
    File to upload to the master node before running
    bootstrap_cmds (for example, debian packages). You can
    use --bootstrap-file more than once.
--bootstrap-mrjob
    Automatically zip up the mrjob library and install it
    when we run the mrjob. This is the default. Use --no-
    bootstrap-mrjob if you've already installed mrjob on
    your Hadoop cluster.
--no-bootstrap-mrjob
    Don't automatically zip up the mrjob library and
    install it when we run this job. Use this if you've
    already installed mrjob on your Hadoop cluster.
--bootstrap-python
    Attempt to install a compatible version of Python at
    bootstrap time. Currently this only does anything for
    Python 3, for which it is enabled by default.
--no-bootstrap-python
    Don't automatically try to install a compatible
    version of Python at bootstrap time.
--bootstrap-python-package=BOOTSTRAP_PYTHON_PACKAGES
    Path to a Python module to install on EMR. These
    should be standard python module tarballs where you
    can cd into a subdirectory and run ``sudo python
    setup.py install``. You can use --bootstrap-python-
    package more than once.
--bootstrap-script=BOOTSTRAP_SCRIPTS
    Script to upload and then run on the master node (a
    combination of bootstrap_cmds and bootstrap_files).
    These are run after the command from bootstrap_cmds.
    You can use --bootstrap-script more than once.
--cloud-fs-sync-secs=CLOUD_FS_SYNC_SECS
    How long to wait for remote FS to reach eventual
    consistency. This is typically less than a second but
    the default is 5.0 to be safe.
--s3-sync-wait-time=CLOUD_FS_SYNC_SECS
    Deprecated alias for --cloud-fs-sync-secs
--cloud-log-dir=CLOUD_LOG_DIR
    URI on remote FS to write logs into
--s3-log-uri=CLOUD_LOG_DIR
    Deprecated alias for --cloud-log-dir

```

```

--cloud-tmp-dir=CLOUD_TMP_DIR
    URI on remote FS to use as our temp directory.
--s3-scratch-uri=CLOUD_TMP_DIR, --s3-tmp-dir=CLOUD_TMP_DIR
    Deprecated aliases for --cloud-tmp-dir
--cloud-upload-part-size=CLOUD_UPLOAD_PART_SIZE
    Upload files to S3 in parts no bigger than this many
    megabytes. Default is 100 MiB. Set to 0 to disable
    multipart uploading entirely.
--s3-upload-part-size=CLOUD_UPLOAD_PART_SIZE
    Deprecated alias for --cloud-upload-part-size
-c CONF_PATHS, --conf-path=CONF_PATHS
    Path to alternate mrjob.conf file to read from
--no-conf
    Don't load mrjob.conf even if it's available
--core-instance-bid-price=CORE_INSTANCE_BID_PRICE
    Bid price to specify for core nodes when setting them
    up as EC2 spot instances (you probably only want to do
    this for task instances).
--ec2-core-instance-bid-price=CORE_INSTANCE_BID_PRICE
    Deprecated alias for --core-instance-bid-price
--core-instance-type=CORE_INSTANCE_TYPE
    Type of GCE/EC2 core instance(s) to launch
--ec2-core-instance-type=CORE_INSTANCE_TYPE,
--ec2-slave-instance-type=CORE_INSTANCE_TYPE
    Deprecated aliases for --core-instance-type
--ec2-key-pair=EC2_KEY_PAIR
    Name of the SSH key pair you set up for EMR
--emr-api-param=EMR_API_PARAMS
    Additional parameter to pass directly to the EMR API
    when creating a cluster. Should take the form
    KEY=VALUE. You can use --emr-api-param multiple times
--no-emr-api-param=EMR_API_PARAMS
    Parameter to be unset when calling EMR API. You can
    use --no-emr-api-param multiple times.
--emr-configuration=EMR_CONFIGURATIONS
    Configuration to use on 4.x AMIs as a JSON-encoded
    dict; see http://docs.aws.amazon.com/ElasticMapReduce/
    latest/ReleaseGuide/emr-configure-apps.html for
    examples
--emr-endpoint=EMR_ENDPOINT
    Force mrjob to connect to EMR on this endpoint (e.g.
    us-west-1.elasticmapreduce.amazonaws.com). Default is
    to infer this from region.
--enable-emr-debugging
    Enable storage of Hadoop logs in SimpleDB
--disable-emr-debugging
    Disable storage of Hadoop logs in SimpleDB (the
    default)
--iam-endpoint=IAM_ENDPOINT
    Force mrjob to connect to IAM on this endpoint (e.g.
    iam.us-gov.amazonaws.com)
--iam-instance-profile=IAM_INSTANCE_PROFILE
    EC2 instance profile to use for the EMR cluster -- see
    "Configure IAM Roles for Amazon EMR" in AWS docs
--iam-service-role=IAM_SERVICE_ROLE
    IAM service role to use for the EMR cluster -- see
    "Configure IAM Roles for Amazon EMR" in AWS docs
--image-version=IMAGE_VERSION
    EMR/Dataproc machine image to launch clusters with

```

```

--ami-version=IMAGE_VERSION
    Deprecated alias for --image-version
--instance-type=INSTANCE_TYPE
    Type of GCE/EC2 instance(s) to launch    GCE - e.g.
    nl-standard-1, nl-highcpu-4, nl-highmem-4 -- See
    https://cloud.google.com/compute/docs/machine-types
    EC2 - e.g. m1.medium, c3.xlarge, r3.xlarge -- See
    http://aws.amazon.com/ec2/instance-types/
--ec2-instance-type=INSTANCE_TYPE
    Deprecated alias for --instance-type
--label=LABEL
    Alternate label for the job, to help us identify it.
--master-instance-bid-price=MASTER_INSTANCE_BID_PRICE
    Bid price to specify for the master node when setting
    it up as an EC2 spot instance (you probably only want
    to do this for task instances).
--ec2-master-instance-bid-price=MASTER_INSTANCE_BID_PRICE
    Deprecated alias for --master-instance-bid-price
--master-instance-type=MASTER_INSTANCE_TYPE
    Type of GCE/EC2 master instance to launch
--ec2-master-instance-type=MASTER_INSTANCE_TYPE
    Deprecated alias for --master-instance-type
--max-hours-idle=MAX_HOURS_IDLE
    If we create a cluster, have it automatically
    terminate itself after it's been idle this many hours
--mins-to-end-of-hour=MINS_TO_END_OF_HOUR
    If --max-hours-idle is set, control how close to the
    end of an hour the cluster can automatically terminate
    itself (default is 5 minutes)
--num-core-instances=NUM_CORE_INSTANCES
    Total number of core instances to launch
--num-ec2-core-instances=NUM_CORE_INSTANCES
    Deprecated alias for --num-core-instances
--num-ec2-instances=NUM_EC2_INSTANCES
    Deprecated: subtract one and pass that to --num-core-
    instances instead
--num-task-instances=NUM_TASK_INSTANCES
    Total number of task instances to launch
--num-ec2-task-instances=NUM_TASK_INSTANCES
    Deprecated alias for --num-task-instances
--owner=OWNER
    User who ran the job (default is the current user)
--pool-clusters
    Add to an existing cluster or create a new one that
    does not terminate when the job completes. WARNING: do
    not run this without --max-hours-idle or with mrjob
    terminate-idle-clusters in your crontab; clusters left
    idle can quickly become expensive!
--pool-emr-job-flows
    Deprecated alias for --pool-clusters
--no-pool-clusters
    Don't run job on a pooled cluster (the default)
--no-pool-emr-job-flows
    Deprecated alias for --no-pool-clusters
--pool-name=POOL_NAME
    Specify a pool name to join. Default is "default"
--emr-job-flow-pool-name=POOL_NAME
    Deprecated alias for --pool-name
-q, --quiet
    Don't print anything to stderr
--region=REGION
    GCE/AWS region to run Dataproc/EMR jobs in.
--aws-region=REGION
    Deprecated alias for --region
--release-label=RELEASE_LABEL
    Release Label (e.g. "emr-4.0.0"). Overrides --image-

```

```

                                version
--s3-endpoint=S3_ENDPOINT      Force mrjob to connect to S3 on this endpoint (e.g. s3
                                -us-west-1.amazonaws.com). You usually shouldn't set
                                this; by default mrjob will choose the correct
                                endpoint for each S3 bucket based on its location.
--subnet=SUBNET                ID of Amazon VPC subnet to launch cluster in. If not
                                set or empty string, cluster is launched in the normal
                                AWS cloud
--tag=TAGS                     Metadata tags to apply to the EMR cluster; should take
                                the form KEY=VALUE. You can use --tag multiple times
--emr-tag=TAGS                 Deprecated alias for --tag
--task-instance-bid-price=TASK_INSTANCE_BID_PRICE
                                Bid price to specify for task nodes when setting them
                                up as EC2 spot instances
--ec2-task-instance-bid-price=TASK_INSTANCE_BID_PRICE
                                Deprecated alias for --task-instance-bid-price
--task-instance-type=TASK_INSTANCE_TYPE
                                Type of GCE/EC2 task instance(s) to launch
--ec2-task-instance-type=TASK_INSTANCE_TYPE
                                Deprecated alias for --task-instance-type
-v, --verbose                  print more messages to stderr
--visible-to-all-users        Make your cluster is visible to all IAM users on the
                                same AWS account (the default)
--no-visible-to-all-users     Hide your cluster from other IAM users on the same AWS
                                account
--zone=ZONE                    GCE zone/AWS availability zone to run Dataproc/EMR
                                jobs in.
--aws-availability-zone=ZONE   Deprecated alias for --zone

```

## report-long-jobs

Report jobs running for more than a certain number of hours (by default, 24.0). This can help catch buggy jobs and Hadoop/EMR operational issues.

Suggested usage: run this as a daily cron job with the `-q` option:

```
0 0 * * * mrjob report-long-jobs
```

### Options:

```

-h, --help                    show this help message and exit
-c CONF_PATHS, --conf-path=CONF_PATHS
                                Path to alternate mrjob.conf file to read from
--no-conf                     Don't load mrjob.conf even if it's available
--emr-endpoint=EMR_ENDPOINT    Force mrjob to connect to EMR on this endpoint (e.g.
                                us-west-1.elasticmapreduce.amazonaws.com). Default is
                                to infer this from region.
--min-hours=MIN_HOURS         Minimum number of hours a job can run before we report
                                it. Default: 24.0
-q, --quiet                   Don't print anything to stderr
--region=REGION               GCE/AWS region to run Dataproc/EMR jobs in.

```

```

--aws-region=REGION    Deprecated alias for --region
--s3-endpoint=S3_ENDPOINT
                        Force mrjob to connect to S3 on this endpoint (e.g. s3
                        -us-west-1.amazonaws.com). You usually shouldn't set
                        this; by default mrjob will choose the correct
                        endpoint for each S3 bucket based on its location.
-x, --exclude=TAG_KEY,TAG_VALUE
                        Exclude clusters that have the specified tag key/value
                        pair
-v, --verbose           print more messages to stderr

```

### s3-tmpwatch

Delete all files in a given URI that are older than a specified time. The time parameter defines the threshold for removing files. If the file has not been accessed for *time*, the file is removed. The time argument is a number with an optional single-character suffix specifying the units: m for minutes, h for hours, d for days. If no suffix is specified, time is in hours.

Suggested usage: run this as a cron job with the -q option:

```
0 0 * * * mrjob s3-tmpwatch -q 30d s3://your-bucket/tmp/
```

Usage:

```
mrjob s3-tmpwatch [options] <time-untouched> <URIs>
```

Options:

```

-h, --help             show this help message and exit
-c CONF_PATHS, --conf-path=CONF_PATHS
                        Path to alternate mrjob.conf file to read from
--no-conf              Don't load mrjob.conf even if it's available
-q, --quiet            Don't print anything to stderr
--region=REGION        GCE/AWS region to run Dataproc/EMR jobs in.
--aws-region=REGION    Deprecated alias for --region
--s3-endpoint=S3_ENDPOINT
                        Force mrjob to connect to S3 on this endpoint (e.g. s3
                        -us-west-1.amazonaws.com). You usually shouldn't set
                        this; by default mrjob will choose the correct
                        endpoint for each S3 bucket based on its location.
-t, --test             Don't actually delete any files; just log that we
                        would
-v, --verbose          print more messages to stderr

```

### terminate-cluster

Terminate an existing EMR cluster.

Usage:

```
mrjob terminate-cluster [options] j-CLUSTERID
```

Terminate an existing EMR cluster.

Options:

```
-h, --help            show this help message and exit
-c CONF_PATHS, --conf-path=CONF_PATHS
                        Path to alternate mrjob.conf file to read from
--no-conf             Don't load mrjob.conf even if it's available
--emr-endpoint=EMR_ENDPOINT
                        Force mrjob to connect to EMR on this endpoint (e.g.
                        us-west-1.elasticmapreduce.amazonaws.com). Default is
                        to infer this from region.
-q, --quiet           Don't print anything to stderr
--region=REGION       GCE/AWS region to run Dataproc/EMR jobs in.
--aws-region=REGION   Deprecated alias for --region
--s3-endpoint=S3_ENDPOINT
                        Force mrjob to connect to S3 on this endpoint (e.g. s3
                        -us-west-1.amazonaws.com). You usually shouldn't set
                        this; by default mrjob will choose the correct
                        endpoint for each S3 bucket based on its location.
-t, --test            Don't actually delete any files; just log that we
                        would
-v, --verbose         print more messages to stderr
```

### terminate-idle-clusters

Terminate idle EMR clusters that meet the criteria passed in on the command line (or, by default, clusters that have been idle for one hour).

Suggested usage: run this as a cron job with the `-q` option:

```
*/30 * * * * mrjob terminate-idle-clusters -q
```

#### Options:

```
-h, --help            show this help message and exit
-c CONF_PATHS, --conf-path=CONF_PATHS
                        Path to alternate mrjob.conf file to read from
--no-conf             Don't load mrjob.conf even if it's available
--dry-run             Don't actually kill idle jobs; just log that we would
--emr-endpoint=EMR_ENDPOINT
                        Force mrjob to connect to EMR on this endpoint (e.g.
                        us-west-1.elasticmapreduce.amazonaws.com). Default is
                        to infer this from region.
--max-hours-idle=MAX_HOURS_IDLE
                        Max number of hours a cluster can go without
                        bootstrapping, running a step, or having a new step
                        created. This will fire even if there are pending
                        steps which EMR has failed to start. Make sure you set
                        this higher than the amount of time your jobs can take
                        to start instances and bootstrap.
--max-mins-locked=MAX_MINS_LOCKED
                        Max number of minutes a cluster can be locked while
                        idle.
--mins-to-end-of-hour=MINS_TO_END_OF_HOUR
                        Terminate clusters that are within this many minutes
                        of the end of a full hour since the job started
                        running AND have no pending steps.
--pool-name=POOL_NAME
                        Only terminate clusters in the given named pool.
--pooled-only         Only terminate pooled clusters
```



<code>-q, --quiet</code>	Don't print anything to stderr
<code>--region=REGION</code>	GCE/AWS region to run Dataproc/EMR jobs in.
<code>--aws-region=REGION</code>	Deprecated alias for <code>--region</code>
<code>--s3-endpoint=S3_ENDPOINT</code>	Force mrjob to connect to S3 on this endpoint (e.g. <code>s3-us-west-1.amazonaws.com</code> ). You usually shouldn't set this; by default mrjob will choose the correct endpoint for each S3 bucket based on its location.
<code>--unpooled-only</code>	Only terminate un-pooled clusters
<code>-v, --verbose</code>	print more messages to stderr

## Running jobs

```
mrjob run (path to script or executable) [options]
```

Run a job. Takes same options as invoking a Python job. See [Options available to all runners](#), [Hadoop-related options](#), [Dataproc runner options](#), and [EMR runner options](#). While you can use this command to invoke your jobs, you can just as easily call `python my_job.py [options]`.

## Python 2 vs. Python 3

### Raw protocols

Both because we don't want to break mrjob for Python 2 users, and to make writing jobs simple, jobs read their input as `str`s by default (even though `str` means bytes in Python 2 and unicode in Python 3).

The way this works in mrjob is that `RawValueProtocol` is actually an alias for one of two classes, `BytesValueProtocol` if you're in Python 2, and `TextValueProtocol` if you're in Python 3.

If you care about this distinction, you may want to explicitly set `INPUT_PROTOCOL` to one of these. If your input has a well-defined encoding, probably you want `BytesValueProtocol`, and if it's a bunch of text that's mostly ASCII, with like, some stuff that... might be UTF-8? (i.e. most log files), you probably want `TextValueProtocol`. But most of the time it'll just work.

### Bytes vs. strings

The following things are bytes in any version of Python (which means you need to use the `bytes` type and/or `b' . . . '` constant

- data read or written by `Protocols`
- lines yielded by `stream_output()`
- anything read from `cat()`

The `stdin`, `stdout`, and `stderr` attributes of `MRJobs` are always bytestreams (so, for example, `self.stderr` defaults to `sys.stderr.buffer` in Python 3).

Everything else (including file paths, URIs, arguments to commands, and logging messages) are strings; that is, `str` on Python 3, and either `str` or `unicode` on Python 2. Like with `RawValueProtocol`, most of the time it'll just work even if you don't think about it.

## python\_bin

`python_bin` defaults to `python` in Python 2, and `python3` in Python 3 (except in Python 2 on EMR, where it's one of `python2.6` or `python2.7`; see `python_bin` for details).

## Your Hadoop cluster

Whatever version of Python you use, you'll have to have a compatible version of Python installed on your Hadoop cluster. mrjob does its best to make this work on Elastic MapReduce (see `bootstrap_python`), but if you're running on your own Hadoop cluster, this is up to you.

## Contributing to mrjob

### Contribution guidelines

mrjob is developed using a standard Github pull request process. Almost all code is reviewed in pull requests.

The general process for working on mrjob is:

- [Fork the project on Github](#)
- Clone your fork to your local machine
- Create a feature branch from master (e.g. `git branch delete_all_the_code`)
- Write code, commit often
- Write test cases for all changed functionality
- Submit a pull request against `master` on Github
- Wait for code review!

It would also help to discuss your ideas on the [mailing list](#) so we can warn you of possible merge conflicts with ongoing work or offer suggestions for where to put code.

Things that will make your branch more likely to be pulled:

- Comprehensive, fast test cases
- Detailed explanation of what the change is and how it works
- Reference relevant issue numbers in the tracker
- API backward compatibility

If you add a new configuration option, please try to do all of these things:

- Add command line switches that allow full control over the option
- Document the option and its switches in the appropriate file under `docs`

## A quick tour through the code

mrjob's modules can be put in four categories:

- Reading command line arguments and config files, and invoking machinery accordingly
  - `mrjob.conf`: Read config files

- `mrjob.launch`: Invoke runners based on command line and configs
- `mrjob.options`: Define command line options
- Interacting with Hadoop Streaming
  - `mrjob.job`: Python interface for writing jobs
  - `mrjob.protocol`: Defining data formats between Python steps
- Runners and support; submitting the job to various MapReduce environments
  - `mrjob.runner`: Common functionality across runners
  - `mrjob.hadoop`: Submit jobs to Hadoop
  - `mrjob.step`: Define/implement interface between runners and script steps
  - Local
    - \* `mrjob.inline`: Run Python-only jobs in-process
    - \* `mrjob.local`: Run Hadoop Streaming-only jobs in subprocesses
  - Google Cloud Dataproc
    - \* `mrjob.dataproc`: Submit jobs to Dataproc
  - Amazon Elastic MapReduce
    - \* `mrjob.emr`: Submit jobs to EMR
    - \* `mrjob.pool`: Utilities for cluster pooling functionality
    - \* `mrjob.retry`: Wrapper for S3 and EMR connections to handle recoverable errors
    - \* `mrjob.ssh`: Run commands on EMR cluster machines
- Interacting with different “filesystems”
  - `mrjob.fs.base`: Common functionality
  - `mrjob.fs.composite`: Support multiple filesystems; if one fails, “fall through” to another
  - `mrjob.fs.gcs`: Google Cloud Storage
  - `mrjob.fs.hadoop`: HDFS
  - `mrjob.fs.local`: Local filesystem
  - `mrjob.fs.s3`: S3
  - `mrjob.fs.ssh`: SSH
- Utilities
  - `mrjob.compat`: Transparently handle differences between Hadoop versions
  - `mrjob.logs`: Log interpretation (counters, probable cause of job failure)
  - `mrjob.parse`: Parsing utilities for URIs, command line options, etc.
  - `mrjob.util`: Utilities for dealing with files, command line options, various other things

## Interactions between runner and job

**Warning:** This information is **experimentally public** and subject to change.

Starting with version 0.4, mrjob is moving toward supporting arbitrary scripting languages for writing jobs. Jobs that don't use the `MRJob` Python class will need to support a simple interface for informing the runner of their steps and running the correct steps.

In this document, the **job script** is a file invoked with `<interpreter> script.blah`, which supports the interface described in this document and contains all information about how to run the job. In the normal case, the job script will be a file containing a single `MRJob` class and invocation, and `<interpreter>` will be `python`.

All interactions between job and runner are through command line arguments. For example, to find out what mappers, reducers, and combiners a job has and what their order is, `MRJobRunner` calls the job script with the `--steps` argument.

Examples of job input/output are given at the end of this document in *Examples*.

### Job Interface

**--steps** Print a JSON-encoded dictionary in the format described in *Format of --steps* describing the individual steps of the job.

**--step-num** Specify the step number to be run. **Always** used with `--mapper`, `--combiner`, or `--reducer`.

**--mapper** Run the mapper for the specified step. Always used with `--step-num`.

**--combiner** Run the combiner for the specified step. Always used with `--step-num`.

**--reducer** Run the reducer for the specified step. Always used with `--step-num`.

`--step-num`, `--mapper`, `--combiner`, and `--reducer` are only necessary for script steps (see *Format of --steps* below).

When running a mapper, combiner, or reducer, the non-option arguments are input files, where no args or `-` means read from standard input.

### Format of --steps

Jobs are divided into **steps** which can either be a `jar` step or a `streaming` step.

#### Streaming steps

A `streaming` step consists of one or more **substeps** of type `mapper`, `combiner`, or `reducer`. Each substep can have type `script` or `command`. A `script` step follows the `--step-num / --mapper / --combiner / --reducer` interface, and a `command` is a raw command passed to Hadoop Streaming.

#### Script substeps

Here is a one-step streaming job with only a mapper in script format:

```
{
  'type': 'streaming',
  'mapper': {
    'type': 'script',
```

```
}
}
```

Some Python code that would cause *MRJob* generate this data:

```
class MRMapperJob (MRJob) :

    def steps(self) :
        return [MRStep (mapper=self.my_mapper) ]
```

The runners would then invoke Hadoop Streaming with:

```
-mapper 'mapper_job.py --mapper --step-num=0'
```

Script steps may have **pre-filters**, which are just UNIX commands that sit in front of the script when running the step, used to efficiently filter output with `grep` or otherwise filter and transform data. Filters are specified using a `pre_filter` key in the substep dictionary:

```
{
    'type': 'streaming',
    'mapper': {
        'type': 'script',
        'pre_filter': 'grep "specific data"'
    }
}
```

*MRJob* code:

```
class MRMapperFilterJob (MRJob) :

    def steps(self) :
        return [MRStep (mapper=self.my_mapper,
                        mapper_pre_filter='grep "specific data"')]
```

Hadoop Streaming arguments:

```
-mapper 'bash -c \''grep "specific data" | mapper_job.py --mapper --step-num=0\''
```

mrjob does not try to intelligently handle quotes in the contents of filters, so avoid using single quotes.

Hadoop Streaming requires that all steps have a mapper, so if the job doesn't specify a mapper, mrjob will use `cat`.

### Command substeps

The format for a command substep is very simple.

```
{
    'type': 'streaming',
    'mapper': {
        'type': 'command',
        'command': 'cat'
    }
}
```

*MRJob* code:

```
class MRMapperCommandJob (MRJob) :

    def steps(self) :
        return [MRStep (mapper_cmd='cat' ) ]
```

Hadoop Streaming arguments:

```
-mapper 'cat'
```

## Jar steps

Jar steps are used to specify jars that are not Hadoop Streaming. They have two required arguments and two optional arguments.

```
{
  'type': 'jar',
  'jar': 'binks.jar.jar',
  'main_class': 'MyMainMan',      # optional
  'args': ['argh', 'argh']      # optional
}
```

Further information on jar steps should be sought for in the Hadoop documentation. Pull requests containing relevant links would be appreciated.

## Examples

### Getting steps

Job with a script mapper and command reducer for the first step and a jar for the second step:

```
> <interpreter> my_script.lang --steps
[
  {
    'type': 'streaming',
    'mapper': {
      'type': 'script'
    },
    'reducer': {
      'type': 'command',
      'command': 'some_shell_command --arg --arg'
    }
  },
  {
    'type': 'jar',
    'jar': 's3://bucket/jar_jar.jar'
  }
]
```

### Running a step

```
> <interpreter> my_script.lang --mapper --step-num=0 input.txt -
[script iterates over stdin and input.txt]
key_1      value_1
key_2      value_2
...
```

## mrjob.cat - auto-decompress files based on extension

Emulating the way Hadoop handles input files, decompressing compressed files based on their file extension.

This module also functions as a **cat** substitute that can handle compressed files. It is used by *local* mode and can function without the rest of the mrjob library.

`mrjob.cat.bunzip2_stream(fileobj, bufsize=1024)`  
Decompress gzipped data on the fly.

### Parameters

- **fileobj** – object supporting `read()`
- **bufsize** – number of bytes to read from *fileobj* at a time.

**Warning:** This yields decompressed chunks; it does *not* split on lines. To get lines, wrap this in `to_lines()`.

`mrjob.cat.decompress(fileobj, path)`  
Take a *fileobj* corresponding to the given path and returns an iterator that yields chunks of bytes, or, if *path* doesn't correspond to a compressed file type, *fileobj* itself.

`mrjob.cat.gunzip_stream(fileobj, bufsize=1024)`  
Decompress gzipped data on the fly.

### Parameters

- **fileobj** – object supporting `read()`
- **bufsize** – number of bytes to read from *fileobj* at a time. The default is the same as in `gzip`.

**Warning:** This yields decompressed chunks; it does *not* split on lines. To get lines, wrap this in `to_lines()`.

## mrjob.compat - Hadoop version compatibility

Utility functions for compatibility with different versions of Hadoop.

`mrjob.compat.jobconf_from_dict(jobconf, name, default=None)`

Get the value of a jobconf variable from the given dictionary.

#### Parameters

- **jobconf** (*dict*) – jobconf dictionary
- **name** (*string*) – name of the jobconf variable (e.g. `'user.name'`)
- **default** – fallback value

If the name of the jobconf variable is different in different versions of Hadoop (e.g. in Hadoop 2, `map.input.file` is `mapreduce.map.input.file`), we'll automatically try all variants before giving up.

Return *default* if that jobconf variable isn't set

`mrjob.compat.jobconf_from_env(variable, default=None)`

Get the value of a jobconf variable from the runtime environment.

For example, a *MRJob* could use `jobconf_from_env('map.input.file')` to get the name of the file a mapper is reading input from.

If the name of the jobconf variable is different in different versions of Hadoop (e.g. in Hadoop 2.0, `map.input.file` is `mapreduce.map.input.file`), we'll automatically try all variants before giving up.

Return *default* if that jobconf variable isn't set.

`mrjob.compat.map_version(version, version_map)`

Allows you to look up something by version (e.g. which jobconf variable to use, specifying only the versions where that value changed).

*version* is a string

*version\_map* is a map from version (as a string) that a value changed to the new value.

For efficiency, *version\_map* can also be a list of tuples of `(LooseVersion(version_as_string), value)`, with oldest versions first.

If *version* is less than any version in *version\_map*, use the value for the earliest version in *version\_map*.

`mrjob.compat.translate_jobconf(variable, version)`

Translate *variable* to Hadoop version *version*. If it's not a variable we recognize, leave as-is.

`mrjob.compat.translate_jobconf_dict(jobconf, hadoop_version=None)`

Translates the configuration property name to match those that are accepted in *hadoop\_version*. Prints a warning message if any configuration property name does not match the name in the hadoop version. Combines the original jobconf with the translated jobconf.

**Returns** a map consisting of the original and translated configuration property names and values.

`mrjob.compat.translate_jobconf_for_all_versions(variable)`

Get all known variants of the given jobconf variable. Unlike `translate_jobconf()`, returns a list.

`mrjob.compat.uses_yarn(version)`

Basically, is this Hadoop 2? This also handles versions in the zero series (0.23+) where YARN originated.

`mrjob.compat.version_gte(version, cmp_version_str)`

Return True if version  $\geq$  *cmp\_version\_str*.



## mrjob.conf - parse and write config files

“mrjob.conf” is the name of both this module, and the global config file for mrjob.

### Reading and writing mrjob.conf

`mrjob.conf.find_mrjob_conf()`

Look for `mrjob.conf`, and return its path. Places we look:

- The location specified by `MRJOB_CONF`
- `~/mrjob.conf`
- `/etc/mrjob.conf`

Return `None` if we can’t find it.

`mrjob.conf.load_opts_from_mrjob_conf(runner_alias, conf_path=None, already_loaded=None)`

Load a list of dictionaries representing the options in a given `mrjob.conf` for a specific runner, resolving includes. Returns `[(path, values)]`. If `conf_path` is not found, return `[(None, {})]`.

#### Parameters

- **runner\_alias** (*str*) – String identifier of the runner type, e.g. `emr`, `local`, etc.
- **conf\_path** (*str*) – location of the file to load
- **already\_loaded** (*list*) – list of real (according to `os.path.realpath()`) conf paths that have already been loaded (used by `load_opts_from_mrjob_confs()`).

Changed in version 0.4.6: Relative `include:` paths are relative to the real (after resolving symlinks) path of the including conf file

Changed in version 0.4.6: This will only load each config file once, even if it’s referenced from multiple paths due to symlinks.

`mrjob.conf.load_opts_from_mrjob_confs(runner_alias, conf_paths=None)`

Load a list of dictionaries representing the options in a given list of `mrjob` config files for a specific runner. Returns `[(path, values), ...]`. If a path is not found, use `(None, {})` as its value.

If `conf_paths` is `None`, look for a config file in the default locations (see `find_mrjob_conf()`).

#### Parameters

- **runner\_alias** (*str*) – String identifier of the runner type, e.g. `emr`, `local`, etc.
- **conf\_path** – locations of the files to load

Changed in version 0.4.6: This will only load each config file once, even if it’s referenced from multiple paths due to symlinks.

### Combining options

Combiner functions take a list of values to combine, with later options taking precedence over earlier ones. `None` values are always ignored.

`mrjob.conf.combine_cmds(*cmds)`

Take zero or more commands to run on the command line, and return the last one that is not `None`. Each command should either be a list containing the command plus switches, or a string, which will be parsed

with `shlex.split()`. The string must either be a byte string or a unicode string containing no non-ASCII characters.

Returns either `None` or a list containing the command plus arguments.

`mrjob.conf.combine_dicts(*dicts)`

Combine zero or more dictionaries. Values from dicts later in the list take precedence over values earlier in the list.

If you pass in `None` in place of a dictionary, it will be ignored.

`mrjob.conf.combine_envs(*envs)`

Combine zero or more dictionaries containing environment variables. Environment variable values may be wrapped in `ClearedValue`.

Environment variables later from dictionaries later in the list take priority over those earlier in the list.

For variables ending with `PATH`, we prepend (and add a colon) rather than overwriting. Wrapping a path value in `ClearedValue` disables this behavior.

Environment set to `ClearedValue(None)` will *delete* environment variables earlier in the list, rather than setting them to `None`.

If you pass in `None` in place of a dictionary in `envs`, it will be ignored.

`mrjob.conf.combine_lists(*seqs)`

Concatenate the given sequences into a list. Ignore `None` values.

Generally this is used for a list of commands we want to run; the “default” commands get run before any commands specific to your job.

Changed in version 0.4.6: Strings, bytes, and non-sequence objects (e.g. numbers) are treated as single-item lists.

Changed in version 0.5.3: Dicts are treated as single-item lists

`mrjob.conf.combine_local_envs(*envs)`

Same as `combine_envs()`, except that paths are combined using the local path separator (e.g. `;` on Windows rather than `:`).

`mrjob.conf.combine_path_lists(*path_seqs)`

Concatenate the given sequences into a list. Ignore `None` values. Resolve `~` (home dir) and environment variables, and expand globs that refer to the local filesystem.

Changed in version 0.4.6: Can take single strings as well as lists.

`mrjob.conf.combine_paths(*paths)`

Returns the last value in `paths` that is not `None`. Resolve `~` (home dir) and environment variables.

`mrjob.conf.combine_values(*values)`

Return the last value in `values` that is not `None`.

The default combiner; good for simple values (booleans, strings, numbers).

## mrjob.dataproc - run on Dataproc

### Job Runner

`class mrjob.dataproc.DataprocJobRunner(**kwargs)`

Runs an *MRJob* on Google Cloud Dataproc. Invoked when you run your job with `-r dataproc`.

*DataprocJobRunner* runs your job in an Dataproc cluster, which is basically a temporary Hadoop cluster.

Input, support, and jar files can be either local or on GCS; use `gs://...` URLs to refer to files on GCS.

This class has some useful utilities for talking directly to GCS and Dataproc, so you may find it useful to instantiate it without a script:

```
from mrjob.dataproc import DataprocJobRunner
...
```

## GCS Utilities

**class** `mrjob.dataproc.GCSFilesystem`

Filesystem for Google Cloud Storage (GCS) URIs. Typically you will get one of these via `DataprocJobRunner().fs`, composed with `SSHFilesystem` and `LocalFilesystem`.

## mrjob.emr - run on EMR

### Job Runner

**class** `mrjob.emr.EMRJobRunner` (*\*\*kwargs*)

Runs an *MRJob* on Amazon Elastic MapReduce. Invoked when you run your job with `-r emr`.

*EMRJobRunner* runs your job in an EMR cluster, which is basically a temporary Hadoop cluster. Normally, it creates a cluster just for your job; it's also possible to run your job in a specific cluster by setting *cluster\_id* or to automatically choose a waiting cluster, creating one if none exists, by setting *pool\_clusters*.

Input, support, and jar files can be either local or on S3; use `s3://...` URLs to refer to files on S3.

This class has some useful utilities for talking directly to S3 and EMR, so you may find it useful to instantiate it without a script:

```
from mrjob.emr import EMRJobRunner

emr_conn = EMRJobRunner().make_emr_conn()
clusters = emr_conn.list_clusters()
...
```

## EMR Utilities

`EMRJobRunner.get_cluster_id()`

`EMRJobRunner.get_image_version()`

Get the AMI that our cluster is running.

Changed in version 0.5.4: This used to be called `get_ami_version()`

New in version 0.4.5.

`EMRJobRunner.make_emr_conn()`

Create a connection to EMR.

**Returns** a `boto.emr.connection.EmrConnection`, wrapped in a `mrjob.retry.RetryWrapper`

## S3 Utilities

`mrjob.fs.s3.s3_key_to_uri(s3_key)`

Convert a boto Key object into an `s3://` URI

**class** `mrjob.emr.S3Filesystem` (*aws\_access\_key\_id=None*, *aws\_secret\_access\_key=None*,  
*aws\_security\_token=None*, *s3\_endpoint=None*)

Filesystem for Amazon S3 URIs. Typically you will get one of these via `EMRJobRunner().fs`, composed with `SSHFilesystem` and `LocalFilesystem`.

`S3Filesystem.make_s3_conn(region='')`

Create a connection to S3.

**Parameters** `region` – region to use to choose S3 endpoint.

If you are doing anything with buckets other than creating them or fetching basic metadata (name and location), it's best to use `get_bucket()` because it chooses the appropriate S3 endpoint automatically.

**Returns** a `boto.s3.connection.S3Connection`, wrapped in a `mrjob.retry.RetryWrapper`

`S3Filesystem.get_s3_key(uri)`

Get the boto Key object matching the given S3 uri, or return `None` if that key doesn't exist.

uri is an S3 URI: `s3://foo/bar`

`S3Filesystem.get_s3_keys(uri)`

Get a stream of boto Key objects for each key inside the given dir on S3.

uri is an S3 URI: `s3://foo/bar`

`S3Filesystem.make_s3_key(uri)`

Create the given S3 key, and return the corresponding boto Key object.

uri is an S3 URI: `s3://foo/bar`

## mrjob.hadoop - run on your Hadoop cluster

**class** `mrjob.hadoop.HadoopJobRunner` (*\*\*kwargs*)

Runs an *MRJob* on your Hadoop cluster. Invoked when you run your job with `-r hadoop`.

Input and support files can be either local or on HDFS; use `hdfs://...` URLs to refer to files on HDFS.

`HadoopJobRunner.__init__` (*\*\*kwargs*)

*HadoopJobRunner* takes the same arguments as *MRJobRunner*, plus some additional options which can be defaulted in *mrjob.conf*.

## Utilities

`mrjob.hadoop.fully_qualify_hdfs_path(path)`

If path isn't an `hdfs://` URL, turn it into one.

## mrjob.inline - debugger-friendly local testing

**class** `mrjob.inline.InlineMRJobRunner` (*mrjob\_cls=None*, *\*\*kwargs*)

Runs an *MRJob* in the same process, so it's easy to attach a debugger.

This is the default way to run jobs (we assume you'll spend some time debugging your job before you're ready to run it on EMR or Hadoop).

Unlike other runners, `InlineMRJobRunner`'s `run()` method raises the actual exception that caused a step to fail (rather than `StepFailedException`).

To more accurately simulate your environment prior to running on Hadoop/EMR, use `-r local` (see `LocalMRJobRunner`).

`InlineMRJobRunner.__init__` (*mrjob\_cls=None*, *\*\*kwargs*)

`InlineMRJobRunner` takes the same keyword args as `MRJobRunner`. However, please note:

- `hadoop_input_format`, `hadoop_output_format`, and `partitioner` are ignored because they require Java. If you need to test these, consider starting up a standalone Hadoop instance and running your job with `-r hadoop`.
- `python_bin`, `setup`, `setup_cmds`, `setup_scripts` and `steps_python_bin` are ignored because we don't invoke subprocesses.

## mrjob.job - defining your job

`class mrjob.job.MRJob` (*args=None*)

The base class for all MapReduce jobs. See `__init__()` for details.

### One-step jobs

`MRJob.mapper` (*key, value*)

Re-define this to define the mapper for a one-step job.

Yields zero or more tuples of (*out\_key*, *out\_value*).

#### Parameters

- **key** – A value parsed from input.
- **value** – A value parsed from input.

If you don't re-define this, your job will have a mapper that simply yields (*key*, *value*) as-is.

**By default (if you don't mess with *Protocols*):**

- *key* will be `None`
- *value* will be the raw input line, with newline stripped.
- *out\_key* and *out\_value* must be JSON-encodable: numeric, unicode, boolean, `None`, list, or dict whose keys are unicodes.

`MRJob.reducer` (*key, values*)

Re-define this to define the reducer for a one-step job.

Yields one or more tuples of (*out\_key*, *out\_value*)

#### Parameters

- **key** – A key which was yielded by the mapper
- **value** – A generator which yields all values yielded by the mapper which correspond to *key*.

**By default (if you don't mess with *Protocols*):**

- `out_key` and `out_value` must be JSON-encodable.
- `key` and `value` will have been decoded from JSON (so tuples will become lists).

`MRJob.combiner` (*key, values*)

Re-define this to define the combiner for a one-step job.

Yields one or more tuples of (`out_key`, `out_value`)

#### Parameters

- **key** – A key which was yielded by the mapper
- **value** – A generator which yields all values yielded by one mapper task/node which correspond to `key`.

**By default (if you don't mess with *Protocols*):**

- `out_key` and `out_value` must be JSON-encodable.
- `key` and `value` will have been decoded from JSON (so tuples will become lists).

`MRJob.mapper_init` ()

Re-define this to define an action to run before the mapper processes any input.

One use for this function is to initialize mapper-specific helper structures.

Yields one or more tuples of (`out_key`, `out_value`).

By default, `out_key` and `out_value` must be JSON-encodable; re-define `INTERNAL_PROTOCOL` to change this.

`MRJob.mapper_final` ()

Re-define this to define an action to run after the mapper reaches the end of input.

One way to use this is to store a total in an instance variable, and output it after reading all input data. See `mrjob.examples` for an example.

Yields one or more tuples of (`out_key`, `out_value`).

By default, `out_key` and `out_value` must be JSON-encodable; re-define `INTERNAL_PROTOCOL` to change this.

`MRJob.reducer_init` ()

Re-define this to define an action to run before the reducer processes any input.

One use for this function is to initialize reducer-specific helper structures.

Yields one or more tuples of (`out_key`, `out_value`).

By default, `out_key` and `out_value` must be JSON-encodable; re-define `INTERNAL_PROTOCOL` to change this.

`MRJob.reducer_final` ()

Re-define this to define an action to run after the reducer reaches the end of input.

Yields one or more tuples of (`out_key`, `out_value`).

By default, `out_key` and `out_value` must be JSON-encodable; re-define `INTERNAL_PROTOCOL` to change this.

`MRJob.combiner_init` ()

Re-define this to define an action to run before the combiner processes any input.

One use for this function is to initialize combiner-specific helper structures.

Yields one or more tuples of (out\_key, out\_value).

By default, out\_key and out\_value must be JSON-encodable; re-define `INTERNAL_PROTOCOL` to change this.

`MRJob.combiner_final()`

Re-define this to define an action to run after the combiner reaches the end of input.

Yields one or more tuples of (out\_key, out\_value).

By default, out\_key and out\_value must be JSON-encodable; re-define `INTERNAL_PROTOCOL` to change this.

`MRJob.mapper_cmd()`

Re-define this to define the mapper for a one-step job **as a shell command**. If you define your mapper this way, the command will be passed unchanged to Hadoop Streaming, with some minor exceptions. For important specifics, see *Shell commands as steps*.

Basic example:

```
def mapper_cmd(self):
    return 'cat'
```

`MRJob.reducer_cmd()`

Re-define this to define the reducer for a one-step job **as a shell command**. If you define your mapper this way, the command will be passed unchanged to Hadoop Streaming, with some minor exceptions. For specifics, see *Shell commands as steps*.

Basic example:

```
def reducer_cmd(self):
    return 'cat'
```

`MRJob.combiner_cmd()`

Re-define this to define the combiner for a one-step job **as a shell command**. If you define your mapper this way, the command will be passed unchanged to Hadoop Streaming, with some minor exceptions. For specifics, see *Shell commands as steps*.

Basic example:

```
def combiner_cmd(self):
    return 'cat'
```

`MRJob.mapper_pre_filter()`

Re-define this to specify a shell command to filter the mapper's input before it gets to your job's mapper in a one-step job. For important specifics, see *Filtering task input with shell commands*.

Basic example:

```
def mapper_pre_filter(self):
    return 'grep "ponies"'
```

`MRJob.reducer_pre_filter()`

Re-define this to specify a shell command to filter the reducer's input before it gets to your job's reducer in a one-step job. For important specifics, see *Filtering task input with shell commands*.

Basic example:

```
def reducer_pre_filter(self):
    return 'grep "ponies"'
```

`MRJob.combiner_pre_filter()`

Re-define this to specify a shell command to filter the combiner's input before it gets to your job's combiner in a one-step job. For important specifics, see [Filtering task input with shell commands](#).

Basic example:

```
def combiner_pre_filter(self):  
    return 'grep "ponies"'
```

`MRJob.spark(input_path, output_path)`

Re-define this with Spark code to run. You can read input with *input\_path* and output with *output\_path*.

## Multi-step jobs

`MRJob.steps()`

Re-define this to make a multi-step job.

If you don't re-define this, we'll automatically create a one-step job using any of *mapper()*, *mapper\_init()*, *mapper\_final()*, *reducer\_init()*, *reducer\_final()*, and *reducer()* that you've re-defined. For example:

```
def steps(self):  
    return [self.mr(mapper=self.transform_input,  
                    reducer=self consolidate_1),  
            self.mr(reducer_init=self.log_mapper_init,  
                    reducer=self consolidate_2)]
```

**Returns** a list of steps constructed with *mr()*

**classmethod** `MRJob.mr(**kwargs)`

A deprecated wrapper for *MRStep*.

## Running the job

**classmethod** `MRJob.run()`

Entry point for running job from the command-line.

This is also the entry point when a mapper or reducer is run by Hadoop Streaming.

Does one of:

- Print step information (`--steps`). See [show\\_steps\(\)](#)
- Run a mapper (`--mapper`). See [run\\_mapper\(\)](#)
- Run a combiner (`--combiner`). See [run\\_combiner\(\)](#)
- Run a reducer (`--reducer`). See [run\\_reducer\(\)](#)
- Run the entire job. See [run\\_job\(\)](#)

`MRJob.__init__(args=None)`

Entry point for running your job from other Python code.

You can pass in command-line arguments, and the job will act the same way it would if it were run from the command line. For example, to run your job on EMR:



```
mr_job = MRYourJob(args=['-r', 'emr'])
with mr_job.make_runner() as runner:
    ...
```

Passing in `None` is the same as passing in `[]` (if you want to parse args from `sys.argv`, call `MRJob.run()`).

For a full list of command-line arguments, run: `python -m mrjob.job --help`

`MRJob.make_runner()`

Make a runner based on command-line arguments, so we can launch this job on EMR, on Hadoop, or locally.

**Return type** `mrjob.runner.MRJobRunner`

## Parsing output

`MRJob.parse_output_line(line)`

Parse a line from the final output of this MRJob into `(key, value)`. Used extensively in tests like this:

```
runner.run()
for line in runner.stream_output():
    key, value = mr_job.parse_output_line(line)
```

## Counters and status messages

`MRJob.increment_counter(group, counter, amount=1)`

Increment a counter in Hadoop streaming by printing to stderr.

### Parameters

- **group** (*str*) – counter group
- **counter** (*str*) – description of the counter
- **amount** (*int*) – how much to increment the counter by

Commas in `counter` or `group` will be automatically replaced with semicolons (commas confuse Hadoop streaming).

`MRJob.set_status(msg)`

Set the job status in hadoop streaming by printing to stderr.

This is also a good way of doing a keepalive for a job that goes a long time between outputs; Hadoop streaming usually times out jobs that give no output for longer than 10 minutes.

## Setting protocols

`MRJob.INPUT_PROTOCOL = <class 'mrjob.protocol.BytesValueProtocol'>`

Protocol for reading input to the first mapper in your job. Default: `RawValueProtocol`.

For example you know your input data were in JSON format, you could set:

```
INPUT_PROTOCOL = JSONValueProtocol
```

in your class, and your initial mapper would receive decoded JSONs rather than strings.

See `mrjob.protocol` for the full list of protocols.

`MRJob.INTERNAL_PROTOCOL = <class 'mrjob.protocol.StandardJSONProtocol'>`  
Protocol for communication between steps and final output. Default: `JSONProtocol`.

For example if your step output weren't JSON-encodable, you could set:

```
INTERNAL_PROTOCOL = PickleProtocol
```

and step output would be encoded as string-escaped pickles.

See `mrjob.protocol` for the full list of protocols.

`MRJob.OUTPUT_PROTOCOL = <class 'mrjob.protocol.StandardJSONProtocol'>`  
Protocol to use for writing output. Default: `JSONProtocol`.

For example, if you wanted the final output in repr, you could set:

```
OUTPUT_PROTOCOL = ReprProtocol
```

See `mrjob.protocol` for the full list of protocols.

`MRJob.input_protocol()`  
Instance of the protocol to use to convert input lines to Python objects. Default behavior is to return an instance of `INPUT_PROTOCOL`.

`MRJob.internal_protocol()`  
Instance of the protocol to use to communicate between steps. Default behavior is to return an instance of `INTERNAL_PROTOCOL`.

`MRJob.output_protocol()`  
Instance of the protocol to use to convert Python objects to output lines. Default behavior is to return an instance of `OUTPUT_PROTOCOL`.

`MRJob.pick_protocols(step_num, step_type)`  
Pick the protocol classes to use for reading and writing for the given step.

#### Parameters

- `step_num` (*int*) – which step to run (e.g. 0 for the first step)
- `step_type` (*str*) – one of 'mapper', 'combiner', or 'reducer'

**Returns** (read\_function, write\_function)

By default, we use one protocol for reading input, one internal protocol for communication between steps, and one protocol for final output (which is usually the same as the internal protocol). Protocols can be controlled by setting `INPUT_PROTOCOL`, `INTERNAL_PROTOCOL`, and `OUTPUT_PROTOCOL`.

Re-define this if you need fine control over which protocols are used by which steps.

## Secondary sort

`MRJob.SORT_VALUES = None`

Set this to `True` if you would like reducers to receive the values associated with any key in sorted order (sorted by their *encoded* value). Also known as secondary sort.

This can be useful if you expect more values than you can fit in memory to be associated with one key, but you want to apply information in a small subset of these values to information in the other values. For example, you may want to convert counts to percentages, and to do this you first need to know the total count.

Even though values are sorted by their encoded value, most encodings will sort strings in order. For example, you could have values like: `['A', <total>]`, `['B', <count_name>, <count>]`, and the value containing the total should come first regardless of what protocol you're using.

See `jobconf()` and `partitioner()` for more about how this works.

New in version 0.4.1.

## Command-line options

See *Defining command line options* for information on adding command line options to your job. See [Configuration quick reference](#) for a complete list of all configuration options.

`MRJob.configure_options()`

Define arguments for this script. Called from `__init__()`.

Re-define to define custom command-line arguments or pass through existing ones:

```
def configure_options(self):
    super(MRYourJob, self).configure_options()

    self.add_passthrough_option(...)
    self.add_file_option(...)
    self.pass_through_option(...)
    ...
```

`MRJob.add_passthrough_option(*args, **kwargs)`

Function to create options which both the job runner and the job itself respect (we use this for protocols, for example).

Use it like you would use `optparse.OptionParser.add_option()`:

```
def configure_options(self):
    super(MRYourJob, self).configure_options()
    self.add_passthrough_option(
        '--max-ngram-size', type='int', default=4, help='...')
```

Specify an `opt_group` keyword argument to add the option to that `OptionGroup` rather than the top-level `OptionParser`.

If you want to pass files through to the mapper/reducer, use `add_file_option()` instead.

If you want to pass through a built-in option (e.g. `--runner`, use `pass_through_option()` instead.

`MRJob.add_file_option(*args, **kwargs)`

Add a command-line option that sends an external file (e.g. a SQLite DB) to Hadoop:

```
def configure_options(self):
    super(MRYourJob, self).configure_options()
    self.add_file_option('--scoring-db', help=...)
```

This does the right thing: the file will be uploaded to the working dir of the script on Hadoop, and the script will be passed the same option, but with the local name of the file in the script's working directory.

We suggest against sending Berkeley DBs to your job, as Berkeley DB is not forwards-compatible (so a Berkeley DB that you construct on your computer may not be readable from within Hadoop). Use SQLite databases instead. If all you need is an on-disk hash table, try out the `sqlite3dbm` module.

`MRJob.pass_through_option(opt_str)`

Pass through a built-in option to tasks. For example, for tasks to see which runner launched them:

```
def configure_options(self):
    super(MRYourJob, self).configure_options()
    self.pass_through_option('--runner')
```

```
def mapper_init(self):
    if self.options.runner == 'emr':
        ...
```

*opt\_str* can be a long option switch like `--runner` or a short one like `-r`.

New in version 0.5.4.

`MRJob.load_options(args)`

Load command-line options into `self.options`, `self._script_path`, and `self.args`.

Called from `__init__()` after `configure_options()`.

**Parameters** `args` (*list of str*) – a list of command line arguments. None will be treated the same as `[]`.

Re-define if you want to post-process command-line arguments:

```
def load_options(self, args):
    super(MRYourJob, self).load_options(args)

    self.stop_words = self.options.stop_words.split(',')
    ...
```

`MRJob.is_task()`

True if this is a mapper, combiner, reducer, or Spark script.

This is mostly useful inside `load_options()`, to disable loading options when we aren't running inside Hadoop.

`MRJob.OPTION_CLASS = <class optparse.Option>`

Redefine this if you want to use a subclass of `optparse.Option` for option parsing.

## Job runner configuration

`MRJob.job_runner_kwargs()`

Keyword arguments used to create runners when `make_runner()` is called.

**Returns** map from arg name to value

Re-define this if you want finer control of runner initialization.

You might find `mrjob.conf.combine_dicts()` useful if you want to add or change lots of keyword arguments.

`MRJob.local_job_runner_kwargs()`

Keyword arguments to create runners when `make_runner()` is called, when we run a job locally (`-r local`).

**Returns** map from arg name to value

Re-define this if you want finer control when running jobs locally.

`MRJob.dataproc_job_runner_kwargs()`

Keyword arguments to create runners when `make_runner()` is called, when we run a job on EMR (`-r emr`).

**Returns** map from arg name to value

Re-define this if you want finer control when running jobs on EMR.

`MRJob.emr_job_runner_kwargs()`

Keyword arguments to create runners when `make_runner()` is called, when we run a job on EMR (`-r emr`).

**Returns** map from arg name to value

Re-define this if you want finer control when running jobs on EMR.

`MRJob.hadoop_job_runner_kwargs()`

Keyword arguments to create runners when `make_runner()` is called, when we run a job on EMR (`-r hadoop`).

**Returns** map from arg name to value

Re-define this if you want finer control when running jobs on hadoop.

`MRJob.generate_passthrough_arguments()`

Returns a list of arguments to pass to subprocesses, either on hadoop or executed via subprocess.

These are passed to `mrjob.runner.MRJobRunner.__init__()` as `extra_args`.

`MRJob.generate_file_upload_args()`

Figure out file upload args to pass through to the job runner.

Instead of generating a list of args, we're generating a list of tuples of (`'--argname', path`)

These are passed to `mrjob.runner.MRJobRunner.__init__()` as `file_upload_args`.

`classmethod MRJob.mr_job_script()`

Path of this script. This returns the file containing this class, or `None` if there isn't any (e.g. it was defined from the command line interface.)

## Running specific parts of jobs

`MRJob.run_job()`

Run the all steps of the job, logging errors (and debugging output if `--verbose` is specified) to `STDERR` and streaming the output to `STDOUT`.

Called from `run()`. You'd probably only want to call this directly from automated tests.

`MRJob.run_mapper(step_num=0)`

Run the mapper and final mapper action for the given step.

**Parameters** `step_num` (*int*) – which step to run (0-indexed)

If `--no-strict-protocols` is set, and we encounter a line that can't be decoded by our input protocol or a tuple that can't be encoded by our output protocol, we'll increment a counter rather than raising an exception. This will be going away in v0.6.0.

Called from `run()`. You'd probably only want to call this directly from automated tests.

`MRJob.run_reducer(step_num=0)`

Run the reducer for the given step.

**Parameters** `step_num` (*int*) – which step to run (0-indexed)

If we encounter a line that can't be decoded by our input protocol, or a tuple that can't be encoded by our output protocol, we'll increment a counter rather than raising an exception. If `--strict-protocols` is set, then an exception is raised

Called from `run()`. You'd probably only want to call this directly from automated tests.

`MRJob.run_combiner(step_num=0)`

Run the combiner for the given step.

**Parameters** `step_num` (*int*) – which step to run (0-indexed)

If we encounter a line that can't be decoded by our input protocol, or a tuple that can't be encoded by our output protocol, we'll increment a counter rather than raising an exception. If `--strict-protocols` is set, then an exception is raised

Called from `run()`. You'd probably only want to call this directly from automated tests.

`MRJob.show_steps()`

Print information about how many steps there are, and whether they contain a mapper or reducer. Job runners (see [Runners](#)) use this to determine how Hadoop should call this script.

Called from `run()`. You'd probably only want to call this directly from automated tests.

## Hadoop configuration

`MRJob.HADOOP_INPUT_FORMAT = None`

Optional name of an optional Hadoop InputFormat class, e.g. `'org.apache.hadoop.mapred.lib.NLineInputFormat'`.

Passed to Hadoop with the *first* step of this job with the `-inputformat` option.

If you require more sophisticated behavior, try `hadoop_input_format()` or the `hadoop_input_format` argument to `mrjob.runner.MRJobRunner.__init__()`.

`MRJob.hadoop_input_format()`

Optional Hadoop InputFormat class to parse input for the first step of the job.

Normally, setting `HADOOP_INPUT_FORMAT` is sufficient; redefining this method is only for when you want to get fancy.

`MRJob.HADOOP_OUTPUT_FORMAT = None`

Optional name of an optional Hadoop OutputFormat class, e.g. `'org.apache.hadoop.mapred.FileOutputFormat'`.

Passed to Hadoop with the *last* step of this job with the `-outputformat` option.

If you require more sophisticated behavior, try `hadoop_output_format()` or the `hadoop_output_format` argument to `mrjob.runner.MRJobRunner.__init__()`.

`MRJob.hadoop_output_format()`

Optional Hadoop OutputFormat class to write output for the last step of the job.

Normally, setting `HADOOP_OUTPUT_FORMAT` is sufficient; redefining this method is only for when you want to get fancy.

`MRJob.JOBCONF = {}`

Optional jobconf arguments we should always pass to Hadoop. This is a map from property name to value. e.g.: `{ 'stream.num.map.output.key.fields': '4' }`

It's recommended that you only use this to hard-code things that affect the semantics of your job, and leave performance tweaks to the command line or whatever you use to launch your job.

`MRJob.jobconf()`

-D args to pass to hadoop streaming. This should be a map from property name to value.

By default, this combines `jobconf` options from the command lines with `JOBCONF`, with command line arguments taking precedence.

We also blank out `mapred.output.key.comparator.class` and `mapred.text.key.comparator.options` to prevent interference from `mrjob.conf`.

`SORT_VALUES` can be overridden by `JOBCONF`, the command line, and step-specific `jobconf` values.

For example, if you know your values are numbers, and want to sort them in reverse, you could do:

```
SORT_VALUES = True

JOBCONF = {
    'mapred.output.key.comparator.class':
        'org.apache.hadoop.mapred.lib.KeyFieldBasedComparator',
    'mapred.text.key.comparator.options': '-k1 -k2nr',
}
```

If you want to re-define this, it's strongly recommended that do something like this, so as not to inadvertently disable the `jobconf` option:

```
def jobconf(self):
    orig_jobconf = super(MyMRJobClass, self).jobconf()
    custom_jobconf = ...

    return mrjob.conf.combine_dicts(orig_jobconf, custom_jobconf)
```

`MRJob.LIBJARS = []`

Optional list of paths of jar files to run our job with using Hadoop's `-libjar` option.

~ and environment variables in paths be expanded, and relative paths will be interpreted as relative to the directory containing the script (not the current working directory).

If you require more sophisticated behavior, try overriding `libjars()`.

New in version 0.5.3.

`MRJob.libjars()`

Optional list of paths of jar files to run our job with using Hadoop's `-libjar` option. Normally setting `LIBJARS` is sufficient.

By default, this combines `libjars` options from the command lines with `LIBJARS`, with command line arguments taking precedence. Paths from `LIBJARS` are interpreted as relative to the the directory containing the script (paths from the command-line are relative to the current working directory).

Note that ~ and environment variables in paths will always be expanded by the job runner (see `libjars`).

New in version 0.5.3.

`MRJob.PARTITIONER = None`

Optional Hadoop partitioner class to use to determine how mapper output should be sorted and distributed to reducers. For example: `'org.apache.hadoop.mapred.lib.HashPartitioner'`.

If you require more sophisticated behavior, try `partitioner()`.

`MRJob.partitioner()`

Optional Hadoop partitioner class to use to determine how mapper output should be sorted and distributed to reducers.

By default, returns whatever is passed to `--partitioner`, or if that option isn't used, `PARTITIONER`, or if that isn't set, and `SORT_VALUES` is true, it's set to `'org.apache.hadoop.mapred.lib.KeyFieldBasedPartitioner'`.

You probably don't need to re-define this; it's just here for completeness.

## Hooks for testing

`MRJob.sandbox(stdin=None, stdout=None, stderr=None)`

Redirect stdin, stdout, and stderr for automated testing.

You can set stdin, stdout, and stderr to file objects. By default, they'll be set to empty `BytesIO` objects. You can then access the job's file handles through `self.stdin`, `self.stdout`, and `self.stderr`. See [Testing jobs](#) for more information about testing.

You may call `sandbox` multiple times (this will essentially clear the file handles).

`stdin` is empty by default. You can set it to anything that yields lines:

```
mr_job.sandbox(stdin=BytesIO(b'some_data\n'))
```

or, equivalently:

```
mr_job.sandbox(stdin=[b'some_data\n'])
```

For convenience, this `sandbox()` returns `self`, so you can do:

```
mr_job = MRJobClassToTest().sandbox()
```

Simple testing example:

```
mr_job = MRYourJob.sandbox()
self.assertEqual(list(mr_job.reducer('foo', ['a', 'b'])), [...])
```

More complex testing example:

```
from BytesIO import BytesIO

from mrjob.parse import parse_mr_job_stderr
from mrjob.protocol import JSONProtocol

mr_job = MRYourJob(args=[...])

fake_input = '"foo"\t"bar"\n"foo"\t"baz"\n'
mr_job.sandbox(stdin=BytesIO(fake_input))

mr_job.run_reducer(link_num=0)

self.assertEqual(mr_job.stdout.getvalue(), ...)
self.assertEqual(parse_mr_job_stderr(mr_job.stderr), ...)
```

## mrjob.local - simulate Hadoop locally with subprocesses

`class mrjob.local.LocalMRJobRunner(**kwargs)`

Runs an *MRJob* locally, for testing purposes. Invoked when you run your job with `-r local`.

Unlike `InlineMRJobRunner`, this actually spawns multiple subprocesses for each task.

This is fairly inefficient and *not* a substitute for Hadoop; it's main purpose is to help you test out [setup](#) commands.

It's rare to need to instantiate this class directly (see `__init__()` for details).

`LocalMRJobRunner.__init__(**kwargs)`

Arguments to this constructor may also appear in `mrjob.conf` under `runners/local`.



`LocalMRJobRunner`'s constructor takes the same keyword args as `MRJobRunner`. However, please note:

- `cmdenv` is combined with `combine_local_envs()`
- `python_bin` defaults to `sys.executable` (the current python interpreter)
- `hadoop_input_format`, `hadoop_output_format`, and `partitioner` are ignored because they require Java. If you need to test these, consider starting up a standalone Hadoop instance and running your job with `-r hadoop`.

## mrjob.parse - log parsing

Utilities for parsing errors, counters, and status messages.

`mrjob.parse.is_s3_uri(uri)`

Return True if `uri` can be parsed into an S3 URI, False otherwise.

`mrjob.parse.is_uri(uri)`

Return True if `uri` is a URI and contains `://` (we only care about URIs that can describe files)

Changed in version 0.5.7: used to recognize anything containing a colon as a URI unless it was a Windows path (`C:\...`).

`mrjob.parse.is_windows_path(uri)`

Return True if `uri` is a windows path.

Deprecated since version 0.5.7.

`mrjob.parse.parse_key_value_list(kv_string_list, error_fmt, error_func)`

Parse a list of strings like `KEY=VALUE` into a dictionary.

### Parameters

- **`kv_string_list`** (*[str]*) – Parse a list of strings like `KEY=VALUE` into a dictionary.
- **`error_fmt`** (*str*) – Format string accepting one `%s` argument which is the malformed (i.e. not `KEY=VALUE`) string
- **`error_func`** (*function(str)*) – Function to call when a malformed string is encountered.

Deprecated since version 0.5.7.

`mrjob.parse.parse_mr_job_stderr(stderr, counters=None)`

Parse counters and status messages out of MRJob output.

### Parameters

- **`stderr`** – a filehandle, a list of lines (bytes), or bytes
- **`counters`** – Counters so far, to update; a map from group (string) to counter name (string) to count.

Returns a dictionary with the keys `counters`, `statuses`, `other`:

- **`counters`**: counters so far; same format as above
- **`statuses`**: a list of status messages encountered
- **`other`**: lines (strings) that aren't either counters or status messages

`mrjob.parse.parse_port_range_list(range_list_str)`

Parse a port range list of the form `(start[:end]) (, (start[:end])) *`

Deprecated since version 0.5.7.

`mrjob.parse.parse_s3_uri(uri)`  
Parse an S3 URI into (bucket, key)

```
>>> parse_s3_uri('s3://walrus/tmp/')
('walrus', 'tmp/')
```

If `uri` is not an S3 URI, raise a `ValueError`

## mrjob.protocol - input and output

Protocols translate raw bytes into key, value pairs.

Typically, protocols encode a key and value into bytes, and join them together with a tab character.

However, protocols with `Value` in their name ignore keys and simply read/write values (with key read in as `None`), allowing you to read and write data in arbitrary formats.

For more information, see [Protocols](#) and [Writing custom protocols](#).

### Strings

**class** `mrjob.protocol.RawValueProtocol`

Just output value (a `str`), and discard key (key is read in as `None`).

**This is the default protocol used by jobs to read input.**

This is an alias for [RawValueProtocol](#) on Python 2 and [TextValueProtocol](#) on Python 3.

**class** `mrjob.protocol.BytesValueProtocol`

Read line (without trailing newline) directly into value (key is always `None`). Output value (bytes) directly, discarding key.

**This is the default protocol used by jobs to read input on Python 2.**

**Warning:** Typical usage on Python 2 is to have your mapper parse (byte) strings out of your input files, and then include them in the output to the reducer. Since this output is then (by default) JSON-encoded, encoding will fail if the bytestrings are not UTF-8 decodable. If this is an issue, consider using [TextValueProtocol](#) instead.

**class** `mrjob.protocol.TextValueProtocol`

Attempt to UTF-8 decode line (without trailing newline) into value, falling back to latin-1. (key is always `None`). Output value UTF-8 encoded, discarding key.

**This is the default protocol used by jobs to read input on Python 3.**

This is a good solution for reading text files which are mostly ASCII but may have some other bytes of unknown encoding (e.g. logs).

If you wish to enforce a particular encoding, use [BytesValueProtocol](#) instead:

```
class MREncodingEnforcer(MRJob):

    INPUT_PROTOCOL = BytesValueProtocol

    def mapper(self, _, value):
        value = value.decode('utf_8')
        ...
```

**class** `mrjob.protocol.RawProtocol`

Output key (str) and value (str), separated by a tab character.

This is an alias for *BytesProtocol* on Python 2 and *TextProtocol* on Python 3.

**class** `mrjob.protocol.BytesProtocol`

Encode (key, value) (bytestrings) as key and value separated by a tab.

If key or value is None, don't include a tab. When decoding a line with no tab in it, value will be None.

When reading from a line with multiple tabs, we break on the first one.

Your key should probably not be None or have tab characters in it, but we don't check.

**class** `mrjob.protocol.TextProtocol`

UTF-8 encode key and value (unicode strings) and join them with a tab character. When reading input, we fall back to latin-1 if we can't UTF-8 decode the line.

If key or value is None, don't include a tab. When decoding a line with no tab in it, value will be None.

When reading from a line with multiple tabs, we break on the first one.

Your key should probably not be None or have tab characters in it, but we don't check.

## JSON

**class** `mrjob.protocol.JSONProtocol`

Encode (key, value) as two JSONs separated by a tab.

**This is the default protocol used by jobs to write output and communicate between steps.**

This is an alias for the first one of *UltraJSONProtocol*, *RapidJSONProtocol*, *SimpleJSONProtocol*, or *StandardJSONProtocol* for which the underlying library is available.

**class** `mrjob.protocol.UltraJSONProtocol`

Implements *JSONProtocol* using the *ujson* library.

**Warning:** *ujson* is about five times faster than the standard implementation, but is more willing to encode things that aren't strictly JSON-encodable, including sets, dictionaries with tuples as keys, UTF-8 encoded bytes, and objects (!). Relying on this behavior won't stop your job from working, but it can make your job *dependent* on *ujson*, rather than just using it as a speedup.

---

**Note:** *ujson* also differs from the standard implementation in that it doesn't add spaces to its JSONs (`{"foo": "bar"}` versus `{"foo": "bar"}`). This probably won't affect anything but test cases and readability.

---

**class** `mrjob.protocol.RapidJSONProtocol`

Implements *JSONProtocol* using the *rapidjson* library.

New in version 0.5.10.

**class** `mrjob.protocol.SimpleJSONProtocol`

Implements *JSONProtocol* using the *simplejson* library.

**class** `mrjob.protocol.StandardJSONProtocol`

Implements *JSONProtocol* using Python's built-in JSON library.

---

**Note:** The built-in *json* library is (appropriately) strict about the JSON standard; it won't accept dictionaries with non-string keys, sets, or (on Python 3) bytestrings.

---

**class** `mrjob.protocol.JSONValueProtocol`

Encode value as a JSON and discard key (key is read in as None).

This is an alias for the first one of *UltraJSONValueProtocol*, *RapidJSONValueProtocol*, *SimpleJSONValueProtocol*, or *StandardJSONValueProtocol* for which the underlying library is available.

**class** `mrjob.protocol.UltraJSONValueProtocol`

Implements *JSONValueProtocol* using the *ujson* library.

**class** `mrjob.protocol.RapidJSONValueProtocol`

Implements *JSONValueProtocol* using the *rapidjson* library.

New in version 0.5.10.

**class** `mrjob.protocol.SimpleJSONValueProtocol`

Implements *JSONValueProtocol* using the *simplejson* library.

**class** `mrjob.protocol.StandardJSONValueProtocol`

Implements *JSONValueProtocol* using Python's built-in JSON library.

## Repr

**class** `mrjob.protocol.ReprProtocol`

Encode (key, value) as two reprs separated by a tab.

This only works for basic types (we use *mrjob.util.safeeval()*).

**Warning:** The repr format changes between different versions of Python (for example, braces for sets in Python 2.7, and different string constants in Python 3). Plan accordingly.

**class** `mrjob.protocol.ReprValueProtocol`

Encode value as a repr and discard key (key is read in as None).

See *ReprProtocol* for details.

## Pickle

**class** `mrjob.protocol.PickleProtocol`

Encode (key, value) as two string-escaped pickles separated by a tab.

We string-escape the pickles to avoid having to deal with stray `\t` and `\n` characters, which would confuse Hadoop Streaming.

Ugly, but should work for any type.

**Warning:** Pickling is only *backwards*-compatible across Python versions. If your job uses this as an output protocol, you should use at least the same version of Python to parse the job's output. Vice versa for using this as an input protocol.

**class** `mrjob.protocol.PickleValueProtocol`

Encode value as a string-escaped pickle and discard key (key is read in as None).

See *PickleProtocol* for details.

## mrjob.retry - retry on transient errors

**class** `mrjob.retry.RetryWrapper` (*wrapped, retry\_if, backoff=15, multiplier=1.5, max\_tries=10*)  
 Handle transient errors, with configurable backoff.

This class can wrap any object. The wrapped object will behave like the original one, except that if you call a function and it raises a retriable exception, we'll back off for a certain number of seconds and call the function again, until it succeeds or we get a non-retriable exception.

`RetryWrapper.__init__` (*wrapped, retry\_if, backoff=15, multiplier=1.5, max\_tries=10*)  
 Wrap the given object

### Parameters

- **wrapped** – the object to wrap
- **retry\_if** – a method that takes an exception, and returns whether we should retry
- **backoff** (*float*) – the number of seconds to wait the first time we get a retriable error
- **multiplier** (*float*) – if we retry multiple times, the amount to multiply the backoff time by every time we get an error
- **max\_tries** (*int*) – how many tries we get. 0 means to keep trying forever

## mrjob.runner - base class for all runners

**class** `mrjob.runner.MRJobRunner` (*mr\_job\_script=None, conf\_paths=None, extra\_args=None, file\_upload\_args=None, hadoop\_input\_format=None, hadoop\_output\_format=None, input\_paths=None, output\_dir=None, partitioner=None, sort\_values=None, stdin=None, step\_output\_dir=None, \*\*opts*)

Abstract base class for all runners

`MRJobRunner.__init__` (*mr\_job\_script=None, conf\_paths=None, extra\_args=None, file\_upload\_args=None, hadoop\_input\_format=None, hadoop\_output\_format=None, input\_paths=None, output\_dir=None, partitioner=None, sort\_values=None, stdin=None, step\_output\_dir=None, \*\*opts*)

All runners take the following keyword arguments:

### Parameters

- **mr\_job\_script** (*str*) – the path of the `.py` file containing the `MRJob`. If this is `None`, you won't actually be able to `run()` the job, but other utilities (e.g. `ls()`) will work.
- **conf\_paths** (*None or list*) – List of config files to combine and use, or `None` to search for `mrjob.conf` in the default locations.
- **extra\_args** (*list of str*) – a list of extra cmd-line arguments to pass to the `mr_job` script. This is a hook to allow jobs to take additional arguments.
- **file\_upload\_args** – a list of tuples of (`'--ARGNAME'`, `path`). The file at the given path will be uploaded to the local directory of the `mr_job` script when it runs, and then passed into the script with `--ARGNAME`. Useful for passing in SQLite DBs and other configuration files to your job.
- **hadoop\_input\_format** (*str*) – name of an optional Hadoop `InputFormat` class. Passed to Hadoop along with your first step with the `-inputformat` option. Note that if

you write your own class, you'll need to include it in your own custom streaming jar (see [hadoop\\_streaming\\_jar](#)).

- **hadoop\_output\_format** (*str*) – name of an optional Hadoop `OutputFormat` class. Passed to Hadoop along with your first step with the `-outputformat` option. Note that if you write your own class, you'll need to include it in your own custom streaming jar (see [hadoop\\_streaming\\_jar](#)).
- **input\_paths** (*list of str*) – Input files for your job. Supports globs and recursively walks directories (e.g. `['data/common/', 'data/training/*.gz']`). If this is left blank, we'll read from `stdin`.
- **output\_dir** (*str*) – An empty/non-existent directory where Hadoop should put the final output from the job. If you don't specify an output directory, we'll output into a subdirectory of this job's temporary directory. You can control this from the command line with `--output-dir`. This option cannot be set from configuration files. If used with the hadoop runner, this path does not need to be fully qualified with `hdfs://` URIs because it's understood that it has to be on HDFS.
- **partitioner** (*str*) – Optional name of a Hadoop partitioner class, e.g. `'org.apache.hadoop.mapred.lib.HashPartitioner'`. Hadoop streaming will use this to determine how mapper output should be sorted and distributed to reducers.
- **sort\_values** (*bool*) – if true, set partitioners and jobconf variables so that reducers to receive the values associated with any key in sorted order (sorted by their *encoded* value). Also known as secondary sort.
- **stdin** – an iterable (can be a `BytesIO` or even a list) to use as `stdin`. This is a hook for testing; if you set `stdin` via [sandbox\(\)](#), it'll get passed through to the runner. If for some reason your lines are missing newlines, we'll add them; this makes it easier to write automated tests.
- **step\_output\_dir** (*str*) – An empty/non-existent directory where Hadoop should put output from all steps other than the last one (this only matters for multi-step jobs). Currently ignored by local runners.

## Running your job

`MRJobRunner.run()`

Run the job, and block until it finishes.

Raise `StepFailedException` if there are any problems (except on `InlineMRJobRunner`, where we raise the actual exception that caused the step to fail).

`MRJobRunner.stream_output()`

Stream raw lines from the job's output. You can parse these using the `read()` method of the appropriate Hadoop-StreamingProtocol class.

`MRJobRunner.cleanup(mode=None)`

Clean up running jobs, temp files, and logs, subject to the `cleanup` option passed to the constructor.

If you create your runner in a `with` block, `cleanup()` will be called automatically:

```
with mr_job.make_runner() as runner:
    ...

# cleanup() called automatically here
```

**Parameters** `mode` – override `cleanup` passed into the constructor. Should be a list of strings from `CLEANUP_CHOICES`

`mrjob.runner.CLEANUP_CHOICES = ['ALL', 'CLOUD_TMP', 'CLUSTER', 'HADOOP_TMP', 'JOB', 'LOCAL_TMP', 'T']`  
`list()` -> new empty list `list(iterable)` -> new list initialized from iterable's items

## Run Information

`MRJobRunner.counters()`

Get counters associated with this run in this form:

```
[{'group name': {'counter1': 1, 'counter2': 2}},
 {'group name': ...}]
```

The list contains an entry for every step of the current job.

`MRJobRunner.get_hadoop_version()`

Return the version number of the Hadoop environment as a string if Hadoop is being used or simulated. Return None if not applicable.

*EMRJobRunner* infers this from the cluster. *HadoopJobRunner* gets this from `hadoop version`. *LocalMRJobRunner* has an additional `hadoop_version` option to specify which version it simulates. *InlineMRJobRunner* does not simulate Hadoop at all.

## Configuration

`MRJobRunner.get_opts()`

Get options set for this runner, as a dict.

## File management

`MRJobRunner.fs`

*Filesystem* object for the local filesystem. Methods on *Filesystem* objects will be forwarded to *MRJobRunner* until mrjob 0.6.0, but **this behavior is deprecated**.

**class** `mrjob.fs.base.Filesystem`

Some simple filesystem operations that are common across the local filesystem, S3, HDFS, and remote machines via SSH. Different runners provide functionality for different filesystems via their `fs` attribute. The `hadoop` and `emr` runners provide support for multiple protocols using `CompositeFilesystem`.

Protocol support:

- `mrjob.fs.hadoop.HadoopFilesystem`: `hdfs://`, others
- `mrjob.fs.local.LocalFilesystem`: `/`
- `mrjob.fs.s3.S3Filesystem`: `s3://bucket/path`, `s3n://bucket/path`
- `mrjob.fs.ssh.SSHFilesystem`: `ssh://hostname/path`

**can\_handle\_path** (*path*)

Can we handle this path at all?

**cat** (*path\_glob*)

cat all files matching `path_glob`, decompressing if necessary

**du** (*path\_glob*)  
Get the total size of files matching *path\_glob*  
Corresponds roughly to: `hadoop fs -du path_glob`

**exists** (*path\_glob*)  
Does the given path/URI exist?  
Corresponds roughly to: `hadoop fs -test -e path_glob`

**join** (*path*, *\*paths*)  
Join *paths* onto *path* (which may be a URI)

**ls** (*path\_glob*)  
Recursively list all files in the given path.  
We don't return directories for compatibility with S3 (which has no concept of them)  
Corresponds roughly to: `hadoop fs -ls -R path_glob`

**md5sum** (*path\_glob*)  
Generate the md5 sum of the file at *path*

**mkdir** (*path*)  
Create the given dir and its subdirs (if they don't already exist).  
Corresponds roughly to: `hadoop fs -mkdir -p path`

**path\_exists** (*path\_glob*)  
Alias for `exists()`. Going away in v0.6.0

**path\_join** (*dirname*, *filename*)  
Alias for `join()`. Going away in v0.6.0

**rm** (*path\_glob*)  
Recursively delete the given file/directory, if it exists  
Corresponds roughly to: `hadoop fs -rm -R path_glob`

**touchz** (*path*)  
Make an empty file in the given location. Raises an error if a non-zero length file already exists in that location.  
Corresponds to: `hadoop fs -touchz path`

## mrjob.step - represent Job Steps

`mrjob.step.INPUT = '<input>'`

If passed as an argument to `JarStep` or `py:class:SparkScriptStep`, it'll be replaced with the step's input path(s) (if there are multiple paths, they'll be joined with commas)

**class** `mrjob.step.JarStep` (*jar*, *\*\*kwargs*)

Represents a running a custom Jar as a step.

Accepts the following keyword arguments:

### Parameters

- **jar** – The local path to the Jar. On EMR, this can also be an `s3://` URI, or `file://` to reference a jar on the local filesystem of your EMR instance(s).
- **args** – (optional) A list of arguments to the jar. Use `mrjob.step.INPUT` and `OUTPUT` to interpolate input and output paths.



- **jobconf** – (optional) A dictionary of Hadoop properties
- **main\_class** – (optional) The main class to run from the jar. If not specified, Hadoop will use the main class in the jar’s manifest file.

*jar* can also be passed as a positional argument

See *Jar steps* for sample usage.

**class** `mrjob.step.MRStep(**kwargs)`

Represents steps handled by the script containing your job.

Used by *MRJob.steps*. See *Multi-step jobs* for sample usage.

Accepts the following keyword arguments:

#### Parameters

- **mapper** – function with same function signature as *mapper()*, or None for an identity mapper.
- **reducer** – function with same function signature as *reducer()*, or None for no reducer.
- **combiner** – function with same function signature as *combiner()*, or None for no combiner.
- **mapper\_init** – function with same function signature as *mapper\_init()*, or None for no initial mapper action.
- **mapper\_final** – function with same function signature as *mapper\_final()*, or None for no final mapper action.
- **reducer\_init** – function with same function signature as *reducer\_init()*, or None for no initial reducer action.
- **reducer\_final** – function with same function signature as *reducer\_final()*, or None for no final reducer action.
- **combiner\_init** – function with same function signature as *combiner\_init()*, or None for no initial combiner action.
- **combiner\_final** – function with same function signature as *combiner\_final()*, or None for no final combiner action.
- **jobconf** – dictionary with custom jobconf arguments to pass to hadoop.

**description** (*step\_num*)

Returns a dictionary representation of this step:

```
{
    'type': 'streaming',
    'mapper': { ... },
    'combiner': { ... },
    'reducer': { ... },
    'jobconf': dictionary of Hadoop configuration properties
}
```

*jobconf* is optional, and only one of *mapper*, *combiner*, and *reducer* need be included.

*mapper*, *combiner*, and *reducer* are either handled by the script containing your job definition:

```
{
    'type': 'script',
    'pre_filter': (optional) cmd to pass input through, as a string
}
```

or they simply run a command:

```
{
    'type': 'command',
    'command': command to run, as a string
}
```

See *Format of -steps* for examples.

`mrjob.step.OUTPUT = '<output>'`

If this is passed as an argument to *JarStep* or `py:class:SparkScriptStep`, it'll be replaced with the step's output path

**class** `mrjob.step.SparkJarStep(jar, main_class, **kwargs)`

Represents a running a separate Jar through Spark

Accepts the following keyword arguments:

#### Parameters

- **jar** – The local path to the Python script to run. On EMR, this can also be an `s3://` URI, or `file://` to reference a jar on the local filesystem of your EMR instance(s).
- **main\_class** – Your application's main class (e.g. `'org.apache.spark.examples.SparkPi'`)
- **args** – (optional) A list of arguments to the script. Use `mrjob.step.INPUT` and `OUTPUT` to interpolate input and output paths.
- **jobconf** – (optional) A dictionary of Hadoop properties
- **spark\_args** – (optional) an array of arguments to pass to spark-submit (e.g. `['--executor-memory', '2G']`).

*jar* and *main\_class* can also be passed as positional arguments

**class** `mrjob.step.SparkScriptStep(script, **kwargs)`

Represents a running a separate Python script through Spark

Accepts the following keyword arguments:

#### Parameters

- **script** – The local path to the Python script to run. On EMR, this can also be an `s3://` URI, or `file://` to reference a jar on the local filesystem of your EMR instance(s).
- **args** – (optional) A list of arguments to the script. Use `mrjob.step.INPUT` and `OUTPUT` to interpolate input and output paths.
- **jobconf** – (optional) A dictionary of Hadoop properties
- **spark\_args** – (optional) an array of arguments to pass to spark-submit (e.g. `['--executor-memory', '2G']`).

*script* can also be passed as a positional argument

**class** `mrjob.step.SparkStep(spark, **kwargs)`

Represents running a Spark step defined in your job.

Accepts the following keyword arguments:

#### Parameters

- **spark** – function containing your Spark code with same function signature as `spark()`
- **jobconf** – (optional) A dictionary of Hadoop properties

- **spark\_args** – (optional) an array of arguments to pass to spark-submit (e.g. `['--executor-memory', '2G']`).

**exception** `mrjob.step.StepFailedException` (*reason=None, step\_num=None, num\_steps=None, step\_desc=None*)

Exception to throw when a step fails.

This will automatically be caught and converted to an error message by `mrjob.job.MRJob.run()`, but you may wish to catch it if you *run your job programmatically*.

## mrjob.setup - job environment setup

Utilities for setting up the environment jobs run in by uploading files and running setup scripts.

The general idea is to use Hadoop DistributedCache-like syntax to find and parse expressions like `/path/to/file#name_in_working_dir` into “path dictionaries” like `{‘type’: ‘file’, ‘path’: ‘/path/to/file’, ‘name’: ‘name_in_working_dir’}`.

You can then pass these into a `WorkingDirManager` to keep track of which files need to be uploaded, catch name collisions, and assign names to unnamed paths (e.g. `/path/to/file#`). Note that `WorkingDirManager.name()` can take a path dictionary as keyword arguments.

If you need to upload files from the local filesystem to a place where Hadoop can see them (HDFS or S3), we provide `UploadDirManager`.

Path dictionaries are meant to be immutable; all state is handled by manager classes.

**class** `mrjob.setup.BootstrapWorkingDirManager`

Manage the working dir for the master bootstrap script. Identical to `WorkingDirManager` except that it doesn’t support archives.

Also used for master node setup script.

**class** `mrjob.setup.UploadDirManager` (*prefix*)

Represents a directory on HDFS or S3 where we want to upload local files for consumption by Hadoop.

`UploadDirManager` tries to give files the same name as their filename in the path (for ease of debugging), but handles collisions gracefully.

`UploadDirManager` assumes URIs to not need to be uploaded and thus does not store them. `uri()` maps URIs to themselves.

**add** (*path*)

**Add a path.** If *path* hasn’t been added before, assign it a name. If *path* is a URI don’t add it; just return the URI.

**Returns** the URI assigned to the path

**path\_to\_uri** ()

Get a map from path to URI for all paths that were added, so we can figure out which files we need to upload.

**uri** (*path*)

Get the URI for the given path. If *path* is a URI, just return it.

**class** `mrjob.setup.WorkingDirManager`

Represents the working directory of hadoop tasks (or bootstrap commands on EMR).

To support Hadoop's distributed cache, paths can be for ordinary files, or for archives (which are automatically uncompressed into a directory by Hadoop).

When adding a file, you may optionally assign it a name; if you don't, we'll lazily assign it a name as needed. Name collisions are not allowed, so being lazy makes it easier to avoid unintended collisions.

If you wish, you may assign multiple names to the same file, or add a path as both a file and an archive (though not mapped to the same name).

**add** (*type*, *path*, *name=None*)

Add a path as either a file or an archive, optionally assigning it a name.

#### Parameters

- **type** – either 'archive' or 'file'
- **path** – path/URI to add
- **name** – optional name that this path *must* be assigned, or None to assign this file a name later.

**name** (*type*, *path*, *name=None*)

Get the name for a path previously added to this *WorkingDirManager*, assigning one as needed.

This is primarily for getting the name of auto-named files. If the file was added with an assigned name, you must include it (and we'll just return *name*).

We won't ever give an auto-name that's the same as an assigned name (even for the same path and type).

#### Parameters

- **type** – either 'archive' or 'file'
- **path** – path/URI
- **name** – known name of the file

**name\_to\_path** (*type*)

Get a map from name (in the setup directory) to path for all known files/archives, so we can build `-file` and `-archive` options to Hadoop (or fake them in a bootstrap script).

**Parameters** **type** – either 'archive' or 'file'

**paths** ()

Get a set of all paths tracked by this *WorkingDirManager*.

`mrjob.setup.name_uniquely` (*path*, *names\_taken=()*, *proposed\_name=None*, *unhide=False*)

Come up with a unique name for *path*.

#### Parameters

- **names\_taken** – a dictionary or set of names not to use.
- **proposed\_name** – name to use if it is not taken. If this is not set, we propose a name based on the filename.
- **unhide** – make sure final name doesn't start with periods or underscores

If the proposed name is taken, we add a number to the end of the filename, keeping the extension the same. For example:

```
>>> name_uniquely('foo.tar.gz', set(['foo.tar.gz']))
'foo-1.tar.gz'
```

`mrjob.setup.parse_legacy_hash_path(type, path, must_name=None)`

Parse hash paths from old setup/bootstrap options.

This is similar to parsing hash paths out of shell commands (see `parse_setup_cmd()`) except that we pass in path type explicitly, and we don't always require the # character.

#### Parameters

- **type** – Type of the path ('archive' or 'file')
- **path** – Path to parse, possibly with a #
- **must\_name** – If set, use *path*'s filename as its name if there is no '#' in *path*, and raise an exception if there is just a '#' with no name. Set *must\_name* to the name of the relevant option so we can print a useful error message. This is intended for options like `upload_files` that merely upload a file without tracking it.

`mrjob.setup.parse_setup_cmd(cmd)`

Parse a setup/bootstrap command, finding and pulling out Hadoop Distributed Cache-style paths ("hash paths").

**Parameters** *cmd* (*string*) – shell command to parse

**Returns** a list containing dictionaries (parsed hash paths) and strings (parts of the original command, left unparsed)

Hash paths look like *path*#*name*, where *path* is either a local path or a URI pointing to something we want to upload to Hadoop/EMR, and *name* is the name we want it to have when we upload it; *name* is optional (no name means to pick a unique one).

If *name* is followed by a trailing slash, that indicates *path* is an archive (e.g. a tarball), and should be unarchived into a directory on the remote system. The trailing slash will *also* be kept as part of the original command.

If *path* is followed by a trailing slash, that indicates *path* is a directory and should be tarballed and later unarchived into a directory on the remote system. The trailing slash will also be kept as part of the original command. You may optionally include a slash after *name* as well (this will only result in a single slash in the final command).

New in version 0.5.8: support for directories (above)

Parsed hash paths are dictionaries with the keys *path*, *name*, and *type* (either 'file', 'archive', or 'dir').

Most of the time, this function will just do what you expect. Rules for finding hash paths:

- we only look for hash paths outside of quoted strings
- *path* may not contain quotes or whitespace
- *path* may not contain : or = unless it is a URI (starts with <scheme>://); this allows you to do stuff like `export PYTHONPATH=$PYTHONPATH:foo.egg#`.
- *name* may not contain whitespace or any of the following characters: ' " : ; > < | = / #, so you can do stuff like `sudo dpkg -i fooify.deb#; fooify bar`

If you really want to include forbidden characters, you may use backslash escape sequences in *path* and *name*. (We can't guarantee Hadoop/EMR will accept them though!). Also, remember that shell syntax allows you to concatenate strings like `"this`.

Environment variables and ~ (home dir) in *path* will be resolved (use backslash escapes to stop this). We don't resolve *name* because it doesn't make sense. Environment variables and ~ elsewhere in the command are considered to be part of the script and will be resolved on the remote system.

## mrjob.util - general utility functions

Utility functions for MRJob

`mrjob.util.args_for_opt_dest_subset(option_parser, args, dests=None)`

For the given `OptionParser` and list of command line arguments `args`, yield values in `args` that correspond to option destinations in the set of strings `dests`. If `dests` is `None`, return `args` as parsed by `OptionParser`.

Deprecated since version 0.5.8.

`mrjob.util.bash_wrap(cmd_str)`

Escape single quotes in a shell command string and wrap it with `bash -c '<string>'`.

This low-tech replacement works because we control the surrounding string and single quotes are the only character in a single-quote string that needs escaping.

Deprecated since version 0.5.8.

`mrjob.util.buffer_iterator_to_line_iterator(chunks)`

Alias for `to_lines()`. Will be removed in v0.6.0.

Deprecated since version 0.5.0.

`mrjob.util.cmd_line(args)`

build a command line that works in a shell.

`mrjob.util.expand_path(path)`

Resolve `~` (home dir) and environment variables in `path`.

If `path` is `None`, return `None`.

`mrjob.util.file_ext(filename)`

return the file extension, including the `.`

```
>>> file_ext('foo.tar.gz')
'.tar.gz'
```

`mrjob.util.log_to_null(name=None)`

Set up a null handler for the given stream, to suppress “no handlers could be found” warnings.

`mrjob.util.log_to_stream(name=None, stream=None, format=None, level=None, debug=False)`

Set up logging.

### Parameters

- **name** (*str*) – name of the logger, or `None` for the root logger
- **stderr** (*file object*) – stream to log to (default is `sys.stderr`)
- **format** (*str*) – log message format (default is ‘%(message)s’)
- **level** – log level to use
- **debug** (*bool*) – quick way of setting the log level: if true, use `logging.DEBUG`, otherwise use `logging.INFO`

`mrjob.util.parse_and_save_options(option_parser, args)`

Return a map from option name (`dest`) to a list of the arguments in `args` that correspond to that `dest`.

This won’t modify `option_parser`.

`mrjob.util.populate_option_groups_with_options(assignments, indexed_options)`

Given a dictionary mapping `OptionGroup` and `OptionParser` objects to a list of strings representation option `dests`, populate the objects with options from `indexed_options` (generated by

`scrape_options_and_index_by_dest()` in alphabetical order by long option name. This function primarily exists to serve `scrape_options_into_new_groups()`.

#### Parameters

- **assignments** (dict of the form `{my_option_parser: ('verbose', 'help', ...), my_option_group: (...)}`) – specification of which parsers/groups should get which options
- **indexed\_options** (dict generated by `util.scrape_options_and_index_by_dest()`) – options to use when populating the parsers/groups

`mrjob.util.random_identifier()`

A random 16-digit hex string.

`mrjob.util.read_file(path, fileobj=None, yields_lines=True, cleanup=None)`

Yields lines from a file, possibly decompressing it based on file extension.

Currently we handle compressed files with the extensions `.gz` and `.bz2`.

#### Parameters

- **path** (*string*) – file path. Need not be a path on the local filesystem (URIs are okay) as long as you specify *fileobj* too.
- **fileobj** – file object to read from. Need not be seekable. If this is omitted, we `open(path)`.
- **yields\_lines** – Does iterating over *fileobj* yield lines (like file objects are supposed to)? If not, set this to `False` (useful for `boto.s3.Key`)
- **cleanup** – Optional callback to call with no arguments when EOF is reached or an exception is thrown.

`mrjob.util.read_input(path, stdin=None)`

Stream input the way Hadoop would.

- Resolve globs (`foo_*.gz`).
- Decompress `.gz` and `.bz2` files.
- If path is `'-'`, read from `stdin`
- If path is a directory, recursively read its contents.

You can redefine *stdin* for ease of testing. *stdin* can actually be any iterable that yields lines (e.g. a list).

`mrjob.util.safeeval(expr, globals=None, locals=None)`

Like `eval`, but with nearly everything in the environment blanked out, so that it's difficult to cause mischief.

*globals* and *locals* are optional dictionaries mapping names to values for those names (just like in `eval()`).

`mrjob.util.save_current_environment(*args, **kws)`

Context manager that saves `os.environ` and loads it back again after execution

`mrjob.util.save_cwd(*args, **kws)`

Context manager that saves the current working directory, and `chdir`'s back to it after execution.

`mrjob.util.scrape_options_and_index_by_dest(*parsers_and_groups)`

Scrapes `optparse` options from `OptionParser` and `OptionGroup` objects and builds a dictionary of `dest_var: [option1, option2, ...]`. This function primarily exists to serve `scrape_options_into_new_groups()`.

An example return value: `{'verbose': [<verbose_on_option>, <verbose_off_option>], 'files': [<file_append_option>]}`

**Parameters** `parsers_and_groups` (`OptionParser` or `OptionGroup`) – Parsers and groups to scrape option objects from

**Returns** dict of the form `{dest_var: [option1, option2, ...], ...}`

`mrjob.util.scrape_options_into_new_groups` (`source_groups`, `assignments`)

Puts options from the `OptionParser` and `OptionGroup` objects in `source_groups` into the keys of `assignments` according to the values of `assignments`. An example:

**Parameters**

- **source\_groups** (list of `OptionParser` and `OptionGroup` objects) – parsers/groups to scrape options from
- **assignments** (dict with keys that are `OptionParser` and `OptionGroup` objects and values that are lists of strings) – map empty parsers/groups to lists of destination names that they should contain options for

`mrjob.util.shlex_split` (`s`)

Wrapper around `shlex.split()`, but convert to str if Python version < 2.7.3 when unicode support was added.

`mrjob.util.strip_microseconds` (`delta`)

Return the given `datetime.timedelta`, without microseconds.

Useful for printing `datetime.timedelta` objects.

`mrjob.util.tar_and_gzip` (`dir`, `out_path`, `filter=None`, `prefix=''`)

Tar and gzip the given `dir` to a tarball at `out_path`.

If we encounter symlinks, include the actual file, not the symlink.

**Parameters**

- **dir** (`str`) – dir to tar up
- **out\_path** (`str`) – where to write the tarball too
- **filter** – if defined, a function that takes paths (relative to `dir` and returns `True` if we should keep them
- **prefix** (`str`) – subdirectory inside the tarball to put everything into (e.g. `'mrjob'`)

`mrjob.util.to_lines` (`chunks`)

Take in data as a sequence of bytes, and yield it, one line at a time.

Only breaks lines on `\n` (not `\r`), and does not add a trailing newline.

Optimizes for:

- chunks bigger than lines (e.g. reading test files)
- chunks that are lines (idempotency)

`mrjob.util.unarchive` (`archive_path`, `dest`)

Extract the contents of a tar or zip file at `archive_path` into the directory `dest`.

**Parameters**

- **archive\_path** (`str`) – path to archive file
- **dest** (`str`) – path to directory where archive will be extracted

`dest` will be created if it doesn't already exist.

tar files can be gzip compressed, bzip2 compressed, or uncompressed. Files within zip files can be deflated or stored.



`mrjob.util.unique(items)`

Yield items from *item* in order, skipping duplicates.

`mrjob.util.which(cmd, path=None)`

Like the UNIX `which` command: search in *path* for the executable named *cmd*. *path* defaults to `PATH`. Returns `None` if no such executable found.

This is basically `shutil.which()` (which was introduced in Python 3.3) without the *mode* argument. Best practice is to always specify *path* as a keyword argument.

`mrjob.util.zip_dir(dir, out_path, filter=None, prefix='')`

Compress the given *dir* into a zip file at *out\_path*.

If we encounter symlinks, include the actual file, not the symlink.

#### Parameters

- **dir** (*str*) – dir to tar up
- **out\_path** (*str*) – where to write the tarball too
- **filter** – if defined, a function that takes paths (relative to *dir* and returns `True` if we should keep them
- **prefix** (*str*) – subdirectory inside the tarball to put everything into (e.g. `'mrjob'`)



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## What's New

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For a complete list of changes, see [CHANGES.txt](#)

### 0.5.11

The *report-long-jobs* utility can now ignore certain clusters based on EMR tags.

This version deals more gracefully with clusters that use instance fleets, preventing crashes that may occur in some rare edge cases.

### 0.5.10

Fixed an issue where bootstrapping mrjob on Dataproc or EMR could stall if mrjob was already installed.

The *aws\_security\_token* option has been renamed to *aws\_session\_token*. If you want to set it via environment variable, you still have to use `$AWS_SECURITY_TOKEN` because that's what boto uses.

Added protocol support for *rapidjson*; see *RapidJSONProtocol* and *RapidJSONValueProtocol*. If available, *rapidjson* will be used as the default JSON implementation if *ujson* is not installed.

The master bootstrap script on EMR and Dataproc now has the correct file extension (`.sh`, not `.py`).

### 0.5.9

Fixed a bug that prevented *setup* scripts from working on EMR AMIs 5.2.0 and later. Our workaround should be completely transparent unless you use a custom shell binary; see *sh\_bin* for details.

The EMR runner now correctly re-starts the SSH tunnel to the job tracker/resource manager when a cluster it tries to run a job on auto-terminates. It also no longer requires a working SSH tunnel to fetch job progress (you still a working SSH; see *ec2\_key\_pair\_file*).

The *emr\_applications* option has been renamed to *applications*.

The *terminate-idle-clusters* utility is now slightly more robust in cases where your S3 temp directory is an different region from your clusters.

Finally, there a couple of changes that probably only matter if you're trying to wrap your Hadoop tasks (mappers, reducers, etc.) in **docker**:

- You can set *just* the python binary for tasks with `task_python_bin`. This allows you to use a wrapper script in place of Python without perturbing `setup` scripts.
- Local mode now no longer relies on an absolute path to access the `mrjob.cat` utility it uses to handle compressed input files; copying the job's working directory into Docker is enough.

## 0.5.8

You can now pass directories to jobs, either directly with the `upload_dirs` option, or through `setup` commands. For example:

```
--setup 'export PYTHONPATH=$PYTHONPATH:your-src-code/#'
```

mrjob will automatically tarball these directories and pass them to Hadoop as archives.

For multi-step jobs, you can now specify where inter-step output goes with `step_output_dir` (`--step-output-dir`), which can be useful for debugging.

All *job step types* now take the `jobconf` keyword argument to set Hadoop properties for that step.

Jobs' `--help` printout is now better-organized and less verbose.

Made several fixes to pre-filters (commands that pipe into streaming steps):

- you can once again add pre-filters to a single step job by re-defining `mapper_pre_filter()`, `combiner_pre_filter()`, and/or `reducer_pre_filter()`
- local mode now ignores non-zero return codes from pre-filters (this matters for BSD `grep`)
- local mode can now run pre-filters on compressed input files

mrjob now respects `sh_bin` when it needs to wrap a command in `sh` before passing it to Hadoop (e.g. to support pipes)

On EMR, mrjob now fetches logs from task nodes when determining probable cause of error, not just core nodes (the ones that run tasks and host HDFS).

Several unused functions in `mrjob.util` are now deprecated:

- `args_for_opt_dest_subset()`
- `bash_wrap()`
- `populate_option_groups_with_options()`
- `scrape_options_and_index_by_dest()`
- `tar_and_gzip()`

`bunzip2_stream()` and `gunzip_stream()` have been moved from `mrjob.util` to `mrjob.cat`.

`SSHFilesystem.ssh_slave_hosts()` has been deprecated.

Option group attributes in `MRJobs` have been deprecated, as has the `get_all_option_groups()` method.

## 0.5.7

### Spark and related changes

mrjob now supports running Spark jobs on your own Hadoop cluster or Elastic MapReduce. mrjob provides significant benefits over Spark's built-in Python support; see *Why use mrjob with Spark?* for details.

Added the `py_files` option, to put `.zip` or `.egg` files in your job's `PYTHONPATH`. This is based on a Spark feature, but it works with streaming jobs as well. mrjob is now bootstrapped (see `bootstrap_mrjob`) as a `.zip` file rather than a tarball. If for some reason, the bootstrapped mrjob library won't compile, you'll get much cleaner error messages.

The default AMI version on EMR (see `image_version`) has been bumped from 3.11.0 to 4.8.2, as 3.11.0's Spark support is spotty.

On EMR, mrjob now defaults to the cheapest instance type that will work (see `instance_type`). In most cases, this is `m1.medium`, but it needs to be `m1.large` for Spark worker nodes.

## Cluster pooling

mrjob can now add up to 1,000 steps on *pooled clusters* on EMR (except on very old AMIs). mrjob now prints debug messages explaining why your job matched a particular pooled cluster when running in verbose mode (the `-v` option). Fixed a bug that caused pooling to fail when there was no need for a master bootstrap script (e.g. when running with `--no-bootstrap-mrjob`).

## Other improvements

Log interpretation is much more efficient at determining a job's probable cause of failure (this works with Spark as well).

When running custom JARs (see *JarStep*) mrjob now respects `libjars` and `jobconf`.

The `hadoop_streaming_jar` option now supports environment variables and `~`.

The *terminate-idle-clusters* tool now works with all step types, including Spark. (It's still recommended that you rely on the `max_hours_idle` option rather than this tool.)

mrjob now works in Anaconda3 Jupyter Notebook.

## Bugfixes

Added several missing command-line switches, including `--no-bootstrap-python` on Dataproc. Made a major refactor that should prevent these kinds of issues in the future.

Fixed a bug that caused mrjob to crash when the `ssh` binary (see `ssh_bin`) was missing or not executable.

Fixed a bug that erroneously reported failed or just-started jobs as 100% complete.

Fixed a bug where timestamps were erroneously recognized as URIs. mrjob now only recognizes strings containing `://` as URIs (see `is_uri()`).

## Deprecation

The following are deprecated and will be removed in v0.6.0:

- `JarStep`.`"INPUT"`; use `mrjob.step.INPUT` instead
- `JarStep`.`"OUTPUT"`; use `mrjob.step.OUTPUT` instead
- non-strict protocols (see `strict_protocols`)
- the `python_archives` option (try *this* instead)
- `is_windows_path()`
- `parse_key_value_list()`

- `parse_port_range_list()`
- `scrape_options_into_new_groups()`

## 0.5.6

Fixed a critical bug that caused Dataproc runner to always crash when determining Hadoop version.

Log interpretation now prioritizes task errors (e.g. a traceback from your Python script) as probable cause of failure, even if they aren't the most recent error. Log interpretation will now continue to download and parse task logs until it finds a non-empty stderr log.

Log interpretation also strips the “subprocess failed” Java stack trace that appears in task stderr logs from Hadoop 1.

## 0.5.5

Functionally equivalent to [0.5.4](#), except that it restores the deprecated `ami_version` option as an alias for `image_version`, making it easier to upgrade from earlier versions of mrjob.

Also slightly improves [EMR cluster pooling](#) with updated information on memory and CPU power of various EC2 instance types, and by treating application names (e.g. “Spark”) as case-insensitive.

## 0.5.4

### Pooling and idle cluster self-termination

**Warning:** This release accidentally removed the `ami_version` option instead of merely deprecating it. If you are upgrading from an earlier version of mrjob, use version [0.5.5](#) or later.

This release resolves a long-standing EMR API race condition that made it difficult to use [cluster pooling](#) and idle cluster self-termination (see [max\\_hours\\_idle](#)) together. Now if your pooled job unknowingly runs on a cluster that was in the process of shutting down, it will detect that and re-launch the job on a different cluster.

This means pretty much *everyone* running jobs on EMR should now enable pooling, with a configuration like this:

```
runners:
  emr:
    max_hours_idle: 1
    pool_clusters: true
```

You may *also* run the [terminate-idle-clusters](#) script periodically, but (barring any bugs) this shouldn't be necessary.

### Generic EMR option names

Many options to the [EMR runner](#) have been made more generic, to make it easier to share code with the [Dataproc runner](#) (in most cases, the new names are also shorter and easier to remember):

old option name	new option name
<code>ami_version</code>	<code>image_version</code>
<code>aws_availability_zone</code>	<code>zone</code>
<code>aws_region</code>	<code>region</code>
<code>check_emr_status_every</code>	<code>check_cluster_every</code>
<code>ec2_core_instance_bid_price</code>	<code>core_instance_bid_price</code>
<code>ec2_core_instance_type</code>	<code>core_instance_type</code>
<code>ec2_instance_type</code>	<code>instance_type</code>
<code>ec2_master_instance_bid_price</code>	<code>master_instance_bid_price</code>
<code>ec2_master_instance_type</code>	<code>master_instance_type</code>
<code>ec2_slave_instance_type</code>	<code>core_instance_type</code>
<code>ec2_task_instance_bid_price</code>	<code>task_instance_bid_price</code>
<code>ec2_task_instance_type</code>	<code>task_instance_type</code>
<code>emr_tags</code>	<code>tags</code>
<code>num_ec2_core_instances</code>	<code>num_core_instances</code>
<code>num_ec2_task_instances</code>	<code>num_task_instances</code>
<code>s3_log_uri</code>	<code>cloud_log_dir</code>
<code>s3_sync_wait_time</code>	<code>cloud_fs_sync_secs</code>
<code>s3_tmp_dir</code>	<code>cloud_tmp_dir</code>
<code>s3_upload_part_size</code>	<code>cloud_upload_part_size</code>

The old option names and command-line switches are now deprecated but will continue to work until v0.6.0. (Exception: `ami_version` was accidentally removed; if you need it, use [0.5.5](#) or later.)

`num_ec2_instances` has simply been deprecated (it's just `num_core_instances` plus one).

`hadoop_streaming_jar_on_emr` has also been deprecated; in its place, you can now pass a `file://` URI to `hadoop_streaming_jar` to reference a path on the master node.

## Log interpretation

Log interpretation (counters and probable cause of job failure) on Hadoop is more robust, handling a wider variety of log4j formats and recovering more gracefully from permissions errors. This includes fixing a crash that could happen on Python 3 when attempting to read data from HDFS.

Log interpretation used to be partially broken on EMR AMI 4.3.0 and later due to a permissions issue; this is now fixed.

## pass\_through\_option()

You can now pass through *existing* command-line switches to your job; for example, you can tell a job which runner launched it. See `pass_through_option()` for details.

If you *don't* do this, `self.options.runner` will now always be `None` in your job (it used to confusingly default to `'inline'`).

## Stop logging credentials

When mrjob is run in verbose mode (the `-v` option), the values of all runner options are debug-logged to stderr. This has been the case since the very early days of mrjob.

Unfortunately, this means that if you set your AWS credentials in `mrjob.conf`, they get logged as well, creating a surprising potential security vulnerability. (This doesn't happen for AWS credentials set through environment variables.)

Starting in this version, the values of `aws_secret_access_key` and `aws_security_token` are shown as `'...'` if they are set, and all but the last four characters of `aws_access_key_id` are blanked out as well (e.g. `'...YNDR'`).

## Other improvements and bugfixes

The ssh tunnel to the resource manager on EMR (see [ssh\\_tunnel](#)) now connects to its correct *internal* IP; this resolves a firewall issue that existed on some VPC setups.

Uploaded files will no longer be given names starting with `_` or `.`, since Hadoop's input processing treats these files as "hidden".

The EMR idle cluster self-termination script (see [max\\_hours\\_idle](#)) now only runs on the master node.

The `audit-emr-usage` command-line tool should no longer constantly trigger throttling warnings.

`bootstrap_python` no longer bothers trying to install Python 3 on EMR AMI 4.6.0 and later, since it is already installed.

The `--ssh-bind-ports` command-line switch was broken (starting in [0.4.5!](#)), and is now fixed.

## 0.5.3

This release adds support for custom `libjars` (such as [nicknack](#)), allowing easy access to custom input and output formats. This works on Hadoop and EMR (including on a cluster that's already running).

In addition, jobs can specify needed libjars by setting the `LIBJARS` attribute or overriding the `libjars()` method. For examples, see [Input and output formats](#).

The Hadoop runner now tries *even harder* to find your log files without needing additional configuration (see [hadoop\\_log\\_dirs](#)).

The EMR runner now supports Amazon VPC subnets (see [subnet](#)), and, on 4.x AMIs, Application Configurations (see [emr\\_configurations](#)).

If your EMR cluster fails during bootstrapping, mrjob can now determine the probable cause of failure.

There are also some minor improvements to SSH tunneling and a handful of small bugfixes; see [CHANGES.txt](#) for details.

## 0.5.2

This release adds basic support for [Google Cloud Dataproc](#) which is Google's Hadoop service, roughly analogous to EMR. See [Dataproc Quickstart](#). Some features are not yet implemented:

- fetching counters
- finding probable cause of errors
- running Java JARs as steps

Added the `emr_applications` option, which helps you configure 4.x AMIs.

Fixed an EMR bug (introduced in v0.5.0) where we were waiting for steps to complete in the wrong order (in a multi-step job, we wouldn't register that the first step had finished until the last one had).

Fixed a bug in SSH tunneling (introduced in v0.5.0) that made connections to the job tracker/resource manager on EMR time out when running on a 2.x AMI inside a VPC (Virtual Private Cluster).

Fixed a bug (introduced in v0.4.6) that kept mrjob from interpreting `~` (home directory) in includes in `mrjob.conf`.



It is now again possible to run tool modules deprecated in v0.5.0 directly (e.g. `python -m mrjob.tools.emr.create_job_flow`). This is still a deprecated feature; it's recommended that you use the appropriate `mrjob` subcommand instead (e.g. `mrjob create-cluster`).

## 0.5.1

Fixes a bug in the previous release that broke `SORT_VALUES` and any other attempt by the job to set the partitioner. The `--partitioner` switch is now deprecated (the choice of partitioner is part of your job semantics).

Fixes a bug in the previous release that caused `strict_protocols` and `check_input_paths` to be ignored in `mrjob.conf`. (We would much prefer you fixed jobs that are using “loose protocols” rather than setting `strict_protocols: false` in your config file, but we didn't break this on purpose, we promise!)

`mrjob terminate-idle-clusters` now correctly handles EMR debugging steps (see [enable\\_emr\\_debugging](#)) set up by boto 2.40.0.

Fixed a bug that could result in showing a blank probable cause of error for pre-YARN (Hadoop 1) jobs.

`ssh_bind_ports` now defaults to a `range` object (`xrange` on Python 2), so that when you run on `emr` in verbose mode (`-r emr -v`), debug logging devotes one line to the value of `ssh_bind_ports` rather than 840.

## 0.5.0

### Python versions

`mrjob` now fully supports Python 3.3+ in a way that should be transparent to existing Python 2 users (you don't have to suddenly start handling `unicode` instead of `str`). For more information, see [Python 2 vs. Python 3](#).

If you run a job with Python 3, `mrjob` will automatically install Python 3 on ElasticMapreduce AMIs (see [bootstrap\\_python](#)).

When you run jobs on EMR in Python 2, `mrjob` attempts to match your minor version of Python as well (either `python2.6` or `python2.7`); see [python\\_bin](#) for details.

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**Note:** If you're currently running Python 2.7, and [using yum to install python libraries](#), you'll want to use the Python 2.7 version of the package (e.g. `python27-numpy` rather than `python-numpy`).

---

The `mrjob` command is now installed with Python-version-specific aliases (e.g. `mrjob-3`, `mrjob-3.4`), in case you install `mrjob` for multiple versions of Python.

### Hadoop

`mrjob` should now work out-of-the box on almost any Hadoop setup. If `hadoop` is in your path, or you set any commonly-used `$HADOOP_*` environment variable, `mrjob` will find the Hadoop binary, the streaming jar, and your logs, without any help on your part (see [hadoop\\_bin](#), [hadoop\\_log\\_dirs](#), [hadoop\\_streaming\\_jar](#)).

`mrjob` has been updated to fully support Hadoop 2 (YARN), including many updates to `HadoopFilesystem`. Hadoop 1 is still supported, though anything prior to Hadoop 0.20.203 is not (`mrjob` is actually a few months older than Hadoop 0.20.203, so this used to matter).

## 3.x and 4.x AMIs

mrjob now fully supports the 3.x and 4.x Elastic MapReduce AMIs, including SSH tunneling to the resource manager, fetching counters and finding probable cause of job failure.

The default `ami_version` (see [image\\_version](#)) is now `3.11.0`. Our plan is to continue updating this to the latest (non-broken) 3.x AMI for each 0.5.x release of mrjob.

The default `instance_type` is now `m1.medium` (`m1.small` is too small for the 3.x and 4.x AMIs)

You can specify 4.x AMIs with either the new `release_label` option, or continue using `ami_version`; both work.

mrjob continues to support 2.x AMIs. However:

**Warning:** 2.x AMIs are deprecated by AWS, and based on a very old version of Debian (squeeze), which breaks `apt-get` and exposes you to security holes.

Please, please switch if you haven't already.

## AWS Regions

The new default `aws_region` (see [region](#)) is `us-west-2` (Oregon). This both matches the default in the EMR console and, according to Amazon, is [carbon neutral](#).

An edge case that might affect you: EC2 key pairs (i.e. SSH credentials) are region-specific, so if you've set up SSH but not explicitly specified a region, you may get an error saying your key pair is invalid. The fix is simply to [create new SSH keys](#) for the `us-west-2` (Oregon) region.

## S3

**mrjob is much smarter about the way it interacts with S3:**

- automatically creates temp bucket in the same region as jobs
- connects to S3 buckets on the endpoint matching their region (no more 307 errors)
  - `EMRJobRunner` and `S3Filesystem` methods no longer take `s3_conn` args (passing around a single S3 connection no longer makes sense)
- no longer uses the temp bucket's location to choose where you run your job
- `rm()` no longer has special logic for `*_folder$` keys
- `ls()` recurses "subdirectories" even if you pass it a URI without a trailing slash

## Log interpretation

The part of mrjob that fetches counters and tells you what probably caused your job to fail was basically unmaintainable and has been totally rewritten. Not only do we now have solid support across Hadoop and EMR AMI versions, but if we missed anything, it should be straightforward to add it.

One casualty of this change was the `mrjob fetch-logs` command, which means mrjob no longer offers a way to fetch or interpret logs from a *past* job. We do plan to re-introduce this functionality.

## Protocols

Protocols are now strict by default (they simply raise an exception on unencodable data). “Loose” protocols can be re-enabled with the `--no-strict-protocols` switch; see [strict\\_protocols](#) for why this is a bad idea.

Protocols will now use the much faster `ujson` library, if installed, to encode and decode JSON. This is especially recommended for simple jobs that spend a significant fraction of their time encoding and data.

---

**Note:** If you’re using EMR, try out [this bootstrap recipe](#) to install `ujson`.

---

mrjob will fall back to the `simplejson` library if `ujson` is not installed, and use the built-in `json` module if neither is installed.

You can now explicitly specify which JSON implementation you wish to use (e.g. `StandardJSONProtocol`, `SimpleJSONProtocol`, `UltraJSONProtocol`).

## Status messages

We’ve tried to cut the logging messages that your job prints as it runs down to the basics (either useful info, like where a temp directory is, or something that tells you why you’re waiting). If there are any messages you miss, try running your job with `-v`.

When a step in your job fails, mrjob no longer prints a useless stacktrace telling you where in the code the runner raised an exception about your step failing. This is thanks to `StepFailedException`, which you can also catch and interpret if you’re [running jobs programmatically](#).

## Deprecation

Many things that were deprecated in 0.4.6 have been removed:

- options:
  - `IF_SUCCESSFUL cleanup` option (use `ALL`)
  - `iam_job_flow_role` (use `iam_instance_profile`)
- functions and methods:
  - positional arguments to `mrjob.job.MRJob.mr()` (don’t even use `mr()`; use `mrjob.step.MRStep`)
  - `mrjob.job.MRJob.jar()` (use `mrjob.step.JarStep`)
  - `step_args` and `name` arguments to `mrjob.step.JarStep` (use `args` instead of `step_args`, and don’t use `name` at all)
  - `mrjob.step.MRJobStep` (use `mrjob.step.MRStep`)
  - `mrjob.compat.get_jobconf_value()` (use to `jobconf_from_env()`)
  - `mrjob.job.MRJob.parse_counters()`
  - `mrjob.job.MRJob.parse_output()`
  - `mrjob.conf.combine_cmd_lists()`
  - `mrjob.fs.s3.S3Filesystem.get_s3_folder_keys()`

`mrjob.compat` functions `supports_combiners_in_hadoop_streaming()`, `supports_new_distributed_cache_options()`, and `uses_generic_jobconf()`, which only existed to support very old versions of Hadoop, were removed without deprecation warnings (sorry!).

To avoid a similar wave of deprecation warnings in the future, the name of every part of mrjob that isn't meant to be a stable interface provided by the library now starts with an underscore. You can still use these things (or copy them; it's Open Source), but there's no guarantee they'll exist in the next release.

If you want to get ahead of the game, here is a list of things that are deprecated starting in mrjob 0.5.0 (do these *after* upgrading mrjob):

- options:
  - `base_tmp_dir` is now `local_tmp_dir`
  - `cleanup` options `LOCAL_SCRATCH` and `REMOTE_SCRATCH` are now `LOCAL_TMP` and `REMOTE_TMP`
  - `emr_job_flow_id` is now `cluster_id`
  - `emr_job_flow_pool_name` is now `pool_name`
  - `hdfs_scratch_dir` is now `hadoop_tmp_dir`
  - `pool_emr_job_flows` is now `pool_clusters`
  - `s3_scratch_uri` is now `cloud_tmp_dir`
  - `ssh_tunnel_to_job_tracker` is now simply `ssh_tunnel`
- functions and methods:
  - `mrjob.job.MRJob.is_mapper_or_reducer()` is now `is_task()`
  - `Filesystem` method `path_exists()` is now simply `exists()`
  - `Filesystem` method `path_join()` is now simply `join()`
  - Use `runner.fs` explicitly when accessing filesystem methods (e.g. `runner.fs.ls()`), not `runner.ls()`
- **mrjob** subcommands - **mrjob create-job-flow** is now **mrjob create-cluster** - **mrjob terminate-idle-job-flows** is now **mrjob terminate-idle-clusters** - **mrjob terminate-job-flow** is now **mrjob temrinate-cluster**

## Other changes

- mrjob now requires `boto` 2.35.0 or newer (chances are you're already doing this). Later 0.5.x releases of mrjob may require newer versions of `boto`.
- `visible_to_all_users` now defaults to `True`
- `HadoopFilesystem.rm()` uses `-skipTrash`
- new `iam_endpoint` option
- custom `hadoop_streaming_jars` are properly uploaded
- JOB `cleanup` on EMR is temporarily disabled
- mrjob now follows symlinks when `ls()` ing the local filesystem (beware recursive symlinks!)
- The `interpreter` option disables `bootstrap_mrjob` by default (`interpreter` is meant for non-Python jobs)
- `cluster pooling` now respects `ec2_key_pair`

- cluster self-termination (see `max_hours_idle`) now respects non-streaming jobs
- `LocalFilesystem` now rejects URIs rather than interpreting them as local paths
- `local` and `inline` runners no longer have a default `hadoop_version`, instead handling `jobconf` in a version-agnostic way
- `steps_python_bin` now defaults to the current Python interpreter.
- minor changes to `mrjob.util`:
  - `file_ext()` takes filename, not path
  - `gunzip_stream()` now yields chunks of bytes, not lines
  - moved `random_identifier()` method here from `mrjob.aws`
  - `buffer_iterator_to_line_iterator()` is now named `to_lines()`, and no longer appends a trailing newline to data.

## 0.4.6

`include:` in conf files can now use relative paths in a meaningful way. See *Relative includes*.

List and environment variable options loaded from included config files can be totally overridden using the `!clear` tag. See *Clearing configs*.

Options that take lists (e.g. `setup`) now treat scalar values as single-item lists. See *this example*.

Fixed a bug that kept the `pool_wait_minutes` option from being loaded from config files.

## 0.4.5

This release moves mrjob off the deprecated `DescribeJobFlows` EMR API call.

**Warning:** AWS *again* broke older versions mrjob for at least some new accounts, by returning 400s for the deprecated `DescribeJobFlows` API call. If you have a newer AWS account (circa July 2015), you must use at least this version of mrjob.

The new API does not provide a way to tell when a job flow (now called a “cluster”) stopped provisioning instances and started bootstrapping, so the clock for our estimates of when we are close to the end of a billing hour now start at cluster creation time, and are thus more conservative.

Related to this change, `terminate_idle_job_flows` no longer considers job flows in the `STARTING` state idle; use `report_long_jobs` to catch jobs stuck in this state.

`terminate_idle_job_flows` performs much better on large numbers of job flows. Formerly, it collected all job flow information first, but now it terminates idle job flows as soon as it identifies them.

`collect_emr_stats` and `job_flow_pool` have *not* been ported to the new API and will be removed in v0.5.0.

Added an `aws_security_token` option to allow you to run mrjob on EMR using temporary AWS credentials.

Added an `emr_tags` (see *tags*) option to allow you to tag EMR job flows at creation time.

`EMRJobRunner` now has a `get_ami_version()` method.

The `hadoop_version` option no longer has any effect in EMR. This option only every did anything on the 1.x AMIs, which mrjob no longer supports.

Added many missing switches to the EMR tools (accessible from the `mrjob` command). Formerly, you had to use a config file to get at these options.

You can now access the `mrboss` tool from the command line: `mrjob boss <args>`.

Previous 0.4.x releases have worked with boto as old as 2.2.0, but this one requires at least boto 2.6.0 (which is still more than two years old). In any case, it's recommended that you just use the latest version of boto.

This branch has a number of additional deprecation warnings, to help prepare you for mrjob v0.5.0. Please heed them; a lot of deprecated things really are going to be completely removed.

## 0.4.4

mrjob now automatically creates and uses IAM objects as necessary to comply with [new requirements from Amazon Web Services](#).

(You do not need to install the AWS CLI or run `aws emr create-default-roles` as the link above describes; mrjob takes care of this for you.)

**Warning:** The change that AWS made essentially broke all older versions of mrjob for all new accounts. If the first time your AWS account created an Elastic MapReduce cluster was on or after April 6, 2015, you should use at least this version of mrjob.

If you *must* use an old version of mrjob with a new AWS account, see [this thread](#) for a possible workaround.

`--iam-job-flow-role` has been renamed to `--iam-instance-profile`.

New `--iam-service-role` option.

## 0.4.3

This release also contains many, many bugfixes, one of which probably affects you! See [CHANGES.txt](#) for details.

Added a new subcommand, `mrjob collect-emr-active-stats`, to collect stats about active jobflows and instance counts.

`--iam-job-flow-role` option allows setting of a specific IAM role to run this job flow.

You can now use `--check-input-paths` and `--no-check-input-paths` on EMR as well as Hadoop.

Files larger than 100MB will be uploaded to S3 using multipart upload if you have the *filechunkio* module installed. You can change the limit/part size with the `--s3-upload-part-size` option, or disable multipart upload by setting this option to 0. You can now require protocols to be strict from [mrjob.conf](#); this means unencodable input/output will result in an exception rather than the job quietly incrementing a counter. It is recommended you set this for all runners:

```
runners:
  emr:
    strict_protocols: true
  hadoop:
    strict_protocols: true
  inline:
    strict_protocols: true
  local:
    strict_protocols: true
```

You can use `--no-strict-protocols` to turn off strict protocols for a particular job.

Tests now support `pytest` and `tox`.

Support for Python 2.5 has been dropped.

## 0.4.2

JarSteps, previously experimental, are now fully integrated into multi-step jobs, and work with both the Hadoop and EMR runners. You can now use powerful Java libraries such as [Mahout](#) in your MRJobs. For more information, see [Jar steps](#).

Many options for setting up your task's environment (`--python-archive`, `setup-cmd` and `--setup-script`) have been replaced by a powerful `--setup` option. See the [Job Environment Setup Cookbook](#) for examples.

Similarly, many options for bootstrapping nodes on EMR (`--bootstrap-cmd`, `--bootstrap-file`, `--bootstrap-python-package` and `--bootstrap-script`) have been replaced by a single `--bootstrap` option. See the [EMR Bootstrapping Cookbook](#).

This release also contains many [bugfixes](#), including problems with boto 2.10.0+, bz2 decompression, and Python 2.5.

## 0.4.1

The `SORT\_VALUES` option enables secondary sort, ensuring that your reducer(s) receive values in sorted order. This allows you to do things with reducers that would otherwise involve storing all the values in memory, such as:

- Receiving a grand total before any subtotals, so you can calculate percentages on the fly. See [mr\\_next\\_word\\_stats.py](#) for an example.
- Running a window of fixed length over an arbitrary amount of sorted values (e.g. a 24-hour window over timestamped log data).

The `max\_hours\_idle` option allows you to spin up EMR job flows that will terminate themselves after being idle for a certain amount of time, in a way that optimizes EMR/EC2's full-hour billing model.

For development (not production), we now recommend always using [job flow pooling](#), with `max\_hours\_idle` enabled. Update your `mrjob.conf` like this:

```
runners:
  emr:
    max_hours_idle: 0.25
    pool_emr_job_flows: true
```

**Warning:** If you enable pooling *without* `max\_hours\_idle` (or cronning `terminate\_idle\_job\_flows`), pooled job flows will stay active forever, costing you money!

You can now use `--no-check-input-paths` with the Hadoop runner to allow jobs to run even if `hadoop fs -ls` can't see their input files (see [check\\_input\\_paths](#)).

Two bits of straggling deprecated functionality were removed:

- Built-in [protocols](#) must be instantiated to be used (formerly they had class methods).
- Old locations for `mrjob.conf` are no longer supported.

This version also contains numerous bugfixes and natural extensions of existing functionality; many more things will now Just Work (see [CHANGES.txt](#)).

## 0.4.0

The default runner is now *inline* instead of *local*. This change will speed up debugging for many users. Use *local* if you need to simulate more features of Hadoop.

The EMR tools can now be accessed more easily via the *mrjob* command. Learn more [here](#).

Job steps are much richer now:

- You can now use mrjob to run jar steps other than Hadoop Streaming. [More info](#)
- You can filter step input with UNIX commands. [More info](#)
- In fact, you can use arbitrary UNIX commands as your whole step (mapper/reducer/combiner). [More info](#)

If you Ctrl+C from the command line, your job will be terminated if you give it time. If you're running on EMR, that should prevent most accidental runaway jobs. [More info](#)

mrjob v0.4 requires boto 2.2.

We removed all deprecated functionality from v0.2:

- `-hadoop-*-format`
- `-*-protocol` switches
- `MRJob.DEFAULT_*_PROTOCOL`
- `MRJob.get_default_opts()`
- `MRJob.protocols()`
- `PROTOCOL_DICT`
- `IF_SUCCESSFUL`
- `DEFAULT_CLEANUP`
- `S3Filesystem.get_s3_folder_keys()`

We love contributions, so we wrote some [guidelines](#) to help you help us. See you on Github!

## 0.3.5

The *pool\_wait\_minutes* (`--pool-wait-minutes`) option lets your job delay itself in case a job flow becomes available. Reference: [Configuration quick reference](#)

The `JOB` and `JOB_FLOW` cleanup options tell mrjob to clean up the job and/or the job flow on failure (including Ctrl+C). See [CLEANUP\\_CHOICES](#) for more information.

## 0.3.3

You can now *include one config file from another*.

## 0.3.2

The EMR instance type/number options have changed to support spot instances:



- `core_instance_bid_price`
- `core_instance_type`
- `master_instance_bid_price`
- `master_instance_type`
- `slave_instance_type` (alias for `core_instance_type`)
- `task_instance_bid_price`
- `task_instance_type`

There is also a new `ami_version` option to change the AMI your job flow uses for its nodes.

For more information, see `mrjob.emr.EMRJobRunner.__init__()`.

The new `report_long_jobs` tool alerts on jobs that have run for more than X hours.

## 0.3

### Features

#### Support for Combiners

You can now use combiners in your job. Like `mapper()` and `reducer()`, you can redefine `combiner()` in your subclass to add a single combiner step to run after your mapper but before your reducer. (MRWordFreqCount does this to improve performance.) `combiner_init()` and `combiner_final()` are similar to their mapper and reducer equivalents.

You can also add combiners to custom steps by adding keyword arguments to your call to `steps()`.

More info: [One-step jobs](#), [Multi-step jobs](#)

#### \*\_init(), \*\_final() for mappers, reducers, combiners

Mappers, reducers, and combiners have `*_init()` and `*_final()` methods that are run before and after the input is run through the main function (e.g. `mapper_init()` and `mapper_final()`).

More info: [One-step jobs](#), [Multi-step jobs](#)

#### Custom Option Parsers

It is now possible to define your own option types and actions using a custom `OptionParser` subclass.

More info: [Custom option types](#)

#### Job Flow Pooling

EMR jobs can pull job flows out of a “pool” of similarly configured job flows. This can make it easier to use a small set of job flows across multiple automated jobs, save time and money while debugging, and generally make your life simpler.

More info: [Pooling Clusters](#)

#### SSH Log Fetching

mrjob attempts to fetch counters and error logs for EMR jobs via SSH before trying to use S3. This method is faster, more reliable, and works with persistent job flows.

More info: [Configuring SSH credentials](#)

#### New EMR Tool: `fetch_logs`

If you want to fetch the counters or error logs for a job after the fact, you can use the new `fetch_logs` tool.

More info: `mrjob.tools.emr.fetch_logs`

### New EMR Tool: `mrboss`

If you want to run a command on all nodes and inspect the output, perhaps to see what processes are running, you can use the new `mrboss` tool.

More info: `mrjob.tools.emr.mrboss`

## Changes and Deprecations

### Configuration

The search path order for `mrjob.conf` has changed. The new order is:

- The location specified by `MRJOB_CONF`
- `~/.mrjob.conf`
- `~/.mrjob` (**deprecated**)
- `mrjob.conf` in any directory in `PYTHONPATH` (**deprecated**)
- `/etc/mrjob.conf`

If your `mrjob.conf` path is deprecated, use this table to fix it:

Old Location	New Location
<code>~/.mrjob</code>	<code>~/.mrjob.conf</code>
somewhere in <code>PYTHONPATH</code>	Specify in <code>MRJOB_CONF</code>

More info: `mrjob.conf`

### Defining Jobs (MRJob)

Mapper, combiner, and reducer methods no longer need to contain a `yield` statement if they emit no data.

The `--hadoop-*format` switches are deprecated. Instead, set your job's Hadoop formats with `HADOOP_INPUT_FORMAT/HADOOP_OUTPUT_FORMAT` or `hadoop_input_format()/hadoop_output_format()`. Hadoop formats can no longer be set from `mrjob.conf`.

In addition to `--jobconf`, you can now set jobconf values with the `JOBCONF` attribute or the `jobconf()` method. To read jobconf values back, use `mrjob.compat.jobconf_from_env()`, which ensures that the correct name is used depending on which version of Hadoop is active.

You can now set the Hadoop partitioner class with `--partitioner`, the `PARTITIONER` attribute, or the `partitioner()` method.

More info: *Hadoop configuration*

### Protocols

Protocols can now be anything with a `read()` and `write()` method. Unlike previous versions of mrjob, they can be **instance methods** rather than class methods. You should use instance methods when defining your own protocols.

The `--*protocol` switches and `DEFAULT_*PROTOCOL` are deprecated. Instead, use the `*_PROTOCOL` attributes or redefine the `*_protocol()` methods.

Protocols now cache the decoded values of keys. Informal testing shows up to 30% speed improvements.

More info: [Protocols](#)

## Running Jobs

### All Modes

All runners are Hadoop-version aware and use the correct jobconf and combiner invocation styles. This change should decrease the number of warnings in Hadoop 0.20 environments.

All `*_bin` configuration options (`hadoop_bin`, `python_bin`, and `ssh_bin`) take lists instead of strings so you can add arguments (like `['python', '-v']`). More info: [Configuration quick reference](#)

Cleanup options have been split into `cleanup` and `cleanup_on_failure`. There are more granular values for both of these options.

Most limitations have been lifted from passthrough options, including the former inability to use custom types and actions. More info: [Custom option types](#)

The `job_name_prefix` option is gone (was deprecated).

All URIs are passed through to Hadoop where possible. This should relax some requirements about what URIs you can use.

Steps with no mapper use `cat` instead of going through a no-op mapper.

Compressed files can be streamed with the `cat()` method.

### EMR Mode

The default Hadoop version on EMR is now 0.20 (was 0.18).

The `instance_type` option only sets the instance type for slave nodes when there are multiple EC2 instance. This is because the master node can usually remain small without affecting the performance of the job.

### Inline Mode

Inline mode now supports the `cmdenv` option.

### Local Mode

Local mode now runs 2 mappers and 2 reducers in parallel by default.

There is preliminary support for simulating some jobconf variables. The current list of supported variables is:

- `mapreduce.job.cache.archives`
- `mapreduce.job.cache.files`
- `mapreduce.job.cache.local.archives`
- `mapreduce.job.cache.local.files`
- `mapreduce.job.id`
- `mapreduce.job.local.dir`
- `mapreduce.map.input.file`
- `mapreduce.map.input.length`
- `mapreduce.map.input.start`

- `mapreduce.task.attempt.id`
- `mapreduce.task.id`
- `mapreduce.task.ismap`
- `mapreduce.task.output.dir`
- `mapreduce.task.partition`

### **Other Stuff**

boto 2.0+ is now required.

The Debian packaging has been removed from the repository.

---

## Glossary

---

**combiner** A function that converts one key and a list of values that share that key (not necessarily all values for the key) to zero or more key-value pairs based on some function. See [Concepts](#) for details.

**Hadoop Streaming** A special jar that lets you run code written in any language on Hadoop. It launches a subprocess, passes it input on stdin, and receives output on stdout. [Read more here](#).

**input protocol** The *protocol* that converts the input file to the key-value pairs seen by the first step. See [Protocols](#) for details.

**internal protocol** The *protocol* that converts the output of one step to the input of the next. See [Protocols](#) for details.

**mapper** A function that converts one key-value pair to zero or more key-value pairs based on some function. See [Concepts](#) for details.

**output protocol** The *protocol* that converts the output of the last step to the bytes written to the output file. See [Protocols](#) for details.

**protocol** An object that converts a stream of bytes to and from Python objects. See [Protocols](#) for details.

**reducer** A function that converts one key and all values that share that key to zero or more key-value pairs based on some function. See [Concepts](#) for details.

**step** One *mapper*, *combiner*, and *reducer*. Any of these may be omitted from a mrjob step as long as at least one is included.

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